

Astronomiae reformatae tomi duo

The Two Tomes of Reformed
Astronomy

[Reformed Astronomy, in Two Tomes]

(1665)

by Giovanni Battista Riccioli, S.J. (1598–1671)

Translation by Scott Weisman



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Translator Version 2

Upright reason dictates that the recipients of the good, of whatever type and level of beneficence it may be, must show gratitude and blessing to the beneficent person in every way possible, commensurate with the value of the beneficence. And one who has benefited all the people of the world — for example, one who invented a new instrument for the good of the world, or a good book — it is fitting for every discerning person, out of the obligation of love of fellow beings, to at least purchase it, so that the man will profit and his heart will be encouraged thereby to invent yet more good instruments in the world. And similarly, all other wise-hearted people will likewise strive and exert themselves to invent good things and instruments needed for the repair of the world and its perfection.

And therefore, whoever says: "What do I need this new instrument for?" — he does not act well towards the world. For if not for the man who invented it, where would you be? And what would your city do? And more than this, if the man did not exert himself, what would the world do?

— R. Pinchas Eliyahu Hurwitz, *Sefer HaBris HaShalem* (1797)

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ArsAstronomica@protonmail.com

A note on the work

A mature reckoning with the heavens as the telescope was revealing them — a sequel to the vast *Almagestum Novum* (1651), built on further years of observation at Bologna with the collaborator Grimaldi, with fresh measurements and corrected parameters at center stage. Across two volumes it treats the Sun, eclipses, the Moon, the fixed stars, and each of the planets in turn, then reduces it all to working tables. It carries some of the earliest sustained telescopic accounts of Saturn's changing shape before its rings were understood, of the bands and spots crossing Jupiter, and of the apparent sizes of the stars — wielded as evidence that the Earth stands still. A vivid window onto astronomy at the dawn of the telescopic age.

A note on the translation process

This translation was produced with the [translation-pipeline](#). See the linked repository for details on the process.

This text is the product of a highly refined automated translation process. It has undergone only cursory human review and should not be treated as an authoritative or scholarly rendering. It is offered solely as a reference and reading aid — a way to make an otherwise inaccessible work approachable — and any passage of real consequence should be checked against the original source.

Acknowledgements

Translated with the assistance of Claude. The translator thanks the [Anthropic](#) team for making this work possible.

[Front cover binding — plain tooled leather, no text.]

[Margin: "1529 (Rar)" — modern handwritten acquisition/inventory note in pencil, upper-left corner. [?] reading of the numeral.]

[Margin: "Rar 9471: 3 fol." — modern handwritten library shelfmark in pencil, upper-right corner. [?] reading of the digits.]

[Preliminary leaf]

[Margin: "2922 Lh" — modern pencil inventory/shelfmark note, upper right. [?]]

[Show-through (mirror image of the facing dedicatory title page), partly legible:]

- "...REFOR..." [i.e. ASTRONOMIAE REFORMATAE] [?]
- "Serenissimo" [To the Most Serene]
- "FERDIN[ando]..." [FERDINAND — i.e. Ferdinand Maria, Elector of Bavaria]
- "BAVRIÆ" [OF BAVARIA]
- "DVCI" [DUKE]
- [central device: an engraved coat of arms / armorial cartouche, seen as a faint show-through block] [?]
- "BONONIAE MD..." [At Bologna, 16--] [?]
- "Ex Typographia Haered..." [From the Printing-house of the Heirs of...] [?]

[The printed face that produced this offset has not yet been imaged; the dedicatory title page proper is expected on a following recto leaf. Reading is from reversed bleed-through and is uncertain throughout.]

[Preliminary leaf]

[Margin: "9471" — modern pencil shelfmark note, upper right (partly cropped at the gutter edge).]

[Show-through (mirror image), partly legible:]

- "...FORMATAE" [i.e. (RE)FORMATAE] [?]
- "Serenissimo" [To the Most Serene] [?]
- "...CANANI?...ETC" [unresolved — reversed bleed-through, illegible] [?]

[No directly printed text is present on these three leaves. They are blank or near-blank preliminary leaves; the dedicatory title page itself faces away from the camera on each and registers only as faint reversed offset. The Tomus I title page proper is expected per the dispatch.]

Dedicatory Title Page

ASTRONOMY REFORMED,

TO

the Most Serene Lord

FERDINAND MARIA,

DUKE OF BAVARIA, ETC.

Diagram. An engraved armorial cartouche occupying the center of the page: the coat of arms of the House of Wittelsbach (Bavaria).

- Crest (top): a ducal/electoral crown held aloft by a winged putto; flanking putti blow trumpets at the upper left and upper right.
- Escutcheon (center): the arms of Bavaria — a shield bearing the lozengy (fusily bendwise) field of Bavaria, quartered with a rampant lion (the Palatine lion); a smaller inescutcheon at the center charged with an orb surmounted by a cross (the imperial orb / Reichsapfel).
- Supporters / surround: an elaborate Baroque strapwork cartouche with two female figures (caryatid-like terms) at the sides; festoons of fruit and flowers hang below; a grotesque mask at the foot.
- Engraver's signature (lower right corner of the plate): "F. Tintus Fe[cit]."

BOLOGNA, 1665.

From the Printing House of the Heir of Vittorio Benacci.

By Permission of the Superiors.

[Verso of the Dedicatory Title Page]

Title Page

ASTRONOMY REFORMED, IN TWO VOLUMES.

The first of these contains the OBSERVATIONS, HYPOTHESES, AND FOUNDATIONS OF THE TABLES.

The latter contains the precepts for the use of the Astronomical Tables, and the Astronomical Tables themselves, 102 [CII] in number.

The first volume is divided into ten Books; their subjects [*Argumenta*] are set out on the following page.

BY THE AUTHOR

Fr. JOHN BAPTIST RICCIOLI [Giovanni Battista Riccioli], OF THE SOCIETY OF JESUS, OF FERRARA.

Diagram. A woodcut printer's ornament: a basket or footed bowl filled with flowers and fruit.

BOLOGNA, 1665.

From the Printing House of the Heir of Vittorio Benacci.

By Permission of the Superiors.

[Verso of the Title Page]

Dedication Epistle

TO THE MOST SERENE AND MOST POWERFUL PRINCE AND LORD, LORD FERDINAND MARIA [Ferdinand Maria, Elector of Bavaria], Arch-Steward of the Holy Roman Empire, ELECTOR OF BOTH BAVARIAS AND DUKE OF THE UPPER PALATINATE, Landgrave of Leuchtenberg.

F. S. [the author's subscription — *Felix Salus* / a respectful salutation]

Under a happy and auspicious sign, Most Serene Prince, the *Astronomy* that I have in my own way *Reformed* now comes forth from the press — born, as it were, from the womb — at the very moment when the Sun has entered Leo. As its natal star, then, it has drawn for its lot the Royal sign of the heavens. Yet by a far happier design it seeks aid and protection for itself from the renowned name of Your Highness; for in your Royal coat of arms, twin Lions set below and above guard, more securely than Atlas, the globe of the world that glows red with the star of the Cross, and uphold it more mightily than Hercules. It has been, and still is, the special mark of this Most Serene House — by its twofold virtue, the orthodoxy of its Faith and the incorruptness of its Fidelity — on the one hand to

protect and guard the Catholic Church and the Supreme Pontiffs, and on the other the Roman Empire and the Emperors; to join political pruden-

dence with sincere Religion, fairness toward men with piety toward God, severity in Justice with the Clemency of Magnanimity, the arts of War with the pursuit of Peace, Wisdom with Fortitude, Arms with Letters — and, as is proper to the Lion's influence, the splendor of Wealth with the most lavish generosity toward learned and good men.

It is remarkable that the wisest Priests of Egypt, to signify the flooding of the Nile, took as their hieroglyph the Lion — the sign set diametrically opposite to Aquarius — rather than Aquarius itself. For what symbolic likeness, I ask, appears between that blazing constellation, which with the heat of its burning and the dry scorching parches the very bowels of the earth — to say nothing of its face — and so vast an abundance of waters as the Nile rolls down at the height of its season? Yet this is a mystery, whether of Nature's more hidden workings or of the secret providence of the Deity: that the subterranean lakes of Ethiopia and Egypt, stirred up by the barking of the Dog-star and the roaring of the celestial Lion, and boiling over, should so seethe up out of those immense cauldrons that the Nile then swells when other rivers are shrinking, and its plenty of waters triumphs at the very time when the rest, for want of water, lie dry or stagnant. Beyond this, if you consider the nature of the Nile and the temperament of the Lion, a great resemblance between the two will be apparent. Other rivers, the moment their banks are broken or overtopped, flood out with tyrannical force and a mass of waves, hostile to fields and farmers, laying waste everything in their path,

and through all the plains they drag the herds along with their stalls.
[verse quotation]

with barrenness, or with dearth of grain, following thereafter. The Nile, by contrast:

Fruitful in its overflowing, it never goes forth but bearing fruit: [verse quotation]

it overcomes its banks in order to enrich the fields; it floods in order to make fertile; and those who dwell beside it hope for most from it precisely when it swells the more proudly — so much so that they fear if it does not rise, and grieve if it does not flow over, and reckon it the shipwreck of their fields whenever they are not overwhelmed by the mass of its waters. The Lion likewise, least savage among wild beasts, is the more clement toward those who submit to him in

proportion as he is the more terrible toward those who despise his majesty: gentler toward women and infants, more kindly toward the well-disposed, more gracious toward those who do him good, more generous toward the hungry — with whom more than once he has shared his food, content himself with a small portion — and more skilled in serving holy or religious men than in raging against them. No wild beast is more easily tamed than the Lion, especially if he keeps company with princes, judging it unworthy of the King of beasts not to put off his ferocity at court and not to put on humanity in the presence of men robed in purple or in the trabea. Ages past saw, under Hanno the Carthaginian, under Augustus, and under Domitian, lions so tame that fawns and hares would play within their very jaws, fearing nothing there — the lions rather fearing to harm the helpless creatures even in the slightest. And a more recent age saw, under John of Austria [Don John of Austria], under Maximilian, and under Rudolph the Second [Rudolf II], lions walking harmlessly through the palace and waiting upon their masters; and at Eitelberg, in the castle of Otto Henry the Palatine [Otto Henry, Elector Palatine], puppies playing with a lion and sleeping safely upon its mane. "To what end," you will say, "this digression about the Nile and about lions?" Why, so that by the Lions glittering on your most noble coat of arms I might persuade you that those Heroic virtues are signified which I recounted above, and which Your Highness has drawn from your Ancestors

Dedication Epistle (continued)

—and which they have drawn from your forebears; for your Ancestors transmitted them to You in an unbroken and illustrious succession of descendants reaching all the way down from CHARLEMAGNE [Charlemagne]. Among these, OTHO [Otho] the Great won an immortal memory and rose to the summit: a man tall indeed in body, but greater in spirit, and destined to grow greater still — had not Heaven, in that very year 1180 in which he was chosen Duke in Bavaria, begrudged him to the earth. Yet his counterpart was his son LUDWIG [Ludwig], Duke of Bavaria, founder of Septivir [the Electoral dignity], Count Palatine, and founder of Straubing — a man marked for his loyalty toward Frederick II [Frederick II], and for his Religion and his Piety toward Innocent IV [Innocent IV]; he earned the praises of both, as a glory of the Empire and an ornament of the Church. His grandson LUDWIG II [Ludwig II], surnamed the Severe — in whom severity of character vied with fairness — ceded Lower Bavaria to his brother Henry. From this line came that distinguished offspring LUDWIG III [Ludwig III], chosen King of the Romans in the year 1314, and soon after Emperor — a man so great that the age did not know what was more to be

admired in him: his kindness toward his peoples, or his love of letters and of learned men, or his zeal for the Orthodox Faith, or his unceasing devotion to the defense of the Church of God. His great-great-grandson ALBERT [Albert], surnamed the Pious but no less the Magnanimous, refused the Kingdom of Bohemia when it was offered him: nobler in the Kingdom within himself, and one who had proved by experience that saying of Horace:

More widely do you reign by mastering your greedy Spirit, than if you
should join Libya to the remote Gades, and both Carthaginians
[Carthages] should serve one master. [verse quotation, Horace, *Odes* II.2]

So from this line was born another ALBERT [Albert], surnamed the Wise, who — emulating his Father's Piety no less than the most devout example of his wife Kunigunde — raised up at Munich a great many Churches, to storm Heaven by them as by fortresses, not with giant-like daring, but with humble devotion. Why then should he not beget a son like himself, WILHELM [Wilhelm], in whom so great a fervor for the Catholic Religion shone forth? Indeed this man begot ALBERT V [Albert V], who showed himself the wiser the more he too bore the surname "the Wise," and who the more keenly propagated the Orthodox Faith. From him your Grandfather WILHELM FERDINAND [Wilhelm] was born, most zealous for the Catholic Religion, who in the year 1597 — that he might withdraw out of the storms of this world into harbor, and thence the more securely into Heaven — abdicated the Dukedom of both Bavarias and gave himself wholly to himself, nay rather wholly to God. Afterward, from RENATA [Renata], that most illustrious Heroine, he received your most excellent Father MAXIMILIAN [Maximilian, Elector of Bavaria], of whom it is harder to keep silent than to speak — yet narrower than his deserts to wish to embrace in a eulogy either his skill in arms, or his cultivation of peace, or his love of law and equity, or his most devout piety, or the rest of those endowments of his for which Germany acclaimed him a Father of his Country. Of all these prerogatives, MOST SERENE FERDINAND MARIA [Ferdinand Maria, Elector of Bavaria], you have willed that they be Yours by hereditary right and by voluntary possession: Prudence above all in the choice of counsels, Equity in your Judgments, the most amiable humanity in governing your subjects, and a steadfast Zeal in defending the Orthodox Faith, together with the warding-off of the enemies of Faith and of the Empire. For from this it came about that your Cohorts withstood the forces of the Turks — superior in number, not in valor — and repulsed, routed, and put them to flight, with a memorable slaughter of the foe and to your own praise.

But how much our Society owes to You, and to your most renowned Parent and Grandfather; how great the Munificence on that side; how it has rejoiced, and rejoices to this day, in a protection that surpasses all glory — this no words can express, no monuments can attest; nor can I be acquitted of so vast a mass of debt, however great Your Magnanimity may be. For to acquit me of it would itself be a new favor and a fresh and immense debt, under which I could never, to all eternity, succumb in repayment. It remains only that the Magnitude of YOUR HIGHNESS deign to admit me — despite the smallness of my Work, the slenderness of my talent, and my own unworthiness — among the most devoted clients of Your Highness.

Your Most Serene Electoral Highness's

[The epistle closes, right-aligned:]

Most humble and most obedient Servant,

Io. Baptista Ricciolus, of the Society of Jesus [Giovanni Battista Riccioli, S.J.]

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INDEX OF THE BOOKS [INDEX LIBRORVM].

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Faculty (grant of permission) of the Reverend Father Girolamo Chiaramonti [Hieronymus Claramontius], of the Society of Jesus, Provincial in the Province of Venice.

Since two Theologians and experts in Mathematics of our same Society have reviewed the *Astronomia Reformata* of Father Giovanni Battista Riccioli [Io. Baptista Riccioli], a Priest of our Society, and have approved that it can be published — we too, having received authority from the Reverend Father Goswin Nickel [Gosuinus Nikel], our Father General and Superior General of the Society of Jesus, grant that it may be committed to print, if it shall so seem good to those to whom this pertains. In witness of this matter we have issued these letters, signed by our own hand and secured with our seal. At Bologna, on the 28th day of October, 1658.

Girolamo Chiaramonti.

Place * of the Seal.

Seen by Master Carlo Gorani [D. Carolus Goranus], Penitentiary, on behalf of the Most Eminent and Most Reverend Lord Archbishop of Bologna and Prince.

Seen — out of his singular benevolence toward the Author — by the Most Reverend Father Inquisitor of Bologna himself, Friar Guglielmo Fochi [F. Gulielmus Fochus], who has also confirmed the license for printing it: his Most Reverend Successor.

Let it be printed. Friar Giovanni Vincenzo Paolini de Gatexio [F. Ioannes Vincentius Paulinus de Gatexio], Master and Inquisitor General of Bologna.

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PROLEGOMENA AD ASTRONOMIAM REFORMATAM

[Prolegomena to the Reformed Astronomy]

In which is set out the System of the World together with the Hypotheses of the First and Second Movable Sphere [Primi, & Secundi Mobilis]; and the Author's endeavour in advancing Astronomy and Cosmography; and finally certain Conclusions are established, by which things hitherto certain are distinguished from things uncertain.

QUANTO progress the Astronomy preceding our own age has made — both by eyes raised to the Heaven, and afterward by Telescopes erected at the common Observatory — so that, as if crowned the natural Queen of the Sciences, it now seems to have at last lifted its head, and from that height to have illuminated whatever nearly all mortals previously either did not see, or lay hidden from them, or had revealed itself to them only by a grudging light: all this is established partly from what is indicated further below, partly from the Preface to the Reader of Tome 1 of the *Almagestum Novum* [*New Almagest*]. Nor, moreover, can this be unknown, except to those to whose knowledge the most distinguished works of the most learned Men in this kind have not come — I mean of Copernicus, Tycho [Tycho Brahe], Longomontanus, Kepler, Lansbergen, Galileo [Galileo Galilei], Magi-

ni [Giovanni Antonio Magini], Scheiner [Christoph Scheiner], Petavius [Denis Pétau], Simon Mayr [Simon Marius], Chiaramonti [Scipione Chiaramonti], Snel [Willebrord Snel], Stevin [Simon Stevin], Wendelen [Govaert Wendelen], Michael Florent van Langren [Michael Florent van Langren], Hevelius [Johannes Hevelius], Gassendi, Boulliau [Ismaël Boulliau], Hérigone [Pierre Hérigone], Morin [Jean-Baptiste Morin], Mersenne [Marin Mersenne], Anton Maria de Rheita [Anton Maria Schyrleus of Rheita], Vincenzo Renieri [Vincentius Reinerus], Johannes Phocylides [Johannes Phocylides Holwarda], Giovanni Battista Odierna [Io. Bapt. Hodierna], Elias à Leonibus [Elias de Leon] [?], and Maria Cunitia [Maria Cunitz], Vicenç Mut [Vincentius Mutus], Eichstad [Lorenz Eichstad], Lineamann [?], Huygens [Christiaan Huygens]; and of many others, whom — lest

I become too long-winded — I am willing, without doing them injury, to leave unnamed; and of Father Francesco Maria Grimaldi, by whose endeavours and discoveries this contribution has been brought together, and from these and from other selected, corrective theses, in our Hypotheses, suppose what concerns the Mundane System, and the things in Astronomy that are certain, and the things still uncertain — that we may reckon them, not unpleasantly to the Reader (as we judge), more briefly yet distinctly — we will set forth beforehand.

ARTICLE I.

On the Creation of the World and the Work of the Six Divine Days, insofar as it bears on establishing his System.

I have dealt with this at sufficient length in Book 9 of the *New Almagest* [*Almagestum Novum*]. The opinions of the learned can be looked up there; here I take up the matter only briefly, drawing chiefly from Sacred Scripture, from the Book of Genesis.

I suppose that at the beginning of time, in one and the same instant, God created Heaven and Earth — that is, the Heaven of Heavens, which is the Empyrean, and the Heaven of the waters, which was made after the Empyrean above [supremum]; and this was done in the work of the second day, as is indicated, where it is said: *the firmament, which divided the waters that were under the firmament from those that were above the firmament*. From this it is supposed that before these waters there already existed Heaven, and therefore that there was no further thing created by Moses before the third day. And so it follows that *Earth* must be understood here also as Elemental Water, or perhaps as the whole of the elemental sphere — that is, the Heaven of the waters, of that same lowest species, whose elemental, or of that same kind, is in the first instant. Since, therefore, in the first instant God created the two extremes of the world — Heaven as the highest roof [tectum supremum], and Earth with Water as the lowest base [infimam basim] — as the foundation, and there was as yet no Star, and therefore the fourth day had not yet been created; let us acknowledge that Copernicus, against the order of things, set down a contrary teaching to that handed down to us by Moses, placing the Earth among the Heaven, the Sun, and the center, asserting it; and that he placed the Earth in the middle, or among the wandering Stars, that is, the Planets. But that light, which arose not in the first instant, if indeed it arose then, was nevertheless still *darkness over the face of the abyss* [tenebræ erant super faciem abyssi], yet a little later, once created — namely, propagated by some successive propagation, or by the motion around

the terraqueous globe — produced the first equinoctial day. And the First Movable [Primum Mobile], by that same motion, brought it about, provided that what afterward was the Sun, by its Diurnal motion — that motion, I say, which then illuminated that Hemisphere of the World in whose middle was either Paradise itself, or the Terrestrial Palestine, the dwelling-place of the first Parents, or of the second Adam. And so God divided the light from the darkness; and the hours of the whole terraqueous globe's surface would have enjoyed the light for twelve hours, and the rest would have lacked it for twelve hours, save for that particular portion of the first day in which the darkness over the whole face of the abyss extended. But it remains uncertain to us whether that light, having arisen at the Horizon from the East, or from the Meridian of Paradise, or of Palestine, can be understood only in this way: *and there was evening, and there was morning* [Factum est vespere, & mane dies unus]. Taken in a figurative manner of speaking, the whole, principally that part, primarily holds the space of time, and of the Day at the meridian. Since the evening twilight of some time is taken either for the future, or already accomplished setting of the Sun; or for the time after midnight already accomplished, before which the Sun can ascend toward our Horizon. Finally, after this men can derive their light not from the necessity itself, and from another at the Sun, or from the Stars; nor likewise so much before all the Stars, when they were independently created. And by this cause, light created, except in that it happens, it is not a body; as it is subject, it lies between Heaven, or the terraqueous mass intervening — there is rather a Vacuum, than that a body should intervene, either airy or watery; nor is it to be thought essentially to depend upon the subject, so that it would stand fast; for already from the beginning, without an intervening Heaven, the light of the heavenly bodies could be both produced and sustained by God alone.

[Margin: 2. *De opere diei* 2.] As for the work of the second day, Moses speaks thus: *God also said: Let there be a firmament made in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters that were under the firmament from those that were above the firmament; and it was so. And God called the firmament Heaven; and it was made evening and morning, the second day.* The word "Firmament" [*Firmamentum*] in Hebrew signifies the *expansum* [the expanse]; and *solidatum* [made solid]. So now let me say that the whole space from the Earth up to the highest Heaven was first filled with a homogeneous water; but on the second day part of this water, left above the Earth, was made thin [extenuatam], and part rarefied into Aethereal air, and finally part condensed into crystalline Heaven, because not a few say: first our mind shrinks from so great a vastness, and from so great a condensation, that the rays of the light of the first Heaven [primigeniæ], and of the Fixed stars in the

firmament, in propagating their rays, would be drawn apart through a manifold refraction. Then, if there were one water, continued from Earth all the way up to Heaven, and properly speaking certain waters would be said to be under the firmament, that is, under that place where afterward the firmament was made, indeed under that place; and certain waters truly under the firmament. But if we say that on the first day the heavenly waters circumterraneous were created, and the heavenly waters were created as the airy Heaven and the aetherial, on the second day; that the Heaven was created aetherial, distinct, and admitted, since it primarily contradicts the fluidity of the Planetary Heaven, which is plain from Comets, and from the wandering Planets, and from the common recession of the motions, the Parts conform to opinion: we choose: then, when from all the other days some body was made of nothing, just as on the first day Heaven, Water, and Earth; on the third day, the Planets; on the fourth, all the Stars; on the fifth, the Fishes and Birds; on the sixth, the Quadrupeds, and Man; the second day alone is without any new production of a body, but is highly incongruous. But if we say that the whole of that space was first vacuum, and afterward a positive disposition, with the inferior World not yet existing, so that there would be a continuous Heaven; on the second day, however, the virtue of those bodies created, but the strength of those things not yet produced into Stars, and of the living bodies; on the second day, whether from nothing, or from the water of either matter, would produce a Fixed star in the firmament, or the Hebraic *Rakia*, that is, *Expansum solidum* [the solid Expanse], we have said, both because that part, in which the Fixed stars were collocated, properly to be solidified with hardness, was accepted, then because the remaining part, which the Planets by their wanderings, and some Comets permeate, ought nevertheless to be future and exist; and immovable, nor as tending to transfer the Planets, or Comets; but as some firm bulwark superior, and inferior to remain — These things, I say, do not move; let it be granted that all these difficulties weigh against the prior opinion adduced, and to the inquirer what meanwhile may intercede the prime water of the superior, and inferior waters, it will be answered with Moses: *the Spirit of God moved over the waters* [Spiritus Domini superferebatur aquis], that is, the spiritual substance of the Deity within, and above either of the waters was; filling that immense vacuum within the waters, and by its immensity filling the inestimable Heaven; whom indeed truly to satisfy with the nature of these opinions is not easy to think out, though also of another literal sound it agrees more closely with Sacred Genesis, and with verisimilitude.

[Margin: 3.] As for the work of the third day, this has many difficulties: For what is said — *Let the waters that are under the Heaven be gathered together into one place, and let the dry land appear; and it was so. And God called the dry land Earth;*

*and the gatherings together of the waters he called Seas [Maria] — is set forth with the greatest verisimilitude: namely either that beforehand, at the first surface of the terrestrial part, the mountains rose up; or that on the third day, they were arranged, that the surface of the Sea exactly intervened, or the Earth — they intervened equally with motions excavated; or that, intervening, the springs of the mountains, and the hills, and within the viscera of the Earth, item the holes dug out, a good part of the water hidden away of the rivers of springs, and floods, refluxes, marine, or the whirlpool of the vortices varying. Nevertheless, not by local motion alone was the work of this day accomplished, as some thought, but God added: *Let the Earth bring forth the green herb, and so on*; and so all plants, and the fruit-bearing wood, without delay of seed, were brought forth,*

[Margin: 4.] On the fourth day, however, God did not say: *Let the Heaven, or the Firmament bring forth*, as he had said on the third: *Let the Earth bring forth*; and afterward he said with the waters: *Let the waters bring forth the creeping creature, and so on*. But he did say: *Let there be Lights made in the Firmament of Heaven, and so on*: he willed indeed these things wholly to depend from his own concourse divine, nor again to assume an occasion of seizing the opinion of those who divinely, or by powers fatal in this inferior thing — unless I have said Light, which through tubes [tubus] on the preceding days was seen, not as a body but as the bodies of the preceding days, has changed by vicissitude; that no body was, because it was scattered in the Sun, as the Stars, by no accidents of bodies the Stars communicated something either of its destruction, or of being destroyed, are given to be in the Sun, and to the Stars; the powers being produced in propagating; light. By whichever of these modes God used, it is certain to be against this sacred text, to assert any Star, or light to have been produced out of the Planets out of God on the fourth day, and therefore the Earth, which was produced in the principle of the first day, was not one of the Planets. Nor have I said the Earth was not from the beginning, nor was the name of Star, because it was not yet created the Sun, nor could it receive light from it, nor perform the office of an illuminator; especially in the waters covered, *Quia* in actual illumination, otherwise when the Moon does not consist in actual illumination, or in a New Moon, or in the Full Moon, by a total eclipse it does not illuminate the Earth, and may meanwhile be a Planet, and could the Sun, as the Stars, lest a substance had been the prime day, or on the second produced under the name of Heaven, but not had been a Star, before it received an illuminating illumination, and what is against it which Moses subjected. *And he set them in the firmament of Heaven* [Et posuit eas in firmamento Cæli]: for that *Fiant, & Posuit* [Let them be made, and He set], at once signify a new production in the office of illuminating. Then the Earth, although covered with waters, was able to receive light

primordially as in a great mirror to reflect it, and much more on the third day appeared the dry land, and so it has the name of Star. But that you may say: it cannot be a Star, because it was not a globe of light, which would illuminate it, nor a Planet, because before the fourth day it was not moved around the annual orb: a Planet is denied by this, that no motion of translation was in Copernicus, ah but rather if the Earth alone has a daily rotation around its axis, it would be moved, in so far as the Moon near the New Moon illuminates that side, by the reflexes of the Sun's rays, that you should say a Planet. But I conclude from this: the Earth on the fourth day from the seat illustrated, fitted; and to illuminate the Moon, and by means of the annual orb it was bound to be called a Light [Luminare], and indeed greater, the Moon though less than the Sun, but in mass, and in the power of illuminating the Moon, from the greater surface reflecting many more rays much greater than the Moon, and so the three out of the two Lights God made. Lastly, you must say, although the Earth is thus moved around the Sun, nor is it moved even with respect to the Moon, and this in turn at fixed days illuminating, nor merits the name of a Light, because God assigned only the Light, which he ordained to illuminate the Earth, as is fitting for Men, beasts, plants prepared, and to distinguish day from night, and the months, and the years, which men were to use: as is plain from Sacred Genesis saying: *Let there be Lights made in the Firmament of Heaven, and let them divide day and night, and let them be for Signs, and seasons, and days, and years; and let them shine in the Firmament of Heaven, and illuminate the Earth* [Fiant Luminaria in Firmamento Cæli, & dividant diem, ac noctem, & sint in Signa, & tempora, & dies, & annos, & illuminent Terram]; with which agree those words of Deuteronomy 4: *Lest perhaps, lifting up your eyes to Heaven, you see the Sun, and the Moon, and all the stars of Heaven, and being deceived by error you adore them, and worship those things which the Lord your God created for the service of all the nations that are under Heaven* [Ne forte elevatis oculis ad Cælum, videas Solem, & Lunam, & omnia astra Cæli, & errore decepti adores ea, & colas quæ creavit Dominus DEVS tuus in ministerium cunctis gentibus, quæ sub Cælo sunt].

I freely grant for this reason that the Earth is not to be ranked among the Lights, although it is in the Copernican hypothesis that the Earth is a Planet, and an erratic Star, and indeed so, with its own atmosphere as in the Planetary Heaven, more remote from the center of the World than Mercury, Venus, and Mars in their perigee, and yet, in the Acronychal position, that is, in a higher Heaven, or in the Planetary part of Heaven, it would truly be said to be set, if not on the first day, at least on the fourth in the Firmament of Heaven. For what concerns the two Lights, and the Stars, Sacred Genesis says: *and let them shine in the Firmament of Heaven, that they may give light upon the Earth, and that they may*

rule over the day and the night, and divide the light, and the darkness

[Luminaribus duobus, & Stellis dicat Sacra Genesis: & posuit eas in Firmamento Cæli, ut lucerent super terram, & præessent diei, ac nocti, & dividerent lucem, ac tenebras]. But the Earth is not among the heavenly bodies which have themselves under the Heaven. And if indeed philosophically the Copernican Earth could be said to be under the Heaven, and in Heaven; this very thing nevertheless by a diverse relation is shown: all the Planets are under the Heaven more remote from the center of the Earth, the Planets, and the Fixed stars themselves are under the supreme Heaven; so absolutely speaking, the Earth is under the Heaven, and all the Stars are in Heaven, which truly cannot be said except by some peculiar manner of speech, as the place of the Earth is given, since it is not exactly its peculiar place, namely, the center of the World. Besides which it is highly incongruous, and because the Stars themselves were created in the ministry [ministerium] for all the nations, which are under Heaven, those very nations with the Earth circumambulate around their own ministries, emending [their courses] from those very lights, and influx, but it is rather right that the ministers, and chiefly the Sun, around the Earth quiet, and immovable, ought to be moved, and to perform the ministry, which to those God enjoined.

[Margin: 5.] The remaining works of the fifth and sixth days, and the constitution of the System of our world, need no inquiries, in what way these things have been said about it up to now; we suppose that there was no violence in any of them, or by the dissimilitude of the very sound of the letter understood; and by no necessity intercede, in another way to be understood; we suppose the Earth, or the terraqueous globe to be in the center of the World, without any annual motion, but excluding chiefly the annual; but above the Elemental Sphere truly, to be the Planetary Heaven, permeable indeed by the Planets, but immovable, and firm, although by no motion of its whole, nor any part circumvolved, and on this account it merits the name of Firmament; the Fixed stars truly to be in the probable Sphere solid, and impermeable; and on this account the Fixed stars themselves to be by perpetual figures of the stars, both as distant among themselves continuous; and likewise it is easier, and a motion of the whole sphere of its own, that all things be moved; whether that Heaven be Aqueous, created on the first day, and afterward consolidated, whether also distinguished. But if any Stars newly seen, and not begotten in the Planetary Heaven, should descend below Saturn the Comets, so as, when they have evaded the sight, since they are partaken in the Firmament of the Fixed stars they do not appear, nor are begotten, id non fine portent, and by some miracle made indelible by that divine virtue penetrating to be solidified the Sphere; let it be granted. Furthermore, to be explained, and of what may be prematurely about the bodies of the First Movable

[Primum Mobile], by whose motion is accomplished the daily revolution of all the Stars in twenty-four hours, or thereabouts, or at least the apparent motion of this is safe.

ARTICLE II.

On the First Movable [De Primo Mobili].

[Margin: 1.] The ancient Astronomers, excepting certain Pythagoreans, in order to reconcile the apparent motion of all the heavenly bodies from East to West, by the apparent proper motion, by which all the Stars likewise from the East gradually toward the West tend to bend, above the Fixed Sphere supposed a single Sphere — that one greater than the rest — which carried off the Fixed Sphere; and all the others contiguous to it, and solid, from their rising in the East are moved into contrary parts; this very thing, which it grants to be a distinct body, contained continuously: by this very thing, indeed, that the inferior sphere can be carried off toward the West, so that nevertheless it is not allowed to be carried off by some [motion], resisting somewhat, and the motion of the First Movable [Primi Mobilis] by contending, not so quickly is it revolved toward the same Meridian, as quickly as it had arrived,

[Margin: 2.] but indeed Nicetas of Syracuse, Heraclides, and Ecphantus the Pythagorean, and Seleucus; but afterward William Gilbert [Gulielmus Gilbertus], Origanus [Origanus], Longomontanus [Longomontanus], Argolus [Andrea Argoli], and Wilhelm Langius [Vuillelmus Langius], judged the Earth to be in the middle of the World, turning around its center by a daily revolution toward the East, and accordingly to be made, and meeting the Fixed Stars, and the Planets, immovable, in a gentle motion; or because they thought the velocity of the daily motion incredible in the Sphere of the Fixed stars, or whether the Planetary Heaven of fluids alternating they thought that ineptitude unfit to take up the Planets, with a constant, and uniform motion. But Philolaus [Philolaus], Aristarchus of Samos [Aristarchus], Nicolaus Cardinal Cusanus [Nicholas of Cusa], Copernicus [Copernicus], Rheticus [Rheticus], Maestlin [Maestlinus], Kepler [Kepler], Galileo [Galileo Galilei], Lansbergen both [Lansbergius] (father and son), Boulliau [Bullialdus], Hérigone [Herigonius], Valentin Naibod [Valentinus Naibodus], Diego de Zúñiga [Calvus Calcagninus, Didacus à Zuniga], Paulus Antonius Foscarinus [Foscarini], Baranzano [Baranzano], Giordano Bruno [Iordanus Brunus], Renatus of Chartres [René Descartes], Hevelius [Io. Heuelius], Wilhelm Schickard [Vuillhelmus Schikardus], Martin Hortensius [Martinus Hortensius], Christoph Wittich [Christophorus Vuittichius], Daniel Lipstorp [Daniel Lipstorp],

Tommaso Campanella [Tommaso Campanella], Christiaan Huygens [Christianus Hugenus], and not a few others besides the daily motion [diurnum vertiginem], a translation also through the Annual Orb, of this around the Sun, attribute to the Earth, besides those motions said, a third motion, by which the axis of the Earth itself is librated, that is, in such a way that the equinoctial points may seem to be in the preceding [signs] toward the West, and so the Fixed stars to recede from them, and at the same time to change their declinations; nor to remain in another motion of the Planets in longitude, than its proper motion toward the East. Which being done, either feignedly, or really, they are the more freed, by feigning, and from the molestation of explicating the daily motion of the Planets, and the solid Sphere of the Fixed stars, and of so simple a position even of the Planets, the view being made, the hypothesis is most beautiful, and the elegance of novelty excited them into love of itself.

[Margin: 3.] But we, to whom not only by the decree of the Sacred Congregation [decreto Sacrae Congregationis], which I repeat from Book 9 of the *New Almagest*, section 4, chapter 40, it is to be obeyed; but also by Physico-mathematical evidence, by how much more from a higher place they fall, by so much greater [is] the percussion of falling weights, indeed proportional to the acceleration of the descent of falling [bodies], translated [hither] by Copernicus from our single line [linea unica], in a Copernican single hypothesis the acceleration cannot be real, or by some other proportionate fear of falling, translated also into the Copernican [system], cannot be real, or by some proportionate fear of falling [bodies], it is plain from things said in the same Book 9, section 4, chapter 19, and from things to be said here Book 1, *On the Sun* chapter 17, and in its Appendix. We, I say, compelled by necessity to explicate by the Reason of the Stars [Ratione Stellæ], that they all may seem to be moved by their proper motion, and slowly toward the East, and quickly toward the West, and in the space of twenty-four hours, or a little after midnight to be turned back to the same Meridian revolved. This perspicuously, and most easily we shall explicate in the Planets first.

[Margin: 4.] Let the Meridian of any place whatsoever be granted as first; the most celebrated, not Geographically for the Fortunate Isles, or the Azores transit, but through the vertical mediterraneum of Paradise terrestrial; or for Jerusalem; and the daily revolution of the Fixed stars from that very same Meridian assumed in the meantime for the exemplar of the First Movable [Primi Mobilis], differing only so little from the apparent rising toward the East, so that not in those after 365, it is repeated to be by Seconds 50" [50"]: And so let us observe the center of the Moon in the same first Meridian in which the Fixed Star Spica [Spica] was, just as Spica recedes from this Meridian, it is moved, not so much by the same

circle [per eundem circum], but by a spiral motion, and without sensible declining from the plane of that same circle, just as its Declination, or Latitude, postulates, it is moved; and at what moment Spica returns to the first Meridian, the center of the Moon will be by a slower motion encompassed,

[Margin: 5.] in the Equator, or in the parallel of the Equator it is distant from the first Meridian toward the East by 12, or 13 degrees, would it not appear observed; so that with a daily motion translated toward the West, so that meanwhile it may seem to have remained Oriental; whereas Spica, and therefore moved again toward the East, by degrees 12, or 13, which to absolve it ought before to arrive at the first Meridian; so indeed: and yet there are not two motions really diverse, much less contrary to themselves; but a single spiral motion always toward the West, as to Longitude toward the West; but much slower in motion than Spica, so that, as the center of the Moon daily persists in the Equator, or in the same parallel, where Spica absolves [its] degree 360, now after days 15, the future is in this Heaven, when Spica is in the highest of the first Meridian; and at degree 30, then Spica also returns with the center of the Moon in the same first Meridian. What I have said about the Moon, may be understood about all the other Planets with a double yet discrimination. First it is, that the Sun always indeed more slowly returns than Spica, when it has been once joined with it, but much more swiftly than the Moon; so that, as the Sun arrives at that very place toward the West, to the Sun alone a single about-degree is left over to be accomplished toward the West, and after the first day's arrival at the Meridian, but it is not nevertheless after days 365 in the same; with the same future the moment in the first Meridian. But the Planet, when it is slower than Spica, in its spiral motion, so much slower it is, by how much nearly its proper motion is its own toward the East. Secondly the discrimination is, that the Moon, and the Sun in their spiral motion always slower than Spica, or any Fixed star are. The remaining Planets however, for the most part, are slower than the Fixed stars, sometimes nevertheless equally swift, and then they are said to be Stationary, because, none being more Oriental, they appear by night, than yesterday; and at the same time return to the Fixed stars, and to the same Meridian. When however they are slower, so that they may seem Direct, supposing motion not appearing toward the East; and yet truly, supposing the single spiral motion toward the West, rather Retrograde, or Tardigrade [more slowly] to be said; and on the contrary when more swiftly they arrive at the same Meridian, [than] the same Fixed [star], suppose Spica, and these, arriving there, themselves are made more Westerly, they seem indeed Retrograde [cum Fixa eadem puta Spica], and are called Retrograde, or rather Atrograde, or Ocygrade [Ocygradi] to be said.

[Margin: 6.] As for the Western motion of the Fixed stars [Fixarum Motus Occidentem versus], if any other motion in them does not appear, than the motion of their declinations by Libration; that very [motion] is the motion of the First Movable [Primi Mobilis], and the measure of all the motions of the inferiors; and in the Equator, of its Parallels it appears. But by subtle observation indeed, and truly Hipparchus [Hipparchus], the Astronomers detected the points of the Equator, at which the Sun arrives, making the Equinox; to differ yearly by a great deal, in the preceding [signs] from the Fixed Star, which had been in them; or near that, indeed; they deduce the Fixed stars more, and more Oriental to be made, as if the Fixed [stars] themselves were moving, and turn toward the East; but Copernicus, who indulges no motion to the Fixed stars, attributes this apparent precession of the Equinoctial points made by the motion of the Earth annual, by libration, and the parallelism of the axis [parallelismo axis terrestris] not made about itself. But to us, who assert the Fixed stars to be moved toward the West daily, it lies upon us to explicate from what cause they may continually seem to tend by the slowest motion toward [rising] in the East, but oblique, and at the same time what the First Movable may be, of which the Type they imitate in the motion from the East and West; for which we shall propose more modes, but not equally probable, that we may choose the more probable ones.

[Margin: 7.] The first, and most ancient mode is, that above the Sphere of the Fixed stars there is another Sphere, suppose a Crystalline Heaven, which above the poles of the Equator is moved revolving on the same Meridian within 24 hours, carrying with it the median Sphere of the Fixed stars; and its poles, from the poles of the Equator distant 23 [degrees] 30' 30" [23° 30' 30"], but in the meantime let the Sphere of the Fixed stars above the poles of the Ecliptic [super polis Ecliptica] be moved insensibly contending toward [rising] in the East; for although the bodies are discrete, and distinct, this is not repugnant to the two motions among themselves. But if you should be unwilling that the whole Sphere should carry off the inferior [one],

lower one, it would suffice that its girdle be carried from the highest periphery of the equator up to that point. **The second mode** is this: if the sphere of the fixed stars is either not solid, or solid yet penetrable, then any given fixed star would move spiralwise toward the west, in the same manner we described in number 4 concerning the Sun, preserving for itself the proper variation of its declination. **The third mode** is this: if the sphere of the fixed stars were to move over the poles of the equator through a span of 24 hours, and at the same time were to be librated toward the poles in such a way as the increase (or decrease) of their declinations requires; while the Sun, however, very nearly retains that same

momentum by which it crosses the equator, so that it is not slower — nor would it move spiralwise so as to be more easterly than it had been a little before, but rather it would become westerly by just as much as the semiannual proper motion of the fixed stars amounts to, which seems to me to come very nearly to 25' 20". For on this account the Precession of the equinoctial points toward the west would be the cause, as the fixed stars, which once would have stood in the Colure of the equinoxes, become each year more easterly by 50' 40". One must beware, however, lest the motion of Libration be such as Joseph Scaliger [Joseph Justus Scaliger] imagined for himself, supposing that the fixed stars retain the same distance from the poles of the world. **The fourth mode** is this: if one admits that this same sphere of the fixed stars moves over the imaginary poles of the equator and over the poles of the ecliptic, whether by one or by two Intelligences, alternately intervening with insensible motions — so that, to put it at its least as far as concerns our measurement or the observation of a moment, by one motion in the third hour it moves toward the west by 30". For on this account the motion of the equator would arise; and in the second the diurnal motion toward the east, so that by the very first motion the whole motion toward the west would be absolutely abolished, which I reckon to be very nearly 8" 40"; nor is there danger here that the motions might be sensible, or at least insensible by reason of slowness, or that they might appear too easterly by reason of the sensibleness of the equator. **The fifth and final mode**, finally, is this: if one, or several, Intelligences move the sphere of the fixed stars toward the west, so that any given fixed star arrives at the meridian so much more slowly than the one preceding it, by as much as the diurnal motion of the fixed stars appears toward the east, which is 8" and very nearly 40", and at the same time they make the fixed stars decline from the equator of the world, just as it appears in fact that they decline.

For these three modes of the diurnal motion of the fixed stars, thought up by Copernicus to be vindicated for the Earth's annual and librational motion, can be represented either by the Earth or by the heavens; but they have not been subjected to the eyes, nor could more of them have been; or else, with the Earth at rest, the Intelligences may move the sphere of the fixed stars with such great dexterity and ingenuity that they may represent these three apparent motions. Certainly, if we could move the globe of the Bear-stars [the constellation] about a point, or move a little globe in the middle of the air itself, stable in its poles — and this little globe of Bear-stars were affixed to no body sustaining it in its poles, but as if held suspended free in the air — and could move it also in this manner, so that we might represent those motions to ourselves. Among the five aforesaid modes, the **fourth** and **fifth** seem to me the more probable, and the more becoming to the Intelligences that move the fixed stars.

ARTICLE III.

On the Hypothesis of the Planets, with respect to the Figure of their Motion in general.

It has long been known that the ancient astronomers, down to Kepler, attempted to explain the motions of the planets, their anomalies, and their *prosthaphaereses* [*prosthaphaereses*] through Eccentrics, Epicycles, or librating little circles — but not without errors, and indeed sometimes errors so enormous that, since the discrepancy from the celestial observations could not be resolved into faulty observations (as in the case of Mars, [where the discrepancy] sometimes [reached] 4 degrees, and in Mercury 7), the aberration persisted, until Johannes Kepler, having got wind of it, suspected that the Eccentricity of the planets ought to be bisected — that the center of the planetary orbit is not the center of the equal motions; for otherwise just equations would never come out right, whereas with the Eccentricity bisected, much more accurate ones do come forth. That is to say: if in the line of the apsides two points are placed on either side of the center, equidistant from it — of which let one be the Earth in the case of the Moon, or the Sun in the case of the other planets, and the other equally distant from the center, that is, distant by as much as is half of the whole Eccentricity — then this would be the center of the equal motions. From this he saw it to follow that not the whole inequality that appears in the motion of the planet is a real one, but that it appears partly from an Optical cause, namely because we are not at the center of the planetary orbit; for even if we were there, we would still see half of the inequality, and consequently also a real inequality, to be acknowledged by one looking upon the planet from the center of the orbit, physically. But since those two points, equidistant from the center, are more proper to an Ellipse than to a Circle — for in an Ellipse two foci, or two centers [*umbilici*] equidistant from the center, are given — he concluded that the way of the planets is not Circular, but Elliptical; and this appears more evidently in Mercury, Mars, and the Moon than in the others, because in the others the lesser diameter, or conjugate, is a little smaller than the greater diameter, and therefore the Ellipse departs not so sensibly from the roundness of a Circle. But Kepler, wholly intent upon assembling Physical and magnetic causes of the motions — ingenious figments, but not so necessary, or congruent — did not demonstrate by Geometric rigor the manner of describing the Ellipse fitting to each planet, nor did he deduce the *prosthaphaereses* exactly from it.

[2.] Those who have embraced Kepler's hypothesis of the Ellipse, ingeniously discovered by him, are every one of the finest astronomers, but above all Ismaël

Boulliau [Ismaël Boulliau] in his most learned *Astronomia Philolaica* [(*Astronomia Philolaica*, Boulliau)], books 1 and 11; Pierre Hérigone [Pierre Hérigone] in volume 6 of his *Cursus Mathematicus* [(*Cursus Mathematicus*, Hérigone)], page 140; Calverus [Caluerus] in his *Uranometria* [(*Uranometria*, Caluerus)], part 2, chapter 4; Seth Ward [Seth Ward], demonstrated in his *Idea Trigonometriae* — to which he subjoins an inquiry into the Foundations of Boulliau's Astronomy, and detects certain errors in Boulliau's use of the Ellipse, by which I know not how Boulliau cleared himself, since the work published on this matter has not come into my hands. Meanwhile, however, Ward delivers the manner of the Equations and of the Eccentricity in the Ellipse exactly, but in that little work he does not teach the manner of demonstrating the Aphelion; which afterward, having heard [of the difficulty], he taught in a little book dedicated to four Astronomers — namely to Boulliau himself, to Gassendi [Gassendi], to Hevelius [Johannes Hevelius], and to Me. Comes Paganus [Blaise de Pagan] likewise excellently elaborated this method through the Ellipse, as did also Giovanni Domenico Cassini [Giovanni Domenico Cassini]. But Vicenç Mut [Vicenç Mut] judges that the Equations of the Center, or of the First inequality, can be better deduced without Eccentricity, through two librations, as he indicated to me recently in a Letter. In the meantime, however, most suppose the simplest motion of the Earth (in the Copernican view) — and therefore the way of the planet — to be through an Ellipse, and as motion; and they reckon it [to go] toward the east; and that very [motion], by reason of its simplicity, is lovable and to be preferred: granted that Boulliau, book 1, resolves this motion into several circles.

[3.] And yet we, the immobility of the Earth having been demonstrated, and the fluidity of the Planetary Heaven nearly demonstrated, and therefore the motion of being carried off rejected — by which motion the Planet is snatched along by the supreme Movable [Primum Mobile], and attributed to each, so that each Planet, by its own diurnal motion toward the west, as we said in Article II, number 4 — we neither can nor ought to assign the way by which the Planet really moves through one simple figure described in one plane; but it must be considered by us as set forth not through one continuous line, but through a spiral line about a Cone, proper to each Planet. Nor only do we ascribe half of the Physically apparent inequality to the motion of the Planet, as recent Astronomy at length acknowledged, but we hold absolutely that it moves unequally — yet with a regulable inequality. But since GOD willed to accommodate these motions to our grasp, so that through a single figure in the same plane we might more easily investigate that motion which is really made through a spiral line — by us not so easily comprehensible, just as if the motion were made in that [single] figure —

He so ordained the spiral motion about the Cone, that it could be designated on its surface by a...

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[Elliptical periphery] more nearly approaching to the circular one in the Sun, Venus, Jupiter, and Saturn, but receding more from the circle in the rest of the Planets. And so in this we dissent from the recent Astronomers, because we employ the Elliptical way of the Planet, under a mere Hypothesis, for entering upon the calculation; whereas they suppose the real way of the Planet to be Elliptical, by which it moves continually toward the east, when in reality it moves toward the west. Nor, on account of the difficulty of comprehending and explaining that spiral motion, ought we to reject it, or to fear for ourselves Kepler's censure — Kepler, who was also undermining the foundations which he himself had invented, [foundations] which with his whole apparatus he had attempted to overthrow.

ARTICLE IV.

On the Distances and Intervals of the Planets, in complement of the System of the World.

[1.] The distance of the Planets, whether from the Sun or from the Earth, is usually expressed by two kinds of measure: one by such parts as the semidiameter of the Sun's Annual Orb, or of the Earth, may have been taken as a unit, together with five or seven ciphers — namely 100000, or 10000000; the other by the semidiameters of the Earth. As to the first kind — the distance of the Planets from the Sun, and from the Earth — these are very nearly close to the truth, now repeated after Copernicus, if we speak of the five lesser Planets, which move about the Sun; for an interval of this kind is gathered together from the Anomaly, Eccentricity, and Equations; and therefore how certain these three elements are, so certain are the intervals, having a necessary connection with them. On the contrary, however, most uncertain is the interval of the Fixed stars from the Sun and from the Earth, as to either kind of measure. As to the distance of the Sun, again, with respect to the semidiameters of the Earth, opinions have hitherto been diverse, whether it be finite, or certainly knowable, or whether infinite. Hence it comes about that the distance of the Moon from the Earth, or from the Sun, does not seem able to be known with certainty as to the first kind of measure, nor as to the second; granted that the distance of the Moon from the Earth, as to the second kind of measure — that is, in semidiameters — is commonly held to be knowable through its parallaxes, [parallaxes] very sensible

and great. But this very thing some have called into doubt, doubting lest perhaps the Refractions of our Air be so great that they suppose a much greater Parallax than that which becomes known to us through observations of altitudes; and accordingly the Moon may be much nearer to the Earth than it has hitherto been reckoned by Astronomers. And because, for the lunar distance, we have a work to be undertaken in inquiring into the Sun's distance, and thence the distances of the remaining Planets — to be reckoned as beginning from the lunar, and to be vindicated — let us free Astronomy from this scruple, which we know to have been done by no one.

On the Distance of the Moon.

[2.] In book 10 of the *New Almagest* [(*Almagestum Novum*)], section 5, therefore, we have treated diffusely the Parallaxes, their doctrine, the Theorems, and the Problems — partly of others, partly devised by us — and at chapter 11, problem 73, we inquired how great the maximum Lunar parallax could be supposed to be, besides that which the recent Astronomers have laid down, but compared with an equal refraction; and we concluded that, even if the Lunar Refraction of a ray from the Aether, or from purest Air into denser Air, were as great as is the Refraction from Water into Glass, at an equal distance of the Moon from the vertex — say at a distance of the Moon from the vertex of 10 degrees — it could not produce a Refraction greater than 30'. Now Tycho [Tycho Brahe], at such a distance of the Moon from the vertex, observed no sensible Refraction; [continues, p. VI right column] but there, with so great a Refraction compensating the parallax, the distance of the Moon from the Earth would be 20 semidiameters of the Earth, granted so great a parallax. Now it is certainly established that, at that distance, the Parallax and Refraction from the vertex are smaller; by as much as the Refraction from Aether into Air is smaller than that from Water into Glass, by so much is it certain that the distance of the Moon from the Earth is much greater than 20 semidiameters of the Earth; and by as much as the difference of densities between Air and Aether is smaller — than the difference between Air and Water — by so much is the augmentation of the Parallax, derivable from the hidden Refraction, less; that is, the defect compensating the parallax. And just as the Refraction of 30' from water to glass, observed by Witelo [Witelo], bears no proportion to the Refraction observed by Tycho, so there is no sensible augmentation, [such] that, on account of a hidden Refraction, the Parallax could be deduced [larger] in the customary ways. It is worthwhile, nevertheless, to see the whole of that chapter, problems 73 and 74, and likewise chapter 12 of that Section. This scruple of Refractions having therefore been removed, it is established from observations of the Altitude of the Moon, seen and

true, that the Lunar distance from the center of the Earth at the Syzygies is never found to be greater than $72\frac{1}{2}$ semidiameters of the Earth, nor less than 52, as I taught in book 4 of the *New Almagest*, chapter 15. And from what has been said there, and afterward corrected in this Volume, book 3, the distance of the Moon at the Conjunctions [Copulis] is at minimum 58' 21", and at maximum 63' 40", in semidiameters of the Earth, from our own observations at any rate.

On the Distance of the Sun from the Earth.

[3.] With how much greater effort and industry than any of the Astronomers, We, together with Father Grimaldi [Francesco Maria Grimaldi], investigated the distance of the Sun from the Earth — not by the most fallacious method of Lunar Eclipses, [a method] indicated by Aristarchus [Aristarchus], praised by Kepler, and by us first cut into [examined] by the conspiracy [confirmation] of Wendelen [Govaert Wendelen]; then in a new way through the Parallaxes of the Sun examined by means of Refractions; then at length, from Physical causes deprehended in the new Theory of the Sun's Eccentricity — [all this] will be clear to the Reader, of which we gave the doctrine in book 3 of the *New Almagest*, chapters 7 and 8, and in the Appendix to chapter 7, which is contained in the end of the first Tome of the same *Almagest*; and in the Volumes of this book, 731, and chapters 13, 14, and 17; we will teach how great a portion of the marrow [pith] of the opinions of the Astronomers we here reduce to two classes, premising nevertheless some of those opinions. For some have thought the Sun to be distant from the Earth by an infinite — or at least by a finite-in-infinite, that is, an indeterminable-to-us — distance; or at least a finite [distance] that cannot from observations be laid down, nor [posited] so great but that a greater might be posited, on the ground that the Parallax of the Sun is not evidently sensible. Others, however, [held] the Sun to be finitely distant from the Earth, yet knowably and demonstrably so. The first opinion is ascribed to Hipparchus [Hipparchus] in earlier considerations, but afterward, from Lunar Eclipses, he laid down so great a distance as Ptolemy [Ptolemy] [held]. But Giovanni Domenico Cassini [Giovanni Domenico Cassini], as we shall say in book 1, chapter 13, first reckoned the parallax of the Sun insensible, but afterward sensible. Wendelen [Govaert Wendelen], having used the Dichotomies [*Dichotomia*], but supposing the air thicker about the Moon — which would retard the evening Dichotomy, hasten the morning one — chose the maximum distance of the Sun [as] 14905 semidiameters of the Earth, very nearly as Posidonius once [held]; for, granting that thickness of the air, he professes the Dichotomies to have come out to him at 7000, very nearly as we too deprehend through diverse Dichotomies, as we show more fully above at the places indicated. Through Refractions, however,

hunted by a new method, we have come at the Sun's parallaxes, and these — as we shall say in book 1, up to the end of chapter 14 — are never found greater than 30"; nay, for the most part smaller. Hence it has become most certain to us that the distance of the Sun from us is never greater than 6430 Earth-semidiameters; nay, that it is greater than this; and that Ptolemy, Copernicus, Tycho, and the others who lay down the Sun's parallax at about 3 minutes have manifestly erred, [these others] having assumed [a value] rather than demonstrated it; and that, in setting up this interval far less [than it should be], they erred — those whom I have cited in book 3 of the *New Almagest* up to the end of chapter 7, and in its very Scholia.

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At length in book 1, chapter 17, we shall show, if a Physical cause of the Eccentricity of the whole Solar [orbit] exists, [that] the axis of the terrestrial shadow is such that the center of the Sun's motion lies there, equal, where the shadow of the Earth ends; and that the cause of half the Eccentricity is the distance of the apex of the Lunar shadow from the Earth, observed by us — hence, and from the Semidiameter of the Sun's Apogee, follows the maximum distance of the Sun from the Earth at 6666. Too small, therefore, are the limits of the Sun's distance which Kepler defines in his Commentary on Mars, page 71, saying: *The Sun is not so near as 230 semidiameters of the Earth, yet not infinitely distant: but it lies somewhere between 700 and 2000. Nor as yet does any certain number seem to be demonstrated.* But correcting him, we said more truly: *The Sun is not so near as 6430 semidiameters of the Earth, nor yet infinitely distant, because it is not distant more than 30000. But between six thousand and thirty thousand semidiameters of the Earth, no certain number is as yet demonstrated.* I add, for the exclusion of an infinity, that most Physicists hold that no infinite bound of vision can be given — nowhere unenclosed; of which kind is a rectilinear Triangle. But however great the distance of the Sun from the Earth be supposed, since it is certain that the Sun is larger than the Earth, [it follows] of necessity that, with a line drawn straight through the center of the Earth, and however far continued, it would at length meet at the apex of the terrestrial shadow, where the other straight line, tangent to the Sun and to the Earth, [meets it]; and the angle which it makes subtending the true semidiameter of the Sun, and [thus] from this semidiameter, and from the two aforesaid straight lines, a rectilinear Triangle must be formed.

But what may lie within the said limits 6430 and 30000 — a probable distance of the Sun — is not easily persuaded to the lovers of their own opinions and

inventions. For to a few it will appear not finite, but infinite, or at least the maximum, namely 30000 semidiameters of the Earth, so that they may safely scorn the parallaxes. To Wendelen [Govaert Wendelen], however, and very nearly to Christiaan Huygens [Christiaan Huygens], a distance about double will be pleasing — that is, about 14000, or 12000, using round numbers; but to us that pleases which is still about double smaller, namely 7427, from many Dichotomies, and the Semidiameter of the Sun's Apogee, and the Eccentricity limited [to it]; or [else] 6666, from the Eccentricity of the Sun measured to the Axis of the Terrestrial Shadow, and from the apparent Semidiameter of the Sun — not repugnant to the evident parallaxes, if the parallax-fallacy of the Lunar Dichotomies be absent, which fallacy usually intervenes between the time of the Dichotomy and the quadrature, and usually diminishes it; for the [interval] is less by about one quarter of an hour; for it is no greater than one hour, yet notably less by this less reckoned [amount]. It is wonderful, nevertheless, that the Dichotomy of Huygens, in this business, is of so ready use, since he professes the proportion of the diameters of the Planet observed through the Telescope; he also confesses the middle distance of the Sun from the Earth to be 12543 Earth-semidiameters; why? Because, if it followed this [proportion] from the apparent diameter of the Sun, 30' 30", then [it would be] as if the Sun truly could not, with this appearance preserved, be distant from us at infinity, unless prohibited from elsewhere.

On the Distance of the five lesser Planets.

[4.] Since it is most well-known to Astronomers that the Eccentricities and mean distances of these Planets depend on their distance from the Sun, how great is the uncertainty, or how great the probability, of the distance of the Sun from the interval [of the Earth], and from the Earth — so great too must it be concerning the interval of these Planets, both [their distance] from one another and from the Earth. And although opinions have been diverse concerning the accurate distance of these Planets from the Sun, in such parts as the Radius of the Sun's Annual Orb is 100000, yet only so much has been advanced in this Astronomy after Copernicus, that it has been acknowledged: the maximum distance of Saturn from the Earth is very nearly tenfold the interval of the Sun from the Earth; the [distance] of Jupiter about fivefold; of Mars about one-and-a-half [sesquialterate]; of Venus about two-thirds [subsesquitercian]; of Mercury about one-third [subtriple]. Indeed, as I reported in book 7 of the *New Almagest* [(*Almagestum Novum*)], section 6, in the Scholia,

[The table of proportional distances, set in the right column:]

Planet	Distance
♄ (Saturn)	953153
♃ (Jupiter)	519966
♂ (Mars)	152366
Telluris (Earth)	100000
♀ (Venus)	72336
☿ (Mercury)	38710

[Resuming the main text, top of right column, p. VII:] ...chapter 2, Kepler in the *Mysterium Cosmographicum* [(*Mysterium Cosmographicum*, Kepler)] attempted to distribute these intervals by inscribing the five Regular Bodies [the Platonic solids], which however did not succeed in all cases — not even granting the translation of the Earth through the Annual Orb, [placing it] among the Superior planets and the Inferior planets; which translation, however, has been proved false by us. But Wendelen [Govaert Wendelen] too, supposing the Earth among the Planets, as we said there, [held] the distances of the Planets from the Sun, the center of the World, to be in the sesquialterate ratio of their periodic times: from which he concludes that the distances of the Planets have among themselves the proportion which the numbers placed in the adjoined little table, here transferred, [have]. We, however, judge that GOD, Best and Greatest, did not have regard to those proportions which seem beautiful to us, but to others — [proportions] which, foreseen by Him for the government of the lower regions of this World, were fitting; and so it is not to be sported with in these concinnities of numbers, [as if] to depart from the apparent celestial motions and measures, in order to represent them by more apt ones — such as in the meantime we judge those to be which, at the end of books 5, 6, 7, 8, and 9, we shall select; and hence it has been pleasing also to represent them, at the end of book 10, in Earth-semidiameters too, according to the quadruple opinion of the Sun's distance from the Earth, indicated at the end of number 3; so that it may be plain to the Readers within what [limits] the determination of a more recent and more certain Astronomy stands. In this place meanwhile, for the venturing of the Fixed stars' distance, it suffices to foreknow the maximum distances of the Sun, and of Saturn, from the Earth, according to the quadruple Hypothesis standing within the true limits, and they are written below.

[The four-row Hypothesis table:]

From the Hypothesis	Maximum distance from the Earth, in Earth-semidiameters:	
	☉ (Sun)	♄ (Saturn)
The highest [Summa]	30000	327610
Of Wendelen [Vuendelini]	14905	162833
Ours [Nostra]	7427	81105
The lowest [Infima]	6666	72795

On the Distance of the Fixed stars.

[5.] On this I have discoursed in book 6 of the *New Almagest* [(*Almagestum Novum*)], chapter 7, entire, and in the Scholia upon it, so diffusely — if I am not mistaken, diligently — that the Reader, not regretting it, may be able to draw erudition from there. The sum of the doctrine handed down there is this: 1. those fixed stars which are in the Zodiac, and are occulted at times by the Planets running beneath them, are certainly higher then, at least than those Planets; 2. those fixed stars which are observed by the naked eye, or are observable, so that they undergo some Refraction (as is certain), it is also certain that they are not distant from us by an infinite interval; for, besides what has been said there in number 3, I add that it is of necessity that they undergo a sensible Refraction, since a Ray from the star, falling refracted upon the surface of the air, is inclined from the perpendicular by some sensible angle, and, with another ray from the star produced to the center of the Earth, and with the Semidiameter of the refracting Sphere, forms a Triangle; but the Physicists hold for certain that it is impossible for an infinite to be bounded on every side; 3. It is certain that it cannot be evidently shown by us how great is the distance of the Fixed stars from the Earth, whether of those which are affixed to the concave lowest surface of the Firmament, or of those which are placed in the deeper part of the Firmament; so that not without reason did Pliny [Pliny], in book 2, chapters 1 and 23, say [that it is] *a fury of the mind, and almost the work of a demented idler, to attempt this measurement* — although with a hope of certitude, [it suffices] that so great an estimate of conjecturing may stand by a settled mind; for we have no way — especially outside the Equator — of investigating the parallax of the Fixed stars, and of discerning it from Refraction, or this latter from the former; and therefore we reject the **Pythagorean** interval there, namely 94500 miles, that is, about 24 Earth-semidiameters.

by 2°23', from which the parallax of the fixed stars would arise as 2°23'. But because the assumed distance of the Moon is uncertain, we do not approve

[Platonicus] in this matter — though we do not reject it either. If we take the Moon's distance at 60 terrestrial semidiameters, the [parallax] would come out as 17993654, and would make the Lunar [distance] 466561 times [the Earth]. And the harmonic distribution of [Bettini], by which he refutes that the fixed stars are at no greater distance than 2290 terrestrial semidiameters, since he ascribes to the parallax of less than half a minute — we have demonstrated [this elsewhere].

But why should we labor to remove the fixed stars to so great a distance with the Copernicans, that the distance of the fixed stars should vanish into nothing, and become as it were that of a point — therefore, from the Copernican Hypothesis [Tycho] and [Magini] [Giovanni Antonio Magini] deduce a distance of the fixed stars of 785,000,000 terrestrial semidiameters. [Longomontanus] makes it 7,906,818. [Scheiner], from [Maestlin] [Michael Mästlin], 13,133,576, from which arises the parallax of the annual orb at 40', just as also from the [Galileo] [Galileo Galilei] interval, which puts it at 1,046,400 terrestrial semidiameters. But from [Kepler]'s interval, 34,077,067, or 60,000,000, he shows that there would there follow a parallax of the annual orb of 1°7' or 24"; which by no means can be detected with great instruments, as [Tycho] says in his *Mechanica*. And from [Lansbergen]'s distance, 41,958,000 terrestrial semidiameters: the parallax of the annual orb of 1", or — from [Hortensius]'s interval, 68,754,937 terrestrial semidiameters — the parallax of the annual orb would be 1', and from [Hérigone]'s, 1,440,000, the parallax of the whole annual orb [would be]; whereas after six months it would be perceptible, namely a minute of 6'. By contrast, if it follows that the parallax of the annual orb ought not to exceed 10", when the least distance of the Sun from the Earth is — as we have said — 6430 terrestrial semidiameters, it would be necessary that the fixed stars be distant from us by more than 308,000,000 terrestrial semidiameters. But, that dismissed, with the hypothesis of the annual orb of the Earth being false, I see no more probable ways of conceiving the distance to be taken than the following.

[Margin: 6]

The first and more probable method, from the proportion of periodic motion to periodic distance: if it is assumed that, as the Sun's period is one year and the Sun's distance from the Earth is 3000 terrestrial semidiameters — least, 6430 according to the said number 3 — so the period of the fixed stars, which to us is the period of the years, 25579: to the distance of the fixed stars there comes the sum 767,376,000, or the least 164,472,970. Or, if it be made that the period of [Saturn] is 30 years, and of the same distance the sum is 327,610, or the least 72,795; and from the said number 4, if the period of the fixed stars is 25579 years,

the distance comes to the sum 2,793,31,026, and the least 620,68174. We see how much from here is doubtful and how uncertain, since the period of [Saturn] is more uncertain than that of the Sun — which is the first and best-known measure of time.

[Margin: 7]

The second method would be, if the Distance of the Sun from the Earth were a mean proportional between the Distance of the Moon and that of the Fixed stars from the Earth. For example, if it were made that, as the Moon's greatest distance is 61 terrestrial semidiameters, so to the greatest distance of the Sun of 7427: to the distance of the fixed stars [comes] the sum 889,683. But to this it does not seem advisable to assent. Yet, that we may say it in one word — Vol. 4: the Refraction of the horizontal Moon at 30', in the middle of the air, at 40'; the Refraction of the stars at 31', and of the Sun at 31½. From which the difference of refraction of the luminaries is one minute, of the Sun and stars half a minute. Nor yet can we make it [come out], as 1: 1, so [the difference]; and so the maximum difference [of refraction] of the Sun, then of the distance, which to me is 7365 terrestrial semidiameters, [comes] to 11047: for the distance of the fixed stars would come out much less than that of [Saturn] — which is hardly probable.

[Margin: 8]

The third [method] perhaps will appeal by its simplicity to anyone: namely, if it should somehow happen that [Saturn]'s distance from the Earth were nearly tenfold that of the Sun, so that [Saturn]'s distance is as it were the center of the five wandering [planets], the distance of the fixed stars likewise from the Earth, that is, of the fixed stars at the decuple distance — the distance of the wandering stars being taken together, that is, of [Saturn] the highest of the wandering stars; thus, by the last Table of number 4, the sum of the fixed stars' distance would be 327,6100. Or, if it please that the Sphere of the fixed stars begins there where [Saturn]'s shadow ends, and this could in no way infusate the fixed stars, to me [Saturn]'s shadow would be 120,000 terrestrial semidiameters; if to this be added our [Saturn]'s distance, which is the maximum 81105, the distance of the fixed stars would be made 201105. Or, more roundly, 200,000. But more than this we play at guesses and uncertainties. For a certain measure of these, GOD, Best and Greatest, has consulted.

[Margin: 9]

Epilogue on the System of the World [Epilogus de Mundi Systemate]

Thus far concerning the System of the World, according to our Hypothesis, in which the Earth is at the center of the World, Immovable, as it was created from the beginning, as the foundation of the World's Edifice, and as the habitation of future men — for whose sake all things, around which the heavenly bodies were bound to serve. But around the Earth the celestial Spheres, and the elements, move both the Sun and the Moon by their twofold [motions]: by their own [motion of] Longitude they appear to move from West toward East, and by the other [motion] from East toward West obliquely, yet really, with one perpetual motion always westward by Spirals in the fluid Aether, described by a law, so as to furnish to human imagination the conceiving of their motion, as if it were made in one [path], almost circular, or rather Elliptical, around a Cone that may be designated by scales; and the five lesser Planets [revolve] around the Sun as the center of their Eccentrics, and as the fountain of light received from it, and mediating around the Earth, as the center, and the terminus of light, and influx, in the fluid Aether, are moved by their own [path], not immovable but permeable, but by spirals always westward toward the West, by a law (as we have described); nor are they ever truly Retrograde, but Stationary, and therefore appear to stand still, since at one and the same moment they recede with the same Fixed Star to the same Meridian, and retreat indeed toward East when they revolve more swiftly toward the Origin, [or move] westward; whereas when they revolve more slowly to the same [point]. Lastly, the Fixed Stars in the solid Heaven move daily, or [by] two motions imperceptible to us mortals, distinct and alternating in turn, now slower toward West, now slower toward East, by that obliquity of latitude declining with respect to the Ecliptic, as is established. Or with the one real motion by Spiral, they are moved by the Intelligences always westward toward the West, in order that they may represent to us the apparent oblique motion toward East. Lastly, the distance of all the stars conspicuous to us — although it be finite — yet differs in this, that the Lunar distance from the Earth is certainly within the closest limits, so much so that observations duly carried out evidently exclude the errors which the terrestrial semidiameters could include. But the Solar distance is nearly certain, yet within wider limits, namely not less than 6430 terrestrial semidiameters, nor greater than 30000. The distances of the planets, indeed, with respect to the Sun, are most nearly certain, inasmuch as they appear from their motions around the Sun itself, and necessary for representing the prosthaphaereses to them; but with respect to the Earth they have a certain latitude, which depends on the [latitude] of the Sun-to-Earth

distance, [their] interval [depending on it]. Lastly, the distance of the fixed stars is at most a matter of probable conjecture, and three or four [methods] of this distance are at hand by probable methods, but neither certain nor demonstrable. It remains for us, by deciding about the Fixed stars and the Planets and the Earth, to indicate how much has thus far been advanced in Astronomy and Cosmography in each particular.

ARTICLE V.

On the Fixed Stars [De Stellis Fixis]

[Margin: 1]

Just as a new Star afforded [Hipparchus] the occasion of enumerating the later Stars [and] the Heavens, and of leaving them as an inheritance to posterity, and as [Pliny] relates in Book 2, chapter 26, so the new Star of the year 1572 [the supernova SN 1572] stirred [Tycho]...

stirred [Tycho] to rectifying the thousands of Fixed stars, and to restoring them into one place as nearly as possible — the new method of [observing] Venus together with the Fixed Stars having been used, that it ought to be in no respect less [accurate] than that of [Hipparchus] left to posterity. To us, however, not a few things were left to be amended, on account of the excessive parallax of the Sun, and of Venus, assumed by [Tycho], which even [Kepler] admits to be unsound. The Ephemerides also; but especially because they falsely supposed that the evening observations of Venus are compensated by the morning ones, and [those] of our observations [are compensated], with a larger instrument, and we corrected the Right Ascensions evidently, and the Declinations of very many of the fixed stars, as will be shown in Book 4, in their proper places.

[Margin: 2]

But since in the Tychonic Catalogue of Right Ascensions that Star is lacking which is second in honor [magnitude] in the shoulder of the Lesser Bear [Ursa Minor], which once shone as the Pole Star, and on account of the latitude of that [star], and the longitude — by a trigonometric calculation we deduced that the increasing longitude decreases for the years 1600 and 1700, which is new and unheard of; this was for us a [matter for] astronomers, and a cause, and at the same time with P. [Bonaventura] Cavalieri [Bonaventura Cavalieri] investigating, [we were] detecting — that it must of necessity be made not in this Star alone, but in all the others whose latitude is greater than [that] of the polar circular [circles]; for from this the Right Ascension is detected by much, the longitude decreasing as

the latitude increases, according to the Theorem which we set forth in Book 6 of the *Almagestum Novum*, chapter 19, problem 11. And it is to be repeated here, Book 4, chapter 1.

[Margin: 3]

Further, we have taught that the Latitude of the Fixed stars, not only by the Right Ascension and Declination, must be corrected and amended, but also that they are immutable, in Book 6 of the *Almagestum Novum*, chapter 15, [as] we shall say below concerning the immutability of the obliquity of the Ecliptic. But concerning the motion of Longitude, of their apocatastasis, [it is] not from one or another comparison, as [Tycho] did, but from 72 comparisons, [that] we shall determine [it] more certainly, Book 4, chapter 19; from which we conclude both the year [of apocatastasis] not to be less than 49"; nor greater [than] 51" seconds, between which terms it [is] more probable, 50".40"', as we teach in Book 4.

[Margin: 4]

Lastly, as to the number and apparent magnitude of the Fixed stars: it is known, both as to quantity, [now] that the Telescope has been invented, by Astronomers: for through it they learned that the Milky Way is as it were a heap of innumerable little stars massed together; thus too the Nebulous [stars] coalesce out of several obscure little stars, [their] light [made] nebulous, in the nebula of Praesepe [36], and in the nebula of Orion [21], and within two degrees [there appear] more stars than 500 in Orion [3], and [40] in the Pleiades, [which] [Galileo] [Galileo Galilei] detected, then 2500 new stars in Orion alone he counted, as our own P. [Giovanni Battista] Zupus [in the Pleiades, Hyades], and in the Sword of Orion 72[?] counted besides. Lately too [Christiaan Huygens] [Christianus Hugenius], in the middle of the Sword of Orion, out of 12 Stars composed into a great [nebula], by a powerful Telescope saw [it]. Accordingly, although the number of the wandering [fixed] stars is not infinite, as [Giordano Bruno] contends in his book *On the Infinite*, and [that they are] innumerable, saying that there are as many Worlds as Stars, and infinite, as [Kepler] gathers in his book *On the New Star*, chapter 21: yet they are innumerable to men, and admirable to us [in] the power and wisdom of the Divine Founder, who created them and preserves them; as David sings in Psalm [147], who numbers the multitude of the Stars, and calls them all by their names [*Qui numerat multitudinem Stellarum, et omnibus eis nomina vocat*]. To this with what great profit Astronomy has gained by the Telescope, and by whose aid [the stars] can [be observed], either by conjunction or vicinity of the Fixed stars with the

Planets, much more evidently are the places of the Planets noted in the sky than by any other instrument.

, whatever [variety] appears in the Declination and Latitude. Now let us run through, in the individual Planets, what our age's Astronomy has detected by the benefit of the Telescope.

[Margin: ♄ (Saturn)]

SATURN, now solitary and round, now three-bodied [tricorporeus], by more perfect Telescopes, now is seen Ellipticized [shaped] in diverse manners — [as observed by] [Galileo Galilei], [Scheiner], [Giuseppe Biancani] [Blancanus], [Pierre Gassendi] [Gassendus], [Hevelius], [Schickard] [Wilhelm Schickard], [Christoph Scheiner] [Scheinero?], and the Fathers of the Society our [colleagues] — [Daniel Bartoli] [P.P. Zupì, Niccolò Zucchi, and Bartoli] — [and] Eustachio de Divinis [Eustachio Divini], [and] Odierna [Giovanni Battista Odierna]; to Us also, and by many other figures [Saturn] has been exhibited. So [Christiaan Huygens] saw [it] with a larger Telescope: with a Telescope of 23 feet, always handle-bearing [ansatus] even when by lesser tubes the tricorporeal [appearance] [was seen]. He asserts the same: that in this Saturnian System a certain little planet was observed by himself, 16 [days], circulating around Saturn within about [16] days, which therefore he calls Saturn's Moon [the satellite Titan]. But he judges the Saturnian Phenomenon of the handles [ansae] to be safe, if it is said to delay within the bright ring, which always accompanies it; otherwise to explain those, [the things] which they propound, are false. We, in Book 10, will show better all those things proposed; if they place Saturn at the nearest Elliptical [figure], it [is] continued by them, [rather] than the vicissitude of that libration which there we expound. But truly through the handles, or rather the Armilla [ring], to preserve the axis perpetually with the plane of the Equator parallel — this most evident from observations [made] with P. Grimaldo [Francesco Maria Grimaldi] we confirmed in the *Almagestum Novum*, [a fact] which [Galileo Galilei] suspects, [Pierre Gassendi] [Gassendus] and [Bullialdus] [Ismaël Boulliau] asserted, [Hevelius] denied, [and] [Huygens] thought by no means exactly close to the solstitial points. The belt [fascia], which We, and then [Huygens], think to be part of the aforesaid ring [armilla], [is] not improbable, in the body of Saturn.

[Margin: 5]

JUPITER, by the help of the Italo-Belgic Telescope, [observed] from [Galileo] in Italy, at the same time as it was first observed by [Simon Mayr] [Simone Mario] in Franconia, with its four little Planets around Jupiter, which complete their

periods within a few days. These [were] thereafter frequently seen by [Scheiner], [Biancani] [Blancanus], [Hevelius], [Huygens], and Us; but especially by D. Vincenzo Renieri [Vincentius Reinerus] of Oliveto, [Galileo]'s disciple, [who from] their Ephemerides [drew them] forth, [bringing them] from that [eternal] light into the [light] of eternal life, which we hope, evoked, [and] as [Daniel Bartoli] [D. Io. Bapt.][?] disclosed [the] celestial secret. Besides, from primary and noble [observations], from the Eclipses frequent in the shadows of [Jupiter's] little Planets of the Jovial body falling on it, we have at the same time concluded that we know that [Jupiter], and that its satellites receive light from the Sun, just as the same [is true] of Saturn, as has been opined of Mars also; the other [satellite], if not in Mars, [Galileo] thought, [by] the agitation of [their] natures, that on the Earth at least they could [be observed] through them in diverse places observed, [we are to] collect the difference of Meridians. But an uncertain number, [it appears], and besides [there are] 4 satellites, [though] at some time others, five [perhaps], as [Rheticus] [Rheinhold?][?] contends; [though we said but] one, treated of in the *Almagestum Novum*, Book 7, chapter 3.

The belt [fascia] indeed on Jupiter's disc — now one, now two, now three, [in] diverse [positions] yet — did not see, [yet] not once, the Fathers of the Society of Jesus our [colleagues]: Io. Bapt. Zupi [Giovanni Battista Zupi], [Niccolò Zucchi] [Nicolaus Zucchius], and [Daniel Bartoli] [Daniel Bartolus], [Francesco Fontana] [Franciscus Fontana], [Huygens], [and] We, with P. Grimaldo [Francesco Maria Grimaldi], so evidently we have observed [them], that perhaps it [is] from the very front [frons] of the easily-changing belt. Diverse positions [situs], either from vertigo [rotation] or from libration around its own center are believed to arise; [Huygens] saw, and those things not once [were] illustrated, [by] Marchio Cornel Malvasia [Cornelio Malvasia, Marquis].

[Margin: ♂ (Mars)]

MARS, [seen] gibbous in figure with little stars in the round quadrature, [observed] from [Francesco Fontana] [and] [Huygens], [by] sufficient indications of light, [its] disc received from the Sun. A spot indeed somewhat single [unique], but now broader, now narrower, [seen] by no one with the same view, as P. Niccolò Zucchi [P. Nicolaus Zucchius]; sometimes [it appeared] double, [as] seen at Naples [by] the Fathers Sersale [Cristoforo Sersale] [and] Daniel Bartoli [Danieli Bartolo], indications of vertigo [rotation], or [signs of] libration around its own center, [or] of its [own] body. But this above all, with [Kepler] showing [it], we knew [to be a] new thing worthy of note, and adept; the perigee of Mars [is made] much closer to the Earth than the Sun.

[Margin: 7]

VENUS, [seen by] [Galileo], [Scheiner], [Gassendi] [Gassendo], [Hevelius], [Francesco Fontana] [Fontana], [Huygens], P. Grimaldo [Francesco Maria Grimaldi], [and] Us, very often seen with the Optical Tube now gibbous, now dichotomized [half], often horn-shaped [corniculata], or falcate [crescent], as we shall exhibit in the schemes [diagrams] of Book 7 of the *Almagestum Novum*, section 1, chapter 2. By an evident Argument, [we know] that it [is] not otherwise than the Moon illuminated by the Sun, [and] so that [it follows] that course; from which it is more evidently established that, near perigee, [it makes] conjunction with the Sun, on account of [its] great latitude...

the [appearance] seen by [Tycho] and Us, but to us by the horns turned downward [is seen], and by the convexity turned upward illuminated from the Sun, as is to be seen in the scheme of the same chapter, page 485[?].

[Margin: 8]

MERCURY too — not rarely [observed by] P. de Rheita [Anton Maria Schyrleus of Rheita], P. Grimaldi [Francesco Maria Grimaldi], and Us — defective [deficiens], and corniculated [horn-shaped] it appeared, just as in [our] presentations, in the same Book 7, section 1, chapter 2; and [as] [Pierre Gassendi] [Gassendo] [saw] illuminated.

[Margin: ♄ (Mercury)]

[Pierre Gassendi] [Gassendus] [saw] that [Mercury] under the Sun's disc; whom we trust now too in this Astronomical matter, from his own Heliocyclium [device], around the Sun circling them, [the planets] changing among themselves.

[Margin: 9]

The vertigo [rotation] of the Planets — of which there are indications in Saturn, Jupiter, and Mars, as touched on above by [Rheticus][?] [Rheinhold?], from which by certain measures and times somehow to define [it]. Concerning which matter, since I once disputed it in person at Bologna, while we were dining [together], I heard him, while [he was] dining, [say] that by a binocular Telescope such periods he had observed, but nevertheless [they were] still imperfect. Let there be trust in the Author.

ARTICLE VII.

On the Sun [De Sole]

[Margin: 1]

The Elliptical figure of the Rising and Setting Sun, not once seen, neither antiquity nor we could [account for] before [Scheiner], [who] studied to investigate the cause; the same [man] [studied] the spots [maculae] in the Sun, and the faculae [appearing] a little before [Galileo], as he himself proves in his *Rosa Ursina*, [that] with the Optical Tube he not only noticed [them], but afterward, [by] so many accurate observations he prosecuted [the matter], as on the testimony of René Descartes [Renato Cartesio], [he] left the rest of his hope, having promised something better in this part to be furnished; if indeed they are moved [around] by the [vertiginous] motion of the Sun, [whether] there be [made] within about 28 days, of which see Book 3 of the *Almagestum Novum*, chapter 4, [where there are] more [things], certainly pleasing, [from] [Kepler] [on] the vertigo of the Sun within 24 hours, introduced.

[Margin: 2]

We, [by] the aforesaid motion, [it being] uncertain, [the matter] dismissed, with all [our] strength, with P. Grimaldo [Francesco Maria Grimaldi], we strove, that its motion in longitude, and in latitude as to declination, and finally [its] distance, and parallax, [be] more certain, and at length [be] made — than before it was — [that] we might attain [it] by investigation. And the motion indeed in longitude, not from observations [made] every two years of the year, [chose] the center, as [Tycho did], but at an interval of years 1812, [we] selected, [comparing] [Hipparchus] against another [observation] at the Equinox of our [time], [made] from the Gnomon of S. Petronio's temple; and [from] observations [made] with the ingenuity of S. Petronio's Gnomon, the Eccentricity necessary for the Equations, and the Sun's Diameter most subtly, and most evidently we determined; confuting those, who suppose a much larger diameter from the Cyst [Cysat?][?] and from [Scheiner]'s observations, detecting, and the cause of error from these [things] committed, on account of the ignorance, [of] propagating a certain manner, that the light of the Sun is propagated, as in Book 1, [section] 4, we shall teach. But we confuted those, who against [Kepler] denied [it] in this matter, [namely] the diameter of the aperture [foramen], [which] takes away from that, [its] diameter of the species of the Sun for that [reason] more full, as [we made] in the Appendix to chapter 1.

[Margin: 3]

We assert the maximum Declination of the Sun [to be] $23^{\circ}30'20''$, [to have been] perpetual, and not changed by new arguments, [contrary] to certain ancient observations, [so] that it may seem to have left [room for] cupidity [doubt], as [Tycho] doubted [this] from his observations. The distance [of the Sun], finally, and the Parallax of the Sun, we show not only [to be] far smaller than the Tychonic, but within limits not to be despised for certainty, [we] conclude, by the new method of the Lunar Dichotomies, and from Refractions.

ARTICLE VIII.

On the Moon, and on Eclipses.

1. We owe genuine thanks to Tycho [Tycho Brahe] for teaching us, on his authority, that the Moon's maximum latitude at the quadratures is very nearly one full degree greater than at the syzygies; that the motion of the nodes itself, besides the two inequalities, undergoes a certain third variation around the octants, over and above the equation. We have nonetheless pursued the matter no less in the longitude of the Moon, drawing the more certain elements from eclipses — not, however, without incredible labor, owing to the discrepancy of the tables among the observations, and the lapses in chronology, into which otherwise distinguished men have fallen, as may be seen in Book I. Moreover, from solar eclipses we have likewise carefully studied the diameter of the Moon as compared with the diameter of the Sun, already known from another source; so that we have rendered not only the total solar eclipses, which Tycho denied, but even annular ones, to be safe [from objection] and free from violence — as the truth of the matter requires.
2. Furthermore, the spots which they call the lunar [maculae], [the work of] Selenography, were depicted by Langrenus [Michael Florent van Langren], Sirsali [Cristoforo Sersale], Hevelius [Johannes Hevelius], Eustachio, and Rheita [Anton Maria Schyrleus of Rheita], with such great and assiduous zeal toward the Moon; and on a grand scale, with telescopes fitted to the eyes, by Father Francesco Maria Grimaldi [Francesco Maria Grimaldi], with no, or the very least, error — we exhibited [this] in print in that work, namely Volume 9 [recte: Tome 1] of the *New Almagest*, chapter 7, in the particular [section] in which he repeatedly set out his observations of their places, in their order, with the figure he assigned them; and that [depiction] is the most outstanding, which the illustrious Marquis Cornelio

Malvasia [Cornelio Malvasia] obtained. We have indeed investigated the causes of this phenomenon rather diligently in chapter 7 [?] & 8, as much as we could. And in chapter 15 on the libration [libratio] of the Moon, first pointed out by Michael Langrenus [Michael Florent van Langren] and Johannes Hevelius [Hevelius], friends most well disposed to us, we so established our [position] that We too have many times contemplated this libration; so that — as is necessary for us — to whatever extent we differ from Father Grimaldi [Francesco Maria Grimaldi] regarding the limits of the librations, and as the nodes, we differ in no small measure also from Hevelius, as will be established at the end of Book 3.

3. It is marvelous, too, with how much subtlety and industry the more recent astronomers, now [proceeding] from the warnings [admonitions] of Kepler, have outdone all their predecessors by a long interval in observing eclipses — telescopes especially affording aid; or whether [this is to be seen] in the observations of [the eclipse] type, such as Gassendi [Pierre Gassendi], Hevelius, Lineman [?], Eustachio, Boulliau [Ismaël Boulliau], Langrenus, enjoyed. Surely whatever could be devised with subtlety, as to how the penumbra of the Earth and the spurious dawn-light [?] [or] residue may be discerned from the umbra itself, and the legitimate beginning [or] end — and we have said that this was most shrewdly discovered by Kepler from this cause; from which the Moon at some [eclipses], though rarely, in a total eclipse, is utterly extinguished, at others; more often, however, in the middle [of the eclipse] it fails, yet there appears nonetheless a reddishness, or [a tinge] toward saffron — with that color in part proper to it [the Moon], it shines with its own light, the rest [received] from the refracted rays of the Sun, and does not fall into the true shadow of the Earth; from which doctrine We have both reclaimed Ourselves and refuted the sophisms of those alleging the contrary. We have likewise from the warning [admonition] of Gottfried Wendelen [Govaert Wendelen], our most beloved friend and a man most accurate in observing eclipses, very many things to do, and we have retained these in their own place, adopted from the eclipse observations of that same man — and indeed [he was] the most furnished with distinguished eclipse observers among the differences. Finally, the matters of astronomy and cosmography, and the chronology itself [depending] on these, which I have noted more than anyone else from observations of eclipses — by the agreement of these we have enriched [our work], the friends of Urania having for the most part shared with us out of their whole heart no few supports, by which posterity may be rendered much more obligated [to them]; and throughout [the work],

Book 5 of the *New Almagest*, we unravel new questions, and on each occasion problems pertaining to eclipses.

ARTICLE IX.

On Comets, and on New Stars.

1. There was a great controversy among the Tychonists and the followers of Chiaramonti [Scipione Chiaramonti], whether comets and new stars were observed by the Tychonics to be above the Moon; as Tycho and his [followers] contended with axes [drawn], or whether [they were] beneath the Moon, as Chiaramonti, with Peripatetic bite, maintained. For the gratification not only of the astronomers, but also of the physicists, we have undertaken this labor in Book 8 of the *New Almagest*, [examining] the observations of the new star [stella nova] — perhaps with excessive prolixity — and, with incredible labor, have set out the calculations [of those observations]; and now, having seized the occasion, we have worked out new [matters] by theorems, and problems, so that I might unfold by various conclusions the controversies; nor is there any reason for so much labor to repent us. As for the star of the Magi [the Star of Bethlehem], under whose guidance [it appeared] at the swaddling-clothes of the Christ-child, we have added something to it — not without pious daring — for the gratification of those who delight in sacred letters; it may be read through under the end of the said Book 8.

ARTICLE X.

On Refractions, on the Altitude of the Refractive Air, and on Twilights.

1. After Tycho was the first who considered refractions — pointed out and measured by a few of his predecessors — and corrected them, [and] then all the astronomers in turn acquiesced in the Table of Refractions published by him; and although [later] Kepler exhibited it at the foot [appended] to the Rudolphine [Tables], notwithstanding that correction which he displayed in the *Optics*, with the increment of the secant in measurable motion — yet this matter we have treated more fully in Book 10 of the *New Almagest*, section 6, in the whole of Problem 57; and, correcting the assumed Tychonic refractions in this section of the Table of Refractions in their threefold tempering, we have accommodated [them]. Afterward, again investigating the refractions more deeply in Tycho's observations made on the day of the solstice, and by my [observation], P. Albert Curtz [Albert Curtz] transmitted to me from Tycho's autograph by

his own hand, I have detected that Tycho himself and Kepler erred, confounding optical refraction with astronomical; both from these causes, and badly accommodating the astronomical refractions of a star to the more remote terrestrial [refractions], they made [them] less effective than they ought to have been greater — as we show in Book 10, chapter 14, where [we treat] many other [matters], and [give] a worthy account of refractions.

2. As for the altitude of the refractive air, with how much labor we have investigated it, the reader will recognize from Book 10 of the *New Almagest*, section 6, problem 43, [and] from problem 43 to 57 [?]; [where] we discuss, also disproving, the Keplerian [doctrine] which holds the altitude of the air to be confined within two Italian miles. Thence, moreover, the physicists too will be able to draw a doctrine not unworthy [of attention] for the altitude of the air, if it be joined with that which has been handed down by us in Book 1 of the *New Almagest*, chapter 30 & 31, & Book 2, chapter 19, & most exquisitely Book 8, section 1, chapter 14, on the twilight halo of the air, [which is] sublime [high up], and on the cloud; and on the threefold use of refraction in the altitude of the high halo, and on the diverse depth of the Sun beneath the horizon in the morning twilight [as compared] with that which it has in the evening, and in the winter twilight [as compared] with that which it has in summer — both from the observations of others, and from our own.

ARTICLE XI.

On the Altitude of Mountains, on the Levelling of Rivers, on the Distance of Sight, and on the Tide and Depth of the Sea.

1. To what purpose, you ask, are these [topics] for an astronomer? Indeed, [they are useful] so that by these means certain astronomical questions may be better resolved, both the parallaxes and the refractions, and those bearing on the motion of the Earth, which is to be ruled out. Therefore, in detecting [the matter], it was necessary first to measure the altitude of mountains, which we did in Book 1 of the *New Almagest*, chapter 11 & Book 10, section 3, problem 31, & section 6; and more fully in Book 6 of the *Geographia Reformata*. It was likewise necessary to eliminate the errors in the physical horizontal amplitude [amplitudo horizontis], that is, the distance to which our sight above the Earth or the Sea extends, [a thing] to be determined — which is set out in Book 1 of the *New Almagest*, chapter 10 & Book 10, section 4, problem 39; by which places something on the

levelling of rivers is explained, [and] which afterward [is] more fully explained in Book 6 of the *Geographia Reformata*. As for the tide of the sea, we touched on it in Book 2 of the *New Almagest*, chapter 15; and on the matter of the tides we set out the explanations found in Book 9, section 4, chapter 14, lest we should renew the Galilean [errors] in explanation, [errors] which arise from the motion of the Earth, both Diurnal and Annual; we set out the true cause of the marine tide [as] repeated by its own tossing [iactatio]; on which occasion the histories of the tide of the sea, gathered together from every quarter, and the rise and fall [reflux] in the hourly flux are to be distinguished, [and] reduced to rules; against the Galilean [errors] we have adduced our opinions, and among the causes of these motions we have enumerated — excepting the opinion of Rheita, of which book I then lacked [knowledge], [a matter] which afterward we examine in Book 10 of the *Geographia Reformata*.

ARTICLE XII.

On the Magnitude and Immobility of the Terraqueous Globe, on the Heaviness and Lightness [of Bodies], on the Acceleration in Descent and Ascent; and finally, on the Vibrations of the Pendulum, and its Use in the Measurement of Time.

1. The magnitude of the terraqueous globe we have measured before, in Book 2 of the *New Almagest*, chapter 7, & Book 6, section 4, [and] from problem 2. Then, renewing the observations, we set [them] forth in the *Theses* published [publicly]; [and] at last, with other [helpers], having attained [results] with incredible labor and industry, together with Father Francesco Maria Grimaldi — God most evidently assisting us — we both demonstrated [it] in Book 5 of the *Geographia Reformata*, and that [result] not [as a] violent [conclusion], but a necessary one, concerning the measurement of the intervals, and the method of others; correcting [it], we reconcile [it] with the more celebrated opinions concerning this magnitude. As for its Immobility, as we indicated above, from the real acceleration of heavy bodies naturally descending, and in proportion to the velocity, we evidently deduced [it]; and in an Appendix to Book 1, we shall speak [of it]. Concerning this acceleration, otherwise [supported] by many physical experiments not to be neglected, one ought to read what we have handed down in Book 2, chapter 21, & at greater length [prolixius] in Book 9, section 4, chapter 16. Finally, having drawn the distinguished properties of the vibration of the pendulum, and the use of these for [reducing] to a

certain measurement the motion of the prime movable [primum mobile], see Book 2 of the *New Almagest*, chapter 20.

2. Up to this point perhaps not without some little offense to the reader — because we have frequently dwelt upon those things which have to do with promoting astronomy and geography — yet far be all boasting from us, [we who are] conscious of our [position], whatever of good we have attained in this kind; [being] of our slenderness [tenuitas] very well aware, we refer [it] as accepted from God, the Best and Greatest, to whose Glory, first by the nod of those above [the superiors], then by their express command, we have applied ourselves to these studies. Nor indeed do we delay anyone, who has said that in the two prior Tomes of the *New Almagest* there is indeed contained an Astronomical Library, & a collection of erudition not common — but yet we find in them nothing nearly newly brought forward by us; we count up in those same books almost 280 Problems, 95 new questions with their own solutions, 88 Theorems, corrections of errors admitted by others, and the dissolutions [refutations] of the fallacies of arguments, more than 320; besides many new Tables, or Tablets newly constructed for astronomical & geographical erudition — God favoring our labors, to whom be Honor & Glory forever.

BOOK ONE

IN WHICH ARE THE OBSERVATIONS OF THE SUN, AND THE FOUNDATIONS OF THE SOLAR HYPOTHESES.

CHAPTER I.

On the Modes of Observing the Equinoxes, Solstices, and the
Maximum Solar Declination, with the Least Fallacy.

This is not the place to treat of these [matters] at length, since they pertain to the organic [instrumental] part of astronomy, for which we have prepared a whole Volume. But so that the observations concerning the Sun, which are to be adduced, may be discerned the better, and [distinguished] from the coarser [observations], it is worth recounting and reviewing the modes by which the

observations of the equinoxes, solstices, and the remaining moments of the Sun's entry into the signs of the Zodiac, in [its] progress through the ecliptic, were [made and] indicated; [and they are] as fallacious as those which lie hidden in them. We shall begin, moreover, with the equinoxes, inasmuch as [they are] the most celebrated cardinal points of the whole Year.

On the Equinoxes.

1. [Margin: The mode by which the shadow [umbra] is investigated.] First, the days of the equinox can be explored by observation, [as to] the line which the apex of the shadow of the Gnomon describes on the physical horizontal plane, from the rising of the Sun up to its setting; for if that line should be straight, it will be an indication of the equinox on that very day. But the day cannot be discerned from this, on which the Sun arrives at the Equator.
2. [Margin: The reckoning of the semidiurnal time.] Second, if the time numbered from the rising of the Sun up to the meridian should be six precisely equal Hours, or rather [more than] 6 hours, & 4 minutes, it will be an indication of the equinoctial Day, or [the day] just before the moment of the Sun's [arrival] at the Equator; provided that the solar [time] be numbered at the moment from the meridian, [for] 6 hours and 4 minutes [?]. For this reason, since refraction at the horizon makes the center of the Sun [appear] elevated optically, by about 4', so that it appears about 4' earlier in the horizon than it really is in the morning, [and] in the evening seems to set [4' later] — at least in the Torrid and Temperate zones. But lest indeed even from this [a day] be given for the true morning [moment] of the Sun's entry into the Equator, & much less, if [the gnomon be] not of perpendicular oscillation, concerning which I have spoken in Book 2 of the *New Almagest*, chapter [vlt. — ultimate/last]. [Margin: Clepsydra Mercurialis, of which Tycho [treats] in Tome 1 of the *Progymnasmata*, chapter 2, & Dudley [Dudlaeus] *de Arcanis Maris*, Book 1, chapter 4. But better [to use] other less fallacious [methods] than anyone who would use [water-clocks], [whether] horologes, [whether] water[-clocks], [whether] sand[-clocks], [whether] of the horizon.]
3. Third, if the meridian line be exactly designated on the physical horizontal plane, [the day] may be cut off [determined], and the meridian line cut, by erecting two fine needles perpendicularly at right angles upon another straight line, [set] very far apart between themselves; or [by] something else which would designate the vertical plane, as our Filar Triangle

[Triangulum Filare], concerning which [we treat] in the *New Almagest*, Book 5, chapter 15. [Margin: The true rising and setting are observed.] For if the center of the rising [and] setting Sun should be in the said line, [extended] through the imagination, or [in] the plane produced, it will be an indication of the equinoctial day, and of the true Rising, or Setting [of the Sun]; [and] both the horizontal refraction lies hidden, which [refraction] amplifies the figure of the Sun into an elliptical [shape], & extends [it] toward the center; though they may be able to collineate to that very center [as] established at the horizontal plane, they nonetheless represent it [as falling] short of it, or beyond it; both [there is] the horizontal parallax, which [parallax] makes the physical horizontal plane differ from the true [horizon].

4. [Margin: The equinoctial shadow.] Fourth, the Ancients observed the equinoxes by the Equinoctial Shadow of the Gnomon, if indeed the Gnomon, that is, the style [stylus] in the scaphe [scaphium], be erected perpendicularly, [and] casts a meridian shadow [of magnitude] foreknown — as much [as] the foreknown Altitude of the Equator demanded. And since in the scaphe the style would be shorter, & on account of this [the shadow] of the shadow [is] liable to notable error in arguing the altitude of the Sun; on account of which [error] conspicuous altitudes, & equating the longitude of many feet, by erecting a gnomon at the horizontal plane, such was the obelisk of 116½ feet in the Campus Martius, of which [obelisk] Pliny [Pliny] [treats in] Book 36, chapter 10; & on account of [this] the meridian shadow observed on the equinoctial days, extended to the Gnomon, was 120 [feet], as is established from Strabo, Book 2, & from others of this kind from Pliny, Book 2, chapter 72, Vitruvius, Book 9, chapter 8, [and] Cleo-

Cleomedes (Book 1) and Ptolemy (*Almagest* II), at chapter 2, sections 4 to 6, where it is shown that this method is not very accurate. Moreover, once the altitude of the gnomon and the length of the shadow are given, and the perpendicular rod stands erect in the plane of the horizon, three quantities arise of the same kind, forming a right angle: the gnomon plays the part of the radius (or whole sine [*Sinus Totus*]), the shadow stands as the tangent of that angle, and the line drawn from the gnomon to the end of the shadow plays the part of the secant. From these the distance of the Sun's upper limb from the vertex in the heavens is found. Let the gnomon then be set up against its shadow: thus the whole sine will be to the other [side] as the tangent is to the secant of the said angle. Add to this, if possible, both the apparent semidiameter of the Sun and a suitable correction, so

that you obtain the true distance of the Sun's center from the vertex when on the meridian. This shows whether the Sun has reached the meridian and the equator, or has fallen short of it, or has crossed it. By however many hours the equinox is distant from the moment of [the Sun's reaching] the meridian, by so many hours [the result] departs from the meridian moment. Accordingly, however much the error has been committed in this matter, it has been committed either in the altitude of the pole, or in the semidiameter of the Sun, or in refraction, or in parallax, or in the observation itself, or in the measurement of the shadow, or in all of these, or in several of these elements. As for the use of gnomons by which the upper edge of the solar shadow is observed at the same time, we shall speak of it below, at section 8.

[Margin: Hipparchus's and Ptolemy's error / hallucination (*Hipparchi & Ptolemæi hallucinatio*).]

5. A fifth method was customary among astronomers, especially the Alexandrians: to observe the equinox by means of equatorial armillae, of the kind we described in Book 3 of the *New Almagest* (chapter 14, section 7). An equatorial armilla consists of two armillae, or large quadrilateral rings on the surface, which mutually intersect each other at right angles in two places. One of them is placed in the plane of the meridian circle, and the other only so far as the distance of the place from the equator and the distance of the equator from the vertex require. Once these are set up, the equinox is observed in this way: the upper part of the equatorial armilla — that is, the part of the equator — represents [the equator], and illuminates the equal cavity of the lower parts equally, unless parallax or refraction perceptibly obstructs this precision. But if the inner [surface] is illuminated more on the northern side than on the southern, it is a sign that the vernal equinox has not yet occurred, if the observation is made in the morning. For all things happen to the southern parts in the opposite manner — as will shortly be said — to the way they happen to the northern. Furthermore, beyond the meridian the cavity of the equatorial armilla is sometimes seen to be illuminated unequally on either side in the western part, [so that] the equinox then occurs after the meridian, since it is illuminated on both sides equally throughout the whole day; this happens not by day but by night, provided only that the illuminations of the regions interchange equally on either side. For if the Sun illuminated the northern part of the cavity today and the southern part tomorrow, know the vernal equinox to have occurred; if on the contrary it illuminated the southern cavity yesterday and the northern this morning, know the autumnal equinox to have occurred. By contrast, if the equinox ceases [to be discernible] — at least so far as physical appearance is

concerned, though it always occurs by the truth of astronomy — for horizontal refraction, raising the image of the Sun, can produce the effect that, although the Sun is still in the southern signs, it nevertheless appears to be in the equator itself, or short of it; and on the contrary, when it is in the northern [signs], it may seem to be in the equator, or beyond it in the southern signs. And this is doubtless the cause why the same armilla appeared twice on the same day, each side illuminated — once around the Sun's rising, by the force of refraction, and again when the refraction ceased around midday. When Hipparchus was astonished at this, [he reported] together with Hipparchus; Ptolemy too testifies of himself (*Almagest* III, on the great construction), attributing this effect to a fault of the armilla — as though it had collapsed from its original [position], as he supposed — rather than to its legitimate setting. But it is parallax that produces the contrary effect, for it anticipates the autumnal equinox optically and retards the vernal equinox, whereas refraction retards the autumnal and hastens the vernal. As for the manner in which this fallacy may be corrected, and the apparent equinox reduced to the true, [Ismaël] Bullialdus [Ismaël Boulliau] has shown excellently (*Astronomia Philolaica* II, chapter 2), and we ourselves have pointed it out (*New Almagest* III, chapter 14, section 9); but ...

we need not go much into it here, since we are able to use observations in which the fallacy of refractions is not implicated — not only recent ones, but ancient ones too. And whenever the armillae of Hipparchus or of Ptolemy must be used, in which the armilla in the meridian appeared equally illuminated on both sides, or as nearly so as possible — then at Alexandria the Sun was at an altitude of nearly 60 degrees, and therefore beyond the danger of perceptible refraction; indeed, in our judgment, beyond parallax too, which did not exceed 6 seconds. And so [Hipparchus] could not be sure of being free from an error of nearly 6 hours in the rest of the equinoxes which Hipparchus, on Ptolemy's testimony, records; nor are they suited to that subtlety which recent astronomy demands — especially if an error of nearly 12 hours could have been committed, as Longomontanus contends (Book 1, *Theoricorum* chapter 1). [Margin reference: Kepler, *Astronomia Optica*, page 146.] He adds that Kepler too, in his *Astronomia Optica* (page 146), found that the equinoxes observed by means of armillae fell out for Tycho as well in such a way that the equinox seemed to occur twice on the same day, by the force of refraction; and therefore that the equinoxes must be sought out by a more reliable method.

6. Sixth, then, with very large instruments properly divided, set up, and adjusted around the same day — as you will now prepare in accordance with the Gregorian Calendar, on the days from the 19th to the 23rd of March, or from the

19th to the 24th of September — observe the meridian altitude of the Sun's center, and convert it carefully from the apparent into the true [altitude] by adding the proper parallax and subtracting refraction. For if the true altitude proves equal to the altitude of the equator, the equinox occurred in the meridian of that day. But by however many minutes, or scruples [seconds], the first [altitude] differed from the altitude of the equator, by so many hours before or after the meridian the equinox occurred. And in the case of the vernal equinox, if the following altitude exceeds the meridian altitude of the equator, it will occur before the meridian; but if it falls short of it, it will occur after the meridian. For the autumnal equinox, the contrary precedes the meridian: if the following altitude exceeds the meridian altitude of the Sun, it will occur after the meridian. As for how far in advance the observation must be sought, whether in the altitude of the pole, or in the observation, or in refraction, or in parallax — so that you will go astray by so many hours from the true equinoctial moment — for that reason you will go astray in the equinox not only from the Ancients, but even from Tycho himself, whose parallax of the Sun is double, and considerably greater than it should be. And the reason why Copernicus too and his predecessors erred, as we shall say hereafter, [is that their values] need correction.

De Solstitijs. [On the Solstices.]

7. First, the winter solstice [*Solstitium Brumale*], because of refractions and parallaxes — which are greater there [near the horizon] — is liable to more fallacies than the summer solstice, whether it is observed by the least altitude, or by the foreknown numeration of the pole, or by the increment of the meridian shadow, or by gnomons and the shadow measured against the gnomon; or otherwise, in cases where, if the fallacies could be avoided, the true meridian altitude of the Sun, observed out of all the altitudes of the whole year or those nearest the solstice, would be the smallest indication of the solstice on the day it occurred. The summer solstice too, although with difficulty, [can be reduced] to the hours of the day at which it occurs, and is observable — although Ptolemy says (*Almagest* II, chapter 2): *In the solstices I hope that neither we nor Archimedes erred in observation and calculation by as much as a quarter-part of a day.* Yet Willebrord [Snel] Snellius [Willebrord Snel], in his notes on the Hessian observations, says it would be a labor of Hercules to avoid a quarter of a day — that is, 6 hours of error — in the solstices. The reason is that on the day immediately preceding and the day following the solstice, the change in the Sun's declination does not exceed 14 seconds in one whole day, and in one hour it varies only by 36 thirds [36''']. Hence, to avoid an error of 6 hours, the

observation must be free of an error of 3 seconds and 36 thirds. Such subtlety the observations of meridian altitudes of the Sun on the solstitial days can scarcely furnish, unless they are carried out with very large instruments most exactly.

[Margin: The fallacy of solstitial observations (*Fallacia observationum Solstitialium*).]

8. If, however, someone is content with the marking of the solstitial day — leaving aside the observation of the decrease of the meridian shadow, and the numeration of time agreeing with half the ...

day — [he must consider] this, which requires the altitude of the pole; and on account of the greatest recess of the points of the occasion of true rising, or of the equinoctial rising observed in the horizon (for there are methods of this kind), exposed to an error of more than a whole day — these things, I say, being neglected, let him observe the proportion of the meridian shadow to the gnomon. Let him gather, as above, the distance of the Sun's upper limb from the vertex, on one or the other day before, and after that day, on which the solstice is expected from an ephemeris. For on whichever day the least of all the distances from the vertex is found, that day is to be taken for the summer solstice; but on whichever day the greatest [distance] is found near midwinter, let that day be taken for the winter solstice. And let the same judgment be made concerning the meridian altitudes observed around either solstice, taken otherwise than by the gnomon's shadow.

9. [Margin: For the summer solstice. Case 1.] But for the hour of the summer solstice too, [the time] at which [the Sun] is closest to panting [to its extreme], one must catch [it] from several continuous [observations]. The meridian altitude of the Sun before and after that day which the ephemeris sets forth for the solstitial day is to be taken; and [the times] of any conversion into the true altitude, with the addition of parallaxes and the subtraction of refraction. If it should happen that two altitudes of immediately consecutive days so exceed the rest that they are equal to each other, the solstice occurred in the middle of the intervening night; and then add to either of the equal altitudes 7 seconds in the second [order]; and to the aggregate subtract the altitude of the equator, previously most exactly foreknown — for in this way, by the same operation, you will gain the maximum declination of the Sun, to which the obliquity of the ecliptic is equal. But if the foreknown altitude of the equator is taken away, the said aggregate will nonetheless be useful, as will appear below.

[Margin: Case 2.] But if it should happen that, out of three true meridian altitudes, the middle of the day is greater than the two nearest days, and these two are exactly equal to each other, know the solstice to have occurred at midday itself, in the very meridian of the intermediate day, without perceptible difference. And then subtract the altitude of the equator from the meridian altitude of the solstice, and the maximum declination of the Sun is left over. This case is rarer than both [the others].

[Margin: Case 3.] When these [conditions] fail, choose three or more continuous meridian altitudes of days, two of all the others greater, and the difference of these (if the operation is exactly done, and subtle) ought not to exceed 14 seconds; divide [it] by the hours, multiply the product by 14. For the quotient will give the hours by which the moment of the solstice followed the meridian of the lesser altitude of the preceding day, or preceded the meridian of the lesser altitude of the following day. Once the moment of the summer solstice is found, subtract 14 seconds from the greater of the differences of the [two] greater altitudes, and from the residue subtract the altitude of the equator; and you will have the maximum altitude of the Sun in that meridian, in whose meridian the solstice occurred, [the meridian] of the equator; and the maximum declination of the Sun is left over.

10. [Margin: For midwinter.] For the winter equinox [recte: solstice] one must proceed in a somewhat opposite manner, but similar [in method], because then the winter solstice obtains, when the Sun in some meridian obtains the least of all the other altitudes observable under other meridians.

[Margin: Case 1.] Let the first case, then, be this: if it should happen that, among the days of several continuous days designated by an ephemeris near midwinter, the immediately preceding and following ones, two immediate altitudes so exceed the rest that they are equal to each other, the winter solstice occurred in the middle of the intervening night. Then again, subtract 7 seconds from either of the equal altitudes, and subtract the residue from the altitude of the equator, so as to obtain the maximum declination of the Sun in that year.

[Margin: Case 2.] The second case will be if, out of three true meridian altitudes taken near midwinter, the middle day's altitude is the lesser of all the other lesser ones — that is, if the other two are equal to each other — then the winter solstice occurred in the meridian of the intermediate day; and once that least altitude has been subtracted from the altitude of the equator, the maximum declination of the Sun is left over: but this case is rarer.

[Margin: Case 3.] The third case, therefore, is when, out of three meridian altitudes of the Sun taken around the supposed midwinter, the rest are smaller but unequal among themselves: choose then two of these that are smaller, and multiply their difference by 24; divide the product by 14. For the quotient will give the hours by which the moment of the solstice followed the meridian ...

of the greater altitude of the preceding day, or precedes the meridian of the greater altitude of the following day. Once the moment of the winter solstice has been acquired, subtract 14 seconds from the difference of the lesser altitudes, and from the residue subtract the altitude of the equator. You will have left over the maximum declination of the Sun observed in that meridian.

**De maxima Solis Declinatione, ac Tropicorum Distantia
Obferuanda, & fimul Altitudine Poli, fi ea non fit præcognita.
[On the maximum declination of the Sun, and the distance of
the Tropics to be observed, and at the same time the altitude
of the pole, if it is not foreknown.]**

11. Above, under numbers 9 and 10, I taught how to observe the maximum declination of the Sun by means of either solstice, when the altitude of the pole — and its complement to 90 degrees, that is, the altitude of the equator — was foreknown from elsewhere most exactly by means of the circumpolar stars. But if this is unknown, or to be confirmed from elsewhere, the [solstitial] moments of both solstices [must be found], and from them the meridian altitude of the Sun — the maximum in summer, the minimum in winter, as I have taught above — is to be observed. For the difference of these altitudes will be the distance of the Tropics from each other, of which the half will be the maximum declination of the Sun; and this, subtracted from the maximum altitude of the summer solstice, leaves the altitude of the equator; and this altitude, in turn, subtracted from 90 degrees, will give the altitude of the pole. For the obliquity of the ecliptic, and the distance of the poles of the equator and of the ecliptic, is always equal to the maximum declination of the Sun.

De Solstitijs obseruandis quando præcognita iam fuerint
Altitudo Aequatoris, & Declinatio Solis maxima. [On
observing the solstices when the altitude of the equator and
the maximum declination of the Sun are already
foreknown.]

12. If, on the day assigned by the ephemeris for the solstice itself, or on the more nearly preceding or following [day], so great a meridian altitude of the Sun is found, and most correctly so, that — at the summer tropic — it equals the aggregate made from the altitude of the equator and the maximum declination of the Sun, or — at midwinter — it equals the residue left over from the subtraction of the maximum declination of the Sun from the altitude of the equator: then know the solstice to have occurred in the meridian of that day. By contrast, if the meridian altitude of the Sun differs from the aggregate required for summer, or from the residue required for the winter solstice, by more than 14 seconds, the solstice is distant from the meridian by one whole day or more; but if by less than 14 seconds, [it is distant] by the [proportional part of the] difference observed, and [you may find it as follows]: multiply the difference of the observed and required altitudes by 24, and divide the product by 14. For the quotient will give the hours by which the moment of the solstice is distant from the meridian of the observation, before or after — as the increments of altitude in summer, or the decrements in winter, will easily teach you.

CAPVT II.

De Instrumentis Maximè Idoneis ad subtiliter obseruandas
Solis, ac fideris cuiufuis Altitudines Meridianas, & præcipuè
De ingenti Gnomone Bononienfi eiꝑ; similibus. [Chapter II.
On the instruments most suitable for observing subtly the
meridian altitudes of the Sun and of any star whatever, and
especially on the great Bolognese gnomon and others like it.]

1. It was excellently done by us [*Præclarè actum est nobiscum*] that in the preceding chapter we learned that, in equinoxes, an error of one hour is to be avoided; and that an error of one minute [of arc] is to be avoided, in order to exclude an error of a whole day in the solstices, [namely] by excluding ...

an error from the observation [exceeding] one quarter of a minute, or 15 seconds. Hence it follows that, in the solstices — unless an error of thirds is risked, that is, an error of one hour; and to avoid an error of thirds, [an error of] 54 [thirds] — or at least one second of [arc-]scruple [must be avoided]. To reach this subtlety of [observing] the altitudes of the Sun's distance from the vertex — to attain it, however, in such a way that the minimum [error] nonetheless does not fall out, and is far more secure — if it cannot be admitted as much error in [the measurement of the] altitude. First, then, the magnitude of the instruments must be considered, but [also] their handling. Far hence, therefore, let there be removed the *Baculus Jacobi* [Jacob's Staff], the *Radius Astronomicus* (whether Greek or Latin), the *Astrolabium*, the *Armilla*, the *Annulus*, the *Torquetum*, and others of this kind; and finally the pendulum quadrant — instruments that are too small in use, and that must be handled by nodding [adjustment]; and for that reason they cannot be of such mass that single seconds [of arc] could be exhibited by them. But among those organs which succeed in this place, [namely] the *Quadrantum*, the *Quadrans*, or in part [those parts] of the *Regula parallactica*, the very great gnomons, and in many ways the gnomons of the *Forma*, the division, and the use of which — and likewise of *Quadrati*, *Quadrantis*, *Sextantis*, & *Parallacticarum* — Tycho has sufficiently taught in his *Astronomia Instaurata Mechanica*; but we leave these aside for the reader, and beyond these there are not a few things worthy of consideration to us, who meditate on this matter.

[Margin: The magnitude of the instruments required (*Magnitudo instrumentorum requisita*).]

2. First, then, it must be settled how small the smallest visible point is, or the discrete points by which the divisions on instruments are designated. To us, indeed, with the keenest acuity in painting, or in painting, or in the very sharpness of the edge, by section, or attrition, [it is] indicated [as follows]. We see, moreover, that no one of sound and most keen sight among men is able to discern between point and point, or between little line and little line, if they occupy the very smallest space — such as that which the most subtle silken thread, drawn out from the silkworm's tiny cocoons, covers; of which thread three hundred most subtle [threads], or sixty, [if?] gathered together, are contained within one foot of a Roman foot; or as is shown, when Ezekiel exhibited [it] in the work of Villalpandus [Villalpandus] [in his commentary] on the Temple. Therefore, in the periphery of the limb, whether of quadrants, or of sextants — such as those of astronomical [instruments] observed by a thread that crosses from one point to another, [in such a way] that they may discern evidently one second [of arc] of a scruple — it is necessary that the magnitude of the radius [be such that] its chord

contain ten *unciae* of the Roman foot, so that, as the said minimum takes [up], evidently visible, 360 [parts]; ten times [that] is this thread [equal to] 3600. Whence indeed the second scruple contains one degree. Nor should you say that lines [can] be obtained by transversals even more subtle, [in] thirds, or [in] quarters [of seconds], or subdivision. For although the major intervals are able to be discerned in transversal lines after the Tychonic manner, the deception of those intervals can occur by a thread, or by a movable sighting-vane, if in the limb itself the [points] do not stand apart more than by the space of the said thread, physically perceptible — of which we shall speak more presently.

[Margin: The smallest visible thing (*Minimum visibile*).]

3. You will ask now how great the semidiameter of the instrument ought to be, of which one degree may take up ten *unciae* of the Roman foot. I answer that it ought to be of such *unciae* nearly 573. For if it is so in the diagram here adjoined, from center A, the portion BKC of the periphery is described — of those [degrees] of which there are 360 in the whole periphery of the circle, whose extremes B and C are connected both with the center by the radii, or straight lines AB and AC, and between themselves by the chord BDC, which, cut at right angles by the perpendicular AK, is bisected — and so cut orthogonally at D, for BD will [be the sine]. The sine of the angle BAD, subtending half a degree, or 30 minutes, will be the radius, or the whole sine [*Sinus Totus*]. And since therefore BC, [given] is 10 *unciae* ...

[Margin: The magnitude of the instruments (*Magnitudo Instrumentorum*).]

Diagram. A narrow isosceles triangle (the geometric construction for sizing the instrument's radius). The apex A is at the top, at the center of the circle. Two long radii AB and AC descend to the base, where the base points B (left) and C (right) lie on the arc of the periphery. The base is the chord BC, with its midpoint D marked just above the base line, and the foot K of the perpendicular AK marked just below D on the base. The perpendicular AK bisects the chord at right angles (at D). The whole figure represents the arc BKC subtending one degree and the half-angle BAD subtending 30 minutes.

- A (apex / circle center): A
- B (base, left end of chord): B
- C (base, right end of chord): C
- D (midpoint of chord BC, where AK meets it): D
- K (foot of the perpendicular on the periphery/base): K

[Text continuing beside and below the figure] ...And since therefore BC is given as 10 *unciae*, and BD [is] of *unciae* 5; if it is done that, as 30 minutes [give] the sine BD of 87265 parts, so the radius AK of 10000000 parts [is to its value] — so, in the same way, BD of 5 *unciae* to another [quantity] — there will result the semidiameter AK of *unciae*; as we shall say, nearly 573, that is, of feet 47³/₄. By this method has been constructed the Table here adjoined, [computed] for a semidiameter of the instrument suitable for exhibiting evidently one [second], or one, or two, or several second scruples, so far as concerns the magnitude of the organ itself: besides this [magnitude], there remains [more] to be considered shortly.

Radius Pedum Rom. & Vnc. Pro
[Radius in Roman Feet & Inches,
For]

	Pedes [Feet]	Vnciæ [Inches]
11		
1	47 &	9
2	23	10 ¹ / ₂
3	15	10 ¹ / ₅
4	11	11 ¹ / ₄
5	9	6 ⁵² / ₈₇
10	4	9 ¹ / ₃

4. Once the instrument has been constructed — whose radius will be of so many feet and *unciae* as the optimum [resolution] of the seconds requires — and once from its center a quadrantal arc has been described, [the arc] is to be divided, and the arc itself [graduated] into 90 degrees; or if it is a sextant, into 60 [degrees], with such equality of the intervals and such subtlety that no perceptible error is admitted. Although this may seem an easy thing to do, it nonetheless demands the highest dexterity in surveying [the divisions], such as you would scarcely find in any mechanical craftsman who is not at the same time well-versed in Geometry and Astronomy. For this reason

[Margin: The division of the degrees into scruples (*Divisio Graduum in scrupula*).]

we have not been accustomed to trust the instrument which we ourselves have prepared, or [that] of Father Francesco Maria Grimaldi [Francesco Maria Grimaldi], of Angela [Angeli?] — if it is permitted to say so, an emulator of ourselves in this subtlety. For the division — further — of a degree into the first sixtieth-part of scruples, and of minutes into the second [order], whether single,

or by threes, or by sixes, or by tens — so that the intervals of these can be discerned evidently — Tycho devised the transversal lines, of which he treats in the *Astronomia Mechanica*, folio B 2, and the next-to-last folio; and so for a long time this practice has been in use among our [people], [namely] in Sextants, and in Quadrants — [the very thing] which Tycho with a double cause [so] named, namely that — by the figure of the division — secondly because it is of equal magnitude, both in the radius and in the limb [*fascia limbi*], of which Tycho himself, [in] the said folio B 2, described and named the *Tychonicum* — inasmuch as gradually ...

with the maximum [magnitude], that which Tycho himself, [at] the foretold folio B 2, described, and named the *Tychonicum*. But afterwards, by use itself, [people] noticed that it was not only too cumbersome, but also subdivided too much, inasmuch as it required transversal lines [numbering] 540, and points 540; and that operations [arising] from so great a multiplication [carry] a peril of error, of which some [people] elegantly disabuse themselves; for which reason another, simpler [division] is chosen — which we shall say presently, on occasion of the *Quadrans of Grimaldi*, so named by the Author, and by the executor of the division, although the Tychonic division [*divisio Tychonica*] was preferred [by the Author?] to be carried out, [in agreement?] with us. The Illustrious Count Carolus Manzinus [Carlo Antonio Manzini] and the most Excellent Doctor Io. Dominicus Cassinus [Giovanni Domenico Cassini] — both most outstanding not only in the theory of astronomy and in geometry, but also in practice and in the mechanics of organs of this kind — most distinguished [men]. Yet I add that we have not before been led astray in subdividing the transversal lines, as Tycho was, but [proceed] as geometrical reasoning requires — unequal [intervals]. For Tycho confesses, at the end of the said *Mechanica*, that on account of that inequality he could err by threes [thirds?], and by more than seconds. *And he says there that the sharpness of the eye [visus acumen] could discern this subtlety in whatever [instrument]; nevertheless the instrument in no way sustains it.* How much more, therefore, did Tycho despair of being able to attain a single second-scruple?

[Margin: The magnitude of the instruments (*Magnitudo Instrumentorum*).]

5. Concerning the *Dioptrae* and *Pinnacidia* [sighting-vanes], by which the stars are observed at night, we shall speak in Book 4, chapter 5. But the principal luminary, the Sun, is observed especially by a direct view collineated [aligned] with the center of [the instrument], or with one or the other [edge], or with both edges; or by a fine needle erected perpendicularly at the center of the instrument; or by the mutual section [intersection] of two orthogonal cross-threads [*chordularum*]

orthogonalium] cutting each other in the same plane, of which one is extended perpendicularly from the center of the instrument, [while] the other represents the vertical plane; or by a cylinder, whose axis is fixed perpendicularly at the center of the instrument, and which is of such thickness that to the eye fixed at the center of the instrument the whole ...

[Margin: The solar sighting-vanes (*Dioptra Solares*).]

would not cover the whole Sun, but would clearly let the equality of the covered part and the uncovered part be discerned. Most often, however, the Sun is observed by looking directly at it; or else by means of a shadow cast by a cylinder set upright at the center of the instrument onto a tablet, marking the middle of the shadow; or by means of the bright image of an aperture admitted through a little hole in a small plate at the center of the instrument and likewise received on a white tablet, marking either the middle or the edge of the Sun's bright image. In either of these arrangements one can err on two counts: in the proper placing of the tablet, the cylinder, the strings, the needles, and so forth; and indeed, with as many seconds as there are strings in an instrument of 48 feet. For however many of the strings—the very finest of silk—stray from the true point of the center of the instrument; or in the case of a line at whose end the other sight must be set in a straight line.

But in an instrument whose radius is only 24 feet, an error will arise of as many binary seconds as the strings foretell (as is clear from the table given as no. 3); and in an instrument of $9\frac{1}{2}$ feet, of as many quinary seconds [*quinariis secundorum*] as there are of the aforesaid strings. There is a second occasion for error in the very use of the instrument, when one does not take exactly the middle of the shadow, or of the bright image, or the edge of either; but is off by so much of a space as the silk thread is thick—or more—in which case the error of seconds is multiplied in proportion to the smallness of the instrument. And in fact, in small instruments it is very necessary for us that the shadows and bright images, and likewise the edges of either, be distinguished more clearly; whereas in larger instruments, a slight error in a single small particle introduces an error of seconds not to be despised. In large instruments, the distance from the aperture, or from the shading edge, of the bright image, or of the shadow, is so great that the limit of either can scarcely be discerned.

Now in the case of Tycho's quadrant [Tychonis quadrans], large and mural, with its radius of not quite five and a quarter cubits [*quinque cubitos quing[ue]; idest pedes $7\frac{1}{2}$* —that is, $7\frac{1}{2}$ feet—it is clear from what has been said that it was prone to error in the mere placing of the sighting devices alone, by at least five seconds;

and by as many again in the instrument's use itself; so that for this reason too we cannot be certain of being free from an error of ten seconds. [Margin: Examination of the Tychonic quadrant — *Tychonici Quadrantis examen.*]

§6. The very placing of an instrument in the plane of a vertical circle involves two difficulties to be overcome. **The first** is that the plane of the instrument on which the band [*fascia*] holding the divisions of the degrees lies should rest in that same plane of the vertical circle as exactly as human skill can manage; otherwise there is a danger of incurring an error not of seconds only, but of several minutes, as experience attests. **The second** is that the perpendicular [plumb-line] suspended from the center of the instrument should fall exactly over the outer edge of the limb, from which the degrees and minutes are reckoned. **Nor**, again, on a twofold count, are we under any less compulsion to fasten it. For if the perpendicular's thread is too thin, it will not long bear a weight suited to keeping it taut, but will break quickly and the more easily the larger the instrument is, and the more it requires a greater length of thread. But if you employ a thicker thread, you will not be able to judge clearly whether its axis falls over the aforesaid outer edge, without fear of an error as great as the little space, or thin line, that is the breadth of the very thinnest silk thread—an error which by itself can produce an error of as many seconds as such threads have receded from the outermost atom of that edge, even in an instrument of 48 feet—indeed of several seconds more if it be of fewer feet, in proportion to what was indicated above. Further: in a quadrant the plumb hangs, or in a movable one it serves to keep the instrument in a vertical plane, and by means of a movable sight indicates the degrees and minutes. But on account of this very motion of its own it requires some firmness of the thread; and to that extent we are led to a thickness greater than that of a simple silk thread, and so into a danger of some few seconds of fallacy.

Finally, I warn that it is not enough to have once set the quadrant or sextant steady in its place, unless you are certain that the pavement, or the walls, to which it is attached can in no way be moved from their former position. Otherwise the position of the instrument must be examined before the observations. As for parallactic [*parallacticis*] rulers, even if one of the two has been duly set up and correctly toward the horizon, yet it is difficult to move the other in the plane of that same vertical circle, as Tycho taught in his *Mechanica*; and we ourselves to such a degree that, with whatever care, we have frequently fallen into an error of two seconds, and somewhat more.

[Right margin, at head: *Mensura Gnomonis Bononiensis* / Measure of the Bologna gnomon — Egnatian.]

minutes, even if we should have a parallactic [instrument] of 8 feet. [Margin: The height of the great gnomons — *Gnomonum magnorum Altitudo*.]

§7. What has been said so far tends to this: that we may recognize, in the first place, how probably we can dread an error of one minute in the Tychonic observations—which we will also confirm by examples and authorities in Book 4, Chapter 4. And next, that we may sharpen the diligence of students of astronomy, especially since by neglecting a few seconds, prone as we are to fall into error about that very first minute, the weakness of our nature, for the most part, falls short of the proposed aim. Certainly in the altitude of the pole, and in observing the equinoxes and solstices, and the obliquity of the ecliptic [*obliquitas eclipticae*]—which are the primary elements, or foundations, of astronomy—no diligence ought to be thought superfluous. Therefore, considering all this, in pursuit of perfection we turned from the customary instruments to the great gnomons; which we have found used by some of the ancients as well—and not only in the use of obelisks, but otherwise too. For although it is not yet clear how great was that gnomon of which Strabo speaks (*Geography* II) [Margin: The gnomon of Pytheas, and of Gassendi — *Gnomon Pythææ, & Gassendi*]:

Thus, at Byzantium, the longest day is fifteen and a quarter hours; and at the summer solstice the gnomon stands to the shadow in the ratio that 120 has to 42. Yet from so many parts—which the ancients wanted to be plainly perceptible and commonly evident—we gather it to have been large enough by their reckoning. Larger still was that one which Gassendi [Pierre Gassendi], as he attests in his *Life of Claudius Fabricius Peireskius* and in his treatise *On the Proportion of the Gnomon to the Solstitial Shadow*, says Pytheas of Marseilles [Pytheas of Marseilles] used at Marseilles: for, dividing it into 600 parts, he there obtained the solstitial shadow as $213\frac{1}{2}$. And at the same place Gassendi himself, in the year 1636, as he reports in his two aforesaid treatises, used as a gnomon the high roof of the College of the Fathers of the Congregation of the Oratory, which was about 9 fathoms [*Orgyias*], or 52 Paris feet; though he reduced that altitude to another kind of small parts, and divided it into 90,000—that is, exactly into 89,328 such parts; and he found the solstitial shadow to be 31,753. Earlier, at Grenoble [Grenoble], he had used the sphere-bearing globe [*sphæristerium*] of the Connétable's [palace], whose summit served as the style of a gnomon, being about 6 fathoms, or 36 feet—more exactly, of 64,690 particles; and the summer shadow was 25,410. [Margin: The gnomon of Vlacq the Belgian — *Gnomon Vlug. Belgi*.]

Far the greatest, however, was that gnomon used in place of a quadrant by Ulugh Beg [*Vlug Beigo*], grandson of Timur-Lang [the Mongol prince Tamerlane], about

the year of our Lord 1437. For, as Johannes Gravius [John Greaves] reports in his *Epistle prefixed to the Tables of Ulugh Beg* [*Epistola Tabulis Vlugianis præmissa*], it equalled the height of the topmost vault of the Temple of Saint Sophia, whose hemisphere's vaulting at Constantinople exceeds 180 Roman feet. Incited by these examples too, in order to obtain the most subtle altitude of the pole of Bologna [Bologna], we devised two temporary gnomons—namely, D. Io. Dominico Cassino [Giovanni Domenico Cassini] in the Malvasia Palace [*Palatio Maluatico*], and P. Franciscus Maria Grimaldus [Francesco Maria Grimaldi] together with me in the new Temple of San Luca [*S. Luciae*] of our College, while its vault was not yet enclosed; which gnomons we shall set forth, together with our observations of them, in Book 4, which is on the Fixed Stars, Chapter 4, where that observation by a circumpolar star is examined—look there for the passage. [Margin: The gnomons of Cassini, and the authorities — *Gnomones Cassini, & Auctores.*] But for establishing the equinox, the solstice, the diameter of the Sun, and its greatest declination, we chose two stable gnomons in the Temple of San Petronio of Bologna [*Templo S. Petronij Bononiæ*]*—the most outstanding, I might say, in all Italy, indeed in all Europe—of which we must speak separately.*

On the Gnomon in the Temple of San Petronio formerly set up by Egnazio Danti

De Gnomone in Sancti Petronij Templo ab Egnatio Dante olim excitato.

§8. While the controversy over the Precession of the Equinoxes was growing—a precession which by now anticipated by nearly ten days the day fixed in the old Calendar—and at the urging of Gregory XIII, truly the supreme Pontiff, of the astronomers, R.P.M. Egnatius Dantes [Egnazio Danti] of Perugia, of the Order of Saint Dominic, professor of mathematics in the venerable University of Bologna and afterwards a bishop, was appointed to settle upon a method for reforming the Calendar. By the authority of the most illustrious Senators—Count Io. Pepoli, perpetual President of the Fabric of the Temple of San Petronio—and of his colleagues, in that same Temple in the year of Christ 1576, in the month of April, he erected a huge gnomon, in order to display clearly, or at least

Diagram. A schematic of the gnomon's principle as a right triangle. At upper left a tall vertical pillar (the gnomon), with the aperture-disk near its top. From the aperture-disk, several straight rays fan downward to the right toward a long horizontal base-line, marking the lengths of the projected solar images / shadows at various dates. Small ellipses (the elliptical solar images) are drawn along the slanting line near points where it meets the base.

- A (top of pillar, aperture): the aperture / top of the gnomon
- B (foot of pillar, lower left): base of the gnomon at the pavement
- G, V, H (along base, left of center): shadow-termini (closely grouped)
- E, Q, F (along base, center): shadow-termini
- I, M (along base, right): shadow-termini, with elliptical solar image
- C (right end of base): terminus
- D (right end of base-line): end of the horizontal meridian line

—at least moderately instructed men, the anticipation of the equinoxes and solstices, and other observations notable in astronomy. And this gnomon lasted right up to the year 1656—that is, for 80 years—whose figure, such as it is, we here subjoin.

AB, on the southern and left-hand wall of the Temple, was the height taken from the pavement up to the vault; BC was a marble strip [*Zona marmorea*] laid in the pavement of the Temple, whose straightness declined westward from the true Meridian line BD by about 9 degrees. For if it had been constructed on the Meridian itself, Egnazio feared he might run into the pillars, or columns, that support the vault, or that it would come out shorter than the length of the winter shadow required; and yet he judged that, owing to its nearness, the hour of the equinox could be determined on BC itself. A was the aperture, whose diameter was 4 parts of the kind of which an uncia [inch] of Bologna [*uncia Bononiensis*] is 5—enclosed in a metal plate of half-a-finger's thickness, fixed to the wall at the convex part of its vault. IC was the diameter of the elliptical solar image, or quasi-elliptical, transmitted through the said aperture on the day of the winter solstice; and then AC was the radius of the lowest edge of the Sun, and AI the radius of the highest edge. At the equinoxes, the diameter of the elliptical image was EF, and AF the radius of the lowest edge, AE of the highest. Finally, GH was the diameter of the elliptical and quasi-circular image at the summer solstice, AH the radius of the lowest edge, and AG of the highest. There were also four other marble tablets, arranged at their proper intervals, marked with the characters of the remaining eight signs of the Zodiac, so that it could be known on what day the Sun was entering each one of them. Supposing, then, the marble strip-line BC to be parallel to the horizon, and AB perpendicular to the horizon—both being known, and the quantity of both being credited by Egnazio—in the triangle ABC, right-angled at B, the angle BAC could be known, measuring the distance of the lowest edge of the Sun from the vertex of Bologna; and BI was known too; and then, from the semidiameter of the Sun, the distance of the Sun's own center from the vertex in the winter solstices. And likewise, in the summer ones, from the observed

quantity BG and BH; and in the equinoxes, from the observed BE and BF. And these being known beforehand, together with the distance of the equator from the vertex of Bologna—namely the altitude of the pole—the hour of the equinox, the solstice, and noon could be known.

Surveyors [Dimensores]		Bologna feet [Pedes Bonon.]	Uncia
A B	Egnazio Danti	67	circiter [about]
	Nobis [by us] from the center	65	9 ¼
B V	Co. Carolo Ant. Māzino	26	0
	Bartholomæo Proualio	25	6
	Nobis	25	6 17/24 [?]
B Q	Com. Manzino	65	1
	Barthol. Proualio	64	7
	Nobis	64	7 22/24 [?]
B M	Com. Manzino	167	7
	Nobis	166	8 7/12
B C	Egnazio Danti	170	
	Nobis	169	2 2/12

The whole IC was at one time found by us to be 4 feet and 11½ unciae. The aperture A, as I have said, was of 4 parts, of the kind of which an uncia of Bologna is 5; therefore, of the kind of parts AB will be, the diameter of the aperture A was 101 such parts—out of 100,000—or in round numbers 100. And half of it must always be added to the radius of the highest edge, and subtracted from that of the lowest, so that the length may be had which agrees with the rays passing through the center of the aperture A, and there intersecting one another by an imaginary, indivisible aperture-point.

On the Gnomon in the Temple of San Petronio recently set up by D. Giovanni Domenico Cassini

De Gnomone in S. Petronij Templo nuper à D. Io. Dominico Cassino excitato.

§10. The Egnatian gnomon, beyond an intrinsic defect, deviated from the plane of the Meridian by nearly 9 degrees; and two other defects it had contracted in the lapse of time—namely a disturbance of the plate of the aperture that admitted the Sun, occasioned by the masons' work; and the declivity of the pavement from its making, through the wearing-down of feet, on account of which the angle ABC, formerly a right angle, had in our time turned out not a little acute. And although even so it furnished some notable uses, yet I more often pondered restoring it and correcting it; and on this matter I consulted with some persons to whom the fabric of this Temple did not yet fully pertain, and spoke also with the most excellent Doctor Io. Dominico Cassino [Giovanni Domenico Cassini] of Genoa, to whom the chair of mathematics, and specifically of astronomy, in this University of Bologna had been entrusted. Therefore, taking the occasion offered by the southern wall, which had to be demolished, and the fabric of the remaining parts already begun, he obtained from the most illustrious Marquis Facchinetti [Facchinetti], President of this fabric, and from its colleagues, or Assistants, that at the expense of the fabric a new gnomon should be erected in that same Meridian line—which both he himself, with the exacter measurements, and I as the inmost foundation of all great undertakings—they urge solicitude over the outcome, since it was doubted by some whether the ratio undertaken by D. Cassini could attain Geometrical exactness [Greek: ἀκρίβειαν (akribēian, "exactness, precision")] of the species [*speciem*], and present it in astronomy. I, consulted among others and an eyewitness having been present beforehand, and an observer of the method begun by him, and—as far as concerned the most exact designation of the Meridian line—a helper and verifier, was no less certain of this man's talent; and being certain of his prudent skill, I pronounced that the matter would proceed most excellently and turn out splendidly. [Margin: The gnomons of Cassini, and the authorities.]

§11. And so that most ingenious man saw that the Meridian could be drawn well and long, in such a way that, avoiding the columns alternately, it would reach the northern wall, and that the aperture AB could be placed in the vault of the Temple itself parallel to the horizon, from whose center, lowered by a plumb-line to the pavement, at last—after the wavering had settled and the spinning come to rest—he marked on the plane of the horizontal marble stone the point D, over which the center of the aperture C hangs perpendicularly; and the altitude CD he composed of wooden foils [*bracteolis ligneis*] joined together, and likewise, when these were let down from C to D, and afterwards [Margin: See the following figure — *Vide sequentem figuram.*]

Diagram. A schematic of Cassini's meridian line. At upper left, a small circle (the vault aperture) labelled with S and P, with I at its left. From the aperture, solid and dashed rays descend to the right onto a long horizontal line representing the pavement / meridian floor-strip, which carries the lettered points A, C, B at its left and D, M, H, O, K, L, N at intervals along it. At the right of the figure is a rectangular outline (the marble slab / floor panel).

- S (at aperture, upper left): point on the aperture
- P (within aperture-circle): center of the aperture
- I (left of aperture-circle): point at the aperture
- A, C, B (on the line, left): closely-set points near the perpendicular foot
- D (below A, on lower line): the marked floor-point beneath the aperture center
- M, H, O, K (along the line, center to right): shadow / image termini
- L, N (right end of line): terminus points
- E (within the rectangular slab outline, right): point on the marble panel

afterwards extended over the horizontal plane, it is measured; and it is found to be of the ancient Roman feet such as Villalpandus [Villalpandus] exhibits in his commentary on Ezekiel, 95 1/24; but the whole DE—conveniently, for finding the angles—of the kind of which the Radius CD is 100,000, made the Tangent DE 251,100; and the diameter of the aperture AB, 100 such parts. The angle CDE is a right angle, because the line DE was made exactly along the channel of standing water [the level], experiment being repeated again and again, equidistant from the horizon, and the line of the ruler bound on both sides between the two marble [strips], so that it is inclined—provision being made that the line DE could endure at the said equidistance for very many years. Moreover, the elliptical solar image, on equinoctial days, occupies a length of three Roman feet and more, and subtends in the sky about 32 minutes; and so it occupies very nearly 6 feet for a single degree. At such a time, therefore, if in designating the extremities of the ellipse it should happen with the edge of a knife, some small error will certainly turn out imperceptible, and much smaller than in the greatest Tyconic quadrant, whose degree occupied scarcely 1 uncia.

§12. The use of the gnomon will become clearer by an example, supposing what has been demonstrated in Book 3 (*Almagestum Novum* [Almagest], new Book 5, together with Nonius [Pedro Nunes] and Snellius [Willebrord Snell])—that the Sun's rays, propagated from that same point of itself to the earth, as SH and SO, are sensibly parallel; and from what is to be demonstrated in Book 4, Chapter 4

(the altitude of the pole of Bologna, in the Temple of San Petronio, being $44^{\circ} 30' 20''$, and of the equator $45^{\circ} 29' 40''$).

LET THIS, THEN, BE THE EXAMPLE

SIT ERGO EXEMPLVM.

§13. In the year 1656, on the 21st day of March, at noon, before trustworthy witnesses skilled in observing, the distance from the perpendicular's point D to the terminus H of the Sun's elliptical image was observed—that is, the Tangent DH—as 95,225; and to the other extremity L, the Tangent DL, 97,098. The semi-aperture AC was 50 parts, and likewise CB; therefore, because of the parallelism of the rays SH and SO, the parallel HO was just as much as KL—namely 50 parts—being the parallel to ACB itself. [Margin: Observation of the Sun's diameter — *Obseruatio Solaris Diametri*; and of the declinations — & *Declinationis*; and of the equinox — & *Aequinoctij*.] Add, then, HO, that is 50 parts, to the Tangent DH, and DO becomes 95,275; the Tangent of the angle DCO, $43^{\circ} 36' 50''$, which was [the angle] S of the higher edge of the Sun's distance from the vertex. From the Tangent DL subtract KL, that is 50 parts, and DK remains; the Tangent of the angle DCK, $44^{\circ} 8' 30''$, of the lower edge I's distance from the vertex. Now the apparent diameter of the Sun IS, their difference, is namely $31' 40''$; and its half, $15' 50''$, added to the degrees $43^{\circ} 30' 50''$, gives the distance of the center P, the Sun's distance from the vertex, $43^{\circ} 52' 40''$ —to which, if from our theses you add a refraction of $5''$, and subtract a parallax of $1''$, there remains the corrected distance of the Sun's center from the vertex, $43^{\circ} 52' 34''$. And this being subtracted from the distance of the equator from the vertex, leaves the northern declination of the Sun's center $37^{\circ} 46'$; to which, in our Table of Declinations corresponding to our obliquity of the ecliptic, $23^{\circ} 30' 20''$, there correspond degrees of Aries $1^{\circ} 34' 43''$. By assigning the single minutes of declination (as is done in equinoxes) to single hours, the equinox is gathered to have occurred at 37 hours 46 minutes before the noon of the 21st day of March. The same is to be done in the other observations of equinoxes, the older of which we set forth in the next, more recent, Chapter.

CHAPTER III

CAPVT III.

Observations of the Equinoxes, or near the Equinoxes, from the year 162 before Christ down to the year of Christ 1656

Aequinoctiorum Observationes, vel prope Aequinoctia ab Anno 162. ante Christum, vsq; ad Annum Christi 1656.

§1. Ptolemy [Ptolemy] (*Almagest* III.2) reports 9 equinoxes—one observed by Hipparchus [Hipparchus] in his book *On the Magnitude of the Year*, and observed at Alexandria by the same man through Equinoctial Armillae; and likewise, Chapter 8, he adds 3 equinoxes observed by himself. But Hipparchus,

[The text below the Caput III heading concerns Hipparchus's equinox observations and a chronological table comparing the reckonings of Hipparchus, Ptolemy, and others; the right column carries the chronological table that follows.]

§2. Moreover Hipparchus [Greek: φιλαλήθης (philalēthēs, "truth-loving")] 1, a lover of truth and faithful—on the report of Ptolemy—confessed that the Autumnal equinoxes by 2, 4, and 6 had appeared a quarter of a day earlier than they ought, having regard to the observed magnitude of the year of 365¼ days; and in 7—which was the Vernal one—he confessed that the Armilla appeared illuminated twice equally on both sides, namely in the morning, and again at hour 5 of the day under the meridian. Which fault was attributed to the Armillae; but it could rather have arisen from morning refraction, representing the Sun higher than it really was, as will be said in Chapter 4, no. 9. These equinoxes, all or some of them, are weighed by Kristmannus [Christmann] on al-Farghānī [al-Farghānī], page (mine) 328; Mulerius [Nicolaus Mulerius] in the Frisian table, page 86; Longomontanus [Longomontanus], *Astronomia Danica*, Theorica, Book 1, Chapter 1; Petavius [Denis Pétau], *De Doctrina Temporum* IV, Chapters 19 and 26; Lansbergius [Lansbergen] in the *Thesaurus Observationum*, class 2; Bullialdus [Ismaël Boulliau], *Astronomia Philolaica* II, Chapter 2; and Franciscus Levera [Francesco Levera], Book 1 of his *Prodromus Astronomiae*, Chapter 3. For me, it is now enough to indicate the Chronological errors of some of them concerning the said equinoxes: for they note a fourth, the Autumnal one, in the year of Alexander 178—Albatenius [al-Battānī], Chapter 27; Regiomontanus [Regiomontanus] in the *Epitome of the Almagest*, Book 3, Proposition 2; and Longomontanus above—on account of the Trebizond version [*versionem Trapezuntinam*]. [Margin: Chronological errors of some of them — *Errores Chronologici nonnullorum*.]

Chronological Table (right column, p. 39)

ANNI LABENTES — "Running / elapsed years." The table groups observations under three observers/epochs (Hipparchus & autumnal; Verna [vernal]; Ptolemaica), giving for each a numbered entry and several era-columns, the Egyptian/Roman calendar date, and the time of day at Alexandria.

(Group)	III. Periodi Calippi	à morte Alexandri M.	Nab onas sari	Ante Christ um	Menses, & Dies Aegyptij, & Romani	Diei partes Alexandriae
Autumn . Hipparc hi	17	162	586	162	Mesori 30. Sept. 27	Vespere
	20	165	589	159	1 Intercal. Sept. 27	Mane
	21	166	590	158	1 Intercal. Sept. 27	Meridie
	32	177	601	147	3 Intercal. Sept. 26	Med. noct.
	33	178	602	146	4 Intercal. Sept. 27	Mane
	36	181	605	143	4 Intercal. Sept. 26	Vespere
Verna	32	178	602	146	Mechir 27. Mart. 24	Mane & h. 5.
	43	189	613	135	Mechir 29. Mart. 23	Med. noct.
	50	196	620	128	Phamenoth 1. Mart. 23	Vespere
(sub-headers)	Adriani	Alexandri	Nab onas s.	Christ i		
Ptolema ica	17 (Antonini)	456	880	132	Athyr 7. Sept. 25	h. 2. p. m.
	3	463	887	139	Athyr 9.	h. 5. a. m.

(Group)	III. Periodi Calippi	à morte Alexandri M.	Nab onas sari	Ante Christ um	Menses, & Dies Aegyptij, & Romani	Diei partes Alexandriae
					Sept. 26 Pachon 7. Mart. 22	
	3	463	887	140		h. 1. p. m.

intending and Gaurico; but in Ptolemy, book 3, chapter 1, instead of 178 one should read 177. The year 177. Therefore, since Krithmannus above, on page 341, and Boulliau above on the Equinoctial of the Autumnal Inequality, follow the Copernican usage, and likewise Vernalis; while Lansbergius above places them in book 3, chapter 13. And Longomontanus and I myself, in book 1, chapters 3 and 14, follow the *Almagest*, with this difference, that he praises my Leuera above, on page 102; yet he errs in saying that the third Calippic Period began in his year 147. As for Petavius too, in book 4, chapter 26, he assigns this same Equinox to the year 4567, that is, to the year of Christ 147. September 27, at its beginning. Soon afterward he adds: *In this year of Thoth of Nabonassar 602 began September 29.* Therefore on Day 27. of September, the year of Nabonassar 602 had not yet begun; so either he slipped through carelessness with his pen, or memory failed him: for he says, *This Equinox is designated by Hipparchus as in the year from the death of Alexander 178. of Nabonassar 602. of the Julian Period 4567.* This year, namely, is the year of Christ 147, the Equinox on Day 27. of September, when Nabonassar had not yet begun, nor Alexander 178; for that began two days after. But it is certain from Ptolemy, book 3, chapter 8, and from Censorinus, chapter 8, that the years both of Alexander the Great and of Nabonassar begin from the first of Thoth.

[Margin: *Nabonassari & Alexandri vera Epocha.* — The true Epoch of Nabonassar and of Alexander.]

They err, moreover, in all things — Longomontanus in marking the Autumnal Equinoxes of Hipparchus, and Leuera in marking the distances of the years from Calippus by counting the year that follows the year of Alexander, and so calling them years of Nabonassar, while assigning them too late. Leuera, besides, has no regard for the relation of those years, which were Calippic years to Hipparchus, and which in the three last Autumnal observations of Hipparchus he doubles for the Calippic year 31. and 32, substituting 31. and 32. for the years 31. and 32; and — what is most groundless — for 36. the year 33, in order to fit his own summaries of the years. The cause or occasion of this error, either from the

nearness of the year of Alexander to that of the death of Ptolemy, or from the year of Ptolemy and of Hipparchus, since they use the Egyptian years — and as for the year from the first of Thoth, the year of Nabonassar, and the year of Alexander — he held that he had begun it, as Krithmannus thought in Alphraganus on page 305, but afterward he thought better of it on pages 329. and 338. He retracted, falsely, that Hipparchus took the beginning of the Calippic years from a preceding Solstice of Summer, whence they would migrate to the year of the Olympiad, and likewise to that of Ptolemy — let alone to the beginning of Hipparchus from Calippus, as Reinhold thinks in the *Prutenicae*, preface 4. Boulliau and Petavius above, and likewise Ptolemy himself, book 3, chapter 1, manifest in Ptolemy, book 3, chapter 1: *In the first year around the Summer Solstice of Calippus 1. of August 1*, that is, at its ending, for thus it stands in the Greek: therefore it must be acknowledged that around the Summer Solstice the Calippic years end and begin. Nor indeed from elsewhere ought Calippus to have begun, since he set his cycle from a preceding Solstice of Summer, witness Geminus and Censorinus, having substituted the cycle of Meton, with the new moon at the beginning of the Summer Solstice.

[Margin: 3]

[Margin: *Errores alij Longomontani, & Leueræ.* — Other errors of Longomontanus and of Leuera.]

The other cause of error in marking the Equinoxes by one or two days too late was the false supposition, advanced by Leuera on page 228. that the first one made by Aristarchus stood from the year of Alexander 44. and from the year of Christ 282. Adducing for false Reinhold, who nevertheless on preface 6. expressly says: *If the first quarter of Thoth in the year 314. before Christ, that is, in the first year from the death of Alexander* — the same Leuera, on page 227. makes the first Olympic year coincide with Salianus' year 775. and with the year of Christ; but on page 228. he makes the first of Nabonassar 747. coincide with that — which, when it ought to cohere with Salianus (erring nevertheless), makes 746. and on pages 214. and 235. he conceives the year as 41. and that of the birth of Christ, which it ought as a consequence to coincide with Salianus, he sets at 44. and so the years 41. coincide with one another, not indeed without an inconstant method in this, on pages 20. 102. and 117. False notions of Chronology he insinuates, immersed in falsehood himself, and incurs imprudently into another series of mishaps. For that the opinion of Salianus, and of those who place the beginning of the Olympic, Nabonassar, and Alexandrian years one year too late, is false, we have demonstrated in our Reformed Chronology, from eclipses noted in the Historians,

together with a series of Consuls and of Censorinus (whom the Chronologers acknowledge as their master) as authority. For

[Margin: 4]

[Margin: *Saliani Chronologia corrigenda*. — The Chronology of Salianus to be corrected.]

for example, from the Consular *Fasti*, which, though corrupted from the first Julian year up to Trajan, are nevertheless certain, with the universal consent of all having weight, it is agreed that in the Julian year 90. the Consuls were M. Vinicius and Statilius Corvinus. To these, moreover, this Eclipse of the Sun belongs, which happened in the natal year of the Emperor Claudius — that is, on the Kalends of August, as Suetonius and Dio relate. But that Eclipse on the Kalends of August: in no other year does any Epoch of Christ, nor any Astronomical Table, present them; from which it follows that the beginning of the Epoch of Christ, that is, 45. completed years, and 90. began on the Kalends of January, and the year of Julian 283. which Censorinus too asserts, who, writing in his own time, says the Book *On the Natal Day* was, in the year of Christ 238. This year, moreover, both Censorinus there says the year of Nabonassar 986. began, and Alexander 562. and so that each, by retroceding exactly to the meridian, for the individual years in our canon of expanded years: the first year of Nabonassar incidentally on the 26. of February, in the year 747. before the Epoch of Christ, and the first of Alexander on the 12. of November, in the year before Christ 324. together with Nabonassar 425. for, by the same kind of computation as Ptolemy, book 3, chapter 8, he reckons, since he says that, with Nabonassar at the beginning, up to the death of Alexander, the completed years are 424. Therefore the first year before Christ coincides with Nabonassar 425. Finally, from Censorinus above it is established that, in the Julian year 283. of this year, and from the Eclipses we showed, of Christ 238. around the Summer Solstice, the year of the Olympiad 114. began. Therefore in the year before Christ 1. the Epoch of Christ was around the Summer Solstice, completed Olympiadic 776. and incidentally 777. and so the year before Christ 776. was the new moon of the Olympiadic 1. running with the year before Christ 776. of the Summer Solstice: the new moon, running around the Summer Solstice, year before Christ 224. And so Alexander the Great died, since the death of Alexander was the Olympiad 114. As Arrian, book 7. and Diodorus, book 17. likewise truly profess the Historians, and that the year before Christ 224. is not 323. but it is false to Giovanni Lucido and Salianus, as Leuera also felt.

[Margin: *Olympiadum vera Epocha*. — The true Epoch of the Olympiads.]

[Margin: 5]

Now indeed from Ptolemy, book 3, chapter 1, he asserts that, ending the eighth year of the first period of Calippus, Aristarchus had observed the Summer Solstice, and the 44. of Alexander; therefore Calippus 50. is, in absolute terms, before the death of Alexander 44. and from the same beginning he begins at the Summer Solstice of Calippus 51. since Alexander 45. began with Nabonassar 469. in the year before Christ 41. years, together with Nabonassar 587. it did not begin except on the Kalends of the following November, in the year before Christ 280. there was the period of Calippus, the year 76. witness Geminus, Ptolemy, and Censorinus; therefore the Solstice of Summer, or his new moon, began in the year before Christ 230. began the first period of Calippus, and in the year before Christ 178. the second one, and 4. seconds, and in the year before Christ 162. the current new moon of Alexander began in 162. For the year of Alexander 163. coincides with that of Nabonassar 587. did not begin except on the 3. of October, since the Equinox the first one of Hipparchus' day 27. September pertained to Alexander 162. and Nabonassar 586. and so coincides with that of Christ 162. and thus of the remaining Autumnal Equinoxes of Hipparchus, which a few days precede in that beginning of Alexander (which Longomontanus marks), and as far as the three first Leuera notes.

[Margin: *Calippi eorum vera Chronotaxis.* — The true Chronotaxis of Calippus and of his people.]

Albatenij Aequinoctium.

[Margin: 6]

Albatenius [al-Battānī], in chapter 27. of his science of the fixed stars, says that the Autumnal Equinox was observed by him at Aracta in the year 1206. from the death of Alexander, on day 19. of the month Elul, that is, the 18. of Pachon, that is, the 19. of September, before sunrise by 4. hours 45. nearly; and between this and the Ptolemaic Autumnal Equinox there had elapsed 743. Egyptian years, and 178. days 17. hours 36. nearly; and therefore in so much time the Equinox preceded by 7. days and 12. hours in a whole Roman year. Let this, therefore, be the synopsis:

Table — Aequinoctium Autumnale (Autumnal Equinox).

Ann. à morte Alexandri (Years from the death of Alexander)	Anno Christi (Year of Christ)	Mensis (Month)	Aracta Horæ p.m. (At Aracta, hours p.m.)		
1206	882	Septéb. 19	Pac hon 8	13	1 5'

You will recall that Albatenus, in the same chapter 27, supposes Aracta to be more eastward than Alexandria by 40' of one hour. Copernicus, book 3, chapter 13, and Longomontanus above, in his commentary on the Sun, found this anticipation of the Equinox very slight, and therefore hold the observation suspect, whose method Albatenus did not disclose. And yet Lansbergius, in the *Thesaurus*, pages 3. and 50, calls this observation a notable one, and says it was at hour 13. 15'. after midday.

[Margin: *Lansbergius notat.* — Lansbergius notes.]

Albatenus, however, holds the contrary: for indeed his own *Tabulae* obtain for this very moment of the Equinox, since they put forward the *Prutenicae*, the *Danicae*, and the *Rudolphinae* — because that *Aracta* of his they gather at hour 23. 40'. after midday, and the *Danicae* and the *Rudolphinae* at hour 3. 55'. which they call tolerable errors. Boulliau, book 2, chapter 2, for hour 13. 15'. after midday, or hour 1. 15'. after the middle of the night, puts it; Joseph Scaliger, on September 18. at hour 14. 21'. and adds, wrongly, that Scaliger reconciled this year with that of Christ 883. against whom see Scaliger; for Petavius, book 4, chapter 6, *On the Doctrine of Times*.

[Margin: *Joseph Scaliger lapsus Chronologicus.* — Joseph Scaliger's Chronological slip.]

Aequinoctia Io. Regiomontani.

[Margin: 14]

In the little Book of observations of Regiomontanus and Walther [Bernhard Walther], we have binary observations, one pair for each Equinox, of the distances of the Sun from the vertex at Nuremberg, whose method is that of Tycho [Tycho Brahe], in the *Progymnasmata* on page 48. and our *Geographia Reformata* on page 49. 26'. For by the Parallactic Rules of the old men of feet they observed in the year 1473. on March 11. at the meridian. The solar distance of the

center from the vertex by the Chord of parts 83600. of which the Radius, that is the length of either Rule representing the whole sine, was 100000. semichord, in the Tables of sines gives the arc of Degrees 24. 42'. 27". which doubled makes the arc gr. 49. 24'. 54". — namely the apparent distance of the Sun from the vertex; from which if you subtract our parallax, not exceeding the second 10". there comes out the true distance of the Sun from the Vertex grad. 49. 24'. 44". which subtracted from the distance of the Equator from the Vertex at Nuremberg gr. 49. 26'. leaves the Northern declination of the Sun of Minutes 1'. and 16". Since therefore the Sun was in the Northern signs, the Equinox had now been made for so many hours; and by minutes before midday, by as many minutes, and by seconds it was declining in the meridian toward the North. Therefore the Equinox was at hour 22. 44'. after midday of the preceding day 10. By this method, from the Chord of the meridian observed by Regiomontanus there, of parts 83810. we collected the Autumnal Equinox made on day 13. of September at hour 17. 30'. after midday at Nuremberg. Examine the synopsis in the table below.

Table — Aequinoctia Regiomontani in Horis post merid. Norimbergæ (Equinoxes of Regiomontanus, in hours after midday at Nuremberg).

Ann o (Yea r)	Christi (of Christ)	In meridiē (At the meridian) — Chorda	Dist. ☉ vera (true distance of ☉) — G. ' "	Decl. ☉ vera (true declination of ☉) — ' "	Aequinoctiu m — D. H. '
1473	Mart. 11	83600	49 24 44	1.16 B	10 22 45
1473	Sept. 14	83810	49 32 30	6.30 A	13 17 30

If you wish the observed, or apparent, distance of the Sun from the Vertex, add to the true [distance] the second 10". of our Parallax.

Aequinoctia Vualtheriana.

[Margin: 15]

Indeed, I should think ill of myself with regard to Bernhard Walther [Bernhard Walther], who deserved excellently of Astronomy right up to his old age — observing, among much else, the days around the Equinoxes especially, by the Parallaxic Rules, noting the Chords of the distances of the Sun from the vertex at Nuremberg, marking down from time to time those which were made by him in clear light, and carefully, or in which there was confidence — if I should not report them here. Especially those made on the Equinoctial day itself, or on the

day next to it: above all when I have seen them undeservedly neglected by the Astronomers of a later age, and so that Tycho himself scarcely sampled any from among them, nor those the best of all. The Method of extracting the time of the Equinox from such Chords I have already delivered, under number 14. The rest examine in the following Catalogue; and if you add our parallax to the Distances of the Sun from the vertex, in such a position you will have the true distance of the Sun from the vertex at Nuremberg, or that arc which by a doubled Sine answers to each of Walther's chords.

Table — Aequinoctia Vualtheri in Horis post merid. Norimbergæ (Equinoxes of Walther, in hours after midday at Nuremberg).

Tempus observati onis à Christo nato — Ann. Ord o (Or der) Mens. D. (Year, Month, Day) (note on clarity) Ad Radium 100000 — Chorda Distantia ☉ vera à vertice — G. ' " Declinatio ☉ vera — ' " (N Aequinoct / ium S apparens) — D. H. '						
16	1477 Mart. 11	Obs. certa	83675	49 27 46	1 46	A 11 1 45
17	1478 Mart. 11	Diligens	83820	49 32 58	6 58	A 11 7 0
18	1479 Sept. 14		83490	49 20 40	6 40	B 14 6 40
19	1487 Sept. 14		83600	49 24 44	1 14	B 14 1 14
20	1488 Mart. 10	Radij debiles	84090	49 43 23	17 23	A 10 17 22
21	1488 Sept. 14	Clara, & diligens	84067	49 42 34	16 34	A 13 7 26
22	1489 Mart. 11	Clara diligens	83625	49 25 26	0 34	B 10 23 26
	1491 Mart. 11	Non valde, sed	83940	49 37 42	11 42	A 11 11 41

Tempus observati onis à Christo nato — Ann.						
Ord o (Or der)	Mens. D. (Year, Month, Day)	(note on clarity)	Ad Radium 100000 — Chorda	Distantia ☉ vera à vertice — G. ' "	Declinatio ☉ vera — ' "	(N Aequinoct / ium S apparens) — D. H. '
		sat clara				
23	1491 Mart. 11	Satis clara	83325	49 34 26	8 26	A 11 8 26
24	1491 Sept. 14	Satis clara	83680	49 28 0	2 0	A 13 22 0
25	1493 Sept. 14	Clara eodē instanti	83934	49 36 28	10 28	A 13 13 32
26	1494 Sept. 14	Clar. sat diligens	83785	49 32 0	6 0	A 13 18
27	1496 Sept. 14	Sat clara diligens valde	84125	49 44 39	18 39	A 13 5 21
28	1501 Mart. 10	Clara certissima	84234	49 59 0	33 0	A 11 9 0
29	1501 Sept. 14	Præclara certissima	83990	49 39 32	13 32	A 13 10 28
30	1504 Mart. 12	Clara præcerta confide	82750	48 52 43	33 17	A 13 9 17

[Margin: *Tychonis usus harum observat.* — Tycho's use of these observations.]

At Tycho, in tome 1 of the *Progymnasmata* page 51, among all the others which he had seen, prefers the observation which in our order is the twentieth; and he says that from it the Equinox was collected for March, on day 10, hour 15. 40'. after midday at Nuremberg.

But if I had employed the Tychonic parallax in that position $2'. 18''$. there would have come out in every case a true distance from the vertex grad. $44. 41'. 15''$. and a Southern declination $15'. 15''$. and so at hour Equinox $15. 15'$. I judge, however, that it pleased Tycho 10. to observe the Equinox, even though the *Radius* — as Walther says — was weak, because in the year 1488. the distance stood at 100. years and an integer for the calculation of the Vernal Equinox observation made in the year 1588. As one about to compare the observation of his own with the Autumnal Walther made in the year 1588. he chose the Autumnal Walther, which is in our order, that is, the year 1588. for which reason of these the Equinox of Nuremberg made September 13. at hour 9. $20'$. after midday, discrepant from our reckoning by $2'$. and more, on account of an excessive parallax $1'. 18''$. assumed, because nevertheless in his own observations such a compensation, in the order of gathering thence the quantity of the Year, of which afterward — Longomontanus, trusting Tycho, commends the examination of these two observations even in his own *Compendium*.

Aequinoctium Gelalaeum Persarum.

[Margin: 31]

Joseph Scaliger, book 4. of the emended *De Emendatione Temporum*, page 304. narrates that Albu Arslam, Sultan of Corasan, or of Mesopotamia, by edict convened eight or more of the most outstanding men, among whom were Omar and Abensina [Avicenna], or Avicenna, in order to constitute the Year of the Persians, and them, in the year of the Christian Era of Dionysius 1079. namely the Hegira 471. and from the slaughter of Iezdegird 448. observed the Vernal Equinox on the 14. of March 5. since it was day 18. of the month Pharudin of the Persians, on day 6. of the month of the Arabs Ramachahim, the Cycle of the Sun 16. the Moon 4. at hour 2. $33'$. after midday. Which day was called Oromazda of the Persians, the New Year of the Just; that is, the New Moon of the Year of the Emperor Iesdegird. Boulliau also, book 2. chapter 2. from a manuscript of the Royal Library of Georgios Chrysokokkes, asserts that the Persian Tables show the true Vernal Equinox to have been in the year of Christ 1079. under the meridian of Tybenes (which is from Aleppo distant one hour), having risen on the side of March on the 14. day, hour 1. $1'. 4''$. as Walther thinks, on the 14. day, hour 2. $35'$. less — that is, the Philolaic Tables exhibit that hour 1. $1'. 27''$. exceeding by 1. of an hour $15'$. The true [Equinox] Longomontanus, in his Commentary on the Sun, did not accept as celestial, but as constituted from the Annual quantity, which Albatenus repeats, having regard to the time of the years $197\frac{1}{2}$. (so correcting the Typographical error in Longomontanus, who has $193\frac{1}{2}$.) which up to the

Albatenian Equinox in the year 882. up to the Persian one of the year 1079. flowed; from which dependent question we still cannot make a firm foundation in such an Equinox.

[Margin: *Ordo* — Order]

Cardinalis Cusani, & Prophatij Aequinoctia.

[Margin: 32]

Nicolaus de Cusa Cardinalis [Nicholas of Cusa], in his treatise *On the Repair of the Calendar*, asserts the year of Christ 1290. from the observation of certain men, whom he does not name, that the Sun entered Aries on the 16. of March after midday, and so on account of constant days 365. h. 5. 49'. 16". Reinhold too, in his *Theory of the eighth-sphere motion* folio 168, has these words: *Alphonsinus too holds that name, by which name Peter de Alliaco reprehends, that the watery quantity of the year is constituted; from which both ancient and recent observations manifestly cry out.* For he narrates the year of the Lord 1290. on the 13. of the month of March, that the entrance of the Sun into Aries was made on the 16. hour, after the calculation became permissible. Which relation, with the relation of Cusanus discordant, who refers those 16. hours and posits them after midday on the preceding day 12. that is Astronomically. As to Boulliau, book 3. of his two Astronomical [tables], the Vernal Equinox of the year 1290. in the Frisian Meridian by the Alphonsine calculation was on March 12. hour 6. 59'. after midday day 13. — there is therefore the difference if it were observed at hour 6. after midday from Cusanus' calculation by hours 33.

which is not inconvenient. The denomination, then, is from the observer of day 13. in the Roman manner, since on that day the observation showed the Equinox at hour 8. before midday, that is, Astronomically, at hour 16. after the preceding midday; that is, in the words of Cardinal Cusanus reported below: *In the year of the Lord 1290. on the 13. of March the Sun was found to enter Aries after hour 16.* But Cusanus does not say the observation was made by himself, or by another, nor in Frisia, nor was Reinhold's consequence necessarily withdrawn, or unconnected. Otherwise Alphonsine calculation errs around the observation, not so much on account of the proper quantity of the Year, and of the Anomaly, and of the Prosthaphaeresis, and of the false dissection of the Meridians, and of the Equation of the natural days, and of an excessive parallax — by these together taken up the error of many hours could stand.

[Margin: 33]

The same Cardinal Cusanus, in the same work on the Calendar, has these words: *Prophatius too, the Jew, and certain other observers, in the year of Christ 1303. the Sun, on the 14. of March hour 8. after the middle of the night, compared to enter Aries.* But this too Boulliau, book 3. chapter 3. says it ought to be understood in the Roman manner, that on that day it was made by observation, even though it were the Astronomical hour 8. after midnight of day 12. then most evidently it is hour 20. after midday of day 12. otherwise it conflicts with the preceding observations, and the consequent observations and the Alphonsine Calculation, which exhibits the year 1303. the Equinox in Frisia on March 12. hour 11. 23'. after midday; and immediately the Philolaic [Tables], which Wranisburgi exhibit on day 12. of March, this on day 18. 35'.

[Margin: 34]

A greater difficulty is that concerning the Equinox, which the same Cardinal in the same work adduces in these words, speaking of the Alphonsine Tables: *Experience found that it is almost in hour 13. it deviates; so that, as Master Henricus Bate of Mechlin in his little book of the Tables of Alphonso, then experience taught in the year 1490. and after this many years, 12. and in the same hour to err.* For if Cardinal Cusanus died in the year 1464. as is established from the Chronicle of his Life, and from the Chronicle of Mathematicians we set at the beginning of the First Tome of the *Almagestum Novum*: how could he have narrated an observation made in the year 1490? But the Alphonsine [Tables] could have been at fault around the year 1490. and in the margin the Philolaic [Tables], on the 3. of March, very low; which is rather to be feared, conjecture and credit the Cusanus to have rather written 1460. proclaim it, for it is easy in typography to invert these numbers, and so to put 6. for 9. Otherwise the Equinox of Cusanus the year 1346. observed, says Reinhold, on March 12. nearly two hours before midday, but he expresses neither the place nor the observer.

Copernici Aequinoctia.

[Margin: 35]

[Margin: *Ordo* — Order]

Nicolaus Copernicus, book 3. of the *Revolutions*, chapter 13. says: *We observed the Autumnal Equinox at Frauenburg, in the year of Christ's birth 1515. on the eighteenth before the Kalends of October; it was, moreover, after the death of Alexander, in the Egyptian year 1840. on the sixth of the month Paophi, an hour and a half after sunrise.* And by this Aracta he supposes Frauenburg to be oriented

from Bologna on the 1. and 6'. He gathers the Autumnal Equinox observed by Albatenus, and his own Egyptian [year] 633. and days 153. and hours 6. 45'. then he adds a few things.

[Margin: 36]

We received also the Vernal Equinox, which was in the year following the birth of Christ noted 1516. at hour 4. and a third after midnight, on the eighth day before the Ides of March. Tycho, however, Tome 1. *Progymnasmata* page 34. and in the *Epistles* page 74. accuses Copernicus in the declination of the Sun, that he everywhere erred by 2. 45'. and therefore in the interval of the Vernal and Autumnal Equinoxes he exceeded by hours 5½. — for two reasons: one in the altitude of the Pole, and the Equator he raised by 2'. 45'. on account of Refractions omitted. For indeed Copernicus, book 3. chapter 2. narrates that he observed by himself, and by others, the distance of the Tropic points not more than 46'. and of first scruples 58'. nearly,

roughly, that is, the angle of the section, namely 23' 28" of the parts of the equator [aequatoris partium], and one fifth of two. Then, in Book III, Chapter 2, he says: "At Frauenburg [Fruemburgi], however, the latitude is found to be 54 of the parts, less 19¼ first scruples." From these consequences he concludes that, in the observation of the Sun's summer solstitial altitude, the altitude is 59° 8', 54"; but the winter [solstice] altitude, once the subtraction of refractions is corrected, comes out as 8' 54" — agreeing with Tycho [Brahe] in his table of refractions — and that, this being settled, the altitude of the equator [Frauenburg] is 35° 36' 3", and the pole 54° 22' 57", and the obliquity of the ecliptic 23° 32' 51". But because Tycho, having sent Elias Olsen [Elia Olai] to Frauenburg — a man of the highest skill and practiced in instruments — discovered, from the circumpolar stars, that the altitude of the pole at Frauenburg is 54° 22' 15", and likewise deduced that the refractions of the Frauenburg observers had been larger than in Denmark; and since this happens at Copernicus's parallax of the Sun, and because the magnitude of the instruments used by Copernicus matters — especially since, on the testimony of Georg Joachim Rheticus [Rheticus] in the preface to his *Ephemerides* of the year 1550, Copernicus was not careful enough about seconds — for these reasons of uncertainty I do not think it worthwhile to try to extract from these observations the true equinox of the years 1515 and 1516. It is enough that these observations can be suspected of an error of three or four hours, or even more, in the matter of the hours.

Equinoxes of Pitati, Nonius, and the Landgrave of Hesse.

[Margin: 37] Pietro Pitati [Pietro Pitati] of Verona, in the preface to his *Ephemerides*, relates that in the year 1520 at Rome, together with Paulus, Bishop of Forlì [Forosempronio], he observed the vernal equinox [Margin: 38] on the tenth of March, after noon. And in the year 1521, likewise on March 10 at 9:17 after noon, at Rome, Pedro Nunes [Petrus Nonius] of Salacia [Salacien.], in Book 2 of his *De Observ. Reg. & Instrumentum Geom.* Chapter 4, asserts that he observed two palm-widths in diameter [duorum palmorum in diametro] at Coimbra. For many years he observed that the minimal distance of the Sun from the vertex came to be precisely 17° , [Margin: 39] and he then supposes the Sun's maximum declination to be $23^\circ 30'$, roughly. From this he concludes that the latitude of Coimbra [Conimbrica] is $40^\circ 30'$ roughly; and afterward in the year 1555 of the Christian era, on the 14th day of the month of September, finding the minimal distance of that same Sun from the vertical point to be $40^\circ 40'$, he infers the declination on the meridian of that day to be 10° to the south. And because, around the points of the equinoxes, the Sun's declination changes by 24 minutes in a single hour, in the section of the autumnal day, on September 14, 10 hours before noon — at which point indeed those Alphonsine tables [Tabulas Alphonsi] are found to fall, which the Spaniards praise (namely the Spaniard he had named a little earlier) — for the calculations of Alphonso do not agree among themselves on everything, and this is also attested by many observations, and the small dimensions of the astrolabe and the study of the Alphonsine hypothesis make the observations suspect.

[Margin: 40] The most distinguished Wilhelm, Landgrave of Hesse [Vuilhelmus Langravius Hassiae], in the year 1572, on March 7, by himself, obtained the Sun's meridian altitude at Kassel [Cassellis] to be $37^\circ 38' 40''$; so the distance from the vertex to the south comes to $1^\circ 10' 11''$. If you add $1^\circ 49''$ to the Sun's altitude — as Lansbergen says in his *Thesaurus* — the observation has 9° [recte: he says]. He then adds: the Sun runs through the equinoctial arc by $1^\circ 10' 11''$ in the space of two days and 22 hours. Therefore the true vernal equinox occurred at Kassel on the 9th day of March at 22:11 after noon. But gathering from his own tables, he says this equinox at Kassel "on the 9th day of March at 22:11 after noon" was altogether as the most distinguished prince observed it. Now Tycho, in Volume 1 of the *Progymnasmata*, citing page 75, says the Landgrave's [meridian altitude] of the Sun was there observed at the altitude of $27^\circ 28' \frac{3}{4}$ on March 7. When the parallax of $22' 22''$ is added, it is reduced to the true [altitude] of $37^\circ 30' 30''$; and supposing there the elevation of the equator to be $38^\circ 41'$, he gathers the southern declination of the Sun to be $1^\circ 10' 30''$, which he says falls into its place

at Υ $27^{\circ} 5' \frac{1}{3}$ — by his own tables' calculation, but by the Alphonsine $27^{\circ} 30'$, and by Copernicus $26^{\circ} 36'$, and of the two more.

[Margin: Ordo]

Equinoxes of the Landgrave [Aequinoctia Landgrauiana], hours from noon. At Kassel.

O r d o	Years of Christ [running]	Months and Days	True altitude on the meridian [G. M.]	True declination of the Sun [' '']	Apparent equinox [D. H. I]
4 1	1567	March 11	38 42	1 40 B	10 22 20
4 2	1568	Sept. 13	38 30	10 20 A	12 13 40
4 3	1571	Sept. 13	38 46	5 40 B	13 5 40
4 4 *	1572	March 7	37 28 $\frac{1}{2}$	71 [recte: 1] 50 A	9 23 30
4 5	1572	March 11	39 3	22 40 B	10 1 20
4 6	1573	March 11	38 36	15 40 B	10 8 20
4 7	1578	March 11	38 54	13 40 B	10 10 20
—	1578	Sept. 14	38 23	17 20 A	13 6 40

The Tychonic Equinoxes, from his own observations.

[Margin: TYCHO] Tycho himself, in Volume 1 of the *Progymnasmata*, page 13, reports five vernal equinoxes and as many autumnal ones, by the days of the old calendar and by hours after noon at Uraniborg [Vraniburgi], where he determines the altitude of the equator as $34^{\circ} 5' 20''$. At that altitude he supposes the parallax of the Sun [parallaxis Solis] to be $2'$ and the refraction of seconds to be $44''$. Therefore, when he says the equinox was observed by him in the year 1584 — March 9 at 21:30 after noon — it is just as if he were to say that the meridian altitude of the Sun was observed on that day to be $33^{\circ} 42' 5''$. For to this,

by adding the parallax $2' 29''$ and subtracting the refraction $44''$, the corrected altitude comes to $33^\circ 43' 50''$; and when this has been subtracted from the equator's elevation of $34^\circ 5' 20''$, it leaves the southern [altitude] corresponding to the Sun's declination of $21^\circ 30'$, to which corresponds the hour 21:30, for the subsequent equinox to be celebrated. By this method, from the five aforesaid equinoxes — apart from those observations which leave the altitudes uncertain — we shall seek out his own observation, but we shall correct it by adding our own parallax, which at such a position is scarcely $16''$, and by subtracting the refraction $44''$. We shall do likewise concerning certain other meridian altitudes around the Tyconic equinoxes, taken from those reported by [Longomontanus] in *Astronomia Danica* Book I, Theorica, Chapter 2, in the commentary on the Sun. Drawing out from there the moments of the equinoxes, both according to the Tyconic parallax and according to our own emerging one, we shall accordingly distinguish them by the characteristics T and N.

[Margin: Ordo]

Equinoxes from Tycho's observations [Aequinoctia ex Tychonis observ.], hours p.m. At Uraniborg [Vraniburgi].

O	M				
r	Years of	. Apparent		True	True
d	Christ [old	D altitude	True altitude	declination ['	equinox [D.
o	style]	. [visa] G. ' "	[vera] G. ' "	"]	H. I]
4	1584 March 9	33 42 5	33 43 50	21 30 A	9 21 30 T
8			33 41 37	23 43 A	9 21 43 N
4	Sept. 12	34 19 35	34 21 20	16 0 B	12 16 0 T
9			34 19 7	3 47 B	12 13 47 N
5	1585 March	34 0 16	34 2 1	3 19 A	10 3 19 T
0	10		33 59 48	5 32 A	10 5 32 N
5	Sept. 12	34 25 24	34 27 9	21 49 B	12 21 49 T
1			34 24 56	19 36 B	12 19 36 N
5	1586 March	34 54 27	34 56 12	9 8 A	10 9 8 T
2	10				

O r d o	Years of Christ [old style]	M . D . Apparent altitude [visa] G. ' ''	True altitude [vera] G. ' ''	True declination [' "]	True equinox [D. H. I]
			34 53 59	11 21 A	10 11 21 N
5 3	Sept. 13	34 7 13	34 8 58	3 38 B	13 3 38 T
			34 6 45	1 25 B	13 1 25 N
5 4	1587 March 10	33 48 39	33 50 24	14 56 A	10 14 56 T
			33 48 11	17 9 A	10 17 9 N
5 5	Sept. 13	33 13 1	34 14 46	9 26 B	13 9 26 T
			34 12 33	7 13 B	13 7 13 N
5 6	1588 March 9	33 42 50	33 44 35	20 45 A	9 20 45 T
			33 42 22	22 58 A	9 22 58 N
5 7	Sept. 12	34 18 50	34 20 35	15 15 B	12 15 15 T
			34 18 22	13 2 B	12 13 2 N
5 8	1589 March 11	34 24 55	34 26 45	21 25 B	10 2 55 T
			34 24 32	19 12 B	10 4 48 N
5 9	1590 March 11	34 18 35	34 20 20	15 0 B	10 9 0 T
			34 18 7	12 47 B	10 11 13 N
6 0	1590 Sept. 12	34 30 15	34 32 0	26 40 B	13 2 40 T
			34 29 57	24 27 B	13 0 27 N
6 1	1593 March 10	34 1 30	34 3 15	2 5 A	10 2 5 T
			34 1 2	0 8 B	9 23 52 N
6 2	1594 March 10	33 56 20	33 58 5	7 15 A	10 7 15 T

O r d o	Years of Christ [old style]	M . D . Apparent altitude [visa] G. ' "	True altitude [vera] G. ' "	True declination [' "]	True equinox [D. H. I]
			33 55 52	5 2 A	10 5 2 N
6 3	Sept. 13	3 6 20	34 8 5	2 45 B	13 2 45 T
			34 5 53	0 32 B	13 0 32 N
6 4	1596 March 11	34 30 45	34 32 30	27 10 B	9 20 50 T
			34 30 17	24 57 B	9 23 5 N
6 5	Sept. 14	33 30 10	33 31 55	33 25 A	12 16 35 T
			33 29 42	31 12 A	12 18 48 N
6 6	1597 March 10	34 2 20	34 4 30	0 50 A	10 0 50 T
			34 2 17	1 23 B	9 22 37 N

[Margin: 67–70 series; the right-hand table]

After the prose-foot of the Uraniborg table, Riccioli adds (left column, foot):

[Margin: Lansbergen] Lansbergen [Lansbergius], in his *Thesaurus*, out of so many Tychonic equinoxes selects a single one to confirm his own tables, which is 52" in our order; and he finds that this falls not at hour 9:8 after noon (Tycho does not have it [there]), but at hour 9:2. As Clavius [Clavius], following Tycho, [reports] in his *Apologia Kalendarii*, but at hour 9:34 at Uraniborg, because at the altitude of 34 grades Tycho assumes the parallax of the Sun to be 2' ½, very nearly; but Lansbergen [takes] 2'. And the difference of half a minute, around the equinox, gives a difference in declination of half an hour. Both parallaxes, nonetheless, are faulty, as [will be shown] below. Boulliau [Bullialdus] too, in Book 2, Chapter 2, from a single Tychonic and a single Hipparchan annual quantity, elicits — namely from the equinoxes in our order, marginal numbers 5 and 56.

The Lansbergian Equinoxes.

In his *Thesaurus* of observations, Lansbergen [Lansbergius] draws two vernal and two autumnal equinoxes of Goes [Goësae]...

[which differ] from itself by not even a second scruple from his own tables. But by the altitude of the equator at Goes [Goësana] — taking the refraction as null, and supposing the parallax to be no greater than 14" for us — the difference of these from 1° 35' varies the declination by the same amount, and the time by 1 hour 35'. We shall therefore append, from Lansbergen and from our own parallax, the equinoxes deduced from his own observations, as they are reported by him himself. So that, if our parallax is true, his own tables err in this place by 1 hour 35'.

[Margin: Ordo]

The Lansbergian Equinoxes of Goes [Aequinoctia Lansbergiana Goesae], hours p.m., old style [stylo veteri].

O r d o	Years of Christ	A. M. D.	Apparent altitude [visa] G. ' "	True altitude [vera] G. ' "	True declination [' "]	True equinox [D. H. I]
6 7	1589	Ma rch 9	38 0 30	38 2 19	26 41 A	10 2 41 L
				38 0 44	28 16 A	10 4 16 Nos
6 8	1589	Se pt. 13	38 22 0	38 23 48	5 12 A	12 18 48 L
				38 22 14	6 46 A	12 17 14 Nos
6 9	1599	Ma rch 10	38 13 20	38 15 9	13 51 A	10 13 51 L
				38 13 34	15 26 A	10 15 26 Nos
7 0	1599	Se pt. 12	38 33 15	38 35 3	6 3 B	12 6 3 L
				38 33 29	4 29 B	12 4 29 Nos

Four Equinoxes observed in the years 1536, 1574, 1575, 1581.

[Margin: 71] I confess I ought to have reported these before the Tyconic ones, but they matter little. So, in the year 1536 — as Daniel Santbech [Daniel

Santbechius] relates in his observations, *Phaenom.* prop. 11 — there was observed at Tübingen [Tubingae] an exact equinox on March 10, at the very noon of that day, from which he himself, and from the Ptolemaic vernal [equinox], supposing Alexandria to be more easterly than Tübingen by $1^{\circ} 28'$, gathers the annual equinoctial value of 365 days, 5 hours, $48' 41'' 42''' 33''$ [recte: $33'''$] $50''' 10'''$.

[Margin: 72] In the year 1574, Egnazio Danti [Egnatius Dantes] of Florence [Florentini], in the presence of many witnesses, observed [the equinox] on March 12, at $26'$ [after noon], before midday — the armilla of the equinoctial circle was equally illuminated on both sides of its cavity, and at once the southern [side] appeared; from which moment he judged the equinox to have occurred.

[Margin: 73] As [Egnazio Danti] relates in part 6 of his *Astrolabio*. Thus in the year 1575, with the same instrument and at the same place, he observed the equinox of March at 12 hours $4' 12''$ after noon. Moreover, at the altitude of the equator 46° , my own parallax of $10''$ retards each of those moments by the same amount; the equinox.

[Margin: 74] In the year 1581, Cesare Lucchini of Bologna [Cæsar Luchinus Bononiensis], a Bolognese, observed [the equinox] on March 11. The Sun's meridian altitude was $45^{\circ} 51' 15''$, by a large quadrant geometrically [constructed], as I read in his manuscript. A parallax of $10''$ added gives the true altitude of the Sun here as $45^{\circ} 51' 25''$; and the declination, $45^{\circ} 29' 40''$ subtracted, leaves a northern declination of $2' 45''$. Therefore the equinox is elicited from this at 2 hours $15'$ after midday, or at hour 2:10, if you wish, taking the refraction at $5''$, which diminishes the altitude of the Sun.

Equinox observed at Bologna by the Reverend Fathers Giovanni Battista Riccioli and Francesco Maria Grimaldi.

[Margin: 75] I had indeed thought to pass these over, since after our solar observations from the year 1641 to 1656 there succeeded those made on the gnomon of San Petronio [Gnomone S. Petronij], to which our own must yield because of the magnitude of the instrument — especially since at that time we determined certain equinoxes using the altitude of the equator...

[altitude of the equator] $45^{\circ} 30' 30''$, which afterward, as we shall show in Book IV, Chapter 4, is found in our observatory to be $45^{\circ} 29' 50''$. Nor have we had the parallax of the Sun adjusted at such an altitude. These matters notwithstanding, it is preferable, from the meridian altitudes which we accept — and indeed together with two intervening quadrants — to add at the same time what

equinoxes ought to result, found in San Petronio, and from the annual precession deduced from there, which is 11' 14" 14''' respectively. We disregard for the present the Julian year of 365 days. And as for the refraction of 6, we scorn it as uncertain.

[Margin: Ordo]

Our Equinoxes at Bologna [Aequinoctia Nostra Bononiae], hours after noon.

O r d o	Years of Christ	An. M. D.	Apparent altitude [visa] G. ' "	True altitude [vera] G. ' "	True declination [' "]	True equinox [D. H. I]
7 5	1641 Sept. 21		46 3 10	46 3 20	33 20 B	22 9 30
	<i>It occurred</i> [Debut]		46 3 12	46 3 22	33 22 B	22 9 33
7 6	1642 March 20		45 29 10	45 29 20	0 30 A	20 0 38
	<i>It occurred</i>		45 29 13	45 29 23	0 27 A	20 0 28
7 7	1643 March 20		45 23 10	45 23 20	6 30 A	20 6 30
	<i>It occurred</i>		45 23 24	45 23 34	6 16 A	20 6 17
7 8	1643 Sept. 22		45 51 0	45 51 10	21 20 B	22 21 20
	<i>It occurred</i>		45 50 50	45 51 0	21 10 B	22 21 10
7 9	1644 March 19		45 17 35	45 17 45	12 5 A	19 12 5
	<i>It occurred</i>		45 17 35	45 17 45	12 5 A	19 12 6
8 0	1645 March 19		45 11 40	45 11 50	18 0 A	19 18 0
	<i>It occurred</i>		45 11 46	45 11 56	17 54 A	19 17 54
8 1	1647 March 20		45 24 10	45 24 20	5 30 A	20 5 30
	<i>It occurred</i>		45 24 9	45 29 [recte: 24] 19	7 [recte: 5] 31 A	20 5 32

O r d o	Years of Christ	An. M. D.	Apparent altitude [visa] G. ' "	True altitude [vera] G. ' "	True declination [' "]	True equinox [D. H. I]
8 2	1649 March 20		45 36 10	45 36 20	6 30 B	19 17 30
	<i>It occurred</i>		45 36 31	45 36 41	6 51 B	19 17 9
8 3	1653 March 21		46 1 0	46 1 10	31 20 B	19 16 40
	<i>It occurred, on the 19th</i> [Debut die 19]		45 13 16	45 13 26	16 24 A	19 16 25
8 4	1654 March 20		45 31 30	45 31 40	1 50 B	19 22 10
	<i>It occurred, on the 19th</i>		45 7 27	45 7 37	22 12 A	19 22 13

Equinoxes observed at Bologna by the great gnomon of the Temple of San Petronio by the most excellent Lord Giovanni Domenico Cassini, or his assistants.

[Margin: 85] The Lord Giovanni Domenico Cassini [Dominicus Cassinus], in the book entitled *Specimen observationum Bononiensium, quae novissime in D. Petronij Templo &c.*, page 10, asserts that he observed the autumnal equinox in the year 1655, on September 23, at 5 hours 4 minutes 35 seconds before midday, in apparent time — that is, on Day 22, H. 18, 55' 25" after midday. But he neither [gives] the observation nor the method by which he derived it from his observations; I believe because he had indicated the method above, in the equinox of the year 1656. He supposes, however, from his observations — concerning which below — the obliquity of the ecliptic to be 23° 30' 20", and the parallax of the Sun, at the altitude of the equator observed here as 45° 29' 40", to be either nil or scarcely perceptible. He has nevertheless communicated to us the tangents of the solar distance of each limb from the vertex — several of them — both for this year 1655, on September 22 and 23, observed by him at midday, from which we shall elicit those distances by the method already given in Chapter 2, number 13.

[Margin: Arcus.]

Year 1655, September 22.

	Tangents	G. ' "
Of the lowest limb of the Sun [Infimi Solis marginis]	98133	44 27 36
Of the highest limb of the Sun [Supremi Solis marginis]	96344	43 56 0
Difference and apparent diameter of the Sun		31 36
Semidiameter		15 48
Distance of the Sun's center from the vertex		44 11 48
Distance of the equator from the vertex		44 30 20
Therefore the Sun's northern declination [Borealis]		0 18 32
And the place of the Sun in the Zodiac, by logarithmic trigonometry	♎	29 16 2
The obliquity of the ecliptic being posited		23 30 20

Year 1655, September 23.

	Tangents	G. ' "
Of the lowest limb of the Sun	99483	44 51 5
Of the highest limb of the Sun	97672	44 19 29
Apparent diameter of the Sun		31 36
Semidiameter		15 48
Distance of the Sun's center from the vertex		44 35 17
Distance of the equator from the vertex		44 30 20
Therefore the declination [Australis — south]		4 57
And the obliquity of the ecliptic being posited		23 30 20
The place of the Sun in the ecliptic	♏	0 12 24
Therefore the true daily motion of the Sun from the 22nd to the 23rd [Motus diurnus Solis verus]		0 56 22

[Margin: 86] In the year 1656, the Lord Giovanni Domenico Cassini, as he reports in the aforementioned book, observed by the same gnomon the apparent vernal equinox at the time of March 19, hour 9:50' 50" after noon, by the following method: from observations on the 19th, 21st, and 23rd at midday — for the 20th and 22nd were somewhat cloudy [subnubili].

[Margin: Arcus.]

Year 1656, March 19.

	Tangents	G. ' "
Of the lowest limb of the Sun	99762	44 55 54
Of the highest limb of the Sun	97940	44 24 14
Apparent diameter of the Sun		31 40
Semidiameter		15 50
Distance of the Sun's center from the vertex		44 40 4
Distance of the equator from the vertex		44 30 20
Therefore the Sun's southern declination [Austrina]		0 9 44
Obliquity of the ecliptic		23 30 20
Therefore by spherical right-angled triangles ✕ the place [of the Sun]		29 35 36

1656, March, on the 21st day, clear [serenis].

	Tangents	G. ' "
Of the lowest limb of the Sun	97048	44 8 30
Of the highest limb of the Sun	95275	43 36 50
Apparent diameter of the Sun		31 40
Semidiameter		15 50
Distance of the Sun's center from the vertex		43 52 40
Distance of the equator from the vertex		44 30 20
Therefore the Sun's northern declination [Borealis]		37 40
Obliquity of the ecliptic		23 30 20
Therefore the place of the Sun in the ecliptic √		1 34 30

88. 1656, March 23, clear sky:

(Observed quantity)	Tangents	G.	I	II
Of the lower margin of the Sun	94407	43	21	8
Of the upper margin of the Sun	92683	42	49	31
Apparent diameter of the Sun			31	37
Semidiameter			15	48
Distance of the Sun's center from the vertex		43	5	19
Distance of the equator from the vertex		44	30	20
Therefore the northern declination of the Sun		1	35	0
Obliquity of the ecliptic				
Therefore the place of the Sun in the ecliptic	♈	3	33	16

Now on the 19th the Sun was distant from the beginning of Aries by $24^{\circ}24'$; on the 21st it was at Aries $1^{\circ}34'30''$; and on the 23rd at Aries $3^{\circ}33'16''$. Therefore, over the two earlier days, the true motion of the Sun in the ecliptic was $1^{\circ}58'54''$, half of which gives a daily motion of $59'27''$. Over the four days it advanced $3^{\circ}57'40''$, a quarter of which likewise gives a daily motion of $59'25''$. But using the daily motion closer to the equinox itself—say $59'27''$ —the $24^{\circ}24'$ requires 24 hours, that is, the distance from the entry into Aries requires 24 hours $50'50''$; or, by my reckoning, 24 hours $51'1''$. Cassini therefore says that the equinox by apparent time fell on March 19 at 9 hours $50'50''$ after midday. Because, by the method common to the southern declination of $9'44''$, it would have been at 9 hours $44'$, by the first observation; but by the second, on account of the southern declination of $37'40''$, it would have been $37'40''$ before midday on the 21st—that is, on the 19th at 10 hours $20'$ after midday—which method is more precise and is the earlier method. Now, if we accept Cassini's annual precession, which is $11'$ of arc, then from these two equinoxes it is possible to predict several other subsequent ones, as in the table written below, adding 5 hours $49'$ for individual years; but in a leap year, after that addition has been made, one day must be subtracted from the sum.

Bologna, Years	March, after midday — D.	H . I — D.	September, after midday H . I
1655	20	4 2 22	1 5 8 5
1656	19	9 5 22 1	0 4 4
1657	19	1 4 22	6 3

Bologna, Years	March, after midday — D.	H . I — D.	September, after midday H . I
		5 0	3
1658	19	2 2 22 1 9	1 2 3 2
1659	20	3 1 22 8	1 1 9 1
1660	19	9 7 22	1 0

Let us now see whether the observations of Signor Cassini, or of his followers, made at the gnomon of San Petronio, agree.

89. Year 1656, September 22:

(Observed quantity)	Tangents	G.	I	II
Of the lowest margin of the Sun	99130	44	44	59
Of the highest margin of the Sun	97335	44	13	35
Apparent diameter of the Sun			31	24
Semidiameter			15	42
Distance of the Sun's center from the vertex		44	29	17
Distance of the equator from the vertex		44	30	20
Therefore the northern declination of the Sun			1	3
Obliquity of the ecliptic		23	30	20
Therefore the place of the Sun in the ecliptic	♍	29	57	22

90. Year 1656, September 23:

(Observed quantity)	Tangents	G.	I	II
Of the lowest margin of the Sun	100495	45	8	30
Of the highest margin of the Sun	98670	44	37	0
Apparent diameter of the Sun			31	30
Semidiameter			15	45
Distance of the Sun's center from the vertex		44	52	45
Distance of the equator from the vertex		44	30	20
Therefore the southern declination of the Sun			22	25
Obliquity of the ecliptic		23	30	20

(Observed quantity)	Tangents	G.	I	II
Therefore the place of the Sun in the ecliptic	$\underline{\alpha}$	0	56	11

Therefore on the 22nd the Sun was distant from the entry into Libra by 2'38", and on the 23rd it had already entered by 56'11". Hence the daily motion was 58'49"; and if these require 24 hours, then 2'38" requires [the rest follows in the right column]... [it requires] 1 hour 4'28". Therefore the equinox comes out from this observation as September 22, hour 1, 40'28" after midday; whereas by the preceding table it ought to have been at hour 0, 44'. Some flaw, then, lies hidden in the observation, and in the omission of parallax or of refraction; for from these two together an error of 20" of arc could arise—that is, in the time of the equinox, an error of 20' of time. An indication of this is, first, that the apparent diameter of the Sun is somewhat smaller than the one usually gathered from equinoxes accurately observed, and second, that the daily motion is, by our reckoning, nevertheless 11'12" less—about which see the following chapter, no. 10. It ought to have been at hour 0, 43'48".

91. I add an observation that [Johannes] Hevelius [Heuelij] recently sent me; for in the year 1654, on September 23, he observed the meridian altitude of the Sun to be about 35°28'40", at Gdańsk [Gedani], where the altitude of the equator is 35°38'. Hence, if you neglect parallax and refraction, the equinox rises out at hour 9, 20' before midday.

CAPUT IV.

On the Quantity of the Equinoctial Year and of the Sun's Daily and Annual Motion.

1. The equinoctial year is the revolution of the Sun from one of the equinoctial points back to the same point. I have already laid down, in Book 3, *Almagestum Novum* [*Almagesti Novi*], chapter 30, that such a year is always to be reckoned of the same quantity. Despite the variation of the Sun's apogee and the eccentricity of the Sun, no inequality of the years follows from these; rather, only within one and the same year does there follow an inequality of the Sun's motion and a variation of the limiting points from which it is measured. Now, if two consecutive equinoxes of the same kind could be observed in such a way that the committed error should not exceed 15", we should immediately have a quantity of the equinoctial year sufficient for determining past and future equinoxes for years around 1600 before and as many after. But for greater security, two equinoxes of the same kind must be chosen whose observations are held more

certain than the rest, and which are separated from each other by the greatest possible interval of years, so that any error in observing should be distributed over many years and become negligible.

[Margin: The requisites for determining the annual quantity.]

Let it be that of Signor [Giovanni Domenico] Cassini [D. Io. Dominicus Cassinus], who, trusting in the magnitude of the Bolognese gnomon, judged that the revolution of a single year would suffice to avoid an error of more than 1' in the quantity of the year, and four years to avoid an error of 15" of arc. But to avoid an error of even 1' in the moment of the equinox, one must guard against error in the altitude of the Sun and of the pole, from which the declination is derived—for although that error abundantly arises within 1" of arc, given the magnitude of this gnomon, nevertheless its use, as I have noted above, is rarely free of an error of 1" of arc, and of others that intervene by accident. Certainly Cassini himself, in the work praised above, at page 18, suspects that, on account of refraction, an error of nearly 1' of arc—though not a constant or steady one—lies hidden in the altitude of the 45th degree. [Tycho] Brahe [Tycho], in the first volume of the *Progymnasmata*, preferred an interval of 100 years; for, distributed over several centuries between his observations and those of Hipparchus, Ptolemy, or [al-Battānī] [Albategnij]—which he reckoned slippery and untrustworthy—or those entangled in the trifles of chronology. As for the observation of Bernhard Walther [Bernardi Vualtheri], made at Nuremberg [Norimbergæ] in the year 1488, he held it much more certain than these, and therefore compared it with his own observation made in the year 1588—the observations that belong to chapter 3, in order, numbers 20 and 56—especially since he was not attempting a universal restoration of the solar course suited to all ages, declaring that the year had been:

	D.	H.	I	II
From Hipparchus to Ptolemy	365	5	55	12
From Ptolemy to [al-Battānī]	365	5	46	20
From [al-Battānī] to Brahe	365	5	49	29
From Ptolemy to Brahe	365	5	47	52

But it is enough for him if it adapts the Sun's course within 300 or 400 years. And from that comparison he establishes the equinoctial year, page 53, as written below:

[Margin: The Tychonic quantity of the year.]

Days 365, hours 5, 48'45".

2. Signor Giovanni Domenico Cassini, in the aforesaid *Specimen* [*Specimine*] of observations, page 15, supposes that Hipparchus's observations are uncertain within half a day, and that Tycho's are within half an hour; and that the same ratio of a half-day to a half-hour holds—which falls between Annos 72 and 1728. He therefore reasons that to use an interval of 72 years between us and Tycho is just the same as to use an interval of 1728 years between Hipparchus and Tycho. On these grounds, which Longomontanus accepts in his *Commentary on the Sun* [for the equinox] of the year 1584, March 11 old style, taking the meridian altitude as $34^{\circ}29'55''$, the altitude of the equator at Uraniborg [Uranic.] being subtracted as $34^{\circ}5'20''$, there remains a northern declination of the Sun of $24'35''$. But since the daily change of declination at the equinoxes is so many minutes [$2'42''$], to the declination of $24'35''$ there corresponds 1 day, and over and above it, 0 hours 54'. So much, therefore, at the time of the equinox; and so the perfecting was at hour 9, $13'6''$ after midday at Uraniborg, but at Bologna at hour 2, $31'4''$ after midday. But for the equinox observed at Uraniborg in 1656, by Cassini, March 9 old style, hour 9, 50' after midday—therefore over 72 years it anticipated by 13 hours 12 minutes 11'', which, divided over the individual years, gives 11' for each year. This subtracted from the Julian year of 365 days 6 hours leaves the equinoctial year of 365 days 5 hours 49'; which, after many considerations, Cassini reckons safer, and which Petavius too had earlier chosen in his *De Doctrina Temporum*, chapter 36, no. 11, and Brahe in the first volume of the *Progygnasmata*, page 12, though he afterwards abandoned it.

[Margin: The Cassinian and Petavian quantity of the year.]

3. But just as I do not grant that the equinox observed by Hipparchus is certain except within half a day—whereas certain ones are certain within fewer hours—and just as I hold the Tychonic one certain within half an hour, so also for the equinox assumed by Cassini from the observation of the 9th, as appears from chapter 3, number 48, I find the Tychonic one, by parallax, to have been on the 9th at hour 21, 30'. But by our reckoning, with parallax applied, at hour 23, 43' with no parallax; at hour 23, 53'; and Cassini, from another observation, brought it down to hour 23, 6'. They are not, therefore, certain within the Tychonic half-hour; and consequently it is safer that the recurrence be over a longer interval of two equinoxes.

[Margin: The Cassinian and Petavian quantity of the year.]

4. Longomontanus, accordingly, in his *Commentary on the Sun*, having corrected the equinoxes according to his own principles, chooses the Hipparchan one, of which in chapter 3, number 7—that is, the vernal equinox in the year 146 before

Christ, March 23, hour 13, after midday, celebrated as observed at Alexandria; and he compares it with the equinox of the year 1587, observed at Uraniborg, March 10, hour 14, 56'. But at Uraniborg [it was] hour 16, 31'; and on account of the inequality of prosthaphaeresis he adds hours 3, 50'; and on account of the inequality of precession he brings the equinox down to about hour 7 [reading uncertain]; and so he reduces the equinox to hours 3, 21' [?]. And so over 1733 years the equinox anticipated by 11 hours 9, 39'; but he himself, through error, [gives] hour 19, 39'; and rounding off again to day 12, hour 20—which, distributing over 1732 years, he finds a single year's anticipation in respect of the Julian years to be 10'40"; and therefore he reckons the quantity of the year to be 365 days 5 hours 49'20"—or, limiting it for the course of the Moon, 365 days 5 hours 49'30".

[Margin: The Longomontanian quantity of the year.]

5. Ismaël [Boulliau] [Bullialdus], in book 2 of his *Astronomy* [*Astronomia Philolaica*], chapter 2, chooses the first vernal equinox of Hipparchus—which, in chapter 3, is the 7th for us—namely the year 146 before Christ, March 24, when, refraction removed, [it fell on] hour 23; but in such a way that the equinox occurred on the 25th, hour 21, 22'35" at Uraniborg, but at Alexandria at hour [?] 1'35". He compares this with equinox no. 56, in our order in chapter 3—that is, with the one observed by Tycho at Uraniborg, March 9, hour 20, 45' after midday—which, by reduction of prosthaphaeresis, he reduces to the mean event of March 11, hour 22, 25'15". Between these two equinoxes he reckons a median of 1734 Egyptian years; the time, divided by 1733 Julian years, gives the quantity of the year written below:

[Margin: The Bullialdine quantity of the year.]

Days 365, hours 5, 49'4"21'''3''''.

6. [Kepler] [Keplerus], in his *Epitome of Astronomy* [*Epitome Astronomiae Copernicanae*] and in the *Rudolphine* [*Tables*] [*Rodulphinis*], uses a year of 365 days 5 hours 48'57"36'''; he does not express [the rest]—as neither does [Govaert] Wendelen [*Lansbergius?*], in his way, in the *Thesaurus* of solar observations toward the end of the third Class, where he defines the mean tropical year as 365 days 5 hours 48'57"2'''22''''24''''''; even though some equinoxes were premised, the usage of which is rather of this kind. Nor does he expound it. But Wendelen [Vendelinus], in his letters to me, and also in the *Idea Tabularum Atlanticarum*, opens up the foundations on which he established the quantity of the tropical year; except that he supposed, as probable, that 33 tropical years contain 12053

whole days, precisely enough; wherefore, divided by 33, there comes out for him a year of 365 days 5 hours 49'5"27"16"". And if anyone should say that 330 years yield not 120530 but 120529 days, from which it would follow that the year were smaller than Wendelen's—then, dismissing these others, since they established the year without bringing in observations, let us put forward our own opinion.

7. That we may inquire into the quantity of the equinoctial year, we choose the equinox most exactly observed at Bologna at the great gnomon of the Temple of San Petronio, in the year of Christ 1655, September 22 Gregorian style—or, old style, on the 12th—at hour 18, 55'25" after midday, as above; but the apogee of the Sun was then in Cancer 8°35'45". So that, with Signor Giovanni Domenico Cassini's observations made there, and with the eccentricity found from the differences of the apparent diameter, we have ascertained—from which, by our own eccentricity, the prosthaphaeresis of the whole [comes to] 3480 parts, of which the Radius is 100000—it follows that, at the distance of the beginning of Libra from the apogee of 81°24'15", the prosthaphaeresis [Prostaphæresis] is 1°58'17", to be subtracted from the mean motion to give the true; but to be added to the true to give the mean. But to the mean motion of the Sun there are owed precisely 48 hours, by which the mean equinox preceded the true; and so the mean fell on September 10 old style, hour 18, 55'25" after midday; but at Alexandria, from my *Geographia Reformata*, it was at hour 20, 28'5". And this was the third year after a leap year.

8. It is now necessary, among the most ancient equinoxes—those observed by Hipparchus—to choose one that fell in the third year after a leap year, and of whose hour we can obtain the greatest possible certainty. Such is the one which, on this account, Ptolemy in book 3, chapter 2, of the *Almagest* [*Almagesti*] reports as observed in year 21, of the third Calippic Period, the first day of the intercalary days, at the sixth hour of the day, by the armillae set up in the portico at Alexandria. From our *Apparatus Chronologicus* [*Chronologicum*], that year was the 158th before the common Epoch of Christ; and the first intercalary day began at midday, or rather at the end of the sixth hour, on the 27th of September. And so we have a truly very long interval between the equinoxes, namely 1812 whole years.

9. As for the hour of the equinox: although Hipparchus is reckoned to have made it at the sixth hour—that is, almost at midday itself—nevertheless from his own preceding observations, which Ptolemy reports in the same book 3, chapter 2, it will be established for anyone skilled in the subtleties of astronomy that it preceded the moment of midday by several hours. For Ptolemy relates that

Hipparchus, in the preceding year, that is in year 20 of the third Calippic Period, observed the autumnal equinox in the morning at first light on the first intercalary day. Therefore at sunrise, or a little after, he saw the lower cavity of the equinoctial armilla equally illuminated on both sides, and therefore thought that only then was the Sun reaching the equator. And so, with horizontal refraction posited—or one not far from the horizon—it had necessarily to be that the Sun appeared higher than it really was by many minutes, and therefore was in truth already southern and had crossed the equator when it appeared on the equator. And so that equinox most certainly occurred several hours before sunrise—namely, by about 4 hours, as I shall show presently. Now it is certain, agreed among all astronomers, that the equinoctial year is said to be of 365 days, 5 hours, and at least 48 minutes; and certainly somewhat less, the Sun's [year] being of 365 days, 6 hours. But let us grant that it was 365 days 6 hours. Then, with an Egyptian year of 365 days having elapsed, if the equinox had fallen in year 20 at hour 4 before sunrise, it could not have occurred in year 21 except at hour 2 after sunrise—that is, at about hour 20 after midday on the 26th of September, or of the first intercalary day, or at hour 4 before the following midday.

10. Now there was then the apogee of the Sun—from our own observations, of which below, in Gemini $7^{\circ}21'$ —and the autumnal section was distant from it by $112^{\circ}39'$; and therefore the prosthaphaeresis of the Sun was $1^{\circ}50'26''$. From these the time of 1 hour $20'50''$ comes out; and accordingly the mean equinox at Alexandria was September 24, hour 23, $9'49''$; but the mean equinox in the year 1655 was September 10, hour 20, $28'5''$. Therefore the precession of the equinox was of 14 days 2 hours $41'44''$ —which, resolved into seconds at the hourly rate of $121,9304''$, and this divided by the elapsed 1812 years, gives an annual precession of $11'12''$.

[For the right column flow:] that is, at that time the difference of the daily declination is $14''$ or $16''$; by which, if the whole error is in error, the error will be of the whole day, even if by one minute it is nearly 4. But that you may avoid the error of the 6 hours, care must be taken in observing the Sun's altitude... an error of $4''$ of arc. From what source, however, did Ptolemy have such great refinement of instruments that he could so confidently say, in book 3, *Almagest*, chapter 2: "But at the solstices I hope that neither we, nor Archimedes, in observation and calculation, have erred even up to a quarter-part of a day." Add to this the uncertainty of the refractions in the wintry brumal observations, mostly very great, and to these still depending on the parallax of the Sun at the horizon—which some make $3'$, some $2'$, others $1'$; Wendelen $15''$. We scarcely [make it] $30''$.

[Margin: Ptolemy's excessive confidence.]

On account of these doubts, and the very great slowness around the solstices, the change of declination—Ptolemy, book 3, chapter 2, said: "The summer solstices observed in the times of Meton and Euctemon, and afterward of Aristarchus, are to be compared with those which fell in our times." But since the observations of the solstices are hard to discern, and those which they handed down do not seem exactly taken—which is indeed approved even by Hipparchus's own judgment—we too, selecting a few, will compare them, not for inquiring into the quantity of the tropical year (granting that the Calippus, Archimedes, and others did this), but because the Greeks began the year not from the equinox but from the summer solstice, or its new moon—however and whenever used in astronomy.

[Margin: The order.]

1. Ptolemy, in book 3, chapter 2, of the *Magna Constructio* [*Almagest*], relates from Hipparchus, in his book *On the Magnitude of the Year*, that Aristarchus, in the 50th year of the first Calippic Period, and the 44th from the death of Alexander the Great—this being 280 before Christ—observed a certain solstice; but before that, 152 years earlier (namely before Christ 432), Meton and Euctemon, while [the latter was] prefect of Athens, observed a solstice, made in the morning, on the 21st of Phamenoth. (Scaliger, book 2, *De Emendatione Temporum*, page 76, and book 5, page 410; and Petavius in his *Uranologium, Variarum dissertationum* book 6, chapter 10, say it was in the year 316 of Nabonassar, on the 27th of June, on feria 1, one day before the true solstice. For Meton, from the observation of the true [solstice], chose the mean to enter his Cycle; whence he is called Metonicus; and so it is to be understood, the Festus Avienus in those verses.)

[Margin: The solstice of Meton.]

But primeval Meton took his beginning from the year When ruddy
Phoebus would scorch with the star of Cancer.

For at Athens in that year the mean solstice fell on the 27th of June at hour 10, 43' after midnight; but the true solstice on the 28th, hour 10, 13'. Petavius adds that the solstice in Hipparchus's time was mean on the 25th of June; the true on the 26th; and in Sosigenes's age the mean on the 24th. The true [solstice], in 25, was wont to fall.

[Margin: The order.]

[Margin: The solstice of Meton.]

But [Philip] Lansbergen [Lansbergius], in his *Thesaurus*, fourth Class of solar observations, against the syntax of this chronology, draws this observation back to Nabonassar; and at Alexandria (when it ought to have been at Athens) collects the solstice at hour 16, 41' after midnight, on the 20th of Phamenoth—at which moment he asserts the Sun to have entered Cancer, and so he holds that the true equinox was on that day, since (the number of the year being changed) it is certain, indeed, that the 21st of Phamenoth was the 26th of June.

[Margin: Lansbergen's lapse.]

2. Ptolemy, in book 3, chapter 2, adds the solstice observed by himself at Alexandria, the summer solstice in the year 463 from the death of Alexander, on the 11th of Messori after midnight following—which he repeats in chapter 4. It was the year of Christ 140, the 22nd of June; which Lansbergen follows, forgetful of the leap year, as he says. From the beginning of the years of Christ to this solstice there are 139 full Julian years, common months 5, days 24, hours 13, 27' at Alexandria, as to apparent time; but as to true time, at hour 13—that is, one hour after midnight. But he ought to have taken the months of a leap year. See our *Apparatus Chronologicus*.

[Margin: Lansbergen's error.]

3. Bernhard Walther [Bernardus Vualtherus], at Nuremberg [Norimbergæ] in the year 1478 [?] of Christ, observed by parallactic rules on the 11th of June; and he himself says he exactly measured the Chord of the distance from the vertex as 44890 parts; and, with the same observed exactly likewise on the meridian of the 13th of June, hence it follows that the Sun, equally in each meridian, declined from the equator, and so the solstice, and the maximum decli- [nation continues into the right column].

[Margin: Walther's solstices.]

Now, from what has been said—Book 3, *Almagest*, chapter 14, number 8, and from [Boulliau] [Bullialdo], book 2, chapter 2—it is sufficiently established that the Sun, about a quadrant [of a circle] after its own rising, by the force of refraction is seen to be more southern in the circle of declination by 4 or 5 minutes; which just as many hours retard the apparent approach of the Sun toward the equator, while it is still represented in the northern signs. Since therefore Hipparchus, in the morning at first light, had reckoned the intercalary days at year 20, and the equinox occurred, and in year 21 had seen, after much time, the Sun still northern, and only passing to the south below the sixth hour, he easily concluded that the equinox was six hours after the preceding year's

equinox—that is, the sixth hour from sunrise—to be the subsequent equinox. And it was possible that some little deception contributed something to this, on account of the situation of the armilla and its placement declining by one or another minute from the plane of the equator. Let it therefore remain nearly certain that that true equinox was at Alexandria in the year 158 before Christ, hour about 20 after midday on the 26th of September.

11. This precession, while I consider it more deeply, I observe to relish of a certain Ideal beauty, congruent with the septenary of days, or the integer hebdomad, and with the novenary of centuries; for, the multiplications being made—11' and 12", over 900 years—it comes out to exactly 7 days, in which the median equinox precedes; from which a marvelous analogy is not doubtful, since it could be received with such great beauty, and moreover upon so great a foundation of observations after the centuries—it betrays itself as resting upon no. 18.

12. Therefore, subtracting from the Sosigenian year of 365 days and 6 hours the 11' and 12", there comes out to us the equinoctial year, which we choose, of 365 days 5 hours 48'48". The equinoctial year is now to be resolved into the hourly second 3155 6928"; and the common year of 365 days into the second 31536000, or 360 degrees into the second 1296000. For if the common year and the sum thence made be multiplied by the Zodiac and divided by the equinoctial year, there will come out the Mean Annual Motion of the Sun; but if a single Day, or a Month of days—28, 30, or 31—resolved into seconds be multiplied by the Zodiac and the sum divided by the equinoctial year, there will be had the Daily and Monthly Motion, as below; the fractions of seconds nevertheless being reduced, up to the sixth scruple, of which in constructing the Tables for many years account is to be taken.

Motus Annuus Dierum (Annual Motion / of Days)	Sign.	Gr.	I	II	III	I		V
						V	V	I
(Annual Motion)	11	29	4	4	30	5	5	1
			5	0		6		
1	0	0	5	8	19	4	3	3
			9			8	5	5
28	0	27	3	5	14	3	3	2
			5	3		9	6	0
30	0	29	3	9	54	1	4	3
			4			6	7	0

Motus Annuus Dierum (Annual Motion / of Days)	Sign.	Gr.	I	II	III	I V	V I	V I
31	1	0	3	1	14	5	2	5
			3	8			3	

On which foundation we have constructed our Tables, to be displayed at the end of the Work.

CAPUT III.

Observations of the Solstices.

1. [Willebrord] Snel [Snellius], in his notes on the Hessian observations, rightly declared that it is a labor of Hercules to avoid the errors in observing the solstices.

[Margin: Ptolemy's excessive confidence.]

[Margin: The order.]

[Margin: The solstice of Meton.]

[Margin: Walther's solstices.]

incidence fell on the meridian of the 12th of June. To this chord corresponds $25^{\circ}56'29''$ [?]. When our parallax of $5''$ is subtracted, the Sun's true distance remains $25^{\circ}56'24''$ from the vertex of Nuremberg — which is in agreement with Tycho [Tycho Brahe], and with what we have admitted up to now, namely $49^{\circ}26'$. If from this you subtract that distance, there remains a true declination of the Sun of $23^{\circ}29'36''$. The maximum, however, from Cassini's [Giovanni Domenico Cassini] observations is $23^{\circ}29'$ [?]. Thus on the 11th and 13th of June it fell short of the maximum by $44''$, which would require the intervening days to be about 3, and so the solstice would have occurred either on the 10th or the 14th of June. But if we wish to retain the equality of declinations of the 11th and 13th, and also the maximum of $23^{\circ}30'20''$, then the true distance of the Sun from the vertex on those days must have been $25^{\circ}55'56''$, though the observed value was $25^{\circ}56'1''$; and the altitude of the pole of Nuremberg is $49^{\circ}26'28''$. Or, at any rate, unless the parallax is increased, the altitude of the pole of Nuremberg in such a position would be $33''$ [?]. You see how slippery and perplexing solstice observations are.

4. In the year 1487 the same Walther [Bernhard Walther], at the same place, on the meridian both of the 13th and of the 14th of December, observed by means of robust and careful sightings [Radios fortes, & diligenter]. He

obtained a chord for the Sun's distance from the vertex of 118790 of those parts of which the radius is 100000, and the observed declination was $23^{\circ}26'30''$. Since, then, from an equal declination there follows an equal solstice, the winter solstice is celebrated midway between the moments, that is, in the middle of the night between the 13th and the 14th. But if one wishes to torment himself, through the uncertainties of refraction and of parallax, with the altitude of the pole and the obliquity of the ecliptic discussed above, in order to track down the time of this solstice, his mind will be pulled in different directions to no purpose.

5. In the year 1490 the same Walther, on the meridian of the 11th rather than the 12th of June, by a clear and careful observation, obtained the Sun's meridian distance from the vertex of Nuremberg. The chord of the distance was 44900 of those parts. Therefore, from this equality, it would follow that the solstice occurred in the middle of the night, with 11 days intervening — by a reasoning similar to the one I used in number 3, since the matter comes out diverse and perplexing. If, however, anyone cares to exercise himself in these calculations, I will furnish him with select observations of the solstitial days, estimated with greater certainty, by adding the arc corresponding to the chords, and the declination observed as set down above. The altitude of the pole is $49^{\circ}26'$.

Solstitial Observations of Walther at Nuremberg

[Solstitiales Observationes Vualtheri Norimbergae]

O r d o	Yea r (An.)	Mo nth (M.)	Da y (D.)	Note added by Walther (in Observat.)	To Radius 100000 (Chord)	Dist. from vertex observed (Gr. ' ")	Declin. of Sun observed (Gr. ' ")
147 6	Jun e	12	reliable [certa]	44890	25 56 29	23 29 31	
147 8	Jun e	11	exactly [exactè]	44890	25 56 29	23 29 31	
	Jun e	13	exactly [exactè]	44890	25 56 29	23 29 31	
	Dec.	11	robust sightings, careful [Radij fort.	118760	72 51 15	23 25 15	

O Year r r d (An. o)	Mo nth (M.)	Da y (D.)	Note added by Walther (in Observat.)	To Radius 100000 (Chord)	Dist. from vertex observed (Gr. ' ")	Declin. of Sun observed (Gr. ' ")
			dilig.]			
148 7	Dec.	13	robust sightings, careful [Radij fort. dilig.]	118790	72 52 30	23 26 30
	Dec.	14	robust sightings, careful [Radij fort. dilig.]	118790	72 52 30	23 26 30
148 8	Dec.	11	clear, careful [Clara diligens]	118780	72 52 8	23 26 8
148 9	Jun e	12	clear, careful [Clara diligens]	44890	25 56 29	23 29 31
149 0	Jun e	11	clear, careful [Clara diligens]	44900	25 56 15	23 29 45
	Jun e	12	clear, careful [Clara diligens]	44900	25 56 15	23 29 45
	Dec.	12	clear, careful [Clara diligens]	118790	72 52 30	23 26 30
	Dec.	13	clear, careful [Clara diligens]	118788	72 52 25	23 26 25
149 3	Dec.	13	clear, careful [Clara diligens]	118800	72 52 15	23 26 55

O r d o	Yea r (An.)	Mo nth (M.)	Da y (D.)	Note added by Walther (in Observat.)	To Radius 100000 (Chord)	Dist. from vertex observed (Gr. ' '')	Declin. of Sun observed (Gr. ' '')
149 6	Dec.	11	very clear, careful [Clar. valdè dilig.]	118800	72 52 55	23 26 55	
149 8	Jun e	12	very clear, careful [Clar. valdè dilig.]	44890	25 56 29	23 29 31	
150 0	Jun e	11	most clear, reliable [Praeclara certiss.]	44883	25 56 14	23 29 14	
	Jun e	13	very clear, careful [Clar. valdè dilig.]	44890	25 56 29	23 29 31	

[Margin: Note for Refractions. (Nota pro Refractionibus.)] If the winter observations are sound — if the altitude of the pole of Nuremberg and the obliquity of the ecliptic (that is, the maximum declination of the Sun, 23°30'20") are correct, and our parallax is 24" — then at the Sun's altitude of 17°, refraction at Nuremberg never on those days exceeded 4'40"; indeed [continues below]...

Of the Tychonic solstitial observations we shall give four summer ones and three winter ones, handed down partly by Longomontanus [Longomontanus] in his Book 2 of the *Theoricorum*, in the Commentary on the Sun, and partly by Father Albert Curtz [Albert Curtz] of our Society, who described them from Tycho's own manuscript and out of his singular generosity transmitted them to me. Now, assuming the altitude of the equator established at Uraniborg by Tycho to be 34°5'30", and our parallax 7", with the Sun at apogee being 57½", and our obliquity of the ecliptic 23°30'20": by whatever means [the solstices are derived], we shall indicate the summer ones, the winter ones being omitted.

Tychonic Observations on Selected Solstitial Days

[Tychonicae Observationes Solstitialibus Diebus selectae]

O

r d o	Years of Christ, days old style	Sun's apparent altitude (G. ' ")	Sun's true altitude (G. ' ")	True declination (Gr. ' ")	Solstice p.m.
	(An. M. D.)				
7	1586 June 12	57 35 36	57 35 43	23 30 13	11 13
8	1587 June 14	57 34 30	57 34 7	23 29 7	12 1
	1589 June 11	57 35 50	57 35 57	23 30 27	11 1
9	By the Tychonic four- fold revolution [Per Tychonici p. quadr. volub.]	57 35 45	57 35 52	23 30 22	11 0
	1593 June 11	57 35 0	57 35 7	23 29 37	12 3
1 0	1589 Dec. 15	10 44 48			
	1590 Dec. 10	10 43 15			
	1594 Dec. 11	10 41 10			
	1589 June 12	57 35 50	57 35 57	23 30 27	11 1
	By Tycho [Per Tychoni]	57 35 50	57 35 57	23 30 27	
	By the revolution [Per Volubil.]	57 35 45	57 35 52	23 30 22	
	By the armillas [Per Armillas]			23 29 50	
	&			23 30	

- Egnazio Danti [Egnazio Danti], in the folio work which he published on the use of the great Gnomon of Bologna in the Temple of San Petronio [Templo D. Petronij] erected by himself, says that in the year 1576, on the 11th of December, the shadow of the Sun's image reached its margin at the maximum declination, and on the following day was diminished; and so the winter solstice fell between the 11th and 12th of December. Yet earlier, namely in the year 1570, he had observed at Florence the Sun's declination at the maximum at the solstice, as he relates in Part 2 of his *Astrolabe*, chapter 34 — but he does not state the day.

[See the Tychonic table above.]

11. [Margin: Linemann observes the solstice. (Linemani Observat. Solstitialis.)]
In the year 1644, on the 22nd of June, Albert Linemann [Albert Linemann] obtained the Sun's meridian altitude of $58^{\circ}47'30''$ at Regiomontium [Königsberg] in Prussia, where he had observed the altitude of the pole to be $54^{\circ}43'$, as he asserts on the memory of ages 7 and 8 [?]. From this the declination would be $23^{\circ}30'30''$, but ours is greater by $10''$. Owing to the uncertainty of whether parallax has corrected the altitude, the moment of the solstice remains uncertain.

12. We, in Book 3 of our *Almagestum* [Almagestum Novum], chapter 27, brought forward the solstices of 4 years, but they suffer from some slight defect of instrument, and from an excess of parallax, since at that altitude of about 69° it cannot exceed $5''$ or $6''$; and we were then using a false altitude of the pole, which we afterward found at our Observatory to be $44^{\circ}30'10''$. With these corrected, more accurate solstices come out, as below.

Solstices Observed by Us at Bologna

[Solstitia per Nos Bononiae observata]

O r d o	Year of Christ (A.)	Mo nth (M.)	Da y (D.)	Altit. observed (G. ' ")	Altit. true (G. ' ")	Declin. of Sun, Ω 23 (' ")	Solstice after noon (D. H. ')
1 4	1643	Jun e	21	69 0 0	69 0 6	30 16	21 6 52
1 5	1644	Jun e	20	68 59 58	69 0 3	30 13	20 12 42
1 6	1645	Jun e	20	68 59 54	68 59 59	30 9	20 18 32
1 7	1646	Jun e	20	68 59 50	68 59 55	30 5	21 1 40
		Jun e	21	69 0 5	69 0 10	30 20	21 0 0
		Jun e	22	68 59 50	68 59 55	30 5	20 22 20

Of the last solstice we are more certain, since we found altitudes of the Sun that were entirely equal on the 20th and 22nd, at the same meridian; and therefore, for the 21st, I have more safely added a parallax of only 5". From this we are confirmed about the Sun's maximum declination of 23°30'20". And since on the 20th and 22nd it fell short by 15" — the daily difference then being 14", therefore 15" requires 25⅔ hours — adding these to the 20th, the solstice would fall on the 21st at 1h40' after noon; but subtracting them from the 22nd, it would fall on the 21st at 1⅔h before noon, that is, on the 20th at 22h20' after noon. By all means, keeping the mean, the solstice fell at the meridian.

Now follow the observations of Giovanni Domenico Cassini [Giovanni Domenico Cassini], who, in the book he has published, entitled *Specimen Observationum Bononiensium*, page 3, writes thus: "In the year 1655, on the 21st of June, at the summer solstice, in the Temple of San Petronio, from the altitude of 71 Bolognese feet, we observed the distance of the Sun's center from the vertex at the meridian point itself to be 20°50'50". But the equator's distance from the vertex is 44°30'20". Therefore the Sun's apparent declination from the equator is 23°30'30". Since, however, the marble band of the gnomon, and the iron, were not yet rounded at the sides, the declinations designated at those very sides... he submitted them to me to be examined, with the faculty to use them — as he relates on page 19. So afterward, by him, they were most generously communicated to me from his own manuscript and notes, in the cause of truth, indeed beyond his obligation toward us:

He read the Marseilles observation, with love and study, thus: "We examine Linemann's observation of the 21st of June of the year 1655. The solstitial [shadow] impressed on the sides, the more evidently we recognize it, the more we find the distance of the Sun's lower margin from the Tangent vertex to be 38904, but 38909, and the upper not 37860." Thus then:

Anno 1655 [Linemann's observation, as reduced]

	(parts)	Gr.	'	"
Tangent of the lower [limb] [Tangentis]	38909	21	15	38
Tangent [of the upper] [Tangentis]	37870	20	44	50
Difference, and Diameter of the Sun		0	31	8
Semidiameter		0	15	34
Distance of the Sun's center from the vertex		21	0	4
Distance of the equator from the vertex		44	30	20

	(parts)	Gr.	'	"
Therefore the Sun's declination then was		23	30	16
Since the Sun adds 4" from the start [Ob distantiam Solis ab initio 4" adde]		0	0	4
Therefore the maximum declination of the Sun [Margin: Maximum declination of the Sun. (Solis maxima Declinatio.)]		23	30	20

This is afterward confirmed by Tycho's emended solstitial altitudes. Now, if on the 21st it fell short of the maximum by 4", then "4" second, and 14"" require hours... 24, and 4"; 4" requires 6h52' hours, by which the solstice would have been after noon on the 21st. Yet, because parallax was wholly omitted, and because of some slight doubt about the connection of the observations, this observation seems to be set after the solstice observation of the year 1658, which I shall presently give from the same author's manuscript and notes.

Anno 1658. June 20

	(parts)	Gr.	'	"
19. Tangent of the Sun's lowest limb [Infimi Solis limbi Tangens]	38912	21	15	44
Tangent of the highest [Supremi Tangens]	37876	20	44	40
Apparent diameter of the Sun [Solis Diameter appar.]		0	31	4
Semidiameter			15	32
Distance of the Sun's center from the vertex, observed [à vertice visa]		21	0	12
True for us [Vera nobis]		21	0	7
Distance of the equator from the vertex [Aequatoris distantia à vertice]		44	30	20
Sun's declination then [Declinatio Solis tunc]		23	30	13

Anno eiusdem 1658. June 21, more accurate [accuratius]

	(parts)	Gr.	'	"
Tangent of the Sun's lowest limb [Infimi Solis Limbi Tangens]	38911	21	15	42
Tangent of the highest [Supremi Tangens]	37871	20	44	32

	(parts)	Gr.	'	"
Apparent diameter of the Sun [Solis Diameter appar.]		0	31	10
Semidiameter		0	15	35
Distance of the Sun's center from the vertex, observed [à vertice visa]		21	0	7
True, on account of our parallax $5\frac{1}{2}''$ [Vera ob nostram parallaxim $5''\frac{1}{2}$]		21	0	$1\frac{1}{2}$
Distance of the equator from the vertex [Aequatoris distantia à Vertice]		44	30	20
Therefore the true declination of the Sun [Ergo vera Solis declinatio]		23	30	$18\frac{1}{2}$
And, the Sun's maximum declination being assumed [Et posita maxima declinatione Solis]		23	30	20

The solstice occurred on the 20th, at the hour after noon... of our solstice of the year 1646. And by our revolutions it ought to have been at hour 21h45'5"12", and so I have applied a parallax of $5\frac{1}{2}''$, since it is only 5", or rather 6". It is customary, at this altitude, to satisfy the astronomical epilogisms. Therefore the Tangents of the 20th must be corrected, so that the true declination comes out to be nearly $23^{\circ}30'7''$.

CAPUT VI.

Observations of the Obliquity of the Ecliptic, that is, of the Maximum Declination of the Sun.

[Obliquitatis Eclipticae Observationes, seu Declinationis maximae Solis.]

1. [Margin: Pytheas. (Pytheas.)] Pytheas of Marseilles [Pytheas of Marseilles] — whether he flourished in the age of Alexander the Great, who died in the 113th Olympiad, that is, in the year 324 before Christ (as many gather from Strabo, with Dicaearchus, the disciple of Aristotle, saying that the writings ascribed to Pytheas displeased him), or whether he lived in the time of Scipio, about the 140th Olympiad, that is, the year 216 before Christ (if indeed he be the same Pytheas of whom Polybius speaks, when Scipio, in questioning, asked the Marseillais — as Gassendi maintains in his second *Letter* to Wendelen): this Pytheas, I say, as Gassendi reports in his *Life* of

Claude Fabri de Peiresc, observed at Marseilles in the year 1636 [recte: Pytheas's ancient observation, reported by Gassendi from a 1636 reconstruction] the proportion of the summer solstitial shadow to the gnomon as 209 to 120. From these two sides [continues]...

at a right angle, the observed altitude of the Sun's upper limb is gathered to be $70^{\circ}47'42''$. If you add to it the semidiameter of the Sun of $15'4''$, there remains the observed altitude of the Sun's center, $70^{\circ}32'41''$ [?]; and to this, if you subtract the distance, there remains the Sun's maximum declination of $23^{\circ}52'41''$ [?]. And yet Gassendi there thinks that this proportion can easily be inferred to be as great as Gassendi himself found it, namely $42\frac{2}{3}$ of those parts of which the gnomon is 120, or 42 of those parts in 89328. Hence the observed altitude of the Sun's upper limb arises as $70^{\circ}25'59''$ [?], of those parts, 11750; and at 89328 parts the observed altitude of the limb was $70^{\circ}10'58''$, and the maximum declination of the Sun $23^{\circ}30'58''$ [?]. But Gassendi, in that place, in his second *Letter* to Wendelen — which is inscribed *On the Proportion of the Gnomon to the Solstitial shadow* — grants that it was one and the same age, yet he does not say it expressly about that observation of Pytheas. For Strabo only, in Book 2, near the end, reports that the proportion of the gnomon to the summer shadow at Byzantium is 120 to 42, the fifth part being subtracted; whereas he holds Byzantium to be on the same parallel as Marseilles, on which account, because of the same proportion of the gnomon to the shadow at Byzantium as at Marseilles by Pytheas, it is believed to have been observed as nearly the same in both places — although it is plain, from a stricter calculation, that it cannot stand thus, as is established from Ptolemy [Ptolemy], in his Book 1 of the *Almagest*, chapter 6, on Pytheas, or from Hipparchus [Hipparchus], who affirms that Marseilles, where the gnomon is to the summer shadow as 20 to $5\frac{1}{2}$, follows the altitude of the Sun's upper limb [?].

2. Hipparchus, in Snel [Willebrord Snel], Book 2 of the *Eratosthenes Batavus*, near the end, has handed down that the equinoctial shadow at Byzantium was found to be to the gnomon as 111 to 120. Therefore, by the laws of right-angled plane triangles, the altitude of the Sun's upper limb is $47^{\circ}13'45''$. Again, through Strabo, Book 2, [he says] that at Byzantium, at the summer solstice, the gnomon has to the shadow the proportion which 120 has to 42, the fifth part subtracted. By the same laws, the altitude of the Sun's upper limb is $70^{\circ}47'42''$. Therefore, from the difference of these arcs, the obliquity of the ecliptic, or the difference of the summer solar declinations from the equinoctial, is nothing at all, namely $23^{\circ}33'57''$ [?] in the time of Hipparchus, let alone of Strabo, who flourished under Tiberius. How greatly he could err in these two days, this very age teaches, unless we

use the highest diligence. But if you listen to Pliny [Pliny], who in Book 6, chapter 34, [says] that at the parallel of Byzantium the gnomon of 9 feet [casts] an equinoctial shadow of 8 feet — the altitude of the Sun's upper limb would be $48^{\circ}22'$, from which, the difference being subtracted, the Sun's maximum declination comes out as $22^{\circ}25'42''$, and so this is suspect. But Pliny gives the account of the whole climate, and does not speak of the gnomon's shadow at Byzantium, but of the shadow of the climate in which Byzantium, Rome, etc., for the most part lie.

3. The ancients defined the distance of the tropic from the equator by 24 whole degrees, and so we can interpret that, when they chose that round number, they meant that greater degree of $23\frac{3}{4}$, rather than $23\frac{1}{2}$. Thus Geminus [Geminus] placed the distance of both tropics from each other as the parts of the meridian which 11 are to the whole meridian of 83, that is, $47^{\circ}24'40''$; and the equator's distance from the tropics $23^{\circ}51'20''$. So Eratosthenes [Eratosthenes], with Hipparchus in Ptolemy, Book 1 of the *Almagest*, chapter 9. The ancient observations defined the distance of the tropic from the equator by 24 degrees... [Margin annotation truncated; see below]

Achilles Tatius [Achilles Tatius], in his *Isagoge*, chapter 16, says: "From the summer tropic to the equinoctial, 24 parts. And Proclus [Proclus], in his *Sphere*, chapter 6, [says] that by the interval of the equidistant, the equator is distant from each of the two by sixty-fourths." Others afterward, seeing it to be a smaller degree, 24 with the smaller, and a greater with the greater $23\frac{3}{4}$, said that the distance of the tropics from each other was nearly 11 parts of those of which the whole meridian is 83; this is $47^{\circ}24'40''$, and the equator's distance from the tropics $23^{\circ}51'20''$. Thus Eratosthenes, and Hipparchus in Ptolemy, Book 1 of the *Almagest*, chapter 9.

Eratosthenes, indeed, by a scaphe [sundial bowl] and by the parallelism of the Sun's radii, abused that opinion both about the distance of the equator and of the tropics, and about the magnitude of the terrestrial circumference. The method of Eratosthenes is set out by Cleomedes [Cleomedes], Book 1 of the *Cyclica Theoria*, chapter 10; and by Pedro Nunes [Pedro Nunes], Book 2, *On Observation*, page 132; and by Willebrord Snel, Book 1 of the *Eratosthenes Batavus*, chapter 9, on a far better scheme than in Maurolyco's third dialogue of the *Cosmographia*, or from Maurolyco in Clavius [Clavius], in the *Sphere*. But since we drew Eratosthenes himself from the very source, Cleomedes, we shall set out his very method, then

his errors, and finally, from his observation itself, we shall derive the distance of the tropic from the equator, corrected.

First, Eratosthenes, and with him Cleomedes, assumed Alexandria, A, and Syene, B, to be under the same meridian. Second, that the arc AB between those cities was 5000 stadia. Third, that radiating rays, sent down to different parts of the Earth, are parallel to one another. So Cleomedes expressly, and so too Ptolemy [?]. Therefore the rays CB, from the Sun's center C, to Syene, and DE, from the extremity of the Sun's upper limb, to Alexandria's scaphe E, are between the parallels. Fourth, that a straight line drawn through parallels, while it makes alternate angles equal, and that, the radius CB being therefore produced through the imagination, to the Earth's center F, and the gnomon at Alexandria being erected on the day of the summer solstice, that is, the style AG of the scaphe, or hemisphere of the concave hemisphere HEI, and the said style continued through the imagination into the center F, the straight line FG, falling

Diagram. A geometric construction illustrating Eratosthenes's measurement of the terrestrial circumference. At the top, two points D (left) and C (right) mark the extremities of the Sun's disk, from which long rays descend obliquely toward the Earth. Below, a circle represents the Earth, with its center marked F. A smaller circle/arc above and to the left represents the scaphe (sundial bowl) at Alexandria. The rays from D and C strike the construction at the points H, E, L, I, G, K, with B marked on the right of the Earth-circle. The gnomon-style and the radius CB extended to the Earth's center F are shown.

- D (top left): extremity of the Sun's disk (one ray-origin)
- C (top right): center / opposite extremity of the Sun's disk (the other ray-origin)
- I (upper, within the scaphe): point on the scaphe rim
- G (center of scaphe): tip of the gnomon-style (stylus AG)
- B (right, on Earth-circle): Syene
- H (left of scaphe): edge of the concave hemisphere
- E (lower left, on scaphe): Alexandria (foot of the scaphe / shadow terminus)
- L (below E): point on the construction
- K (below scaphe): point on the Earth-circle near center
- F (center of Earth-circle): center of the Earth

upon the parallels GF and DE — therefore the angle EGF is equal to the angle BFG. Fifth, therefore, the arc AB, subtended by the angle BFG, is equal to the arc AE, subtended by an equal angle AGE. Sixth, that Syene is under the summer tropic,

because gnomons at the meridian of the summer solstice cast no shadow for 300 stadia around. With these things laid down, on the day of the summer solstice Eratosthenes noted the arc AE, observing the shadow EA, terminated by the ray DE, in the bottom of the scaphe of Alexandria, all around; measuring it, he found it to be the fiftieth part of the whole circle, that is $7^{\circ}12'$. Therefore he concluded that the arc AB too was 5000 stadia, of $7^{\circ}12'$; and so the whole circumference of the Earth was 250000 [stadia].

[continued from the discussion of Eratosthenes's scaphe construction]

to the point K, the arc BK is almost a full quadrant, and the rays cannot diverge — they cannot even sensibly be parallel — because the Earth's semidiameter KF is not, in physical terms, equal to the true semidiameter of the Sun: as a terrestrial body, the Earth exceeds it, and contains it $5\frac{1}{3}$ times over, by Ptolemy's data; whereas in our own data (treated in *Almagestum Novum* III) it contains it 33 times and more. Yet this much is most truly demonstrated, and is established by Nunes [Pedro Nunes] and by Snel [Willebrord Snel] above, and by ourselves (III.5): the Sun's rays, issuing from one and the same point of its body and reaching different places on the Earth however far apart, are at a distance from one another such that they may be taken as parallel. Of this kind are the rays CB and CGL drawn through the apex G of the stylus AG; and so Eratosthenes ought to have proceeded in such a way that, the angle BFG being his angle AGL, this angle AGL came out physically equal — and accordingly he should have added to the arc AE the arc EL, which is just as large as the angle EGL (that is, CGD), subtending the apparent semidiameter of the Sun, namely $15' 5''$. From observations [?] the arc AL ought thus to have come out as $7^{\circ} 27' 5''$. So too the arc AB, between the summer tropic [tropicum aestivum], or the vertex of Syene, and the vertex of Alexandria in Egypt — for the vertex of Alexandria is contiguous with it, as Ptolemy affirms in *Syntaxis (Almagest)* I.12 and 13, and in *Geographia* I, table 13: it is distant from the equator by $30^{\circ} 58'$. For he says, in the same chapter 12, "*From the point of the vertex of Alexandria to the equinoctial, $30^{\circ} 58'$ are demonstrated.*" From this $30^{\circ} 58'$, therefore, subtracting the arc AB, falsely supposed by Eratosthenes to be the arc between the tropic and the equator — for it came out to him as $23^{\circ} 46'$; or because it came out to him as running from 11 to 83 [?], that is, $51' 20''$ [?] — he reckoned the latitude of Alexandria, the altitude of the pole, to be $31^{\circ} 3\frac{1}{2}'$, which was afterwards found by Ptolemy, by the rules of parallax, to be $30^{\circ} 58'$. From this true arc AB, then, subtracting the arc shown above, $7^{\circ} 27' 5''$, there is left the true distance of the tropic from the equator, in Eratosthenes's own time, $23^{\circ} 31' 5''$ — or, setting aside my own parallax, $23^{\circ} 31'$. But why Ptolemy, wishing to retain the altitude of the pole at Alexandria and the

Eratosthenic distance of the tropic from the equator, went astray as to the Moon's maximum latitude in the quadratures by 20', and how from this it is inferred that the obliquity of the ecliptic was at that time about 20' less than minutes [?] less than Ptolemy supposes, we have stated in *Geographia Reformata* CXXVIII; and we shall say more when we treat of the observations of the Moon's latitude.

[Margin: The true obliquity of the ecliptic in Eratosthenes's time — 23°31' [?]]

§5. Ptolemy, in *Almagest* II.6, parallel 11; in *Geographia* I.23, parallel 10, says that the longest day in Rhodes is, by observation, 14½ hours, and that the altitude of the pole there is likewise 36°. But this cannot be made consistent unless the maximum solar declination of 23° 30' is assumed — for this alone is taken in the Tables and in the tables of the Prime Movable [Primum Mobile] under the pole-altitude of 36°: the semidiurnal arc answers to 7h 15', and the [whole] day to 14h 30'.

§6. Pappus of Alexandria, who flourished about A.D. 390, in his *Mathematical Collections* I.6, theorem 35, takes as the foundation of his demonstration this: "*The diameter of the sphere has, with respect to the diameter of the summer tropic, by capacity, the same proportion that 629 has to 529; for the straight line drawn from the center of the sphere to the center of the tropic has, by its length, the same proportion to the semidiameter of the tropic that 10 has to 23,*" etc. Here Commandinus adds in his commentary: "*For the maximum right sine of the declination of the Sun, namely of 23½°, is 23924, of which the semidiameter of the sphere is 60000,*" etc., or 39874, of which the semidiameter of the sphere is 100000, as is clear from the Tables of Sines. But this could not be unless the maximum declination were 23° 30'; for if it were 23°[31'] [?], as Ptolemy holds, or if Pappus's result followed from it, 23° 50', its sine would be very different — namely 40408. Pappus therefore knew that the maximum solar declination which Ptolemy had followed, too timidly, from Eratosthenes's error, was false.

[Margin: Pappus's view on the obliquity of the ecliptic.]

§7. al-Battānī [Albategnius], in chapter 4 *On the Science of the Stars*, asserts that he observed, with the greatest diligence he could muster, the minimum distance of the Sun from the vertex on the meridian as 12° 26', and the maximum as 59° 26'. From this he established the distance between the tropics as 47° 10', and from the equator 23° 35'; and accordingly the pole-altitude of al-Raqqā [Aractae] as 36°. But whether he could have erred by a full 5' — whether others may have seen otherwise — to me does not seem impossible; indeed, very [likely].

[Margin: al-Battānī's observation.]

§8. About A.D. 1070, Arzachel [al-Zarqālī] the Spaniard observed the distance of the tropic from the equator as $23^{\circ} 34'$; and in A.D. 1140, Almaeon [Ibn al-... of] Almansor as $23^{\circ} 33' 30''$; and in A.D. 1210, Thebit [Thābit ibn Qurra's] son, likewise, $23^{\circ} 33' 30''$; and in A.D. 1300, Prophatius the Jew [Jacob ben Makhir] $23^{\circ} 32'$, as Copernicus reports in *De Revolutionibus* III.2. Reinhold [Erasmus Reinhold] in his *Theoricae*, Nunes [Pedro Nunes] in *On Observation* II, Regiomontanus in the *Epitome of the Almagest*, proposition 17, Clavius [Christoph Clavius] in his *Sphaera* p. 262, and Lansbergen [Philips van Lansbergen] in his *Thesaurus* observed [the same]. As for the *Solarium*, Class 1, who places Prophatius the Jew only 68 years after Almaeon — when in fact it was 160 years after him, and 230 after Arzachel — and who, as praised by Lansbergen himself, affirms that Copernicus drew it from that source (I believe in order to draw it into agreement with his own Tables): why he should draw the Albatenian [observation] to $23^{\circ} 38'$, neglecting the refraction-parallax. But all the aforesaid observations differ by few minutes, so that — given the uncertain manner of observing in those times — we are not so certain of the error of three or four minutes deviated, nor [can we say] that the obliquity of the ecliptic was greater than $23^{\circ} 30'$, or $31'$, or thereabouts.

[Margin: Arzachel. — Almaeon. — Thebit. — Prophatius. — Lansbergen is noted.]

§9. In A.D. 1460, Purbach [Peurbach] and Regiomontanus, the distinguished astronomers of Vienna in Austria, took the meridian altitude of the Sun at the summer solstice as $65^{\circ} 6'$, and at the winter [solstice] as $18^{\circ} 10'$. Lansbergen in his *Thesaurus* says that the *Solarium* observed it, and adds the distance of the tropics seen as $23^{\circ} 28'$ of the zodiac, but on account of the parallax in the winter [solstice] $2' 11''$ and the refraction $5' 4''$, but inserting his own parallax $58''$, the true arc came out between [the tropics] $59' 51''$, or close to 47° ; and the obliquity of the ecliptic $23^{\circ} 30'$. Granted, indeed, that Regiomontanus in the *Epitome of the Almagest*, proposition 17, may have placed it as observed at $23^{\circ} 28'$ — yet he himself does not cling to that, in that in his own Tables he chose $23^{\circ} 30'$. Clavius too admits this in his *Sphaera* II, where nonetheless he reports Regiomontanus's observation as far different, as does Lansbergen; for he relates that the Viennese solstitial altitude was observed at $65^{\circ} 30'$, and the winter [solstitial] altitude at $18^{\circ} 30'$. From this he infers the pole-altitude of Vienna as $48^{\circ} 20'$; whereas from the Lansbergian observation it is 48° , and from our *Geographia Reformata* it is $48^{\circ} 22'$.

[Margin: Regiomontanus.]

§10. In the preceding section, among all the solstitial observations of Bernhard Walther — three in number related — there is none that sets the maximum

declination of the Sun beyond $23^{\circ} 30'$, nay, many set it well below; and Dominicus Maria Ferrariensis [Domenico Maria Novara of Ferrara], as Clavius has it in his *Sphaera*, found it at $23^{\circ} 29'$. But Johannes Werner [Vernerus] [found it at] $23^{\circ} 28\frac{1}{2}'$; yet it is credible that this befell him because of uncorrected refraction, for he found it greater, after the Copernican manner, by grades $23^{\circ} 28' 30''$, as he himself affirms in *De Revolutionibus* III.2 — inasmuch as, since (as he had said in II.2) he found the distance of the tropics from himself to be $46^{\circ} 58'$, almost; and in III.2 he adds the latitude of Frauenburg found by himself to be $54^{\circ} 19' 30''$. To these if you add $23^{\circ} 28' 30''$ for the supposed [solar] declination, it follows that he observed the meridian altitude as $12^{\circ} 12'$; and yet the true pole-altitude, by the Tyconic instruments from the circumpolar stars, is at Frauenburg $54^{\circ} 22' 15''$, as Tycho relates in *Progymnasmata* tom. 1, p. 34. From this he infers him to have erred by reason of refraction by $2' 45''$, which, subtracted from the winter altitude $12^{\circ} 9' 15''$, [yields] also $23^{\circ} 28' 30''$ for the [solar] declination. There remains the Ptolemaic parallax-excess, which by his use is $1' 35''$ — in the winter [solstitial] altitude of the Sun, 12° , he uses $2' 59''$; and since these cannot but be $24''$, the corrected altitude remains $12^{\circ} 7' 40''$. From this, by the Frauenburg altitude of the equator which is $35^{\circ} 37' 45''$, the maximum solar declination, with these subtracted, is left as $23^{\circ} 30' 5''$.

[Margin: Corrected Copernicus.]

§11. Rightly, therefore, Petrus Apianus [Peter Apian] in *Primo Mobili*, A.D. 1530, and Oronce Finé [Orontius Finaeus] in *Cosmographia* II.24 for the same time, and Pedro Nunes [Petrus Nonius] in *On Observation* II, in the year 1555, declared the obliquity of the ecliptic to be $23^{\circ} 30'$ — which Clavius in his *Sphaera* p. 262, and Scheiner [Christoph Scheiner] in *Rosa Ursina* p. 356, and Galileo [Galilei] in his *Dialogues on the World System*, chose as the common opinion, although they do not add observations. Nor is this much opposed by Egnazio Danti [Egnatius Dantes] in part 2 of his *Astrolabe*, chapter 34, where he relates that in A.D. 1570 the solstitial altitude of the Sun on the meridian was taken by himself at Florence as $69^{\circ} 49'$, and the winter [altitude] as $22^{\circ} 51'$; from which he infers the obliquity of the ecliptic as $23^{\circ} 29'$ — for if you add our parallax $5''$ to the summer altitude, and subtract the refraction $3' 25''$, the summer altitude comes out as $69^{\circ} 49' 5''$, and the winter as $22^{\circ} 51' 20''$; and so the distance of the tropics $47^{\circ} 1' 10''$, and the distance from the equator $23^{\circ} 30' 35''$.

[Margin: Apian. — Orontius. — Nunes. — Clavius. — Scheiner. — Galileo. — Danti.]

[Top of folio 21, completing §11:]...from which he infers the obliquity of the ecliptic as $23^{\circ} 29'$ — for if to the summer altitude you add our parallax $5''$, but subtract from it the refraction $3' 25''$, the summer altitude comes out as $69^{\circ} 49' 5''$, and the winter [altitude] as $22^{\circ} 51' 20''$; and so the distance of the tropics $47^{\circ} 1' 10''$, and the distance from the equator $23^{\circ} 30' 35''$.

§12. Christoph Rothmann [Rothmannus] and Jost Bürgi [Iustus Byrgius], the distinguished astronomers of the Landgrave of Hesse [Landgravius Hassiae], about A.D. 1570, by the same [method], found the corrected altitude of the equator at Kassel [Cassellis] to be $38^{\circ} 40' 40''$; and the solstitial altitudes of the Sun, as Snel [Snellius] has it, mostly $62^{\circ} 11'$, rarely $60^{\circ} 12'$. Subtracting therefore the altitude of the equator, the obliquity of the ecliptic is left as $23^{\circ} 30' 20''$ — which Cassini too found in agreement with us, in the year 1655. Likewise, Johannes Homelius [Hommel], in A.D. 1570, as Tycho witnesses (*Progymnasmata*, p. 631), observed the meridian altitude [of the Sun] at the summer solstice as $62^{\circ} 11'$; and at Leipzig [Lipsiae], where the altitude of the equator, as Tycho says, is $38^{\circ} 41'$, the distance from the tropic is therefore $23^{\circ} 30'$.

[Margin: The Hessians. — Hommel.]

§13. Tycho [Brahe], from his own observations (*Progymnasmata* tom. 1, pp. 17 and 28, and in his *Epistolae* p. 40), set, for the year 1587, the obliquity of the ecliptic at $23^{\circ} 31' 30''$; but because of an excessive parallax of the Sun — and Kepler therefore correcting this excess in the *Rudolphine [Tables]*, pp. 27 and 116, says that we may perpetually use $23^{\circ} 30'$ — but, as I have already said in the preceding section, from the choicest of Tycho's observations, using the truer parallax, we have deduced the minimum solstitial declination of the Sun as $23^{\circ} 29' 7''$, the maximum as $23^{\circ} 30' 27''$, and the mean as $23^{\circ} 30' 22''$.

[Margin: Tycho.]

§14. Lansbergen, in his first class of *Solarium* observations, recounts that observed by himself at Goes [Goesae] in A.D. 1589: the meridian altitude of the Sun at the summer solstice as $61^{\circ} 58'$, and at the winter [solstice] $15^{\circ} 2' 30''$; but, applying his own refraction and parallax, he gathers it as $61^{\circ} 59' 4''$ — this being $14^{\circ} 58' 43''$ — and the difference, or distance of the tropics, [yields the tropic distance] $47^{\circ} 0' 21''$; and the obliquity of the ecliptic $23^{\circ} 30' 10''$, as great as he says the Landgravians [observed], which he finds very close — but, retaining the Lansbergian refraction $6'$ in the winter [solstice], and at the summer solstice $6''$, and applying our parallax $23''$, the summer altitude comes out as $61^{\circ} 58' 6''$, the winter as $14^{\circ} 56' 46''$, and so the obliquity of the ecliptic $23^{\circ} 30' 40''$.

[Margin: Lansbergen.]

§15. By this observation Gassendi [Pierre Gassendi] at Marseilles ascertained the obliquity of the ecliptic as $23^{\circ} 30' 58''$, as we have already said in section 1 on the occasion of Pytheas. Therefore in his *Institutiones Astronomicae* I, chapter 8, he said it was $23^{\circ} 31'$, or just a little, indicating that it could be something less by some seconds. But Wendelen [Govaert Wendelen, Vendelinus], in a most learned letter to me, full as it were, asserting it from the stars [observed], writes that, while he was dwelling in the province of Forcalquier [Forcalcarii], from the circumpolar stars he obtained the pole-altitude as $43^{\circ} 54'$, and the meridian distance of the Sun from the vertex over many years at the summer solstice he found to be $20^{\circ} 24'$; subtracting my own parallax $6''$, it comes to $20^{\circ} 23' 54''$; and this subtracted from the pole-altitude [yields] the distance of the tropic from the vertex $23^{\circ} 30' 6''$ [?]. Although, according to Gassendi in his Epistle 2 to Wendelen, Wendelen is said to be at $23^{\circ} 30' 24''$. And Wendelen himself asserts this same [value] in his *Diatriba*, which is entitled *Loxias, or On the Obliquity of the Sun* — in which, however, he is deceived, when from Pappus of Alexandria he gathers the obliquity for A.D. 400 as $23^{\circ} 42' 6''$, as is clear from what was said in section 6 from Commandinus.

[Margin: Wendelen.]

§16. We ourselves, in the preceding section, from our observations (section 14 and 17), deduced the maximum declination of the Sun to be never less than $23^{\circ} 30'$, nor greater than $23^{\circ} 30' 25''$; but for the reasons there alleged we choose $23^{\circ} 30' 20''$; and this, constant, we have used in our Tables, caring nothing for the anomaly which others, and Wendelen in the said opuscle published in 1626, endeavored to introduce — namely one arising from the inconstancy of refractions at the winter solstice. And so, in order to bring our two conclusions into view, it pleases [us] to set down the opinions of the authors, both as they lie with them, and as deduced from a correction of their observation, with the marginal numbers of this section appended, so that through them the places of the authors and the examinations of their observations may be found.

§17. In the *Memorial of the Ninth Century* of Albert Linemann [Albertus Linemannus], I find Wenceslaus of Nová Plzeň [Veuceslaus de Nova Pilzna], in A.D. 1416, with a great quadrant and the Ptolemaic four-cubit iron rules...

[Margin: Immutability of the obliquity of the ecliptic.]

at Prague [Pragae] [it is reported] that the Sun was observed at the beginning of Cancer with a meridian altitude of 63° 26'; from which, if you subtract the altitude of the equator 39° 55' 30", there remains the distance of the tropic 23° 30' 30".

Obliquity of the Ecliptic, or the Maximum Declination of the Sun

[*Obliquitas Eclipticae, seu Declinatio Solis Maxima.*]

Num. margin.	Authors named above under the marginal numbers	Obliq. Eclip. Gr.	'	"	Years before Christ
1	Pytheas of Marseilles [Massiliensis]	23	5	4	324
			2	1	
2	Hipparchus, from Strabo's report [ex Strabonis relata]	23	3	5	140
			3	7	
—					140
3	But from Ptolemy [Sed ex Ptolemaeo]	23	5	2	
			1	0	
3	Geminus, Proclus, Achilles Tatius, in round number	24	0	0	<i>After Christ</i> [Post Christum]
3	Ptolemy [Ptolemaeus]	23	5	2	140
			1	0	
5	Ptolemy, elsewhere [Ptolemaeus aliunde]	23	3	0	140
			0		
6	Pappus of Alexandria [Pappus Alexandrinus]	23	3	0	390
			0		
4	Eratosthenes, fallaciously [fallaciter]	23	4	0	<i>Before Christ</i> [Ante Chr.]
			6		
—	or [vel]	23	5	2	230
			1	0	
7	but necessarily corrected [Sed	23	3	5	<i>Years of Christ</i> [Anni Chr.]
			1		

Num. margin.	Authors named above under the marginal numbers	Obliq. Eclip. Gr.	'	"	Years before Christ
	necessario correctus]				
7	al-Battānī	23	3	0	880
	[Albatenius]		5		
8	Arzachel the	23	3	0	1070
	Spaniard [Arzachel		4		
	Hispanus]				
8	Almaeon of	23	3	3	1140
	Almansor [Almaeon		3	0	
	Almansoris]				
8	Thebit, son of Qurra	23	3	3	1210
	[Thebit Corae filius]		3	0	
8	Prophatius the Jew	23	3	0	1300
	[Prophatius Iudaeus]		2		
9	Purbach and	23	2	0	1460
	Regiomontanus, but		8		
	he chose this				
	afterward				
	[Purbachius &				
	Regiomontanus, sed				
	elegit hic postea]				
—		23	3	0	
			0		
10	Bernhard Walther	23	3	0	1476
	[Bernardus		0		
	Vualtherus], neither				
	greater nor less [non				
	maiolem, nec				
	minorem]				
—		23	2	3	1498
			9	1	
10	Domenico Maria of	23	2	0	1500
	Ferrara [Dominicus		9		
	Maria Ferrar.]				

Num. margin.	Authors named above under the marginal numbers	Obliq. Eclip. Gr.	'	"	Years before Christ
10	Johannes Werner [Ioannes Vernerius]	23	2	3	1500
			8	0	
10	Copernicus, fallaciously, but corrected [Copernicus fallaciter, sed correctus]	23	2	3	1525
			8	0	
—		23	3	5	
			0		
11	Petrus Apianus and Orontius [Petrus Apianus, & Orōtius]	23	3	0	1530
			0		
11	Pedro Nunes [Petrus Nonius]	23	3	0	1555
			0		
11	Egnazio Danti, fallaciously, but corrected [Egnatius Dantes fallaciter, sed correctus]	23	2	0	1570
			9		
—		23	3	3	
			0	5	
12	Christoph Rothmann and Bürgi [Christophorus Rothmannus, & Byrgius]	23	3	2	1570
			0	0	
12	Johannes Homelius, corrected [Ioannes Homelius correct.]	23	3	0	1570
			0		
13	Tycho, but fallaciously [Tycho, sed fallaciter]	23	3	3	1587
			1	0	

Num. margin.	Authors named above under the marginal numbers	Obliq. Eclip. Gr.	'	"	Years before Christ
—	but corrected, at most [sed correctus, ut summū]	23	3	2	
			0	7	
—	and twice [& bis]	23	3	2	
			0	2	
13	Kepler [Keplerus]	23	3	3	1627
			0	0	
14	Lansbergen, fallaciously [Lansbergius fallaciter]	23	3	1	1589
			0	0	
—	but corrected [sed correctus]	23	3	4	
			0	0	
11	Clavius, Galileo, Scheiner [Clavius, Galilaeus, Scheiner]	23	3	0	1612
			0		
15	Pierre Gassendi, not greater [Petrus Gassendus nō maior]	23	3	0	1636
			1		
15	We, from Wendelen [Nos ex Vendelino]	23	3	6	
			0		
15	Govaert Wendelen [Gottefridus Vuendelinus]	23	3	2	1650
			0	4	
16	We, together with Father Grimaldi [Nos cum Patre Grimaldo]	23	3	2	1646
			0	0	
17	Wenceslaus of Nová Plzeň [Vinceslaus de Noua Pilzna]	23	3	3	1416
			0	0	

I. Conclusion [I. CONCLVSIO]

For our own and the preceding century, if seconds are to be disregarded, the obliquity of the ecliptic was, and is, $23^{\circ} 30'$ rather than $31'$, since most observations and authorities support this. But if account is to be had of the seconds, then $23^{\circ} 30' 20''$ is to be chosen, on account of the most recent observations, carried out with larger instruments — so that whoever should strive to increase or diminish it by about ten seconds is not to be severely condemned.

II. Conclusion [II. CONCLVSIO]

It is much more probable that the obliquity of the ecliptic is unchangeable, and that it was, and will be, as great as it now is. First, because — apart from the 4 or 5 minutes in which the ancients could easily have erred — we have deduced just such a value from the ancient observations of Eratosthenes, Hipparchus, and Ptolemy, and of Pappus of Alexandria. Secondly, because, although a few of the fixed stars favor Tycho's conjecture (who supposed that they vary their latitude on account of an external cause — namely on account of a variable obliquity of the ecliptic), yet more [stars] contradict this opinion and retain the same latitude they once had, or nearly the same; and that variety, diverse [as it is], rather than the variety which the ancient supposed obliquity was thought to be, [we showed], as we showed in *Almagestum Novum* VI.15. Thirdly, because, if the obliquity of the ecliptic of the ancients is reduced, and is now brought down to $23^{\circ} 30'$, then the maximum latitude of the Moon in the quadratures observed by Ptolemy comes out almost as great as Tycho finds it — which is an indication, though not indeed a necessity, but rather a probability of our opinion. Fourthly, because to affirm the maximum [variation] is, at the maximum, in need of a foundation; but a change of the obliquity of the ecliptic is of the maximum moment, since it influences very many astronomical operations, and, that being changed, it would be necessary in each century to construct anew many Tables of the Prime Movable and of the Fixed [stars], and certain [Tables] of the [Secondary] Movables; whereas, on the other hand, we have neither sufficient theoretical reasoning *a priori*, nor an *a posteriori* foundation sufficient — much less the maximum needed for establishing this change — as is clear from the observations laid out above. Fifthly and finally, not a few, and those not to be repented of, astronomers stand for its immutability: namely Ptolemy in *Almagest* I.11; Thebit, in Maurolico's *Cosmographia*, dialogue 3; Agostino Ricci [Augustinus Riccius] in his treatise *On the Motion of the Eighth Sphere* [*De Motu Octavae Sphaerae*]; Athanasius Kircher in his *Magnes*, p. 477 of the first edition; Simon

Stevin [Steunus] in Hérigone [Herigonius] tom. 5, p. 579; Vincenzo Renieri [Vincentius Reinerus], in the *Medicean Tables*, again published in chapter 7, num. 7; Pierre Gassendi in his *Life of Peiresc* for the year 1635, and in his Epistle to Wendelen on the proportion of the gnomon to the solstitial shadow; and Kepler, chapter 12, [in the] *Rudolphine [Tables]*, saying: "*That the obliquity of the ecliptic was once greater is a matter not only doubtful, but refuted by valid arguments from the very observations of the ancients gathered by me, and beyond doubt plainly false.*"

[Margin: Immutability of the obliquity of the ecliptic.]

CHAPTER VII [CAPVT VII]

Observations of the Quadrants and Semicircles of the Year [Anni Quadrantum Observationes, & Semicirculorum]

The year is divided into four parts by the cardinal points of the ecliptic, that is, the points and moments of the equinoxes and solstices. The first quadrant embraces the time from the vernal equinox to the summer solstice; the second, from the summer solstice to the autumnal equinox; the third, from the autumnal equinox to the winter [solstice], that is, the winter solstice; the fourth, from the winter solstice [bruma] to the vernal equinox. That these times are unequal is manifest from astronomical observations. And the times are unequal: the time from the Sun's entry into Aries [Υ] up to its entry into Libra [ϱ]; the time from [its entry] into Libra to the following entry into Aries [Υ]; likewise the time from the Sun's entry into Cancer [ϖ] up to its entry into Capricorn [φ]; the time from [its] entry into Capricorn [φ] to the following entry into Cancer [ϖ]. This can be established to some extent from the equinoxes observed (chapter 3) and the solstices (chapter 5), as well as from the opinions to be reported shortly.

[Margin: none]

Table I. The Tarrying of the Sun in the Northern and Southern Semicircles [I. TAB. Mora Solis in semicirculis Boreal. & Austr.]

Authors	From the start of Υ to the start of ϱ — D.	H . '	From the start of ϱ to the start of Υ — D.	H . '
Hipparchus and Ptolemy, <i>Almagest</i> III.2 & 4	187	0 0	178	5 55 $\frac{1}{3}$
Ptolemy, corrected	186	1 5	178	1 2

Authors		From the start of Υ to the start of $\ominus$ — D.	H . ' $\frac{1}{2}$	From the start of $\ominus$ to the start of Υ — D.	H . ' $\frac{1}{3}$
by Longomontanus and Boulliau [Bullialdo]			1 0 $\frac{1}{2}$		8
The same, corrected by us [Idem correctus à nobis]	189		1 0 9	178	1 55 0 $\frac{1}{3}$
Pliny [Plinius] 18.25, after Sosigenes [ex Sosigene]	186		0 0	179	6 0
al-Battānī [Albatenius] 27 & 28	186		1 4 4 5	178	1 30 4
al-Battānī, corrected by Longomontanus [à Longomótano]	186		1 1 4 5	178	1 0 4
Petrus Pitatus [Pietro Pitati], in Nunes's <i>Theoricae</i> [apud Nonium in Theoricis]	186		2 3 3 8	178	2 11 6
Copernicus, <i>De Revolutionibus</i> III.16 [I.3.Reuol.c.16]	186		2 0 $\frac{1}{2}$	179	3 48 $\frac{3}{4}$
Regiomontanus, from chapter 3, num. 15	186		1 4 8 5		
Walther [Vualtherus], from chapter 3, nums. 21, 22, 23, 24, 28, 29	186		1 2 3 4	178	1 0 6
	186		1 2 8		
Reinhold [Reinholdus] in Purbach's <i>Theoricae</i> ,	186		8 1 3	178	2 42 1

Authors	From the start of Υ to the start of Ω — D.	H . '	From the start of Ω to the start of Υ — D.	H . '
p. 31				
but p. 39 [sed pag. 39]	186	9 1 8	178	2 37 0
Magini [Maginus] in <i>Theorica Solis</i> c. 9	186	7 4 6	178	2 10 2
Landgrave of Hesse [Lamgravius Hassiae], from what was said in chapter 3, num. 43	186	2 2 0 0	178	1 40 9
Tycho, tom. 1, <i>Progymnasmata</i> pp. 13, 19 & 107, but from correction of chapter [3], nums. 48 to 66, variously, more often however, or somewhat [vel aliquando]	186	1 3 8 0	178	1 18 1 $\frac{3}{4}$
	186	1 4 5 5	178	1 45 5
	186	1 4 4	178	1 44 5
	186	1 4 9 5	178	1 46 5
Goclenius [Goclenus] in <i>Urania</i> , p. 53	186	8 0	178	2 0 1
Argoli [Argolus] in <i>Pandosion</i> I.1 c. 8	186	1 3 8 0	178	1 30 1
Lansbergen in his <i>Thesaurus</i> , observed, or from what was said in chapter 3, num. 67 [à num. 67]	185	1 1 6 2	179	1 37 3

Authors	From the start of Υ to the start of ϱ — D.	H . '	From the start of ϱ to the start of Υ — D.	H . '
Wendelen [Vendelinus] in letters [sent] to me [in litteris ad me datis]	186	1 0 5	178	1 49 3 ½
Vicenç Mut [Vincentius Mutus] in <i>Sole Alphonsino</i>	186	2 5 3 4	178	5 55 ¼
We, from chapter 3, nums. 75 to 79 [Nos ex c. 3. à num. 75. ad 79.]	186	1 5 4 3	178	1 56 4
D. Giovanni Domenico Cassini [D. Io. Dominicus Cassinus], in the heliameter [in Heliometro]	186	1 5 4 3	178	1 56 4

Below the table: *Do not be surprised if the Time compounded from the Sun's tarrying in the Northern semicircle, and from the Tarrying in the Southern, does not answer exactly to the quantity of the equinoctial Year asserted by the authors; for that correction was demanded [by it], and from it rather a different quantity of the Year is gathered among them.*

Table II. The Tarrying of the Sun in the Vernal and Summer Arcs of the Ecliptic [II. TAB. Mora Solis in Ecliptica Arcu Verno, & Aestivo]

From the Sun's
entry / To the entry
[Ab ingressu Solis /
Ad ingressum] —

Authors	In Υ to In ϱ — D.	H . '	In ϱ to In ϱ — D.	H . '
Ptolemy, <i>Almagest</i> III.2 & 4, with Hipparchus [cum Hipparco]	94	1 0 2	92	1 0 2

From the Sun's
entry / To the entry
[Ab ingressu Solis /
Ad ingressum] —

Authors	In ♀ to In ♂ — D.	H . ' In ♂ to In ♀ — D.	H . ' In ♂ to In ♀ — D.
Pliny 18.25, emended by Petavius [emendatus à Petauio], II, differs [from] <i>Urania</i> c. 5	93	1 0 2	92 1 0 2
Ausonius, in his <i>Eclogues On the Reckoning of the Days</i> [in <i>Eclogis de ratione dierum</i>]	94	1 0 2	92 1 0 2
al-Battānī [Albatenius] c. 27 & 28	93	1 0 4	93 0 45
Pitatus [Pietro Pitati], in Nunes's <i>Theoricae</i> [apud Nonium in Theor.]	93	1 1 0 ½	93 1 36 3 ⅘
	92	2 0 1	93 1 0 3
Goclenius [Goclenus] in <i>Urania</i>	92	1 0 7	93 2 34 0
Walther [Vualtherus], from what was said in chapter 3, nums. 3 & 5	93	4 1 7	93 1 8 4
Tycho, tom. 1, pp. 13, 19 & 107, together [simul] but from what was said in chapter 3, nums. 3 & 5 [sed ex	93	1 4 0	93 1 5 4

From the Sun's entry / To the entry [Ab ingressu Solis / Ad ingressum] —		H		H
Authors	In ♀ to In ☿ — D.	. ' In ☿ to In ♄ — D.	. ' In ☿ to In ♄ — D.	. ' In ☿ to In ♄ — D.
dictis c. 3. & 5.]				
Lansbergen, from the positions in his <i>Thesaurus</i> [ex positis in Thesauro]	93	2 2 92 7		1 45 3
Magini [Maginus] in <i>Theorica Solis</i>	92	2 4 93 0 9		1 57 0
We, from what was said in chapter 3, nums. 3 & 5 [Nos ex dictis c. 3. & 5.]	93	0 3 93 6		1 18 4
D. Giovanni Domenico Cassini [D. Io. Dominicus Cassinus]	93	2 5 93 0		1 12 2

III. TABLE. The dwelling of the Sun [*Mora Solis*] in the Autumnal and Winter Arc of the Ecliptic.

From the Sun's entry / to its entry		H M		H M
	In ♄ / In ♁ — D.	. . In ♁ / In ♀ — D.		. . In ♁ / In ♀ — D.
Authorities				
Pliny [Pliny], book 18, ch. 25, emended	89	3 0 90		3 0
Ausonius, in the <i>Eclogues</i> , above	88	6 0 90		0 0
Magini [Giovanni Antonio Magini], in his <i>Theory of the Sun</i>	89	1 9 89 8		4 1
Tycho [Tycho Brahe], vol. 1, above	89	1 3 89 0 7		0 4 7
— or as corrected by us	89	1 4 89		0 4

From the Sun's entry / to its entry	In ϖ / In φ — D.	H M . . In φ / In γ — D.	H M . .
		0 0	4
Walther [Bernhard Walther], from what was said in ch. 3 and 5	90	1 4 88 0 6	5 1 5
We, from our observations	89	1 1 89 4 1	0 4 5

CAPUT VIII.

Selected Observations of the Sun's Meridian Altitudes outside the Equinoxes and Solstices.

To thoroughly understand the Sun's motion, the moments of the equinoxes and solstices are not sufficient; observations are also required of the times at which the Sun is found at certain other points of the ecliptic, outside the four cardinal points — especially around the middle parts of Taurus, Leo, Scorpio, and Aquarius. Then, in order to compare these positions with those drawn from the astronomical tables, the reliability of the tables is established; and at the same time, with a view to constructing the tables themselves, the place of the apogee and the quantity of the eccentricity are found by the Sun's discovered position and by the motion of the solar apogee. For the inequality of the solar motion shows itself plainly in the unequal dwelling [*mora*] of the Sun in the northern semicircle — 8 days more than in the southern — and, in these centuries of ours, by 14 hours 18 minutes more in the spring quadrant than in the autumnal, and by 13 hours 26 minutes more in the summer quadrant than in the winter. This inequality cannot be otherwise accounted for by astronomers than by an eccentric circle of the Earth, or by an eccentric ellipse, or by an epicycle equivalent to the eccentric — as I have set out more fully in book 3 of the *New Almagest* [*Almagestum Novum*], from chapter 17 through 24.

Moreover, from the medley of observations found among writers — chiefly Walther, the Hessian observers [the Landgrave's at Kassel], Tycho, Kristmann, and others among them — we shall select the more reliable ones, those more suited to the advancement of astronomical study; nor shall we add to them either parallaxes or refractions, but shall take only those places on the Earth where the observations were made, together with the year, month, and day, and with the altitude of their pole drawn from our *Geographia Reformata*. Then, in the

following chapter, we shall search out from them the place of the Sun in the ecliptic.

Distances of the Sun's Meridian [position] from the Vertex of Nuremberg, selected out of Bernhard Walther — among them, those marked *Clara*, *Diligens*, or *Praecl.* being noted as certain or quite certain.

Years of CHRIST	Month / Day	Chor d	Dist. ☉ from Vertex — G.	'	"
1476	Iunij 12	44890			
	Septemb. 13	83400			
	Septemb. 19	87090			
1477	Martij 11	83675			
Anno 1478	Martij 11	83820			
	Martij 31	71434			
	Iunij 11	44890			
	Iunij 13	44890			
	Iunij 21	45267			
	Septemb. 10	81190			
	Sept. 11	81800			
	Sept. 12	82480			
	Sept. 13	83050			
	Sept. 30	93410			
	Octobr. 8	98040			
	Nouemb. 26	11730			
		0			
	Decemb. 11	11876			
		0			
Anno 1479	Febr. 21	94860	56	3	4
				7	0
	Martij 28	73350			
Anno 1487	Decemb. 7	11862			
		5			
	Decemb. 13	11879			
		0			

Years of CHRIST	Month / Day	Chor d	Dist. ☉ from Vertex — G.	'	"
Anno 1488	Decemb. 14	11879 0			
	Ianuarij 2	11652 5			
	Ianuar. 3	11627 5			
	Ianuar. 9	11472 5			
	Ianuar. 31	10624 0			
	Febr. 1	10575 0			
	Febr. 10	10120 0			
	Febr. 17	97338			
	Mart. 2	89010			
	Mart. 3	88400			
	Mart. 19	78460			
	Mart. 24	75334	44	1 5	2 0
	Mart. 25	74710			
	April. 9	65780			
	Augusti 27	55950			
	Sept. 1	75975			
	Sept. 6	79090			
	Sept. 10	81550			
	Sept. 11	82190			
	Sept. 13	83434			
	Octob. 8	98350			
	Octob. 31	10967 5			
	Decemb. 11	11878			

Years of CHRIST	Month / Day	Chor d	Dist. ☉ from Vertex — G.	'	"
		0			
Anno 1489	Ianuar. 7	11507			
		5			
	Ianu. 22	10988			
		0			
	Mart. 2	89188			
	Mart. 11	83625			
	Mart. 24	75489			
	April. 4	68834			
	April. 28	46200			
	Iunij 7	45043			
	Iunij 10	44940			
	Iunij 12	44890			
	Iunij 29	46534			
	Iulij 31	57750			
	Augusti 24	70950	41	3	2
				3	1
	Sept. 7	79550			
	Sept. 11	82040			
	Sept. 27	91870			

[The "Selected out of Walther" table continues across the opening.]

Selected out of Walther	Month / Day	Chor d	Dist. ☉ from vertice — G.	'	"
1489	Octob. 28	1083			
		13			
	Nouemb.	1180			
	30	13			
Anno 1490	Febr. 28	9055			
		0			
	Maij 2	5435			
		0			

Selected out of Walther	Month / Day	Chor d	Dist. ☉ from vertice — G.	'	"
Anno 1491	Iunij 12	4490 0			
	Iunij 21	4532 5	26	1 1	4 8
	Augusti 5	6014 0			
	Decemb. 12	1187 90			
	Decemb. 13	1187 88			
	Ianuar. 6	1154 90			
	Ianu. 21	1104 80			
	Febr. 14	9886 0			
	Mart. 13	8268 0			
	April. 18	6121 0			
Anno 1492	Iulij 18	5192 5			
	Iunij 11	4488 8			
	Iunij 12	4488 8			
Anno 1493	Sept. 27	9202 0			
	Sept. 13	8332 0			
	Sept. 22	8886 7			
	Sept. 23	8946	53	8	2

Selected out of Walther	Month / Day	Chor d	Dist. ☉ from vertice — G.	'	"
		0			8
	Octob. 14	1015 34			
	Nouemb. 18	1156 88			
Anno 1494	Ianuar. 5	1156 88			
	Ianuar. 15	1126 40			
	Febr. 13	9926 7			
	Iunij 12	4490 0			
	Iunij 13	4491 0			
	Sept. 13	8317 1			
	Decemb. 13	1188 00			
Anno 1495	Iunij 11	4492 0			
	Sept. 11	8176 4			
	Sept. 30	9337 8			
	Decemb. 15	1187 88			
Anno 1496	Iunij 10	4502 5			
	Augusti 30	7480 0			
	Sept. 10	8161 2			

Selected out of Walther	Month / Day	Chor d	Dist. ☉ from vertice — G.	'	"
Anno 1497	Sept. 13	8349 0			
	Octob. 1	9440 0			
	Decemb. 11	1188 00			
	Mart. 28	7308 0			
	April. 24	5794 0			
	Maij 28	4624 0			
	Iunij 10	4492 5			
	Octob. 1	9430 0			
	Octob. 27	1079 00	65	1 7	5 8
Anno 1498	Iunij 11	4491 0			
	Iunij 12	4489 0			
	Iulij 23	5362 5	31	6	1 8
	Augusti 15	6390 0			
	Sept. 12	8256 6	48	4 5	5 8
	Octob. 11	9977 5	59	5 1	2
	Nouemb. 10	1132 25	68	5 7	3 5
	Nouemb.	1167	71	2	2

Selected out of Walther	Month / Day	Chor d	Dist. ☉ from vertice — G.	'	"
	23	66		6	7
Anno 1499	Ianuar. 26	1083 50	65	3 6	2 0
	Febr. 11	1004 66			
	Mart. 12	9991 7			
	April. 21	5964 0			
	Maij 11	5087 5			
	Maij 29	4612 5			
	Iunij 12	4492 5			
	Iulij 11	4950 0	28	3 9	3 4
	Augusti 13	6435 0			

Selected out of Walther	Month / Day	Cho rd	Dist. ☉ from vertice — G.	'	"
Anno 1500	Martij 8	853 00			
	Mart. 29	722 17			
	April. 24	577 57	33	3 4	1 5
	Maij 19	481 40			
	Maij 28	461 83			
	Iunij 11	448	25	5	3

Selected out of Walther	Month / Day	Cho rd	Dist. ☉ from vertice — G.	'	"
Anno 1501		90		6	9
	Iunij 12	448			
		83			
	Iulij 28	564			
		88			
	Decemb. 30	116	71	3	1
		950		4	3
	Ianuar. 17	111			
		817			
	Mart. 10	842			
		34			
	April. 14	630	36	4	3
		90		6	4
	Maij 2	588			
		75			
	Iunij 6	451			
Anno 1503		00			
	Sept. 13	833			
		67			
	Sept. 28	925			
		00			
	Decemb. 10	118			
		775			
	Mart. 17	800			
		80			
	Mart. 28	732			
		40			
	April. 18	611			
		00			
	April. 27	566			
		36			
	Maij 11	508			
		25			

Selected out of Walther	Month / Day	Cho rd	Dist. ☉ from vertice — G.	'	"
	Maij 25	468 17	27	4	3 0
	Maij 31	457 50			
	Iunij 10	449 00			
	Iulij 27	556 34			
	Augusti 10	626 13	36	2	2 9 5
	Decemb. 12	118 750	72	5	5 0 0
Anno 1504	Ianu. 10	114 340	69	4	1 4 1
	Febr. 9	101 620	61	4	2 5
	Mart. 12	827 50	48	5	5 2 3
	April. 20	596 90			
	Maij 10	509 10	29	2	3 9 8
	Maij 28	460 90			
	<i>Ultima Solarium</i> [the last solar one] Iunij 3	452 80			

From the foregoing we now select 24 observations for the Sun's position around the beginnings and middle parts of the signs. We shall determine that position by assuming the distance of the equator from the vertex of Nuremberg to be $49^{\circ} 26'$, together with our parallax and the old Almagestic refraction; for once the distance seen from the vertex is corrected and converted into the true [distance], the Sun's true declination will be established, and from this — and from the maximum declination of $23^{\circ} 30' 20''$ — the place of the Sun will at once follow by spherical triangle, without recourse to a table of declinations. The more reliable

positions, however, are those of the northern signs, since these are not subject to the uncertainty of refractions.

From Walther's observations — Ann. / Mens. / Dies	Declinatio vera — Gr.	' "	Solis locus in Ecliptica — S.	G r . ' "
1504 Ianuar. 10	20	2 5 2 6 A	♊	2 1 3 9 4 0
1499 Ianuar. 26	16	1 4 2 0 A	♊	1 3 3 5 4 0
1504 Februar. 9	11	3 3 9 9 A	♊	2 3 2 9 3
1479 Febr. 21	7	1 2 2 5 A	♋	1 3 5 1 9 7
1504 Mart. 12	0	3 1 3 0 B	♋	1 2 1 3 0
1488 Mart. 24	5	1 4 0 7 B	♋	1 4 5 3 6
1501 April. 14	12	3 3 9 5 B	♌	3 2 8 2
1500 April. 24	15	5 5 1 3 B	♌	1 1 5 3 6
1504 Maij 10	19	5 2 6 8 B	♌	2 4 2 8 6 8
1503 Maij 25	22	2 3 1 6 B	♍	1 3 1 2 1 2
1500 Iunij 11	23	2 2	♍	2 5 4

From Walther's observations — Ann. / Mens. / Dies	Declinatio vera — Gr.	' "	Solis locus in Ecliptica — S.	G r . ' "
		9 6 B		7 9 8
1490 Iunij 21	23	1 1 4 7 B	♄	8 2 9 4
1499 Iulij 11	20	4 3 7 2 B	♄	2 7 2 7 0
1498 Iulij 23	18	1 4 9 8 B	♂	7 5 5 7
Resid. of the preceding Table — Ann. / Mens. / Dies	Declinatio vera — Gr.	' "	Solis locus in Ecliptica — Sig.	G r . ' "
1503 Augusti 10	12	5 4 6 3 B	♂	2 4 4 5 9 0
1489 Augusti 24	7	5 3 2 9 B	♍	9 5 0 4
1498 Septemb. 12	0	4 1 0 5	♍	2 5 5 8 5
1493 Septemb. 23	3	4 4 2 6 A	♌	9 2 3 0 5
1498 Octob. 11	10	2 6 6 A	♌	2 0 2 7 9
1497 Octob. 27	15	5 2 4 0 A	♍	1 2 1 3 4 0
1498 Nouemb. 10	19	3 2 5 5	♍	2 1 3 7 2 5

Resid. of the preceding Table — Ann. / Mens. / Dies	Declinatio vera — Gr.	'	"	Solis locus in Ecliptica — Sig.	G r . ' "
			A		
1498 Nouemb. 23	22	5	3	♊	1 3 5
			5		0 3 5
			A		
1503 Decemb. 12	23	3	1	♊	2 2 4
			0 5		9 3 5
			A		
1500 Decemb. 30	22	1	5	♋	1 3 1
			2 A		8 9 0

To these we append 20 positions of the Sun drawn from the excellent observations of the Landgrave of Hesse [the Kassel observatory program], which Snellius published, selected from those made at Kassel from the year 1568 onward with instruments now rectified, and repeated with the altitude of the equator set at 38° 40' 20"; from those that are subject to a less certain refraction we have departed, so that we may use our own parallax alone, and the obliquity of the ecliptic, of which we spoke above.

Ann. Christi in Meridie — Ann. / M. / D.	Altit. visa — Gr.	'	Declinatio vera — Gr.	'	"	Locus Solis in Ecliptica — Sig.	G r . ' "
1658 Iun. 28	61	11	22	3	4	♊	1 2 2
					0 6		5 0
					B		
Iulij 20	57	10	18	2	4	♋	6 3 5
					9 7		8 0
					B		
Aug. 24	46	10	7	2	5	♋	1 5 1
					9 0		0 4 5
					B		
Sept. 13	38	30	0	1	2	♋	0 2 8
					0 6		6

Ann. Christi in Meridie — Ann. / M. / D.	Altit. visa — Gr.	'	Declinatio vera — Gr.	' "	Locus Solis in Ecliptica — Sig.	G r . ' "
				A		
1571 Mart. 13	39	30	0	2 2 9 8	♈	1 1 5 3 5
				B		
Sept. 13	38	46	0	5 5 4	♏	2 4 1 9 5 0
				B		
Octob. 3	31	2½	7	3 0 9	♐	1 2 5 9 9 0
				A		
1572 Mart. 11	39	3	0	2 3 2 8	♈	1 1 4 7
				B		
April. 30	56	7½	17	2 1 7 7	♏	1 4 1 8 6 0
				B		
Maij 24	60	59	22	1 4 8 6	♐	1 9 5 2 0
				B		
1573 Mart. 11	38	56	0	1 3 5 8	♈	0 1 3 5 8
				B		
1575 April. 11	50	25	11	4 4 4 9	♏	0 4 2 1 5
				B		
Iulij 20	57	24	18	4 4	♏	6 2 4

Ann. Christi in Meridie — Ann. / M. / D.	Altit. visa — Gr.		Declinatio vera — Gr.	' "	Locus Solis in Ecliptica — Sig.	G r . ' "
				3 7		2 4
				B		
1578 Mart. 12	39	18	0	3 3 7 8	Υ	1 3 2 4 2
				B		
1593 Iun. 14	62	10 $\frac{3}{5}$	23	3 2 0 0	♄	0 0 0
				B		
stylo Iun. 15	62	$7\frac{2}{3}$	23	2 2 7 6	♄	3 2 0 5
veteri Sept. 12	38	55 5/1 0	0	1 4 5 3	♅	2 2 3 9 0 5
				B		
1594 Iun. 10	62	10 $\frac{1}{3}$	23	3 6 0	♄	2 5 3 8 8 0
1596 Mart. 23	43	48	5	7 5 2	Υ	1 5 3 2 7 0
Maij 7	58	8	19	2 4 7 6	♄	2 4 0 6 3

The Tychonic Meridian Altitudes of the Sun, observed at Uraniborg — where the altitude of the equator is $34^{\circ} 5' 30''$ — I selected out of Longomontanus' *Astronomia Danica*, book 2, *Theoricorum* ch. 2, in the *Commentary on the Sun*, and from Willebrord Snel among the Bohemian observations, and from those which P. Albert Curtz [Albert Curtz], S.J., sent to me, excerpted from Tycho's manuscripts, of which some too were published at Vienna. But the observations of the year 1601 — some were made at Benatky Castle, where the altitude of the equator is $39^{\circ} 41' 30''$; some at Prague, where the altitude of the equator is $39^{\circ} 55' 30''$; and the refraction found by Tycho is greater by 2 minutes than in Denmark. From these, using our parallax and obliquity of the ecliptic, we derive the places of the Sun in the ecliptic.

Anni CHRISTI
stylis veteri —

An. / Mens. / Dies	Alt. merid. ☉ visa — G.	' "	Declinatio vera — Gr.	' "	Locus Solis Ecliptica — S.	' "
1582 April. 27	50	5 0 2	16	4 3 6 9	♈	2 5 1 5
				B		
Maij 24	56	2 0 4	22	1 3 8 7	♊	4 1 4 0
Augusti 9	47	3 1 0	12	5 5 7 0	♌	1 5 3
1583 Mart. 14	35	2 3 2 0	1	1 3 6 0	♍	1 5 1 5
				B		
April. 26	50	3 4 0 5	15	4 2 0 5	♈	3 1 8 8
Sept. 13	34	1 2 3 0	0	7 2 5	♎	4 3 8 5
1584 Mart. 11	34	2 5 9 5	0	2 5 3 5	♍	5 5 9 9
				B		
April. 30	51	4 3 8 0	17	4 1 3 0	♈	4 2 4 0
Iulij 28	50	3 5 1 1	16	2 3 6 0	♌	4 3 7 0
Sept. 12	34	1 5 8 5	0	1 5 2 5	♎	2 3 7 5
1585 Mart. 13	35	1 4 0 5	1	4 5 5	♍	4 4 2 7
				B		
April. 26	50	3 2 9 0	16	3 0 4	♈	3 5 8

Anni CHRISTI
stylis veteri —

An. / Mens. / Dies	Alt. merid. ☉ visa — G.	' "	Declinatio vera — Gr.	' "	Locus Solis Ecliptica — S.	' "
Iulij 27	50	6 3	16	1 1	♌	1 5
		0		0		3
Sept. 10	35	1 4	1	5 5	♍	1 5
		1 0		0		4 4
1586 Mart. 11	34	1 3	0	1 3	♎	3 2
		8 0		2 0		1 0
B						
April. 27	50	5 3	16	4 1	♏	2 4
		2 0		7 0		3 0
Iunij 12	57	3 3	23	3 1	♐	4 5
		5 6		0 2		5 3
Sept. 13	34	7 0	0	2 0	♑	5 0
						5
1587 Mart. 12	34	3 1	0	3 1	♒	1 5
		6 5		0 5		5 2
B						
April. 29	51	2 3	17	1 1	♓	2 5
		0 5		5 5		0
Iunij 14	57	3 3	23	2 1	♈	1 4
		4 0		9 0		5 4
Iulij 27	51	0 5	16	5 3	♉	7 1
		0		5 0		5
Sept. 12	34	3 0	0	3 2	♊	4 2
		7		1 0		1 5
1588 Mart. 12	34	5 3	0	4 3	♋	5 1
		3 0		7 5		9 8
B						
April. 27	51	0 2	16	5 0	♌	5 0
		0		5		2

Anni CHRISTI
stylis veteri —

An. / Mens. / Dies	Alt. merid. ☉ visa — G.	' "	Declinatio vera — Gr.	' "	Locus Solis Ecliptica — S.	' "
Sept. 12	34	1 2	0	1 2	♏	2 0
		8 0		2 0		9
1589 Mart. 11	34	2 5	0	1 5	♏	4 2
		4 5		8 5		7 2
B						
Iunij 12	57	3 3	23	3 7	♏	5 5
		5 0		0		8 2
<i>alio instrum.</i>	57	3 2	23	3 2	♏	8 5
		5 5		0		0
<i>alio instr.</i>	57	3 4	23	3 2	♏	0 0
		5 5		0 0		
<i>Tychonico vet.</i>	57	3 5	23	3 2	(no value)	
		5 0		0 7		
<i>Tychonico nou.</i>	57	3 5	23	3 4	(no value)	
		6		0 1		
Iulij 29	50	1 1	16	1 5	♏	3 4
		8 5		2 5		3 0
Sept. 9	35	3 0	1	2 5	♏	3 3
		5		9		9
Dec. 15	10	4 4	23	3 1	♏	1 4
		4 8		0 7		6 0
A						
1590 Mart. 11	34	1 3	0	1 3	♏	3 3
		8 5		2 5		1 5
B						
April. 26	50	4 3	16	4 1	♏	3 2
		5 0		0 0		7
Sept. 12	34	3 1	0	2 1	♏	5 2
		0 5		4 0		9 4

Anni CHRISTI
stylis veteri —

An. / Mens. / Dies	Alt. merid. ☉ visa — G.	' "	Declinatio vera — Gr.	' "	Locus Solis Ecliptica — S.	' "
1592 Sept. 10	35	5 5	0	5 1 9 5	♍	3 2 1 7
				B		
1593 Mart. 10	34	1 3 0	0	4 3 0	♋	4 4 5 8
				A		
Iunij 11	57	3 0 5	23	2 4 9 0	♊	1 2 7 0
				B		
1594 Mart. 10	33	5 2 6 0	0	9 4 5	♋	3 3 5 2
				A		
Sept. 13	34	6 2 0	0	0 2 0	♍	5 1 9 0
				B		
<i>Susp.</i> Dec. 11	10	4 1 1 0	23	3 5 3 5	(no value)	
				A		
1596 Martij 11	34	3 4 0 5	0	3 4 4 5	♈	2 0 7
				B		
Sept. 14	33	3 1 0 0	0	3 0 6	♊	3 2 0 0
				A		
1597 Mart. 10	34	2 2 0	0	3 4 0	♋	5 4 0 8

Anni CHRISTI
stylis veteri —

An. / Mens. / Dies	Alt. merid. ☉ visa — G.	' "	Declinatio vera — Gr.	' "	Locus Solis Ecliptica — S.	' "
				A		
1601 <i>Bena-tica</i>	52	2 5	12	4 3	♈	3 2
Apr. 23		6 0		5 0		7 0
				B		
Iun. 26	63	1 1	23	2 4	♊	2 4
		0 0		8 5		1 8
<i>Pragae</i> Aug. 6	56	3 1	16	4 4	♉	5 3
		8 0		2 7		1 3
<i>st. nouo</i> Sept.	47	2 3	7	3 1	♊	4 8
3		7 0		2 0		8

I pass over Jacob Christmann's [Jacob Christmann's] solar observations, inasmuch as I gather from book 1, chapter 7, of his own work that they are not exact to within 4 minutes. But from our own, which I obtained at Bologna in the College of St. Lucia together with Father Francesco Maria Grimaldi [Francesco Maria Grimaldi], made on the most serene days, with two quadrants, and not seldom in threes and fours, I select those which were the more accurate,

and not all of them, for there are in fact more than 500. But I add a selection, so as not to burden the pages with superfluous prolixity. Applying our obliquity of the ecliptic, the parallax, and the refraction, I add the declination, and from trigonometry the place of the Sun.

Meridian Altitudes of the Sun Observed by Fathers Riccioli [Riccioli] and Grimaldi [Grimaldi]

Latitude of the place [Altitudo Aequatoris]: 45° 29' 50".

The columns are: the observed meridian altitude [Alt. merid. ☉ visa]; the true declination of the Sun [Declinatio ☉ vera]; and the place of the Sun in the ecliptic [Locus Solis in Ecliptica]. Each gives degrees, minutes, and seconds. In the declination column, **B** marks a boreal (northern) declination and **A** an austral (southern) one.

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Month, Day	Alt. merid. ☉ visa (° ' ")	Declinatio ☉ vera (° ' ")	Locus Solis in Ecliptica (Sign ° ' ")
Mart. 23	46 33 30	1 3 50 B	♈ 2 40 5
Augusti 15	59 36 0	14 6 15	♏ 22 20 21
Augusti 31	54 13 0	8 43 20	♏ 7 39 12
Octob. 12	38 6 30	7 23 30 A	♏ 18 49 5
Octob. 23	34 7 0	11 23 20	♏ 29 40 32
Nouéb. 11	28 5 0	17 26 20	♏ 18 42 45
Martij 21	46 5 0	0 35 20 B	♈ 1 28 38
Mart. 22	46 30 30	1 0 50	♈ 2 32 34
Mart. 30	49 36 0	4 6 45	♈ 10 21 33
April. 6	52 16 20	6 46 40	♈ 17 12 43
April. 12	54 27 40	8 58 0	♈ 23 0 11
April. 20	57 16 0	11 46 15	♈ 0 45 47
Maij 5	61 59 10	16 29 25	♈ 15 22 23
Maij 16	64 48 0	19 18 15	♈ 25 59 0
Maij 22	66 3 40	20 33 55	♈ 1 44 0
Maij 30	67 25 30	21 55 40	♈ 9 26 30
Iunij 4	68 3 50	22 34 5	♈ 14 12 20
Iunij 11	68 41 0	23 11 15	♈ 20 50 3
Iunij 29	68 45 55	23 16 10	♈ 7 53 48
Iulij 11	67 35 40	22 5 55	♈ 19 23 48
Iulij 30	63 54 45	18 25 0	♏ 7 37 0
Augusti 4	62 36 30	17 6 45	♏ 12 27 40
Augusti 6	62 5 0	16 35 0	♏ 14 17 39
Augusti 21	57 25 0	11 55 15	♏ 28 48 30

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Month, Day	Alt. merid. ☉ visa (° ' ")	Declinatio ☉ vera (° ' ")	Locus Solis in Ecliptica (Sign ° ' ")
Nou. 14	27 7 0	18 29 30	♌ 22 40 38
Nou. 18	26 2 30	19 29 15	♌ 26 45 55
Dec. 17	22 6 0	23 27 0	♏ 26 10 20
1 Febr. 4	29 30 45	16 0 25 A	♍ 16 15 55
6			
4			
5			
Martij 10	41 39 30	3 50 15 A	♈ 20 20 25
Mart. 21	45 59 50	0 30 10 B	♈ 1 15 38
April. 19	56 52 30	11 22 50	♈ 29 39 10
Maij 9	63 0 10	17 30 25	♉ 18 57 35
Iunij 5	68 9 30	22 39 45	♊ 15 1 5
Iulij 27	64 40 40	19 10 55	♊ 4 31 52
Augusti 4	62 41 20	17 11 35	♊ 12 10 18
Aug. 14	59 47 0	14 17 15	♊ 21 46 30
Octob. 6	40 11 30	5 18 20 A	♋ 13 24 20
Octob. 11	38 18 0	7 11 55	♋ 18 18 42
Nou. 3	30 15 0	15 16 0	♋ 11 18 55
Nou. 23	25 1 0	20 31 0	♏ 1 29 30
1 Mart. 1	38 6 10	7 23 50 A	♈ 11 10 0
6			
4			
6			
Mart. 30	49 24 50	3 55 10 B	♈ 9 52 5
Maij 8	62 42 0	17 12 15	♉ 17 52 0
Maij 29	67 12 0	21 42 10	♊ 7 59 56
Maij 31	67 30 0	22 0 15	♊ 9 52 0
Iulij 11	67 39 10	22 9 25	♊ 18 59 2
Iulij 28	64 30 20	19 0 35	♊ 5 14 45
Aug. 4	62 45 40	17 15 55	♊ 11 54 48

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e
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r

Month, Day	Alt. merid. ☉ visa (° ' ")	Declinatio ☉ vera (° ' ")	Locus Solis in Ecliptica (Sign ° ' ")
Aug. 18	58 34 45	13 5 9	♌ 25 25 10
Sept. 22	45 44 40	0 15 0	♍ 29 22 22
Nou. 22	25 16 40	20 15 20 A	♊ 0 13 58
1 Januar. 23	26 8 0	19 23 45 A	♋ 3 37 40
6			
4			
7			
Mart. 20	45 24 10	0 5 30	♎ 29 46 12
April. 18	56 22 30	10 52 50 B	♍ 28 14 50
Iunij 16	68 53 30	23 23 45	♊ 24 37 11
Iulij 17	66 48 0	21 18 15	♎ 24 21 50
Iulij 29	64 20 10	18 50 25	♌ 5 56 2
Nou. 17	26 28 30	19 3 0 A	♍ 24 55 15
1 Febr. 25	36 48 30	8 42 20 A	♎ 7 44 50
6			
4			
8			
Mart. 9	41 24 20	4 4 25 A	♎ 19 41 52
Iunij 12	68 45 15	23 15 20 B	♊ 21 55 5
1 Mart. 20	45 37 0	0 7 20 B	♍ 0 18 24
6			
4			
9			
1 April. 24	58 29 0	12 59 15	♎ 4 17 53
6			
5			
0			
Aug. 21	57 35 0	12 5 20	♌ 28 19 32
1 Martij 22	46 25 0	0 55 20 B	♍ 2 18 46
6			
5			

Year	Month, Day	Alt. merid. ☉ visa (° ' ")	Declinatio ☉ vera (° ' ")	Locus Solis in Ecliptica (Sign ° ' ")
3				
1	Maij 22	65 56 52	20 27 8 B	♊ 1 10 35
6				
5				
5				
	Maij 23	66 0 34	20 38 50	♊ 2 8 7
	Augusti 7	62 0 48	16 31 3	♊ 14 40 1
	Augusti 8	61 41 29	16 11 44	♊ 15 37 33
	Sed in S. Petronio	61 41 0	16 11 15	♊ 15 39 13

Lastly, we present several meridian observations of the vertex-distances made with the great gnomon of San Petronio of Bologna [the San Petronio meridian line], together with the apparent diameter of the Sun derived from them, and from this the place of the Sun deduced—on the assumption of an obliquity of the ecliptic of 23° 30' 20" and an altitude of the pole in the same basilica of 44° 30' 20".

In the table that follows, each observation gives, for the stated date: the tangent of the vertex-distance of the lower limb [Limbi inferioris] and of the upper limb [Limbi superioris] (expressed as a large integer, the tangent reckoned to a radius of 100000); the resulting apparent diameter [Diameter apparens]; the semidiameter [semidiameter]; the distance of the center from the vertex [Centri distantia à Vertice]; the declination [Declinatio], marked **B** (boreal) or **A** (austral); and the place in the ecliptic [Locus in Ecliptica]. For the first observation only, the distance of the equator from the vertex [Aequatoris distantia à Vertice], 44° 30' 20", is also given. The "Arcus" columns give the corresponding arc in degrees, minutes, and seconds.

Year, Month, Day	(note)	Quantity	Tangent	
			Arcus (° ' ")	
1655 Iunij 21	Solis	Limbi inferioris	38909	21 15 38
		Limbi superioris	37870	20 44 30

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
		Diameter apparens		0 31 8
		semidiameter		0 15 34
		Centri distantia à Vertice		21 0 4
		Aequatoris dist. à Vertice		44 30 20
		Declinatio B.		23 30 16
		Locus in Ecliptica		♐ 29 27 30
1655 Iunij 22	exactiùs Solis	Limbi infer.	3891 1	21 15 42
		Limbi super.	3787 1	20 44 32
		Diameter app.		0 31 10
		semidiam.		0 15 35
		Centri distantia à Vertice		21 0 7
		Declinatio B.		23 30 18½
		Locus in Ecliptica		♐ 0 19 55
1655 Iulij 26	Solis	Limbi infer.	4719 7	25 15 57
		Limbi super.	4609 5	24 44 50
		Diameter app.		0 31 7
		semidiam.		0 15 33½
		Centri dist. à Vertice		25 0 23
		Declinatio B.		19 29 57
		Locus in Eclipt.		♑ 3 10 48
1655 Iulij 29	Solis	Limbi infer.	4867 1	25 57 10
		Limbi super.	4755 8	25 26 6
		Diameter app.		0 31 4

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1655 Iulij 30	Solis	semidiam.		0 15 32
		Centri dist. à Vertice		25 41 38
		Declinatio B.		18 48 42
		Locus in Eclipt.		♌ 6 3 11
		Limbi infer.	4918 7	26 11 20
		Limbi super.	4807 0	25 40 25
		Diameter app.		0 31 3
		semidiam.		0 15 32
		Centri dist. à Vertice		25 55 57
		Declinatio B.		18 34 23
1655 Aug. 31	Solis	Locus in Eclipt.		♌ 7 0 8
		Limbi infer.	7290 9	36 5 44
		Limbi super.	7152 1	35 34 22
		Diameter app.		0 31 22
		semidiam.		0 15 41
		Centri dist. à Vertice		35 50 3
		Declinatio B.		8 40 17
		Locus in Eclipt.		♍ 7 47 14

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1655 Sept. 15	Solis / dubia	Limbi infer.	891 67	41 43 21
		Limbi super.	875 54	41 12 12
		Diameter app.		0 31 9
		semidiam.		0 15 34½

Year, Month, Day	(note)	Quantity	Tan gent	Arcus (° ' ")
		Centri dist. à Vertice		41 27 46
		Declinatio B.		3 2 34
		Locus in Eclipt.		⌘ 22 21 3
1655 Sept. 22	Solis	Limbi infer.	981 33	44 27 36
		Limbi super.	963 34	43 55 49½
		Diameter app. semidiam.		0 31 46 0 15 53
		Centri dist. à Vertice visa vera		44 11 42 44 11 37
		Declinatio B.		0 18 43
		Locus in Eclipt.		⌘ 29 13 4
1655 Sept. 23	Solis	Limbi infer.	994 83	44 51 5
		Limbi super.	976 72	44 19 29
		Diameter app. semidiam.		0 31 36 0 15 48
		Centri dist. à Vertice		44 35 17
		Declinatio A.		0 4 57
		Locus in Eclipt.		⊕ 0 12 24
1655 Sept. 24	dubia	Limbi infer.	100 853	45 14 35
		Limbi super.	990 16	44 43 4
		Diameter app. semidiam.		0 31 31 0 15 46
		Centri dist. à		44 58 50

Year, Month, Day	(note)	Quantity	Tan gent	Arcus (° ' ")
1656 Ianuar. 1	Solis / Lubrica	Vertice		
		Declinatio A.		0 28 30
		Locus in Eclipt.		♌ 1 11 24
		Limbi infer.	244 590	67 45 46
		Limbi super.	238 210	67 13 40
		Diameter app.		0 32 6
		semidiam.		0 16 3
		Centri dist. visa à vert.		67 29 43
		sed vera		67 32 53
		Declinatio A.		23 2 33
		Locus in Eclipt.		♍ 11 4 7
1656 Ianu. 2	Solis / minus certa	Limbi infer.	243 570	67 40 45
		Limbi super.	237 150	67 8 10
		Diameter app.		0 32 35
		semidiam.		0 16 18
		Centri dist. visa à vert.		67 24 28
		sed vera		67 27 38
		Declinatio A.		22 57 18
		Limbi infer.	239 850	67 22 3
		Limbi super.	233 690	66 49 54
		Diameter app.		0 32 9
		semidiam.		0 16 4½
1656 Ianu. 5	Solis / certior sed non certa	Centri dist. visa à vert.		67 5 58½

Year, Month, Day	(note)	Quantity	Tan gent	Arcus (° ' ")
1656 Ianu. 9	Solis / Lubrica	sed vera		67 9 8
		Declinatio A.		22 38 48
		Locus in Eclipt.		☿ 15 6 25
		Limbi infer.	233 950	66 51 22
		Limbi super.	228 050	66 19 21
		Diameter app.		0 32 1
		semidiam.		0 16 1
		Centri dist. visa à vert.		66 35 22
		sed vera		66 38 12
		Declinatio A.		22 7 52
		Locus in Eclipt.		☿ 19 10 2
		Limbi infer.	223 270	65 52 23
		Limbi super.	217 790	65 20 15
		Diameter app.		0 32 8
1656 Ianu. 15	Solis	semidiam.		0 16 4
		Centri dist. visa à vert.		65 36 19
		sed vera		65 38 49
		Declinatio A.		21 8 29
		Locus in Eclipt.		☿ 25 16 8

The right-hand column of folio 27 continues the same table:

Year, Month, Day	(note)	Quantity	Tang ent	Arcus (° ' ")
1656 Mart. 19	Solis	Limbi infer.	9976 2	44 55 54
		Limbi super.	9794	44 24 14

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
			0	
		Diameter app.		0 31 40
		semidiam.		0 15 50
		Centri dist. visa à Vert.		44 40 4
		verior		44 49 0
		Declinatio A.		0 9 40
		Locus in Eclipt.		☿ 29 35 43
1656 Mart. 20	Solis / sed nubilo	Limbi infer.	9838	44 31 56
			0	
		Limbi super.	9660	44 0 33
			0	
		Diameter app.		0 31 23
		semidiam.		0 15 41
		Centri dist. à Vertice		44 16 14
		Declinatio B.		0 14 6
		Locus in Eclipt.		♃ 0 35 17
1656 Mart. 21	Solis / sereniss.	Limbi infer.	9704	44 8 30
			8	
		Limbi super.	9527	43 36 50
			5	
		Diameter app.		0 31 40
		semidiam.		0 15 50
		Centri dist. à Vertice		43 52 40
		Declinatio B.		0 37 40
		Locus in Eclipt.		♃ 1 34 30
1656 Mart. 22	Solis / sub nubilo	Limbi infer.	9571	43 44 43
			2	
		Limbi super.	9398	43 13 21
			1	
		Diameter app.		0 31 22

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
		semidiam.		0 15 41
		Centri dist. à Vertice		43 29 2
		Declinatio B.		1 1 18
		Locus in Eclipt.		Υ 2 33 50
1656 Mart. 23	Solis / sereno	Marg. infer.	9940 7	43 21 8
		super.	9268 3	42 49 31
		Diameter app.		0 31 37
		semidiam.		0 15 48
		Centri dist. à Vertice		43 5 19
		Declinatio B.		1 25 1
		Locus in Eclipt.		Υ 3 33 16
1656 April. 11	Solis	Marg. infer.	7292 1	36 6 0
		Marg. super.	7152 9	35 34 32
		Diameter app.		0 31 28
		semidiam.		0 15 44
		Centri dist. à Vertice		35 50 16
		Declinatio B.		8 40 4
		Locus in Eclipt.		Υ 22 12 6
1656 Iulij 23	Solis	Limbi infer.	4619 2	24 47 36
		Limbi super.	4509 8	24 16 19
		Diameter app.		0 31 17
		semidiam.		0 15 47
		Centri dist. à Vertice		24 32 6
		Declinatio B.		19 58 14
		Locus in Eclipt.		♂ 1 5 30

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1656 Aug. 8	Solis	Marg. infer.	5494 4	28 47 10
		Marg. super.	5377 0	28 16 1
		Diameter app. semidiam.		0 31 9 0 15 35
		Centri dist. à Vertice		28 31 36
		Declinatio B.		15 58 44
		Locus in Eclipt.		♌ 16 21 5
1656 Aug. 9	Solis	Limbi infer.	5560 5	29 4 32
		Limbi super.	5442 6	28 33 27
		Diameter app. semidiam.		0 31 5 0 15 33
		Distant. centri à Vert.		28 49 0
		Declinatio B.		15 41 20
		Locus in Eclipt.		♌ 17 18 45
Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1656 Aug. 20	Solis	Limbi infer.	6377 5	32 31 40
		Limbi super.	6251 3	32 0 20
		Diameter app. semidiam.		0 31 20 0 15 40
		Centri dist. à Vertice		32 16 0
		Declinatio B.		12 14 20
		Locus in Eclipt.		♌ 27 53 30
1656 Sept. 22	Solis	Limbi infer.	9913	44 44 59

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
			0	
		Limbi super.	9733	44 13 35
			5	
		Diameter app.		0 31 24
		semidiam.		0 15 42
		Centri dist. à Vertice		44 29 17
		Declinatio B.		0 1 3
		Locus in Eclipt.		♄ 29 57 22
1656 Sept. 23	Solis	Limbi infer.	1004	45 8 30
			95	
		Limbi super.	9867	44 37 0
			0	
		Diameter app.		0 31 30
		semidiam.		0 15 45
		Centri dist. à Vertice		44 52 45
		Declinatio A.		0 22 25
		Locus in Eclipt.		♌ 0 56 11
1656 Sept. 24	Solis	Limbi infer.	1018	45 31 53
			72	
		Limbi super.	1000	45 0 21
			20	
		Diameter app.		0 31 32
		semidiam.		0 15 46
		Centri dist. à Vertice		45 16 7
		Declinatio A.		0 45 47
		Locus in Eclipt.		♌ 1 54 57
1656 Sept. 29	Solis	Limbi infer.	1090	47 29 13
			80	
		Limbi super.	1070	46 57 40
			90	
		Diameter app.		0 31 33

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1656 Oct. 15	Solis	semidiam.		0 15 47
		Centri dist. à Vertice		47 13 27
		Declinatio A.		2 43 7
		Locus in Eclipt.		± 6 47 25
		Marg. infer.	1356 41	53 36 3
		Marg. super.	1330 41	53 4 11
		Diameter app.		0 31 52
		semidiam.		0 15 56
		Centri dist. à Vertice		53 20 7
		Declinatio A.		8 49 47
1656 Nou. 11	Solis / semidubia	Locus in Eclipt.		± 22 38 15
		Limbi infer.	1916 70	62 26 51
		Limbi super.	1874 30	61 55 6
		Diameter app.		0 31 45
		semidiam.		0 15 53
		Centri dist. à Vert. visa		62 10 59
		vera		62 12 23
		Declinatio A.		17 42 3
		Locus in Eclipt.		ℳ 19 40 15
1656 Nou. 23	Solis	Limbi infer.	2175 30	65 18 42
		Limbi super.	2123 00	64 46 41
		Diameter app.		0 32 1
		semidiam.		0 16 0½
		Centri dist. à Vertice		65 4 52

Year, Month, Day	(note)	Quantity	Tang ent	Arcus (° ' ")
1656 Dec. 21	Solis	Declinatio A.		20 34 32
		Locus in Eclipt.		↗ 1 47 28
		Limbi infer.	2500 50	68 12 9
		Limbi super.	2434 40	67 40 5
		Diameter app.		0 32 4
		semidiam.		0 16 2
		Centri dist. à Vertice		67 58 57
		Declinatio A.		23 28 37
		Locus in Eclipt.		↘ [?] [?] [?]

The right-hand column of folio 28 continues the table:

Year, Month, Day	(note)	Quantity	Tang ent	Arcus (° ' ")
1657 Ianu. 10	Solis / Lubrica	Limbi infer.	2309 66	66 35 21
		Limbi super.	2251 85	66 3 20
		Diameter app.		0 32 1
		semidiam.		0 16 0½
		Centri dist. à Vertice		66 21 30
		Declinatio A.		21 51 10
		Locus in Eclipt.		↘ 21 1 33
1657 Ianu. 29	Solis	Limbi infer.	1917 90	62 27 44
		Limbi super.	1875 10	61 55 42
		Diameter app.		0 32 2
		semidiam.		0 16 1
		Centri dist. vera à Vert.		62 13 53

Year, Month, Day	(note)	Quantity	Tang ent	Arcus (° ' ")
1657 Febr. 10	Solis	Declinatio A.		17 43 33
		Locus in Eclipt.		≈ 10 14 21
		Limbi infer.	1653 80	58 50 22
		Limbi super.	1619 50	58 18 20
		Diameter app.		0 32 2
		semidiam.		0 16 1
		Centri dist. à Vertice		58 35 31
1657 Mart. 16	Solis	Declinatio A.		14 5 11
		Locus in Eclipt.		≈ 22 23 37
		Marg. infer.	1042 75	46 12 0
		Marg. super.	1023 70	45 40 10
		Diameter app.		0 31 50
		semidiam.		0 15 55
		Centri dist. à Vertice		45 56 0
1657 Mart. 19	Solis	Declinatio A.		1 25 40
		Locus in Eclipt.		× 26 25 5
		Marg. infer.	1000 50	45 0 50
		Marg. super.	9822 0	44 29 10
		Diameter app.		0 31 40
		semid. am.		0 15 50
		Vera Centri dist. à Vertice		44 44 55
1657 Mart. 28	Solis	Declinatio A.		0 14 35
		Locus in Eclipt.		× 29 23 30
		Limbi infer.	8842 0	41 29 0

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
1658 Mart. 20	Solis	Limbi super.	8680 5	40 57 30
		Diameter app.		0 31 30
		semidiam.		0 15 40
		Vera Centri dist. à Vertice		41 13 10
		Declinatio B.		3 17 10
		Locus in Eclipt.		Υ 8 15 48
		Limbi infer.	9907 5	44 44 0
1658 April. 4	Solis	Limbi super.	9726 3	44 12 20
		Diameter app.		0 31 40
		semidiam.		0 15 50
		Vera Centri dist. à Vertice		44 28 5
		Declinatio B.		0 2 15
		Locus in Eclipt.		Υ 0 5 38
		Marg. infer.	8064 0	38 53 0
1658 Iunij 20	Solis	Marg. super.	7914 0	38 21 30
		Diameter app.		0 31 30
		semidiam.		0 15 45
		Vera Centri dist. à Vertice		38 37 5
		Declinatio B.		5 53 15
		Locus in Eclipt.		Υ 14 58 54
		Limbi infer.	3891 2	21 15 45
		Limbi super.	3787 6	20 44 41

Year, Month, Day	(note)	Quantity	Tangent	Arcus (° ' ")
		Diameter app.		0 31 4
		semidiam.		0 15 32
		Vera centri Dist. à Vert.		21 0 8
		Declinatio B.		23 30 12
		Locus in Eclipt.		II 29 14 3

Table of solar meridian observations (continued)

This table continues the series of San Petronio gnomon and quadrant solar observations. Columns: **An. M. D.** (Year, Month, Day); **Distantiarum à Vertice Tangentes** (Tangents of the vertex-distances) — with the sub-rows giving, for each observation, the lower limb [*Limbi inferior.*], upper limb [*Limbi superior.*], apparent diameter [*Diameter appar.*], its half [*semidiam.*], true vertex-distance of the center [*Vera centri dist. à Vertice*], declination (B = boreal / A = austral) [*Declinatio*], and the ecliptic place [*Locus in Eclipt.*]; and **Arcus Gr. ' "** (Arc, in degrees, minutes, seconds).

Year, Month, Day	Quantity	Tangent value	G r ' "
1658 June 21, Sun (dubious)	Lower limb	38906	2 1 3
			1 5 2
	Upper limb	37868	2 4 2
			0 4 7
	Apparent diameter		0 3 5
			1
	Half-diameter		0 1 3
			5 2
	True vertex-dist. of center		2 5 5
			0 9 4
	Declination B.		2 3 2
			3 0 6
	Place in ecliptic	II	. . .
1659 Jan. 19, Sun (suspect)	Lower limb	214580	6 0 4
			5 8

Year, Month, Day	Quantity	Tangent value	G r ' "
1659 Feb. 8, Sun	Upper limb	209460	6 2 5 4 8 0
	Apparent diameter		0 3 5 1 8
	Half-diameter		0 1 5 5 9
	True vertex-dist. of center		6 4 3 4 4 0
	Declination A.		2 1 1 0 4 0
	Place in ecliptic	♊	2 5 3 9 1 4
	Lower margin	170710	5 3 1 9 8 9
	Upper margin	167150	5 6 3 9 4
	Apparent diameter		0 3 4 1 5
	Half-diameter		0 1 5 5 4
	True vertex-dist. of center		5 2 0 9 2
	Declination A.		1 5 4 4 1 0
	Place in ecliptic	♈	1 5 5 9 8 2
1659 Mar. 29, Sun	Lower margin	87800	4 1 0 1 7
	Upper margin	86285	4 4 2 0 7 1
	Apparent diameter		0 2 3 9 9
	Half-diameter		0 1 5

Year, Month, Day	Quantity	Tangent value	G r ' "
1659 May 15, Sun	True vertex-dist. of center		4 0
			4 1 4
	Declination B.		1 3
			3 2 3
	Place in ecliptic	Υ	8 5
			8 4 4
	Lower margin	48420	4 2
			2 5 1
	Upper margin	47300	5 0 0
			2 1 5
	Apparent diameter		5 8 1
			0 3 1
	Half-diameter		1 9
			0 1 4
1659 Aug. 14, Sun	True vertex-dist. of center		5 0
			2 3 5
	Declination Bor.		5 4
			1 5 1
	Place in ecliptic	Υ	8 6 5
			2 2 3
	Lower margin	58620	4 7 9
			3 2 4
	Upper margin	57350	0 2 4
			2 5 3
	Apparent diameter		9 0
			0 3 4
	Half-diameter		2 1
			0 1 2
	True vertex-dist. of center		6 0
			3 5 5
	Declination B.		0 5
			1 2 2
			4 4 5

Year, Month, Day	Quantity	Tangent value	G r ' "
1660 Nov. 14, Sun	Place in ecliptic	ϱ	2 2 4 1 1 0
	Lower margin	198350	6 1 4 3 4 0
	Upper margin	193860	6 4 4 2 2 8
	Apparent diameter		0 3 5 1 2
	Half-diameter		0 1 5 5 6
	True vertex-dist. of center		6 5 1 2 8 6
	Declination A.		1 2 5 8 7 6
	Place in ecliptic	$\mathfrak{M}$	2 3 3 2 4 0
	Lower margin	215572	6 6 5 5 2
	Upper margin	210420	6 3 5 4 4 2
1661 Jan. 18, Sun	Apparent diameter		0 3 0 2
	Half-diameter		0 1 0 6
	True vertex-dist. of center		6 3 2 4 0 3
	Declination A.		2 2 3 0 0
	Place in ecliptic	$\mathfrak{N}$	2 2 4 9 3 0
	Lower margin	202770	6 4 5 3 4 3
	Upper margin	198110	6 1 0
1661 Jan. 24, Sun			

Year, Month, Day	Quantity	Tangent value	G r ' "
			3 3
	Apparent diameter		0 3 5 1 3
	Half-diameter		0 1 5 5 6
	True vertex-dist. of center		6 2 3 3 7 1
	Declination A.		1 5 1 8 7 1
	Place in ecliptic	≈	5 2 4 8

CAPUT IX.

On the Hypothesis of the Solar Motion, its Apogee, and the Motion of the Apogee.

1. It is certain among all astronomers that the Sun lingers longer in the boreal semicircle of the ecliptic than in the austral; and that it formerly lingered longer in the spring quadrant than in the autumn; and that even now it lingers longer in summer than in spring — as is clear from what was said in Chapter VII. It would be absurd to suppose, as some of the early astronomers did, that the celestial body of the Sun is moved unequally in actual physical fact — that is, that it really carries itself round with such an apparent inequality. Rather, either the Sun is moved uniformly in an epicycle, while the Sun in the meantime is carried by the epicycle off from a circle concentric with the Earth; or — more probably — it is carried in an eccentric circle whose center differs from the center of the Earth, a circle which carries the solar body uniformly: so much so that, if our eye were at the center of the deferent circle carrying the Sun, it would see no inequality in the Sun's motion at all. We set out this hypothesis, with all its properties, fully in Book 3 of the *Almagestum Novum*, Chapter 4; and in Chapters II and following of the same we showed the method of deducing the prosthaphaeresis from the given (or half-) diameter of the epicycle, or from the eccentricity, and of reducing the mean motion of the Sun to the

true, or apparent, motion. (We treated the method of deducing the prosthaphaeresis in *Almagestum Novum* III, Chapters 19, 20, and 21.)

2. Kepler, however, considering in the lesser planets the equant circle introduced by Ptolemy, and the difference of the apparent diameter of the Sun at apogee and (where it is greatest) at perigee, and that the least distance of the Sun from the Earth requires no more than half of the whole of that eccentricity — which is necessary and concluded for the solar prosthaphaereses in the work on Mars and in the *Epitome of Copernican Astronomy* — held that an equant ought to be introduced into the solar theory, and that the eccentricity ought to be bisected. He proceeded thus: he made the half of that eccentricity belong to the center of the orbit, and the remaining half to the center of the orbit carrying the Sun. Yet, since the Sun is moved uniformly about the center of this orbit, some on that account say that this is the center of equality, or the center of mean motion. But because it is proper to an ellipse to have in its greater diameter two points equally distant from the center of the ellipse itself — points which are called the umbilici, or foci, and by the concurrence of whose radii an ellipse is described from the burning of the rays in either of the said points — therefore there is no doubt that the Sun's orbit is rather an ellipse than a circle, and that the inequality, which when the Sun is collocated in the Earth appears according to the Sun's motion, is real. For although the apparent semis is on account of the distance of the eye from the center of the deferent orbit, yet the other semis is a real inequality, on account of the distance of the center of the orbit carrying the Sun from the point, or center, of equal motions. So at last Kepler inferred that the solar prosthaphaeresis is to be bisected, comprised as the Optical Equation by two straight lines drawn from the Sun — one to the center of the Earth, the other to the adjoined point of equality — of which kind are SC and SF, if the Sun be supposed at S, or HT and HC, if the Sun be placed at H. In the Physical Equation it is comprised by two straight lines drawn, one from the Sun to the center of the ellipse, the other likewise to the other focus, or point of equality — of which kind are SC and SF, if the Sun be supposed at S (or HC and HF, if the Sun be placed at H). Hence the **Optical Equation** is the angle CST, or in the second case CHT, and its base is the semi-eccentricity CT; while the **Physical Equation** is the angle CSF, or in the second case CHF, and its base is the semi-eccentricity CF. But how this is to be demonstrated by exact Geometry in the ellipse —

Diagram. A semicircular (half-ellipse) figure illustrating the bisection of the solar prosthaphaeresis into the Optical and Physical Equations. A vertical diameter runs from A (top) through F, G, T to P (bottom), with the curved arc bowing out to the left and meeting the vertical at A and P. The point S is set high on the left arc and H low on the left arc; multiple straight lines are drawn from S and from H to the interior points F, G, T along the vertical axis, forming the angles of the optical and physical equations described in the text.

- A (top of vertical diameter)
- F (upper interior point on the axis)
- G (middle interior point on the axis)
- T (lower interior point on the axis)
- P (bottom of vertical diameter)
- S (upper point on the left arc — one position of the Sun)
- H (lower point on the left arc — the second position of the Sun)

— the whole prosthaphaeresis of the Sun in an ellipse, with both its Optical and Physical parts taken separately, Kepler does not show; and for that reason Ismaël Boulliau [Ismaël Boulliau] labored at it. For that reason, too, Seth Ward [Seth Ward] contended most exactly to demonstrate it — though he did not fully succeed — in his *Inquisitio in Bullialdi Astronomiam Philolaicam*, and in his work issued two years afterward, which he entitled *Astronomia Geometrica*, where he undertakes to demonstrate the said Equations, both in the circle and in the ellipse — points, nodes, and inclinations. And even before these, the Count of Pagan [Blaise de Pagan], having perfected all things, embraced the Copernicans, and from there, together with the diurnal and annual motion of the Earth in place of the eccentric circle and the deferent circles, and with the bisection of the eccentricity — so far as it is suited to representing the Sun's inequality by an eccentric circle and an ellipse of its motions — [represented these].

3. We hold certain things from what has been said in Book 9 of the *Almagestum Novum*, Section 4, and from the things to be said in Appendix II of this Third Book, where the Sun rests in the Eccentric Center; and about the Sun, near the underlying scheme of the figure, we shall always exhibit its diurnal spirals, so as not to designate the Sun anywhere — yet near the Sun, just as round a certain cone it describes its diurnal spirals, that they may designate how near to the ellipse's surface the very nearly circular periphery may approach the circular, and so that the annual inequalities also may be represented as able to be represented in this feigned hypothesis of the ellipse, or even of the circle, provided only that the Sun's

eccentricity be bisected. By these things, foreknown, what is to be denominated belongs to the inquiry into the same Sun's apogee, of which the method is handed down in Book 14 of the *Almagestum Novum*, Chapter 4. As an example of the eccentricity we declared, having assumed (in the same Third Book, Chapter 5, num. 85, 86) the moments of two equinoxes, and beyond that in Chapter 7, num. 165, the Sun's place at Bologna at the gnomon of San Petronio, namely Grade 7° , $0'$, $18''$ of Leo.

4. In the following figure, with the Earth's center at T, I describe the ecliptic ABPD, and the line of the equinoxes BTD — which, being cut by T, cuts the line of the absides AP, somewhat inclined at D, toward B; because we are most certain that at the present time the Sun's apogee A has passed beyond the beginning of Cancer. In this line let there be assumed, according to the ancient hypothesis, the whole eccentricity TC; and with the center made at C, describe the Sun's orbit SV, and to the points of intersection M and N draw the straight lines CM and CN; then, with the Sun placed at S, under the point L of Leo, draw the line TSL of the true place, and the line CS of the mean place.

Diagram. A figure showing the ecliptic and the Sun's eccentric orbit. An outer circle (the ecliptic ABPD) is centered on T, with the Earth at T. A vertical diameter runs from A (top) through C and T to P (bottom); a horizontal diameter runs from B (left) through M, T, N to D (right). The line of the absides passes through A–C–T–P. An inner circle (the Sun's orbit SV), centered on C, is drawn; the Sun S sits on the upper-left of the inner circle, with V at the bottom. The line L–S–T (true place toward L in Leo) is drawn from the upper left through S to T. The zodiac symbol Libra ♎ stands at B (left) and Aries ♈ at D (right).

- A (top — the apogee)
- L (upper-left, exterior — the true place of the Sun in Leo)
- S (the Sun, on the inner orbit)
- C (center of the Sun's eccentric orbit)
- B (left end of the equinoctial line — marked ♎ Libra)
- M (interior point on the horizontal, left of T)
- T (the Earth's center)
- N (interior point on the horizontal, right of T)
- D (right end of the equinoctial line — marked ♈ Aries)
- V (bottom of the inner orbit)
- P (bottom — the perigee)

In the year 1655 the Sun was observed at Bologna at the meridian of day 30 July at L, that is, at Grade $7^{\circ}, 0', 8''$ of Leo. Therefore the arc LAD, and likewise the angle LTD measured from the beginning of Aries, was computed to be Grade $127^{\circ}, 0', 8''$; and, completed to two right angles, namely the angle BTL — which is the same as MTI — was Grade $52^{\circ}, 59', 52''$. In the same year the Sun's ingress into Libra B was observed on day 22 September, at Hour 18, 55', p.m., at Bologna. The time between both observations was 54 days, 18 hours, 55'; from which, by the things established in Chapter 4, the mean motion ought to be Grade $54^{\circ}, 0', 35''$ — and such is the angle SCM, or ICS. Finally in the year 1656 the Sun's ingress into Aries was observed at the same place on 19 March, at Hour 9, 51', p.m.

— in an ellipse equally distant from the line of the absides, or made not at all from the distances [of the absides].

5. (Continuing the worked example on the right-hand column of the previous folio, beginning the second observation series:) Likewise, by the same method drawn from the two said equinoctial points, and with the Sun observed in the meridian of the day 31 August of the same year 1655, in Virgo Grade $7^{\circ}, 47', 15''$ — according to what was related in the observations of Chapter 8 — we find the Sun's apogee in Cancer Grade $7^{\circ}, 13', 12''$. Again, from the same equinoxes, and with the Sun observed in the year 1655 in the meridian of 23 July in Leo Grade $1^{\circ}, 5', 31''$ — as we adopted the observations in the same chapter — we get the apogee in Cancer Grade $9^{\circ}, 58', 29''$. Thirdly, in the triangle CIT, having acquired the side TI, [partition] 4224. Thirdly, in the triangle CIT we find the angle CIT, Grade $34^{\circ}, 58', 17''$; the angle CTI is found, Grade $28^{\circ}, 50', 0''$. There was, moreover, the angle LTD, Grade $127^{\circ}, 0', 8''$; subtracting from this the angle CTI, Grade $28^{\circ}, 50', 0''$, there remains the distance of the Sun's apogee from the beginning of Aries, that is, the angle ATD, Grade $98^{\circ}, 9', 8''$. Accordingly the time of the Sun's apogee was, at that time (the positions placed in Cancer Grade $8^{\circ}, 9', 8''$) —

[The right column of p. 62 carries the detailed trigonometric working that produces these results. Its principal steps, transcribed in order:] In the triangle CIS, with radius CS assumed of 100000 parts, from the angle CIS, Grade $125^{\circ}, 1', 43''$, and from the angle CSI, Grade $0^{\circ}, 57', 42''$, by Trigonometry the side IC is collected, of 2049 such parts, the radius IC being 100000; there remains IM, [partition] 97951. Secondly, in the triangle MIT, the side IM being found, [partition] 97951, and from the said angle MTI, Grade $52^{\circ}, 59', 52''$, and the angle IMT, Grade $1^{\circ}, 58', 25''$, the side TI is collected, [partition] 4224. Thirdly, in the

triangle CIT, the side TI being acquired, [partition] 4224, and from the said (as above) angle CIT, Grade $34^{\circ}, 58', 17''$, the angle CTI is found, Grade $28^{\circ}, 50', 0''$. There was, moreover, the angle LTD, Grade $127^{\circ}, 0', 8''$; from which, subtracting CTI, Grade $28^{\circ}, 50', 0''$, there remains the distance of the Sun's apogee from the beginning of Aries, that is, the angle ATD, Grade $98^{\circ}, 9', 8''$. Hence at that time the Sun's apogee was in Cancer Grade $8^{\circ}, 9', 8''$.

By the same method, from the two said equinoxes, and with the Sun observed in the meridian of day 31 August of the same year 1655 in Virgo Grade $7^{\circ}, 47', 15''$ (according to what was related in the observations of Chapter 8), we find the Sun's apogee in Cancer Grade $7^{\circ}, 13', 12''$. Again, from the same equinoxes, and with the Sun observed in the year 1655 in the meridian of 23 July in Leo Grade $1^{\circ}, 5', 31''$ (as the observations were related in the same chapter), we obtained the Sun's apogee in Cancer Grade $9^{\circ}, 58', 29''$. Then in the year 1656, with the vernal equinox observed on 19 March at Hour 9, 51', p.m., according to the said Chapter 5, [and] in the autumnal at Hour 0, 44', p.m., according to the said Chapter 8, we deduced the Sun's apogee in Cancer Grade $8^{\circ}, 9'$. Neglecting therefore, amid so many negotiations from so many observations, the things which adhere as more certain conclusions toward the end of the year 1655, the Sun's apogee comes out to stand beyond Grade 7° and short of Grade 10° of Cancer — indeed beyond Grade 8° of Cancer, by three of the aforesaid observations. But that it is short of the extreme, namely Cancer Grade $7^{\circ}, 13', 12''$, and Grade $9^{\circ}, 58', 29''$: the arithmetic mean is Cancer Grade $8^{\circ}, 35', 51''$. We set the Sun's apogee at the end of the year 1655 at Cancer Grade $8^{\circ}, 36'$.

[Margin: The Sun's apogee at the end of the year 1655.]

6. But because in the aforesaid method we supposed the center of the mean motions to be the very center of the Sun's orbit — and yet, the eccentricity being bisected, the center of the Sun's orbit ought to be constituted beyond the center of the Sun's orbit by as great an interval as is the semi-eccentricity, and distant from the center of the apparent motions, or of the Earth, by the whole eccentricity for the Sun's prosthaphaereses owed throughout — although tentatively, in some way or other, that we might observe sometimes one equinox, sometimes the other, with the summer observations, in the quadrant near the vernal equinox, [and] near the autumnal, in order to demonstrate geometrically the apogee line so derived: as well in the circle as in the ellipse, especially since, among the other properties of the ellipse, this is by far the most notable, and is treated below by us, namely that any radius whatever drawn from the foci to the

circumference, two such taken at once, are equal to the Axis, or to the greater diameter itself; and likewise this straight line, drawn from either of the foci to the extremity of the lesser of the two diameters — which lesser diameter is called in Greek [Greek: διάμετρος (diametros, "diameter")], or rather the transverse of the ellipses [Greek: διάμετρος (diametros, "diameter")] — is equal to the semi-diameter, that is, to the greater [half-axis] of the ellipses. And this same thing, however much it is multiplied by Trigonometry, has not yet succeeded for us — although we tried it — namely, with Kepler, with Boulliau, with the Count of Pagan, and with Seth Ward. Therefore we set forth another method which does not need Trigonometry, and which works on the solar motion's observations at the two points of the circle, [the two points] equally distant from the line of the absides, or made not at all from the distances [of the absides].

7. First, indeed, because it is certain not only in the Circular Hypothesis, but also in the Elliptical drawn from Conic elements, that the true motion of the Sun is swifter at perigee and slowest at apogee: if within the same Tropical Year there be observed two days on which the true motion of the Sun is one and the same minimum, [it follows] that in the one and the other [observation] the ecliptic place is manifest from these, [namely] that the ecliptic place forthwith reveals there the apogee. But if it errs even by a few seconds in the Sun's altitudes, on this occasion it will err by far more grades in the place of the apogee.

Secondly, it is certain that the true place of the Sun, computed for the prior semicircle of the Anomaly, according to the order of the signs from the apogee, is less than the mean motion; and therefore that the Equations in this whole semicircle are to be subtracted; and in the semicircle of the posterior anomaly, [the true place] is greater than the mean motion of the Sun proceeding from the apogee; and consequently that the Equations are to be added. Comparing, however, the true motion made from day to day, or in equal times, and absolutely, the computation made from the apogee, it is certain that in the superior anomaly's semicircle — which is above the Diacentron — the true motion of the apogee is less than the mean motion; within the Diacentron, or in the inferior anomaly's semicircle, [that] near perigee the true motion is greater than the mean motion; and that the transition from the one extreme to the other is nowhere except at the points of the Diacentron, at which the mean motion is most nearly equal to the true motion. Therefore by continuous observations those places are denoted in which, within the same Tropical Year, the true and equinoctial motion is equal, and the ecliptic arc intercepted between the two is

bisected: with that position given, the situations of the apogee and of the perigee will be most certain. But this method demands a more delicate observer.

Thirdly, it is certain that, at the two places equally distant from the apogee, the apparent motions of the Sun are made equal. Therefore, if there be observed two such motions which involve two such places, the intercepted ecliptic arc will be bisected by the line of the absides intercepting the place — both the apogee and the perigee. For the First and Second method we have not yet adopted observations of our own, or others suitable enough; but for this Third method we have here two suitable pairs of observations, [and] of the same certainty, which nevertheless it pleases [me] to bring forward into the middle.

8. From the things related in Chapter 8: in the year 1655 the Sun appeared at the Temple of San Petronio at Bologna in the meridian of the day 22 September in Virgo Grade $29^{\circ}, 13', 4''$; and on day 23 in Libra Grade $0^{\circ}, 12', 24''$. Therefore the diurnal true motion was Grade $59', 20''$. In the year 1656, however, the Sun appeared at the same place on the meridian of 21 March in Aries Grade $1^{\circ}, 34', 30''$; and on day 23 [in Aries] Grade $2^{\circ}, 33', 50''$. Therefore the diurnal true motion was Grade $59', 20''$. The ecliptic arc from Libra Grade $0^{\circ}, 12', 24''$ to Aries Grade $2^{\circ}, 33', 50''$ is Grade $182^{\circ}, 21', 26''$, of which the half is Grade $91^{\circ}, 10', 43''$; which, added to Libra Grade $0^{\circ}, 12', 24''$, gives Grade $91^{\circ}, 23', 7''$; and accordingly the place of the perigee in Capricorn Grade $1^{\circ}, 23', 7''$, and the apogee in Cancer Grade $1^{\circ}, 23', 7''$. But that this is false — not only from the things said toward the close of the previous number, but also from the things now to be said, and from other observations — is detected by us.

For in the year 1655, as I related in Chapter 8, on 22 May in our Observatory the Sun appeared at the meridian in Gemini Grade $1^{\circ}, 10', 35''$; and on day 23 in Gemini Grade $2^{\circ}, 8', 7''$; whence the diurnal true motion was $57', 32''$. Again in the same year, on 7 August in the meridian, the Sun appeared to us in Leo Grade $14^{\circ}, 40', 1''$; and on day 8 in Leo Grade $15^{\circ}, 37', 33''$. So on the same day the Sun was seen at the San Petronio gnomon to be in Leo Grade $15^{\circ}, 39', 13''$. Standing then by our observations, the true diurnal motion was likewise $57', 32''$; and so, equal to the ecliptic arc, from Gemini Grade $1^{\circ}, 10', 35''$ to Leo Grade $15^{\circ}, 35', 33''$, [is] Grade $74^{\circ}, 26', 58''$, of which the half is Grade $37^{\circ}, 13', 28''$; which, added to Gemini Grade $1^{\circ}, 10', 35''$, makes the place of the apogee in Cancer Grade $8^{\circ}, 24', 3''$. On account of the diversity, however, of the aforesaid observations, we think it ought to be retained —

[Margin: The foundations of Longomontanus and of Kepler concerning the motion of the Sun's apogee.]

— the apogee at the end of the year 1655 in Cancer Grade 8° , $36'$, according to the said number 5.

On the Sun's Apogee discovered by others before us, and on its Motion.

9. When Hipparchus [Hipparchus] had found the Sun's apogee in Gemini Grade 5° , $30'$, about 140 years before Christ, and Ptolemy [Ptolemy] reports it the same in nearly the same place — as he himself relates in *Almagest* III [*Magna Constructio*, Book 3, Chapter 4] — and since 280 years before Christ existed (which did not suffice for evidently determining the change of the apogee, for those intervening), held that it sufficed [for the foundation]. Albategnius [al-Battānī], however, in the year of Christ 883, has Chapter 28, "On the science of the Stars," observed the Sun's apogee in Gemini Grade 22° , $17'$; that is, the annual progress [of] $59'$, $4''$. But when Arzachel [al-Zarqālī], in the year of Christ 1076, found it the same in Grade 17° , $50''$ [recte: 17° , $50'$], he held that a regression had occurred — from which some thought it Albategnian, some Arzachelian, some of one or the other, as Fulvius reports it [exposed], in *Almagestum Novum*, Chapter 25. The rest of the more recent Observers of our age, and the men of the preceding century, set the Sun's apogee beyond the beginning of Cancer, of whom we set down below selected opinions at the foot of this Chapter, together with the annual motion. Among them Longomontanus [Longomontanus], setting [it] in the year 1590, [held] the apogee in Cancer Grade 5° , $30'$; and, the world being founded at the beginning of Aries, [held] the apogee to have been at the beginning of Aries; and so, in the year 1554, [held] the apogee to have been at Grade 95° , $30'$, [from which he] concludes the annual motion $1'$, $50''$, $14'''$. Kepler [Kepler] likewise, supposing the world founded in the year 3993 before Christ, in the *Rudolphine Tables*, page 42, [held] the apogee to have been then at the beginning of Aries; but in the year 1588, in Cancer Grade 5° , $32'$; and so [from] the apogee then in the year 1581 having progressed to Grade 95° , $32'$, gathers its annual motion $1'$, $2''$.
10. We, however, since we have granted that the Sun's apogee was at the beginning of Aries at the beginning of the world, deemed it too fallacious to gather the motion of the apogee from a beginning so uncertain and controverted as the year of the world's founding, of which there exist beyond 70 diverse opinions. Among these the most probable is the one

which holds the founding [to be] according to the LXX [Septuagint] Interpreters, in the year 5634 before Christ. Adding 1655 years makes 7289; therefore if to so many years the procession 98°, 36' [be applied], there comes about — from the beginning of Aries, [advanced] one grade — the second [grade of arc] 48 $\frac{2}{3}$. But if, according to the common edition, the world was created in the year 4184: to make in our most recent Chronology the years 5839 — to which, the procession of Grade 98°, 36' being added: and so, finished from another [reckoning] from the Chronologia Reformata, [with] the world's founding in the year 4064 — we shall gather the years 5719, the procession [being] completed [of] Grade 98 min. 36; and to the fourth, which afterwards we retain — not because it gathers from that year of the world founded, lest some mean place between Kepler and Longomontanus, [and] Wendelinus [Govaert Wendelen] from there, whose opinions see in the following Table. Nor indeed do they fail, among whom only the minutes [differ] — for the sake of facility let it please.

Apogee of the Sun [Apogei Solis]

The following table collects the position of the solar apogee and its annual motion as determined by various authors.

Authors	Year of Christ	Locus Apog. (Sign)	G			Motus Annuus'	"	'''	''''
			r	'	"				
Hipparchus	Before 140	♊ Gemini	5	3	0	0	0	0	0
				0					
Ptolemy [Ptolemaeus]	After 139	♊ Gemini	5	3	0	0	0	0	0
				0					
al-Battānī [Albatenius]	883	♊ Gemini	2	1	0	0	5	4	0
			2	7			9		
al-Zarqālī [Arzachel]	1076	♊ Gemini	1	5	0	0	4	1	1
			7	0			2	6	4
Alphonsine [Alphonsini]	1252	♊ Gemini	2	4	0	0	2	2	5
			8	0			6	6	4
Bernhard Walther [Bernard. Vualther.]	1488	♋ Cancer	4	1	0	·	·	·	·
				5					
Copernicus,	1515	♋ Cancer	5	8	0	0	2	2	1

Authors	Year of Christ	Locus Apog. (Sign)	G r · ' "	Motus Annuus'	" "' '"
corrected [Copernic. correct.]					4 0 4
Pedro Nunes [Petrus Nonius]	1552	♋ Cancer	1 2 0 · 8		· · ·
Tycho [Brahe]	1588	♋ Cancer	5 3 0 0 0		4 0 0 5
Jost Bürgi [Iustus Byrgius]	1588	♋ Cancer	5 5 2 · 3 0		· · ·
Longomontanus	1590	♋ Cancer	5 3 0 1 0		1 5 1 0 4
Kepler [Keplerus]	1588	♋ Cancer	5 3 0 1 2		2 0 0
Magini, in the Supplement [Maginus in Supl.]	1588	♋ Cancer	5 3 4 0 0 5		4 0 0 5
Lansbergen [Lansbergius]	1599	♋ Cancer	6 2 5 1 2 6		7 3 3 0 8
Boulliau [Bullialdus]	1588	♋ Cancer	5 2 2 0 3 9		5 0 0 7
Wendelen [Vuendelinus]	1600	♋ Cancer	5 4 0 1 2		2 8 2 1
Vicenç Mut [Vincentius Mutus]	1650	·	· · · 1		1 0 0
We, in the <i>Almagestum Novum</i> [Nos in Almag. Nou.]	1646	♋ Cancer	7 2 1 1 6 5		1 1 0 0
We, now [Nos nunc]	1655	♋ Cancer	8 3 0 1 6		2 4 4

CAPUT X.

On the Eccentricity of the Sun [De Solis Excentricitate].

If the eccentricity were not to be bisected, but the center of the deferent circle carrying the Sun were the center of the mean motions, then once the place of the apogee was given it would be easy, from a single observation of the Sun's true place, to gather the eccentricity, which is the foundation of the whole computation. For let there be, in the figure attached here, the deferent circle of the Sun ASP, with the Sun S in the rear semicircle of the eccentric — that is, on the far side of the circle's center C. Draw the straight line CS for the mean motion, and from the Earth's center T draw TS for the apparent motion. Then, at a given moment of observation, since the mean motion of both the Sun and the apogee from the start of the year is known from the tables, the distance of the apogee from the head of Aries follows in consequence; and by subtracting it, the mean distance of the Sun from the apogee is had — that is, the mean anomaly, namely the arc AS. The angle ACS is therefore given. But the true distance of the Sun from the apogee reckoned on the ecliptic, that is the arc ATS, is found from the observed true motion together with the angle CST, which equals the external angle ACS by Proposition 32 of Book I of the *Elements*. Subtract, then, the angle ATS from ACS, and you will have the angle CST. So in this triangle all the angles are given together with the one side CS, which is assumed to be 100000 parts. Therefore CT, the eccentricity, will not lie hidden, by the laws of triangles.

Diagram. A quarter-arc (right semicircle) figure illustrating the solar eccentric. The arc runs from A at the top, through S on the right, to P at the bottom; C marks the center of the deferent circle and T (below C) the Earth. Straight lines connect the points.

- A (top of arc): the apogee
- S (right side of arc): the Sun's position
- P (bottom of arc): the perigee
- C (center): center of the deferent circle (center of mean motion)
- T (below C): the center of the Earth (true motion)

But because, as we shall show below, we in fact suppose that the eccentricity must be bisected, and that the center of the mean motions is not the center of the circle but the center of the ellipse carrying the Sun — and consequently that it is the semidiameter of the circle, and not the ellipse, that is to be assumed, except perhaps in the one case where it lies on the [minor] axis — and because by that

single case the manifest inequality of the Sun's mean motion is measured neither by the arc of the circle nor by the arc of the ellipse carrying the planet subtended under the same angle, for this reason another path has had to be entered upon, by which the astronomer is forewarned not to proceed on the circle.

I. PROBLEM.

Given a certain instant of time, the true place of the Sun, and its apogee: to find, in the ellipse, the whole eccentricity, the equation, and the distance of the Sun from the Earth and from the center of the mean motions.

Let there be the ellipse ASPB, whose axis is AP, and on it the two foci T (center of the Earth) and F (center of the mean motions); and let the Sun be at S. To this point draw the radii FS and TS; then produce FS until SM equals the radius FS, and draw FM. The triangle FSM will be isosceles; and so, by Proposition 5 of Book I, the angles SMF and SFM will be equal to one another, and the whole TM will equal the axis AP, since any two radii drawn from the foci, or umbilics, of the ellipse taken together equal the larger diameter of the same — as Count [Blaise de] Pagan [Comes Paganus] demonstrated in Book III, Theorem 5 of his Geometry. Therefore, since the semidiameter AC is reckoned at 100000 parts, AP will also be 200000, and so, by assuming TM and subtracting it, you will already have the Sun's distance from the apogee — that is, the remaining distance of the Sun's true place from the apogee, which is called the *true anomaly*, namely the angle ATS, measured not by the arc of the ellipse AS but by the arc of the ecliptic, as said in the foregoing number.

Likewise subtract from the Sun's given mean motion, by the tables, the motion of the apogee, and you will have the distance of the Sun's mean place from the apogee, which is called the *mean anomaly*, or the simple one — namely the angle AFS, measured also by the arc of the ecliptic. By Proposition 32 of Book I, the angles FTS and FST are equal; so, both taken together and then FTS subtracted, the angle FST becomes known. And this is the whole equation sought, that is the difference between the true and the mean place of the Sun; the half of it in the isosceles triangle just spoken of will give, taken singly, the angles SMF and SFM. Therefore in the triangle FMT there are given the side TM, 200000 parts, and the angle TMF, and the angle TFM, the latter constant.

—from the Anomalistic angle AFS, the angle SFM being diminished, by its complement to two right angles. The benefit of Trigonometry will therefore not leave the whole eccentricity FT hidden, except that the angle FMT is too small, being scarcely a hundred-thousandth part of the side TM, 200000 parts; for which

reason that little particle FT can be drawn out exactly enough by the tables: I have thought up another method, which is written below.

Produce from the point M the parallel MN to AT itself, until it meets the line NT orthogonally, perpendicular to AP; and from the other focus F draw the parallel FN. Then FN will be in the line FR, equal to NT itself; and in the triangle MNT, right-angled at N, the angle NTM is known, being the complement of the angle ATS, as given above; and so, by Proposition 32 of Book I, the third angle TMN is known. To this is adjoined the angle SMF, and the whole angle TMF; and again the third angle TMR, to which the angle SMF being adjoined makes the angle FMR, right-angled at R; and so the third angle RFM is known. First, then, in the triangle NMT, the side TM being given, as above, 200000 parts, the sides MN and NT are sought; then in the triangle RFM, FR being given, equal to NT, the side MR is sought — for the difference of this from the side MN, that is the line RN, equals the eccentricity sought FT, in the parallelogram FRNT. Or, because in the triangle FST all the angles are given, as above, and the sides too, take the sine of one of the angles opposite the angles — namely the sine of the angle SFT and of the angle STF — and joining them into one sum, and from the assumed sine of the angle FST, then take the said sum from AP, 200000 parts: so the sine of the angle FST and AP, 200000 parts, give the sine of the angle FST as the eccentricity FT.

The eccentricity FT being acquired, and the data being as above in the triangle FST, with all the angles given, the distance of the Sun from the center of the mean motions will be given by Trigonometry. And if the Sun were in the rear semicircle of the anomaly, as at B, the lines FB and TB being drawn, the angle AFB will be known by subtracting the whole mean anomaly of the planet FB and the whole one TB from the whole circle of anomaly, 360 degrees. The remaining things are to be carried out by the method, as above. By this method, examining at many places observed by us, or by others, we nowhere find an eccentricity which satisfies more observations than if the whole FT be set at 3480 parts, of which AC is 100000, and the semi-eccentricity CT or CF be 1740 parts — as we shall presently confirm by another experiment.

[Margin: The eccentricity found.]

II. PROBLEM.

Given the Sun's apparent semidiameter in mean, greatest, and least distance from the Earth: to verify the eccentricity itself, and the necessity of bisecting it.

From the observations reported in Chapter 8, it is established that in the great gnomon of the Temple of San Petronio the Sun's apparent semidiameter was

observed on the 20th and 21st of June to be 15' 32". So at the end of June, when the Sun was at apogee, it ought to have been seen so much smaller — that is, 15' 30". On the other hand, on the 28th of March and the 29th of September, when the Sun was at mean distance, the semidiameter was observed to be 15' 45" and 15' 47", of which the mean is 15' 46". At last, in mid-January, when the Sun was at perigee, the observed value was 16' 4". But if the mean of the Sun's distance be taken at 100000 — this being the straight line CS in the diagram attached — and the mean apparent semidiameter, that is the angle SCM, at 15' 46", then inquire in the triangle CSM, right-angled at M, after the Sun's true semidiameter SM; you will find it 15' 46" of such parts, the little fractions being neglected. Then with this SM, and with the Sun's greatest distance ST, 101740 parts, in the triangle STM, right-angled at M, you will find the angle STM, which subtends the Sun's apparent semidiameter, 15' 30". And finally, with FS, the Sun's least distance, 98260 parts, and with SM, 46 parts, in the triangle FSM, right-angled at M, you will find the angle SFM, which subtends the Sun's apparent semidiameter, 16' 4". Therefore the chosen semi-eccentricity of 1740 parts satisfies the observations best; and hence likewise is established the necessity of bisecting that eccentricity, which necessity is for the equating of the solar motion. For the whole eccentricity, which in the figure is expressed by the number 3 — that is, by FT — requires, for reducing the figure to the angle FST, the bisection.

Qualium Radius Orbis,
seu Ellipsis est 100000.

Authors	Year of Christ	Such Eccentr.	Aequat. max. Gr.	'	"
Ptolemy with Hipparchus [Ptolemaeus cū Hipparcho]	139	4152	2	2	0 3
al-Battānī [Albatenius]	883	3465 $\frac{3}{11}$	1	5	0 9
al-Zarqālī, after 400 [Alzachel post 400- cōsid.]	1076	3465 $\frac{3}{11}$	1	5	0 9
Alphonsine, Nunes, and Reinhold [Alphonsini, Nonio, & Rainoldo]	1252	3465 $\frac{3}{11}$	2	1	0 0
But Mulerius and Mut	1252	3780	2	1	0

Qualium Radius Orbis,
seu Ellipsis est 100000.

[Sed Mulerio, & Muto]				0	
Bernhard Walther	1488	3548	2	1	3
[Bernardus Vualther]					5
Copernicus, corrected	1515	3592 $\frac{3}{5}$	2	3	0
[Copernicus correctus]					
Reinhold, as to mean	795	3694	2	7	0
[Reinholdus quoad media]					
Pedro Nunes [Petrus Nonius]	1552	3781	2	1	0
				0	
Tycho and Magini	1588	3584 $\frac{1}{6}$	2	3	1
[Tycho, & Maginus]					5
Jost Bürgi [Iustus Byrgius]	1588	3591 $\frac{1}{3}$	2	3	3
					0
Longomontanus	1590	3571 $\frac{1}{25}$	2	2	4
					8
Kepler [Keplerus]	1588	3600	2	3	4
					6
—but bisected, eccentricity [sed bissecta Eccentric.]	1588	1800	.	.	.
Boulliau [Bullialdus]	1588	3568	2	2	4
					1
—but bisected, eccentricity [sed bissecta Eccentric.]	1588	1784	.	.	.
Lansbergen, as to mean	720	3853	2	1	3
[Lansbergius quoad mediam]				2	0
Wendelen	1600	3490 $\frac{1}{2}$	2	0	0
[Vuendelinus]					
—but bisected, eccentricity [sed bissecta Eccentric.]	1600	1745 $\frac{1}{4}$	2	0	0

Qualium Radius Orbis,
seu Ellipsis est 100000.

We, in the <i>Almagestum</i> <i>Novum</i> [Nos in Almagesto Nouo]	1646	3460	1	5 0 9
—but now, in the year, in the ellipse [sed nūc Anno in Ellipsi]	1658	3480	1	5 3 9 0
—and in the circle [& in Circulo]			1	5 4 9 0

CAPUT XI.

On geometrically determining the true place of the Sun, on constructing the table of equations, on those distances of the Sun from each focus of the ellipse, on defining the ellipse itself, and finally on representing the inequality of the Sun's motions in the ellipse and in the circle [De loco Solis Vero Geometrice determinando, Aequationum Tabula construenda, Distantiis Solis ab vtroque Foco Ellipsis, & ipsa Ellipsi definienda, ac deniq; de Inaequalitate Motuum Solis repraesentanda in Ellipsi, & in Circulo].

I. PROBLEM.

To determine the place of the mean distance of the Sun and of the Earth in the ellipse.

Briefly, this place lies on either side at the extremes of the line bisecting and orthogonally cutting the line of the apsides, or the minor diameter of the ellipse, which is called—

—Diacenter [Diacentron], as in the following figure BCD; for when the Sun is at B, or at D, its distance from the center of the Earth T, namely BT, or DT, is just as great as AC, namely 100000 parts, of which AP is 100000 [recte: 200000]. For let there be drawn from B, by way of example, the straight lines FB and TB, from the foci of the ellipse; there arise two triangles, equilateral and equiangular. For FC,

the semi-eccentricity, equals CT, and the remaining half-line CT and BC is a common side, and the angles—

Diagram. An ellipse with its axes drawn and an external point. The major axis runs horizontally; A is at left, the long axis runs through to L and H at the right; F is above the center, C the center, T below it. B is on the left of the ellipse, D below. Lines are drawn from B and from the foci to several points, with a small inner figure of lines crossing near the center.

- A (left, on the ellipse): the apogee end of the axis
- F (above center): one focus
- C (center): center of the ellipse
- T (below center): the other focus (center of the Earth)
- B (left, on the ellipse): the Sun at the diacenter (mean-distance point)
- D (below, on the ellipse): the diacenter on the opposite side
- H, L (right, outside / on the produced axis): auxiliary construction points

—are right angles by the definition of the diacenter, or by the construction indicated above. Therefore both these triangles are equal by Proposition 4 of Book I, and equiangular; and so the side BT equals the side BC. But since the two radii taken together are equal, as said in the foregoing chapter, the whole AP, then either of those is equal to half of the whole AP, that is to AC itself; and the angle FBC equals the angle TBC.

II. PROBLEM.

Given the eccentricity: to find the maximum equation of the Sun's motion, and the mean anomaly, and the true one.

Since the maximum equation, or the difference between the mean and true motions of the Sun, occurs not at the extremes of the line which in Greek is called *diacentros* [Greek: διάκεντρος (diakentros, "through the center" — the cross-diameter)], that is, the line which, drawn through the center of the Earth, cuts the line of the apsides orthogonally, as it falls in the hypothesis of the circle and of the unbisected eccentricity — but at the extremes of the line which is called the Sun's distance, and the minor diameter of the ellipse, where also is the situation of the Sun's mean distance, in such a way that the true motion is at its greatest, and the mean motion nearest to it: this being so, if in the foregoing diagram the angle CBF be found, which we said above to equal the angle CBT, then it being doubled will give the whole equation FBC, the maximum and greatest, and the Optical CBT will equal the Physical CBF.

Now in the triangle CBF, right-angled at C by construction, the base BF is given, 100000 parts, and CF, 1740 parts, by the said number 5 of the foregoing chapter. Therefore by Trigonometry the angle CBF, that is the Optical equation, is $0^{\circ} 59' 48''$; and so the whole, the maximum equation FBT, is $1^{\circ} 59' 36''$. The sum then, from the right angle BCF and the acute CBF, is $0^{\circ} 59' 48''$; and by Proposition 32 of Book I, the angle BFC, equal to the mean anomaly AFB, subtracted finally from the angle CBT, $0^{\circ} 59' 48''$, leaves the true anomaly, the angle BTC, $89^{\circ} 0' 11''$, the right angle being subtracted.

III. PROBLEM.

Given the eccentricity: to find the minor diameter in the ellipse.

In the foregoing figure, from the said Problem I, in the triangle CBF, right-angled at C, the base BF is given, 100000 parts, and CBF, $0^{\circ} 59' 48''$, and BFC, $89^{\circ} 0' 11''$. Therefore by the Analysis of right-angled triangles, BC comes out $99984 \frac{7}{8}$ parts. Therefore the whole minor diameter BD is $199969 \frac{3}{4}$ parts.

IV. PROBLEM.

Given the eccentricity: to find the equation befitting the Sun placed at the extreme of the line Diagios, or drawn orthogonally to the line of the apsides through the center of the Earth, and the Sun's mean anomaly, and the true one, in this same situation together with the Sun's distance from the Earth.

In the foregoing figure, the line drawn from the Sun H, perpendicular to HT, and produced to L until HL equals the radius FH, and the whole TL, as is often inculcated by the property of the ellipse, equals the whole AP, 100000 [recte: 200000] parts; by conjoining F and L, the rectangle FL arises, for the triangle FHL is isosceles, and the angle L, by Propositions 5 and 32 of Book I, is half the external angle FHT. Now in the triangle FTL, right-angled at T by construction, TL is given, just as much as AP, 200000 parts, and FT, from the said number 5 of the foregoing chapter, 3480 parts. Therefore by the laws of right-angled triangles the angle L is $0^{\circ} 59' 48''$, and so its double, or the whole equation FHT, is $1^{\circ} 59' 36''$ — a little less, indeed, but still less than the maximum equation found at the extremes B and D, by Problem II repeated.

Further, the right angle FTL, joined to the angle L, makes a sum of $90^{\circ} 0' 59'$ [recte: $90^{\circ} 59' 48''$ — see note]; and as great is the external AFL, that is, in the prior semicircle ABP, the Sun's mean anomaly; but in the rear, the Sun's mean anomaly is the complement to the circle. The true anomaly, however, is the right angle at T, that is 90 degrees, in the prior semicircle, but in the rear 270 degrees.

At last, in the right-angled triangle FTH, the angle FHT is given, $1^{\circ} 59' 36''$. Therefore its complement, the right angle, is $88^{\circ} 0' 24''$; and FT, 3480 parts; therefore by the Canon of right-angled triangles the distance of the Sun from the Earth comes out, HT, 199921 $\frac{1}{2}$ parts.

V. PROBLEM.

Given the eccentricity and the Sun's mean anomaly: to find the composite equation, and to construct the tables of equations in the ellipse.

In the following figure of the ellipse ABPD, let the axis be AP, and its center C, but the center of the true and mean motions T, and let the Sun be at S. To this point draw the radii FS and TS, and let the radius FS be produced to M, so that SM equals the radius TS; and so, by the said property of the ellipse, FM equals AP. Draw also the axis MT; then the triangle MSF will be isosceles, and the angle M half of the whole equation FST. Likewise, with the Sun at O, the lines FO and TO being drawn, and TO produced, so that OL equals the radius TO, and TL drawn, the whole TL will become equal to the whole AP; and the angle L half of the whole equation FOC. Now in the first case the sides FT, 3480 parts, and FM, 200000 parts, are given—

Diagram. A large ellipse standing on its long (vertical) axis, with foci and several radii drawn to two positions of the Sun. A is at top, P at the bottom; the center C lies on the axis with F above it and T below it; B is at left, D at right of center. The Sun appears at S (left) and at O (upper right); M and L are exterior points reached by producing the radii. Lines radiate from F and T to S, O, M, and L.

- A (top of axis): the apogee
- P (bottom of axis): the perigee
- C (center): center of the ellipse
- F (on axis, above C): one focus (center of mean motion)
- T (on axis, below C): the other focus (center of true and mean motions / the Earth)
- B (left), D (right): the diacenter points (minor-axis extremes)
- S (left): one position of the Sun
- O (upper right): another position of the Sun
- M (lower left, exterior): point where FS is produced so that SM equals TS
- L (upper right, exterior): point where TO is produced so that OL equals TO

—and the mean anomaly given AFS, the complement to two right angles, namely the angle MFT; therefore by the Canon of triangles the angle M is manifest, and its

double the equation, or the composite, by Optics — that is, the angle FST. For example, if AFS be 45 degrees, M will be found $42^{\circ} 16' 6''$; the equation FST is $1^{\circ} 24' 32''$, which in the prior semicircle is to be subtracted from the mean anomaly, so as to have the true anomaly ATS, but in the rear semicircle the mean anomaly subtracted from 360 degrees will give the angle AFO, whose complement is OFT. And to the mean anomaly is to be added the equation FOT, so as to have the true anomaly.

VI. PROBLEM.

Given the eccentricity and the whole equation, that is, the composite equation, to find the Sun's distance both from the Centre of the Earth and from the Centre of the Mean Motions, that is, from either Focus of the ellipse, on the assumption that the anomaly is the Mean anomaly.

Now that, by Problem V in the preceding figure, the whole equation FST has been found through the Mean anomaly AFS by subtracting the Mean from this equation, the angle FTS is also given, and likewise the eccentricity FT, amounting to 3480 parts, opposite the angle FST. Therefore, by the Laws of oblique-angled triangles, FS — the distance of the Sun from the Centre F — will be known, opposite the angle T, and when it has been subtracted from 200000 parts, the remainder ST will be known: the distance of the Sun from the Earth, together with FS and TS, jointly making up 200000 parts. Let the example be the case of the preceding Problem, namely Mean anomaly 45° , equation $1^{\circ} 24' 32'' 16'''$; from which both FT, amounting to 3480, and FS, amounting to 97585, are inferred, and TS, amounting to 102415, which together make up 200000 parts.

VII. PROBLEM.

Given the Mean anomaly of the Sun and the eccentricity, to distinguish the Physical equation from the Optical.

First seek, by Problem V in the preceding figure (for example), the whole equation FST, and by Problem VI the Sun's distance, that is SF, and, a line CS having been drawn to the centre of the ellipse, seek the angle in triangle CSF, on account of the half-eccentricity FC, opposite which lies CFS — which in this semicircle is the complement of the Mean anomaly AFS — together with the side FC, amounting to 1740, and FS, amounting to 97585. The angle CSF is found to be $0^{\circ} 42' 49''$. But there had been found FST, $1^{\circ} 24' 32'' 16'''$. Therefore the Optical equation in this position is $0^{\circ} 41' 43''$, and the Physical as above.

VIII. PROBLEM.

For a given moment of time, with the eccentricity given, to find geometrically in the ellipse the Sun's True place, its Distance from the Earth, and from the Centre of the Mean Motions.

Gather, for the given time, the Mean Motion of the Sun from the Tables, and the Motion of the Apogee, and subtract the Mean Motion of the Apogee from the Mean Motion of the Sun, and by Problem V gather the whole equation; to the Mean Motion in the prior semicircle add it, but in the posterior subtract it, and you will have the Sun's True Motion, and likewise the Sun's distances from the Earth, etc. Example for the meridian of Bologna, in the year 1656, on the 21st of August. The Mean Motion of the Sun from Our Tables is 8 signs $18^{\circ}34'22''$. But the Apogee is 3 signs $8^{\circ}36'37''$. Therefore the Mean anomaly in figure num. 5, namely angle AFS, is 5 signs $9^{\circ}57'45''$, whose complement is $0^{\circ}2'15''$, that is angle MFT, with which, and with side FT, by Trigonometry the angle M, $57'15''$, is found, whose double, that is the equation FST, is $1^{\circ}14'30''$. And so, the Motion of the Mean having been subtracted, the True Motion remains, 4 signs $17^{\circ}18'3''$. This will be the case if the Sun was seen in $17^{\circ}18'45''$ of Leo, as we observed it. Then, in triangle FST, the angle at S being given, $1^{\circ}15'50''$, and SFT as above, $140^{\circ}2'15''$, FTS is given, $38^{\circ}41'55''$, and FT, 3480 parts; therefore FS, the distance of the Sun from the Centre of the mean motion, is then $98642\frac{1}{2}$ such parts, which, subtracted from the whole AP, 200000 parts, leaves the Sun's distance from the Earth ST, $101357\frac{3}{4}$.

IX. PROBLEM.

To resolve all the Problems of this Chapter in the Circle, with the Eccentricity bisected.

Diagram. A geometric construction within a circle, used for the bisected-eccentricity computation of the Sun's true place. The vertical diameter runs from A at top through the interior to P at bottom; the centre C sits on it. To the upper left is S; on the diameter near C are F (above C) and T (below C). To the right are M and, below it, O. Several lines run from S to M, O, and T, and from T to M and O, forming the triangles used in the demonstration.

- A (top): endpoint of the vertical diameter (apogee direction)
- S (upper left): the Sun's position on the circle
- F (on diameter, above centre): the Centre of the mean motions (one focus / eccentric centre)
- C (centre): the Centre of the circle

- T (on diameter, below centre): the Centre of the Earth
- M (right): point on the circle
- O (lower right): point on the circle
- P (bottom): lower endpoint of the vertical diameter (perigee direction)

Let there be, in the following figure, a Circle ASPM bearing the Sun, with diameter and Line of the Absides AP, in which the point of the mean Motions F lies distant from the Circle's Centre C by 1740 parts, and the Earth T from the Centre C by just as much. Let CM be the semidiameter perpendicular to AP itself, and let the Sun be set at the extreme M; for then in Triangle CMF, with the rectangle [scil. right angle] at C, side FC is given, 1740 parts, and by Radius CM, 100000 parts, you find by Trigonometry the angle CMF, $0^{\circ}59'50''$, and so the whole [equation] $1^{\circ}59'40''$, which in the ellipse, by Problem II, was found to be $1^{\circ}59'38''$.

Let the Sun now be in O, to which draw the Lines FO and CO, and the perpendicular OT; for then in Triangle CTO, with the rectangle at T, with the given base CO, 100000 parts, and the side CT, 1740 parts, you find by the Laws of Right-angled triangles the angle COT, $0^{\circ}59'49'' \frac{1}{3}$, and TCO, $89^{\circ}0'10'' \frac{2}{3}$; and side TO, amounting to $99989 \frac{7}{8}$; with which, and side CT, 1740, and side FT, 3480, in Rectangle FTO, you find the whole Equation FOT, $1^{\circ}59'40'' 20'''$. And so, with the Sun placed in O, the maximum Equation occurs, and there too the Sun's Distance from the Earth is $99989 \frac{7}{8}$. For the Mean falls between M and O, and thus Problems I, II, IV are resolved.

For Problem V and the rest, let it be in the same Figure. Let the Sun be in S, to which draw from the three points F, C, T the Lines FS, CS, and TS; the given Anomaly being AFS, its complement SFC is given, and likewise its complement [scil. the supplement] is given, and the side FC is 1740 parts, and CS, the Radius, 100000 parts. Therefore the Physical Equation CSF is given, and the Sun's Distance SF, and the angle FCS, whose complement to two right angles, namely the angle SCT, with which and side CS, 100000 parts, and CT, 1740 parts, you find the Sun's Distance from the Earth ST, and the Optical equation CST, which, with CSF, composes the whole Equation, whence the Sun's true place will be had.

X. PROBLEM.

Given the distance of the Foci in the Ellipse, and this with the Axis together with the Angle of Anomaly, to find the point of the Elliptical periphery in which the Sun is, and so to describe the Ellipse through any number of such points.

Diagram. A circle within which an ellipse is being constructed by points, showing the focal-radii construction for a given anomaly. The vertical diameter runs from D at top to I at bottom. Inside are the labelled points P, L (upper left), S, B, N, F, G, C, and M (right), with several lines crossing from the upper-left points to G and M.

- D (top): upper endpoint of the vertical diameter
- L (upper left): terminus on the circle of the arc of the Mean anomaly
- P (upper left, near L): point where line LF cut produces the Sun's position
- S (interior): the Sun's position, where LF meets the perpendicular SN
- B (interior right of S): point on the diameter (semi-axis end region)
- N (interior): foot of the perpendicular from S
- F (interior, on/near axis): one Focus
- G (interior, below F): the other Focus
- C (interior, below G): centre of the circle
- M (right): point on the circle
- I (bottom): lower endpoint of the vertical diameter

In the following figure, let there be given the Axis BC of the ellipse to be described, and on it the distance of the Foci FG, and from F, as from the centre, at the interval of the whole BC, describe the Circle DLIM, and produce BC to D and I. Let the given Mean anomaly be the angle DFL; produce it from the terminus L through F, by Arc DL; through F let the Line LM be drawn, which will be equal to the Diameter BC, and as will soon be proved. Then from G draw the Line LG, and cut it in two equally [bisect it], and through the bisection, a perpendicular SN being drawn to it, the Sun is found at point S, where the line LF is cut. For at point S, where line LF is cut, the Sun will be found; for when SG is drawn, all the way to P, since by construction it is made Equal to LN itself, and NS is common, and each of the Angles at N, by construction, is a right angle, then by Elem. I.4 they will be equal — the two sides SG and SL. But GS and FS, taken together, are equal to the whole FL, that is, to the sought Diameter of the Ellipse BC; therefore GS and FS are the two radii of the Foci of the Ellipse, and the Elliptical...

elliptical periphery, describers of the Sun by their own motion. But from point S, the point of the Elliptical periphery in which the Sun is will be the point, and by drawing GP let the angle DGP be constituted as the True Anomaly. Likewise operate for any other given angle of Mean Anomaly to F, and you will have the remaining points by which the Elliptical periphery is to be described.

XI. PROBLEM.

To represent the inequalities of the Solar Motion both in the prior and posterior anomaly, that is in the upper and lower semicircle, and at their extremes, whether in the Ellipse or in the Circle.

Diagram. A large composite circular construction, centred on the Earth at T, used to display the inequalities of the solar motion. An outer circle is graduated and numbered around its rim from 1 to 20 (reading clockwise from near the top: 1, 2 to the upper left; 20, 19, 18 to the upper right; 17, 16, 15, 14, 13, 12, 11 down the right and bottom; 10, 9, 8, 7, 6 up the lower left). Inside, three concentric/eccentric circles (the ecliptic AG, the eccentric, and the ellipse) carry numerous radial lines drawn from the common centre out to the rim. The interior is densely lettered with capital Roman letters A, B, C, D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, V, X, Y, Z and lowercase Greek letters (α , β , γ , δ , ϵ , ζ , η , θ , λ , μ) marking the points where the lines of the Mean Motions cut the several peripheries. A runs at the top of the vertical axis, with H below it; the central cluster around the figure's middle holds E, F (Earth/centre region), with B at left, G and the small Greek letters near the centre; the vertical axis descends through D, K to P at the bottom.

- A (top of vertical axis): apogee point on the ecliptic
- H (below A): point on the eccentric/ellipse on the axis
- E, F (centre region): focus and centre of the construction (Earth/mean-motion centres)
- B (left, on horizontal): point on the axis/diameter
- C (lower-centre, on axis): centre
- D, K (lower axis): points on the vertical axis below centre
- G (centre-right): focus / centre point
- P (bottom of vertical axis): perigee point
- M, N, O, Q, R, S, L, V, X, Y, I, Z and Greek $\alpha \dots \mu$: the successive points where the Mean-Motion lines cut the ecliptic, eccentric, and elliptical peripheries
- 1–20 (rim): the graduated divisions of the outer circle

The figure inscribed below is described from the Earth's centre T, at the very great interval of the ecliptic A6, P14, whose AP is the Line of the Absides, and on it C, the Centre of the Ellipse, that is, of the circles EBDG, and the Foci T and F. And because around F the Sun describes Equal Angles by its Mean Motion, let there be described from F, at an interval greater than CE, the circle HIKL, whose periphery is divided into 12 Equal Arcs by the points H, M, N, I, O, Q, K, R, S, L, V, X; and through these let there be drawn from F to the Ecliptic the lines of the Mean

Motions FM2, FN4, FI6, FO8, FQ10, FKP, FR11, FS13, FL15, FV17, FX19; and from the Centre T, through those points E, a, b, c, d, e, f, g, h, i, k, l, by which the lines of the Mean Motions cut its Circumference — which are E, a, b, c, d, e, f, g, h, i, k, l — let the lines of the True Motions be drawn, each to the Ecliptic, namely Ta1, Tβ3, Tγ5, Tδ7, Tε9, TDP, Tζ12, Tη14, Tθ16, TΑ18, Tμ20, TEA.

With these things accomplished, you will see that the True motion of the Sun about the Apogee A is slower, and about the Perigee P swifter; and that in the prior semicircle of the Anomaly A6P, the motion is continually accelerated from the Apogee to the Perigee, and the Arc of True Motion is smaller than the Arc of Mean. For A1 is smaller than 1,3; and this is smaller than 3,5; and this smaller than 5,7; and this smaller than 7,9; and this than 9,P. But in the posterior semicircle, from the Perigee to the Apogee, you will see it retarded. For arc 12,14 is smaller than P12; and 16,14 than 12,14; and 16,18 than 14,16; and 18,20 than 16,18; and 20,A than 18,20. And by comparing the True Motion with the Mean, made in Equal time — likewise in the Ellipse, or Circle EBDG, you will see the Arcs which the Sun runs through become continually greater from the Apogee toward the Perigee (of which kind are Arcs Ea, ab, bc, cd, de, dD) and, from the Perigee toward the Apogee, become continually smaller (of which kind are Dζ, ζη, ηθ, θλ, λμ, μE).

1. Property.

[Margin: 1. Proprie- / tas.] But about the Apogee A, the True motion of the Sun is slower, about the Perigee P swifter; and so in the prior semicircle of the Anomaly A6P it is continually accelerated from the Apogee to the Perigee — and the Arc of True Motion smaller than the Arc of Mean. In the posterior semicircle, by contrast, the Arc of True Motion is greater than the Arc of Mean, if it is reckoned according to the succession of the signs from the Apogee; thus the True Arc A9 is greater than the Mean Arc P12, etc.

2. Property.

[Margin: 2. Proprie- / tas.] Now in comparing the True Motion with the Mean made in Equal time, taken one by one and not with relation to the Apogee: in the upper semicircle the Mean Motion is greater than the True, namely in the semicircle YAZ. But in the lower YPZ, the Mean is smaller than the True. For 1A is smaller than 2A, and smaller [is] 1,3 than 2,4, and smaller 3,5 than 4,7, and to the right of A20 [is] smaller; A19 and 20,18 than 19,16, and 18,16 than 17,15; contrariwise, to the left, 7,9 is greater than the Mean 8,10, and the True 9P greater

than the Mean 10P, the True P11 greater than the Mean P12, and likewise the True 12,14 greater than the Mean 11,13, etc.

3. Property.

[Margin: 3. Proprie- / tas.] In comparing the True Motion with the Mean not one by one, but always from the Apogee: in the prior semicircle of the Anomaly...

about the Apogee, the Mean Motion is greater than the True, not only relatively, but also absolutely, because the Arc itself of the Mean A10 is greater than the True Arc A9. By contrast, in the posterior semicircle the True is greater, if it is computed according to the succession of the signs from the Apogee; thus the True Arc AP12 is greater than the Mean AP11, and the True AP12 than the Mean P12, etc.

4. Property.

[Margin: 4. Proprie- / tas.] But because the passage from the slowest Motion about the Apogee to the swiftest about the Perigee does not occur except through the Mean, and the passage from the slowest to the swiftest occurs through a middling motion; and so, at the points coinciding with the mean — that is, with the True at the extreme Diacenters B and G — it happens that this equality of the Mean Motion with the True at the extremes occurs equally where the Mean Distance of the Sun from the Earth is, and the Maximum...

Prosthaphaeresis occurs in the Ellipse; for in the Circle with the eccentricity not bisected, the Maximum Equation occurs at the extremes of the line drawn orthogonally through the Centre of the Circle, but in the Circle with the eccentricity bisected, the Maximum Equation occurs at the extremes of the line drawn orthogonally through the Centre of the Earth, and at the Mean Distance of the Sun in either Circle. By the Hypothesis it happens that, at the points between the said straight lines drawn orthogonally — one to the Centre of the Circle, the other to the Centre of the Earth — the Sun's ellipse differs in part from the circle, in such a way that the Maximum Equation in the Circle exceeds the Maximum Equation in the Ellipse by a few seconds; for these things follow from what has been said above.

	Maximum Equation	
	I	II
In the Ellipse	1	5
		9

	Maximum Equation	
In the Circle with the eccentricity not bisected	1	5 9
In the Circle with the eccentricity bisected	1	5 9

CHAPTER XII.

Selected Observations of the Apparent Diameter of the Sun, and concerning a notable Fallacy into which otherwise distinguished Astronomers have fallen, very recently detected.

[Margin, left: Excentri-/tas Solis / bissecada.]

[Margin, right (¶2, opposite "Hinc didicimus"): Excentri-/citas Solis / Bissecada.]

By what methods the Apparent Diameter of the Sun is observable, we have already taught in *Almagestum Novum* Book 3, Cap. 10, and in its Scholia, and afterward in Book 7, in the Appendix to the said Cap. 10 — which we suppose all to be reviewed by the reader in this place. For from these it will be established why we are by no means compelled to relate the observations of others there reported — indeed, also some of our own and certain older ones — preferring to these the more recent ones, which were made by the Great Bolognese gnomon [the San Petronio meridian line], in the Temple of San Petronio, by taking the apparent distances, at either Meridian, of the Sun's limb from the vertex. For when the smaller is subtracted from the greater — that is, the distance of the upper limb from the distance of the lower limb — the apparent diameter of the Sun is at once obtained; and indeed with such great subtlety as the immense distance affords, which receives the Elliptical figure of the Sun, since the altitude of the gnomon of this San Petronio is 95 1/24 Roman Feet, at the perpendicular [zenith]; while the distance of the aperture from the Centre of the Solstitial Ellipse is about 100 ¼ Feet, and from the Centre of the Equinoctial Ellipse 133 Feet nearly, and from the Centre of the Brumal [winter-solstice] Ellipse 264 ½ Feet. From which it follows that in none, or in the very fewest seconds, is there an error, provided this diameter is observed accurately on clear meridian days. A specimen of several observations of the Solar Diameter we have already exhibited in Cap. 8, from num. 159 to 201 — from which, when rightly considered, we have deduced the subscribed Solar Diameters. Suppose that D. Cassinus [Giovanni Domenico Cassini] determined the same a little otherwise in the prior book of his observations.

Apparent Diameter of the Sun,
from observations made at the
Bolognese Gnomon

	Apogee		Mean dist.		Perigee	
	M.	S	M.	S	M.	S
Sun in		.		.		.
D. Io. Dom. Cassino [Cassini]	31	8	31	4	32	1
				0		0
Nobis [Ourselves]	31	0	31	3	32	4
				2		

[¶2] Hence we have learned that the Eccentricity, which the difference between the True and the Mean Anomaly of the Sun implies — that is, the distance of the centre of the Earth — must be bisected, and only its half taken; adding from the distance of the Centre of the Sun's Orbit that the centre of the equal motions of the Sun is not the centre of the Sun's Orbit, but the point on the Line of the Absides, by as many distances from the Centre of the Orbit toward the Apogee as the Centre of the Earth is distant from the same Centre of the Orbit toward the Perigee; so that the Sun's Orbit is rather an ellipse than a circle, with the elliptical properties that it has in its larger diameter, two points equally distant from the centre of the Ellipse — and these gathered from the radii reflected from the periphery — and which concur. For when in Cap. 10 we had found the whole Eccentricity, that is, the distance of the centre of the equal motions of the Sun from the Centre of the Earth, to be 3480 parts (of the kind of which the semidiameter of the Sun's Orbit is 100000), and the apparent Diameter of the Sun at its Mean distance from the Earth to be 31'32": if the centre of the Sun's Orbit be distant from the Centre of the Earth by only half the aforesaid Eccentricity — that is, by 1740 parts (of the kind of which the semidiameter of the Sun's Orbit is 100000) — and in the Mean distance of the Sun, that is at 100000, the apparent semidiameter of the Sun be 15'46", the semidiameter accordingly will be of $92\frac{1}{3}$ such parts; and at the maximum distance of the Sun from the Earth, the Diameter appearing equal to 101740, it comes out 31'0". And at the minimum distance, 98160 parts, it comes out 32'4" — by as much as we find, nor ever a greater, but rather a smaller, fallacy in the aforesaid Gnomon, as we said in Cap. 9, num. 3.

[¶3] But from the more observations made, after the two prior tomes of the *Almagestum Novum* were published, we choose out a few in which by our own diligence and by exquisite observation made with P. Grimaldo [Francesco Maria Grimaldi]. The *first* was in the Year 1654, on the 21st of June; in which, for the

aperture wide 32 parts, in a table, as located above, with the plane of the aperture parallel, the most obscure base of the right [erect] cone of the Sun's species turned out [to be] 174 parts; but with the diameter of the aperture subtracted, the lucid base remains corrected at 142 parts, and the half of it 71. The distance, however, of the table from the aperture was 15700 parts; therefore the semidiameter of the Sun near the Apogee [is] $15'33''$, and the diameter $31'6''$. For as BF, 15700 parts, is to the whole sine 100000, so is AB, 71, to the Tangent $452\frac{1}{4}$. The Angle AFB, $15'33''$, or the Residuum of the Logarithm of the distance...

Diagram. A small geometric figure illustrating the pinhole-image cone: two long straight lines cross at F (the aperture), opening out to the right toward a short vertical segment marking the image. A is the upper terminus, B the middle (foot of the image), and C the lower terminus; FB is drawn horizontally, with AB above and BC below forming the half-angle of the solar cone at the table.

- F (left): the aperture (foramen), apex of the crossing rays
- A (upper right): upper edge of the projected solar image
- B (right, middle): foot of the perpendicular / centre of the image (FB horizontal)
- C (lower right): lower edge of the projected solar image

FB, amounting to 15700, which is in Vlacq [Vlacquo] 58041003. To this is added the Logarithm of the side AB, 71 parts, which is 18512583, [and it] makes the Tangent-logarithm 76553586. The Angle AFB, $15'33''$. Therefore toward the end of June, with the Sun at Apogee, it ought to have been somewhat smaller.

The *Second* was in the same Year, on December 17, on which, with the aperture pierced likewise at 32 parts, we excepted [allowed for] in the table, as located above, the lucid base of the Sun's cone, 440 parts, at the distance of $36\frac{5}{12}$ feet, that is of the aforesaid 43700 parts; the diameter of the aperture therefore having been removed, there remains the corrected base of 408, and the semibase AB, 204, whose Logarithm is 23096302; and of the distance BF, 43700 parts, the Residuum Logarithm is 53595186. The sum of these is the Tangent-logarithm 76691488. The Angle AFB, $16'3''$; wherefore the apparent diameter of the Sun was $32'6''$.

The *Third* was in the Year 1656, on January 5, on which the lucid base of the Sun's cone, taken through an aperture wide 74 parts, was 298 such parts; but with the aperture subtracted, it was 224, and the semibase AB, 112, whose Logarithm is 20492180; and of the distance BF, it was 24000 parts, whose Residuum Logarithm is 56197888; which, with the said Logarithm, makes...

yields 7669006/8. By the table of logarithmic tangents the angle AFB comes to 16'4". Therefore the apparent diameter of the Sun was 32'8" near perigee, which is very nearly what we earlier derived from the San Petronio gnomon as well. This determination is most reliable and most exact. So that no one need be surprised that I prefer these diameters to all the others, let no one suppose, even so, that I am holding the opinions of others in contempt: I report them, selected, for the reader's instruction, not as a view to be followed.

Authors (see
the places in
the *New*

<i>Almagest</i> , Book 3, Cap. 10)	In apogee (M.)	In apogee (S.)	In mean distance (M.)	In mean distance (S.)	In perigee (M.)	In perigee (S.)
Aristarchus, Archimedes, Sosigenes	30	0	30	0	30	0
Ptolemy & al- Farghānī	31	20	32	18	33	20
al-Battānī & Maurolyco	31	20	32	28	33	40
Alphonsine astronomers, and nearly so Thābit	31	20	32	30	33	50
Peurbach, Regiomontan us & Clavius	31	0	32	27	34	0
Copernicus	31	40	32	44	33	54
Reinhold, once (<i>minimum</i>)	31	28	32	36	33	44
Maginus, in Eccentr. (<i>mean</i>)	31	24	32	36	33	54
...tricity (<i>maximum</i>)	31	20	32	36	34	4

Authors (see the places in the <i>New Almagest</i> , Book 3, Cap. 10)	In apogee (M.)	In apogee (S.)	In mean distance (M.)	In mean distance (S.)	In perigee (M.)	In perigee (S.)
Michael Mästlin	29	36	31	11	31	45
Daniel Santbech	31	0	32	0	33	0
Tycho [Brahe], Mulerius, Blancanus	30	0	31	0	32	0
Longomonta nus	30	0	31	4	32	8
Kepler & Hérigone	30	0	30	30	31	4
Maginus, in suppl. Ephem.	30	0	30	30	31	0
Lansbergen	33	34	34	42	35	58
Athanasius Kircher	30	20	30	54	31	28
Boulliau	32	18	32	52	33	30
Gassendi & P. Fournier S.J.	30	12	30	38	31	6
D. Vicenç Mut Govaert	31	18	.	.	32	46
Wendelen	29	30	30	0	31	4
Michael Florent van Langren	29	20	30	0	30	33
We, in other places	30	50	31	56	33	8
Now, most	31	0	31	40	32	8

Authors (see
the places in
the *New*

<i>Almagest</i> , Book 3, Cap. 10)	In apogee (M.)	In apogee (S.)	In mean distance (M.)	In mean distance (S.)	In perigee (M.)	In perigee (S.)

certainly

Giovanni Domenico Cassini	31	8	31	40	32	10

**Enormously
false,
written
below:**

Giovanni Battista Cysat	36	0	37	0	40	0
Scheiner, in the <i>Rosa</i> <i>Ursina</i>	46	0	50	0	56	0
P. Michael Staudacher S.J.	.	.	38	0	.	.

Should the diameter of the aperture be subtracted from the diameter of the bright solar image admitted through it?

[Margin: 5] I answer wholly in the affirmative, with Kepler in his *Astronomia Optica* (Cap. 11) [Kepler, *Astronomia Optica (Paralipomena ad Vitellionem)*]. This will easily be evident to anyone who considers the figure of the Bolognese gnomon set out in Cap. 2, nn. 11 and 12. To obtain the true distance from the vertex of the upper and the lower margins of the Sun, the part HO must be added to the rays DH of the upper margin, IH being equal to the semi-aperture AC; and to the rays IH of the lower margin, the tangent DL, equal to the semi-aperture AC, must be subtracted. Thus the breadth of the solar image is enlarged by the aperture so that the image OK is bounded by the rays ICO and ICK. From this argument, drawn from the aperture's own center C, on account of the causes there adduced. We shall show the same thing in the following diagram, in which let AB be the height of the gnomon, with its center C; and from the outermost

edge of the Sun, D, let the radius pass through A and fall onto the tablet at point E; but the other ray, radiating from C, falls at F; and from the outermost edge G let two rays be propagated, one through B onto H, the other through C onto I. These will intersect one another, for...

Diagram. A geometric pinhole-projection construction shown at the upper right of the page. At the left a circle represents the Sun, with its uppermost edge labelled G and its lowermost edge labelled D. Rays drawn from these edges pass through a small central aperture (with points A, L, C, B clustered at the gnomon/aperture in the middle) and cross to form the projected image on the tablet at the right, where the rays strike at points E, F, K, I, H. The crossing of the rays produces the inverted image whose breadth is enlarged by the aperture's width.

- G (left, top of solar disk): upper edge of the Sun
- D (left, bottom of solar disk): lower edge of the Sun
- A, L, C, B (center cluster, at the aperture): the gnomon edge and the aperture's center C, with the semi-aperture endpoints
- E (right, topmost): point where the upper margin's ray strikes the tablet
- F (right, upper): point of the ray from the aperture's center
- K (right): boundary of the projected image
- I (right, lower): point where the lower margin's ray strikes
- H (right, bottom): foot of the projected image

The rays DAE & GBH, at the outer point L; and the rays drawn through the aperture's center, at point C, by whose intersection a perpendicular line LCK is drawn down to the tablet EF, cutting it in two. A triangle LKE will be formed, right-angled at K, in which the side EK is given from the dimension of the semidiameter of the bright solar image. Hence, if the other side KL or EL were given, the angle ELK would also be given, which doubled would yield the angle ELH — that is, DLG — the measure of the apparent diameter of the Sun at L. But neither of these is to be had. We must therefore have recourse to the angle FCI, the measure of the apparent diameter at C, which is known from its half FCK. For the aperture's distance CK is given from the table, and the other side FK, if it rests on the semi-base EK, is subtracted; and these differ by an insensible amount, since AC and EF are parallel. They are equal to the semidiameter AC, because the rays DE and DF, owing to the Sun's vast distance, are sensibly parallel, as we show in Book 3 of the *New Almagest*, Cap. 5. As to why we do not use an indivisible aperture, so that one might have the intersection at C without

subtracting the aperture itself — that will be plain from what is said below, against the practice of those who use such an aperture.

Should the latitude of the aperture also be subtracted in observations of solar eclipses, in order to obtain the Sun's diameter?

[Margin: 6] In the *New Almagest*, Book 5, Cap. 15, on the investigation of magnitude and diameter, I said in that place — at nn. IV and VI — that half the aperture is to be subtracted from the semidiameter of the bright solar image. Let that figure be transcribed here, in which let the base of the bright solar image observed through the aperture be BCED, whose semidiameter is AB and AE. Now let the Sun be eclipsed by the Moon: let the shadowed portion of the image be GCHD, and by means of a compass let the portion GE be marked off, the eclipsed part in such units that the whole diameter BE is 12. Suppose then that the Sun's diameter is known in minutes and seconds; for if it be made that, as 12 is to the Sun's diameter in minutes and seconds, so are the parts GE, and so on, then the portion of the Sun eclipsed appears to be known in minutes and seconds. But since we have warned, with Kepler, that there lurks in this practice a fallacy — because the base received through the aperture is too large and not proportionate to the Sun's diameter exactly, the excess being the latitude of the aperture, which must be subtracted in this way: from the semidiameter of the bright base AB let BN be subtracted, a portion as great as is the semidiameter of the aperture, and in the interval AN let a circle NKIL be described; the base will then be proportional, whose diameter, divided into 12 equal parts, gives the measure of the eclipsed portion GI. But because the portion PG of the image through the aperture is illuminated by the solar rays, that is, by as great a latitude as the semidiameter, the apparent eclipse turns out smaller than it would appear if observed through an indivisible aperture...

Diagram. A geometric figure at the lower right showing two overlapping circles used to analyze the eclipsed solar image projected through an aperture. The outer (upper) circle, representing the bright solar base, carries points B (top), N below it, A near the center with K, P, L, D ranged across the middle, and E lower down; the inner/lower circle carries G, C, I and F toward the bottom, with H at the very bottom. The construction marks off the eclipsed portion GE / GI against the reduced circle NKIL.

- B (top): top of the bright solar base, semidiameter endpoint
- N (below B): point where the aperture's semidiameter is subtracted from AB
- A (center): center of the base

- K, P, L, D (middle row, left to right): points defining the reduced circle and the image's horizontal diameter (BE through the center)
- E (lower, right of center): the other semidiameter endpoint of the base
- G, C (inner circle, upper): boundary of the shadowed (eclipsed) portion
- I (inner circle): point on the reduced circle NKIL
- F (inner circle, lower): point on the eclipsed boundary
- H (bottom): lowest point of the lower circle

divisible; and therefore that bright little zone is to be subtracted, and the eclipsed portion measured for that part, which is IP. Then let it be made that, as 12 is to the diameter of the Sun in scruples, so is GF; and from this the true quantity of the eclipsed part is yielded in scruples.

[Margin: 7] Against this precept of the Fathers Antonius Labouera and Honoré Fabre: they say that here one need not deal with investigating the Sun's diameter, taken under the angle, since they grant that the bright base of the aperture's diameter is to be subtracted; but they wish this done in a fixed proportion, which has the semidiameter of the Sun as a part of the shadow induced by the lunar body, in that it makes no difference to the notation of the known quantity NI, discrete from the quantity BE. As to this — which they try to prove no more aptly than absurdly — it follows, if the table-figure of the eclipse be advanced more and more toward the aperture, that the same eclipse appears greater and greater the nearer it stands, and indeterminably so. For at one and the same time two observations of the same eclipse, per the aperture, would be made in two places, which yet were one observation. Suppose the semidiameter were 12 parts, and in one observation the semidiameter AE were of 144 parts, and the eclipsed portion EG of 24 parts, that is, the sixth part of the semidiameter AE. In this case, if PG of 12 parts is to be added to PE, EI will be of 36 parts, with the 12 dropped; but truly from IE there is left AI of 132 parts, and IP, of 24. By this emendation, therefore, the eclipse is reduced to $\frac{132}{144}$, that is, to the corrected semidiameter AI. But in the other observation, the aperture kept equal, the table receiving the eclipsed image of the Sun being moved farther from the aperture, so that AE becomes 432 parts, and the eclipsed part EG, the sixth of AE, that is 72 — AI then remaining 12 parts — EP evades to 84, and IP to 72; the line EI is 12, and AI of 420 parts remains. Therefore by this emendation the eclipse is reduced to $\frac{72}{432}$ of the corrected semidiameter of the Sun. Reduced to a common denominator of the fractions, the eclipsed part is $\frac{24}{432}$ of the solar semidiameter in the prior observation, and $\frac{76}{420}$ of the same semidiameter in the second.

[Margin: 8] We answer, however, that the said Fathers have been deceived, supposing in the two observations that the same proportion holds between AE and EG, which in those cases is not the same; for it should be the same in both, the proportion between the whole corrected diameter NI and the corrected shadow IP being equal to the observed shadow EG. But between false, or uncorrected, solar diameters and shadows, that same proportion ought not to hold, even with the correction made on both sides; let it be made by subtracting the same quantities of the aperture. Just as, if from two given lines, here and there, in a sub-double proportion of scruples, the greater line be increased by a quantity equal to the doubled scruple put a palm's length: certainly it will not preserve the same geometric proportion between the two, those two lines being increased by an arithmetically equal amount. P. Grimaldi [Francesco Maria Grimaldi] confirmed this acutely too, with others adduced. But on this dispute, more will be set out in the Appendix to this chapter, reserved for the end of this Book 1.

Against the diameter of the Sun asserted by the Fathers Scheiner, Cysat, and others.

[Margin: 9] Scheiner, in Part 1 of the *Rosa Ursina*, Book 4, Cap. 3, says: "It is established that the apparent diameter of the Sun, while it tarries in Cancer, presents itself as a minimum of 46 minutes." He nonetheless assumes for his own proposal there the Tyconic diameter of 32', and in Cap. 4 he proposes a way of observing it himself with the present diameter through the aperture, as it were indivisible, by which the solar image is received in a dark chamber, marked round about with a compass into parts equal to those into which he had supposed the distance of the image from the aperture to be divided, namely into 10000 parts; and the aperture — "as small as can be made physically," he says, "since the smallest aperture, which mocks the keenest sight, flees." Some indeed confess that observations made with a larger aperture are deceptive: if from 10000 parts of the distance of the aperture from the bright solar base of one image to another there results the sine of the visual semidiameter of the Sun, its double will be the whole diameter. He then subjoins the observations made at Rome — by many, and by men skilled in such matters — namely P. Christoph Grienberger, P. Gregorio à San Vincentio, P. Pietro Antonio Rauizza (once my own most learned teacher in theology, and a man of conspicuous integrity), P. Nicolò Zucchi (likewise most learned, a man of the deepest piety) — to whom it can scarcely be said how much I owe.

| Apparent diameter of the Sun observed at Rome by Scheiner, from the diameter of the solar image in parts such that the distance of the image from the aperture was 10000 ||||| |||| |---|---|---|---|---|---|---|---| Year | Through | Image Diam. (Parts) | Solar Diam. (Min.) | Year | Through | Image Diam. (Parts) | Solar Diam. (Min.) | | 1625 | aperture | | | 1626 | | | | Oct. 15 | minim. | 150 | 51 | Dec. 23 | minimum | 165 | 56 | | | minim. | 137 | 47 | | | 136 | 47 | | | minim. | 114 | 39 | | | 112 | 38 | | | | | | 90 | 31 | | | Nov. 23 | minim. | 130 | 45 | Dec. 23 | maius | 160 | 55 | | | minim. | 120 | 41 | | maius | 144 | 50 | | | minim. | 115 | 39 | | priore | 120 | 41 | | | minim. | 100 | 35 | | | 104 | 36 | | | | | | 85 | 30 | | | Nov. 28 | minim. | 143 | 49 | Dec. 23 | maius | 114 | 39 | | | minim. | 120 | 41 | | priore | 93 | 32 | | | minim. | 110 | 38 | | | 82 | 29 | | | Dec. 25 | minim. | 136 | 37 | Dec. 23 | maxi- | 105 | 37 | | | minim. | 125 | 43 | | | mum | 95 | 33 | | | minim. | 117 | 40 | | | 84 | 29 | | | minim. | 106 | 37 | | | | | | 1626 Mar. 23 | minim. | 155 | 53 | 1627 Iunij 21 | mini- | 155 | 53 | | | minim. | 136 | 47 | | | 140 | 48 | | | minim. | 122 | 42 | | | 110 | 38 | | | minim. | 115 | 39 | | | 95 | 33 | | Iulij 14 | minim. | 137 | 47 | Sept. 23 | mini- | 162 | 56 | | | minim. | 125 | 43 | | | 142 | 49 | | | minim. | 119 | 41 | | | 130 | 45 | | | minim. | 102 | 36 | | | 108 | 37 | | Oct. 19 | minim. | 160 | 55 | | | | | | minim. | 125 | 43 | | | | | | Dec. 21 | minim. | 138 | 48 | | | | | | minim. | 110 | 38 | | | | | | minim. | 93 | 32 | | | | | | Dec. 22 | minim. | 140 | 48 | | | | | | minim. | 122 | 42 | | | | | | minim. | 107 | 37 | | | | | | minim. | 87 | 30 | | | | |

Scheiner adds that this variation, found on the same day and with the same aperture, arose from this: that at one moment the nucleus took on a less bright appearance about its extreme border, and when he took it from the very middle of the image — about which no one is well informed, and seeing it, he doubted whether the appearance were as if not true — he nonetheless said the diameter showed itself to him as 38' minimum on 28 November, and 33' on 21 June; whence he concludes it to be really still larger.

[Margin: 10] Another follower of these, from our own Society, wrote to me that in the year 1652 at Innsbruck, and in the year 1637 likewise observed there on 6 and 20 September, with an aperture of 28, and a second aperture of 10, the Sun's diameter was 37'30", or 37'40" — but more often 38'. When he used a larger aperture, the apparent magnitude of the Sun would diminish, since rather something is to be added for the larger aperture; he reckoned it false that so large an aperture should admit too much brilliance, which would obscure...

and obliterate the true margins, and the whole image, so as not to be had with the exactness needed for an accurate measurement of the diameter, established at

the smallest. Now if the feet 28 are resolved into inches, they become 336 inches; and if the inch be divided into 100 particles, the length of the canal will from that be 33600 such particles; and if the latitude of the aperture stood at such a distance of minutes — 2', that is, by the solution of right triangles, the aperture-diameter would be of 2'. Or, of 20 such, the inch being 100. Again, if he had used that aperture, he gathered at such a distance — a semidiameter of the solar image of 16'25", that is, a diameter of 32'50" — the part being said to be the semi-aperture, that is, the parts 30'42", a smaller value than is owed, because, on account of the over-small aperture, the operation becomes ever harder, as we too have tested elsewhere more than once, and lately with P. Grimaldi as well.

[Margin: 11] For in the year 1658, on 11 August, in the Hall of the Assumption of the B[lessed] Virgin in our College, obscured most exquisitely, through the smallest possible aperture, the solar image admitted onto paper at a distance of 13' 5°/9 of a Roman inch — such that an inch contained the whole light too, the impure image among the impure margins being of 1328 such parts. Hence EK, so that in the figure of number 9. it was 664; but the semidiameter of the aperture being subtracted, AC of such parts is 2: there remains FK of 662; whence the angle FCK is 18'5"; and the apparent diameter of the Sun, 36'12". Again, in the same month, on the 18th, with the same aperture retained, but at a distance of 12821 parts (the altitude of the observation demanding it), the bright solar base EH was 1356 parts, and EK 678, and so the angle EKF 18'15"; whence there results the diameter of the Sun 36'30". If you comprehend the part of the bright base illuminated by the chosen image and the purest light, EH was 1176, EK 588; the doubled AC subtracted, there remains FK 586; whence the semidiameter of the Sun 15'40", and the diameter 31'20". This too in the Bolognese gnomon, found on another day, with a latitude of the impure border of 110 parts, which being subtracted so that the just solar semidiameter may be had — a quite sound agreement here.

[Margin: 12] But because Scheiner used a distance of the aperture of 10 Roman feet, I propose between C and S the lines of the length written below, which, continued five times, make the tenth part of the said distance,

[here let us understand the parts to be 240, of which a Roman foot's inch is 100. Drawn therefore 240, per 5: they become 1200. Per 10: they make 12000, equalling 120 inches — that is, 10 feet. Because, as I said, the use of distance is squarable, we have arrived today at a Roman foot for the smallest aperture, the bright solar image being computed for the impure margin, of as much as the written-below little line is, that is, parts 240, of which one inch is 100.]

[diagram: a short horizontal line segment, the unit of length, drawn between rule-marks across the column]

Hence the semidiameter of the Sun would come out 20'5", and the diameter 40'10"; but the impure latitude of the border being subtracted, it was of base 110, and a half — 55; whence the semidiameter of the Sun 15'41", and the diameter 31'22".

[Margin: 13] These things performed, it is better to use a larger aperture, purer for vision, both as to the vertex and in the diameter itself, but of greater latitude of minutes. Trigonometry advises this; but the distance ought to be large, and of 100 feet if it can be, as in the San Petronio gnomon of 100 feet and more. For then the bright image acquires a width quite ample for the Sun, and that on account of the magnitude of the aperture being intense enough for obscuring the whole well-nigh of the penumbra of the impure border; and if here it sin in mere light, the diameter is rendered insensible, or contemptible, in comparison with the bright image of the image, and the distance of the aperture. Against this, if you employ a too-small aperture, and one nearly indivisible, that distance ought not to advance to 10 feet...

Diagram. A small schematic at the upper right, showing the impure-light border of a projected solar image. A circle (the bright solar base) carries the labels A at the upper left of the rim and B at the lower right of the rim; inside it, concentric dotted/double rings mark the penumbral fringe, with C marked in the upper-inner region and D in the lower-inner region. The figure illustrates that with an impure (penumbral) border the apparent amplitude AB exceeds that of the pure light CD.

- A (upper-left rim): outer edge of the impure (penumbral) solar image
- B (lower-right rim): opposite outer edge of the impure image
- C (upper-inner): edge of the pure-light image
- D (lower-inner): opposite edge of the pure-light image

the opposite image will be, as in the following diagram, whose amplitude with the impure light will be AB, but that of the pure light CD; yet it is more easily separable, and slippery to fallacy; and if there be anything in this measure you err, you will commit a great error in the diameter of the Sun, and a still greater one, on account of the latitude of the aperture not being taken away, which in the smallest aperture cannot be determined justly.

[Margin: 14] But the cause of the impure places within AC and DB — about which Scheiner himself, in Part 2 of the *Rosa Ursina*, Book 4, Cap. 5, says: "The periphery

of this solar image is not cleanly cut, but softly torn and rough, so that it is scarcely distinguished from the consort of shadows, especially if the eye applies effort" — the cause requires, when measured with a compass that is near to it, the cause (I say) of this quasi-penumbra has hitherto been disclosed by no one; though I know it was disclosed too by P. Grimaldi, after some years' observations of light and colours, who affirms a most luminous and most certain notion; and the manner of propagation of light is known to be neither *Direct*, nor *Reflected*, nor *Refracted*, but *Diffacted*, or scattered into more languid rays. By which thing many of the said Father's experiments interfere, which otherwise could not be saved. So, in this way: the rays of the Sun, striking onto the edges of the aperture, are split into weaker rays, and the tablet, or paper, set opposite the aperture, with a malign and torn light, and somewhat colours it with a sub-reddish or sub-rubric colour, or with ferrugineous tints — the more, the nearer it stands to the aperture; the more remote, the more these debilitated and remiss rays evade, so that at a great distance they do not affect the sensible tablet. Because, if the aperture be so ample that such a great splendour enters, then by reflection of its own from the air round about it is impeded, and conquered by the propagation of the rays scattered from the edge of the aperture.

[Margin: 15] For the rest, whatever be the cause aforesaid, it stands established to us, from the most recent and recondite Philosophy, as a thing decided: that there is something here of uncertainty, that is, a fallacy, which Scheiner's Method does not exclude, nor the manner of observing the Sun's diameter through the aperture used by the Fathers Cysat and others, since it is least of all certain.

[Margin: Arguments against Scheiner's solar diameter.] First — for the mere inconstancy, which is plain in Scheiner's experiments, is an argument. Secondly — it is certain that we have taken the Moon's diameter from its distance from the fixed stars of known note, and the distance does not exceed 35', indeed it reaches 34'; and yet, as in the observations of Book 3, when the whole Moon was seen to have obstructed the Sun, but this was far from impossible if the Moon were near apogee, of 40', as Scheiner wishes. Thirdly — using the Filar Triangle, of which in the *New Almagest*, Book 5, Cap. 15; but with the subtlest equal lines stretched in a Meridian plane, and with the eye fixed within a wooden tube, and protected by a coloured glass, the solar disk transits the plane of the Meridian, while a companion numbers meanwhile the inches of altitude with a loud voice, the oscillations being most nearly 9 of a Roman foot, of which in Book 2 of the *New Almagest*, Cap. 20, Prob. 5; and one simple oscillation of time exhibits 30"; thirty of them, and as I have warned, in the equinoxes, from the first contact at the western margin until the contact of the eastern margins of the solar disk, and the oscillations of the eastern margins are never numbered as more than 264, nor

266. They are never fewer than 240. And so then I judge the Sun's diameter to be no more than 33'15", nor less than 30', which experiment evidently calls back each one to its own use. Wherefore, although it can in no way be precisely determined what the Sun's diameter is — because in those contacts the judgment of observation hesitates over about two or three contacts at most, hence I take it as certain that the Sun's diameter in the equinoxes cannot be 34', nor less than 30', as Staudacher would have it, nor 40', etc., as Scheiner. So let it stand established to the modern reader, as far as the cause goes, that we have preferred the observations of the solar diameter made at the San Petronio gnomon...

done in the same way through a slightly larger aperture, and we determined it to be 31' 0" at apogee, 31' 32" at mean distance, and 32' 4" at perigee.

CAPUT XIII.

On the Parallax of the Sun, and its Distance from the Earth.

That the parallax of the Sun is imperceptible, and consequently could once be suspected of being nil, was [the view of] Hipparchus [Hipparchus]. Although it can be found fairly readily by means of lunar eclipses, as Ptolemy [Ptolemy] there reports (*Almagest* V, ch. 11; *Magna Syntaxis* chs. 14 and 15) — where he also hands down the method of gathering it from lunar eclipses, which we have taught more accurately (*Almagestum Novum* III, ch. 7, Probl. 2) — we nevertheless showed there that this method does not possess the subtlety which recent astronomy requires, since solar eclipses, even without evident proof, can be deceptive. Or one may use the Sun's mean distance of 1168 semidiameters of the Earth, as Ptolemy will have it (the horizontal parallax being 2' 57"), or the mean distance of 1465½ semidiameters of the Earth (the horizontal parallax being 14"), as Wendelen [Govaert Wendelen] will have it, or some value intermediate between these. By the same token (*ibid.* book 1, ch. 11, Problem 6) we showed that, if half the angle [semiangularus] is subtracted [recte: *semiangulum*] —

[Margin: The labor of astronomers in gathering the Sun's parallax.]

The parallaxes of the Sun are assumed to be larger than they are; yet I do not think they can be held to. It happens, however, that nearly all fall into some self-contradiction, as Lansbergen [Lansbergen] demonstrates (*Trigonometria*, and ourselves *ibid.* book 4, *Almagestum Novum* I, ch. 16). For one must take the parallax and the Sun's distance together at a single diameter of the Sun's apparent distance, with the increment or decrement agreeing with the anomaly,

and also with the angle by which the diameter of the Earth's shadow exceeds the diameter of the Moon's apparent body, and so forth.

After Tycho [Tycho Brahe], Kepler [Kepler] recognized that the Sun's parallax could not be as great as Tycho had assumed, and he openly declared this (*Ephemerides* num. 7, p. 5, and in his *Commentaries on Mars*). For he saw that Mars at perigee in its epicycle approaches the Earth more nearly than the Sun does, and yet from his own observations — fully in agreement with Tycho's own — that it is much less so at that very approach to the Earth than is the case with Tycho. He maintains that the Sun's horizontal parallax is smaller than the Tyconic value, namely about one minute, which he holds also in his preface to the *Ephemerides* of the year 1619, declaring the agreement of the *Harmonics*'s intervals, and likewise in the *Rudolphine [Tables]*.

[Margin: Kepler's internal inconsistencies.]

Yet badly: for in the foundation of the *Ephemerides* and in the *Commentaries on Mars* he set the Sun's distance at apogee at 1800 terrestrial semidiameters. For from this, by trigonometry, there follows a horizontal parallax of 1' 55"; and conversely, if the horizontal parallax is one minute less, there follows from this a solar distance of 3438 terrestrial semidiameters, as I taught at greater length (*Almagestum Novum* III, ch. 7, Scholium 2). Langrenus [Langrenus] too supposed the Sun's distance to be about 3420 terrestrial semidiameters. But Wendelen, who in the *Opusculum on the Obliquity of the Sun* published in the year 1626 had assumed a horizontal solar parallax of one minute, afterwards in his letter to me of the year 1647 chose 15" of seconds, as I reported (*Almagestum Novum* III, fol. 109), and a solar distance of 14905 semidiameters at apogee, of 14656 at mean distance, and of 14407 at perigee. On account of the dichotomies and other foundations, which he reported to us from these same letters in his letter, [I treated this] in the same ch. 7, num. 12. For I there confuted Rheticus's [Rheticus] opinion fairly fully in Scholium 3.

Now therefore on this matter, on which depends in great part not only the system of the Sun itself but also that of the other lesser planets, as Kepler forewarned, [and which bears] on the dichotomies of the Moon, and on the Problem of Aristarchus [Aristarchus] which we labored over (as we set out at length *ibid.* book 3, ch. 7, Probl. 3) — and accordingly we deduced the solar distances and parallaxes inscribed below, corrected nonetheless according to our new eccentricity, which is now bisected.

☉ Distance at apogee	Horiz. parall.	☉ Mean distance	Horiz. parall.	☉ Distance at perigee	Horiz. parall.	
	'	"	'	"	'	"
Semidiameter s of the Earth	0	2 Semid. of 7 the Earth	0	2 Semid. of the 8 Earth 1/2	0	2 9
7427		7300		7173		

This indeed Don Antonio Rocca [Antonio Rocca] approved in his most learned letters, which he sent me asserting his observation, and not much afterward [so did] Don Giovanni Battista Odierna [Giovanni Battista Odierna], in a lengthy and uncommonly erudite letter sent to me; and he retained it likewise in his published work entitled *Ephemerides Medicaeorum*, where in the address to the reader he says: *The Sun's height from the mean Earth amounts, at the minimum, to 7300 terrestrial semidiameters*. I have also heard that Don Ismaël Boulliau [Ismaël Boulliau], where he reads of our foundations in the *Almagestum Novum*, has decided to alter his own system, and to place the Sun far higher than he had done in his *Astronomia Philolaica*. Indeed, Don Antonio Rocca, writing in the month of May of the year 1651, [held] that scarcely any perceptible time elapses between the dichotomy [dichotomy] of the Moon and quadrature; and that therefore the Sun ought rather to be raised than lowered. But because by reason of the parallax the Moon often appears hollowed [cava], when it is now dichotomized — indeed, when it is in quadrature aspect with the Sun — how the observation is to be corrected I taught in the Appendix to the first volume of the *Almagestum Novum*, which is to be found at the end of book 7. There, then, consult the Appendix bearing on book 3, ch. 7, where I confirmed by other observations that the maximum distance of the Sun from the Earth cannot be much less than 7000 terrestrial semidiameters, since an integral hour intervenes between the time of quadrature and that of true dichotomy. Let Kepler stand [as witness], who in his *Astronomia Optica*, p. 237, said: *But when the Moon is dichotomized, by careful inspection of the section of the Moon's face within a few hours you can carry the indication of the true quadrature*. As to determining the parallactic distance of the Sun, Kepler preferred the dichotomies of the Moon to eclipses themselves and to the terrestrial shadow: read over his words adduced [by me] (*Almagestum Novum* III, ch. 7, num. 10).

[Margin: The first method.]

Nor, however, are there lacking other methods of investigating parallaxes, made not only by observations carried out, or under the tropics, or at the equator,

which we handed down (*ibid.* book 3, ch. 7, num. 4 and 5), but also others. Of these let the First be that of Father Georgius [Giambattista] Riccioli of our Society; already, from the year 1653, it was communicated to me through his letter. In the appended diagram, let ABC be the meridian, in which the vertex is B and the pole of the world is P, and BR the quadrant of the vertical circle, in which let the Sun be at point S, and the Sun's observed distance from the vertex be BS. Let the moment of the observation [serving] for the declination of the Sun be PS. Let the perpendicular oscillations be now numbered from the moment when the Sun's distance from the vertex was captured, to the moment when the Sun reached the meridian; and let it be known besides that such oscillations correspond, in their entirety, both to a complete revolution of the equator and to a revolution of the diurnal motion of the Sun; then, by the rule of three, if the oscillations of the Sun's diurnal revolution give, for example, 59' 8", how many minutes will the oscillations numbered from the observation up to the meridian give? For as often as the said numeration is subtracted, with the minutes corresponding to it, it will give the corrected [recte: *emendatum*] angle BPS — together with which, both with the complement of the pole's altitude BP, and with the complement of the declination —

Diagram. A circle with a quadrant of the vertical circle constructed from the celestial meridian, illustrating Riccioli's pendulum-oscillation method for the solar parallax.

- B (top of circle): the vertex (zenith)
- P (upper right): the pole of the world
- A (left): one end of the meridian ABC
- C (right): the other end of the meridian
- S (interior): the position of the Sun on the vertical circle
- R (lower interior, near center): a point of the vertical circle's quadrant BR

— PS will give the Sun's true distance from the vertex, the difference of which from the observed [distance] will give the parallax sought. But if the Sun stands more than 70 degrees from the vertex, it is liable to refractions, which ought to be discerned without prior knowledge of the parallax; and the slightest error in numbering the time, or in the situation of the meridian line, or in the altitude of the Sun and of the pole, can be great — that is, can introduce a discrepancy of two or three minutes.

[Margin: The second method.]

The Second method is indicated by Don Giovanni Domenico Cassini [Giovanni Domenico Cassini] in his specimen of observations, p. 3, where he judges the solar parallax to be imperceptible, both by other arguments and by an observation of the year 1653, on the 4th day of April, at the hour after midday of $8\frac{1}{3}$, when the Sun stood from the preceding point — the head of Gemini, at $90^{\circ} 3'$ — and the Moon, near its first quarter, approached the circle of latitude of the aforesaid star [the head of Gemini]; for between the middle of the apparent dichotomy time (which had great latitude) and the Moon's coming to the circle of latitude of the star — which he determined from the line of section produced up to the star — he could scarcely detect the 7th [recte: *septimam*] minute of the hour as the interval due between the quadrature of the Sun and the star. He adds, moreover, that he attributes much to this observation, because no lunar parallax is involved in this practice, and the apparent place of the Moon is taken not from astronomical tables, but from comparison with the fixed star duly established. But if we use our [value] for the Sun and for the place of the said fixed star, and consider the time which elapsed from the Moon's coming to the center within the circle of latitude of Castor, up to the quadrature with the Sun, and the effect of the parallaxes optically retarding the dichotomy — as stated *Almagestum Novum* vol. 1, p. 731 — we [find] far more minutes of time than the 7th [recte: *septimam*] which we deduced [recte: *deprehendimus*] between the dichotomy and the quadrature; and accordingly: from this observation it is concluded that the Sun's horizontal parallax is less than about 27 seconds, and not even imperceptible.

[Margin: The sixth method.]

Afterward, however, the same Cassini, as we have it in the *Ephemerides* of the Illustrious March[ese] Cornelio Malvasia [Cornelio Malvasia], fols. 156, 173, and 186, confessed that, from his Table of Refractions, the summer [refraction] yielded for him a solar parallax either nil, or at most $15''$ of seconds; and from the equinoctial [refraction], $30''$ of seconds; and from the Table of Winter Refractions, a parallax of one minute. He nevertheless chose a horizontal solar parallax of $58' 37''$ [recte: $5' 8'' 37'''$ — minutes-and-seconds of arc] at apogee, in the mean distance of $19' 36''$, and at perigee of $1' 0'' 58'''$. Why? Because from this it follows that the Sun's mean distance from the Earth is 3460 terrestrial semidiameters, the seventeen-thousandths of which equal the semidiameters $58\frac{822}{1000}$, for the simple solar eccentricity, which agrees with the mean distance of the Moon from the Earth: so that the point at which the Sun's annual orbit lies should be a point in the circumference of the Moon's orb — namely, what the Moon occupies as often as it is in the Sun's apogee line, namely in the 7th degree of Cancer. It is also $58\frac{822}{1000}$, the square of which is the Sun's distance 3460; and so the mean

proportional between the semidiameter of the Earth, 1, and the Sun's distance [is established]. Now whether the beauty of this symmetry suffices as a foundation for determining the said parallax absolutely, [I leave aside] — than which we have obtained one fully twice as small from many dichotomies duly corrected; or whether some other symmetry, equally beautiful, can be devised for that [parallax] which we shall set out below in [Hypothesis] 2. We propose [it as] Hypothesis, [for] astronomers to test. We meanwhile will attempt certain other methods which, together with Father Francesco Maria Grimaldi [Francesco Maria Grimaldi], we have devised, for [obtaining] the Parallax from the Refractions themselves — including much worth knowing, which, if Cassini weighs it, he will perhaps coordinate his Refraction and Parallax Tables otherwise, by that skill and sagacity with which he is endowed.

CAPUT XIV.

On Astronomical Refractions, their Comparison, and their Use together with Parallaxes; and a New Inquiry into Parallaxes by means of Refractions.

How much astronomy owes to Tycho [Tycho Brahe], and then to Kepler [Kepler], for the measurement and use of refractions — astronomy having been recalled [from neglect] — no one tolerably practiced in these matters is ignorant. Yet not a few things among them, found in part to need correction, in part clearer explanation, lest they offer students of astronomy an occasion for error: the reader is therefore ignorant [of nothing], if from these very notions, or from definitions, we set out upon this treatment from a somewhat higher starting point.

Article I. Definitions, or Notions of the Terms.

The **True Celestial Horizon**, or **Rational** [horizon] — so called simply *Horizon* — is the greatest circle of the celestial sphere, described from the habitable point of the Earth through the Earth and the universe, as the center, as it were, from the pole [recte: from the vertex — *à vertice*]; such is, in the adjoined figure, the circle described by the line ACB, indicated, and from the vertical point of the habitation L, by the line DCE described.

The **Terrestrial Horizon** is the greatest circle of the terrestrial globe, [described] through the center of the Earth and from the place inhabited on the Earth's surface, as from the pole, described by the line DCE.

The **Physical Horizon**, or [the horizon] in a sensibly simple [sense] so called, is the greatest circle of the celestial sphere described from the vertex touching the Earth, and equidistant from the True Horizon — such is FIK.

The **Physical Horizon**, or **Terrestrial** [physical horizon], of the eye raised above the Earth, is the greatest circle of the Earth touching the lines [recte: tangent lines] drawn from the eye to the Earth: such is GNH; for it touches the lines OM, OL, [touching] the Earth at G and H, tangent and produced from the eye O. Hence it comes about that such an eye, which cannot see anything of the terrestrial surface within this terrestrial horizon, can nevertheless see the celestial [things] below either horizon.

The **Vertical line** is that which, from the vertex of the inhabitant, that is, the Zenith, is understood as produced through the inhabitant himself up to the center of the Earth — such is VOIC.

For the remaining Definitions: let there be, in the 2nd figure here, a portion of the terrestrial vertical circle AB, and a portion of the air around it [in which] refraction [occurs] DE, in the same plane. Let the physical horizon of the eye be AR, and the rational [horizon] CQ; and let the vertical line be VC; let there then be the arc TOG, of the planetary heaven — say of the Sun — described in the same plane from C, and the arc of the supreme heaven VSK.

Let first the Sun be below the horizon at G, whence at point I, of the physical horizon, and of the surface of the refractive air, falls the ray GI, which, having entered the said air, does not proceed in a straight line, but is in fact refracted, by the greater density of the said air, along IA, to the eye A. In this case the eye A, by the refracted ray AI, will see the Sun's im-

Diagram. A semicircular figure showing the horizon circles and the refraction of a solar ray below the horizon. The semicircle stands on the diameter A–B with the vertex V at the top.

- V (top): the vertex (zenith)
- A (left end of base): position of the eye / one end of the physical horizon
- B (right end of base): the other end of the base
- F (left, inner): point on the physical horizon FIK
- K (right, inner): point on the physical horizon FIK
- O (center): the center / point on the vertical line
- I (interior, left of center): point where the ray meets the refractive air
- H (interior, right): point on the horizon GNH

- G (interior, lower): the true position of the Sun below the horizon
- N (interior): point on the terrestrial physical horizon GNH
- L (base, right of center): point of the rational horizon
- C (center of base): the center of the Earth
- E (base): point of the refractive-air portion DE
- M (interior, left): point on the line OM
- D (left, near base): point of the refractive-air portion DE

— the Sun's **image** in F, at point R of the physical horizon below point R. Let there be drawn besides from A the straight line AGK, intersected at the points [recte: cutting through the points], through the Sun G, up to K, by which, were the opacity of the Earth not in the way, [the line] sustaining the propagation of the rays — and [so forth].

The density of the air refracting the rays, the eye A could see the Sun directly at G, beneath point K, but it sees the same [Sun] by the straight line CGL, if the eye were at the center of the Earth; and likewise, were the opacity of the Earth and the density of the air not in the way, it would see it [the Sun] illuminated beneath point L.

[Margin: The second case.]

Let, in the second [case], the Sun be at point H of the True Horizon, whence the ray incident at M is imagined to proceed toward N, [but] in reality is refracted at the eye A by MA, and thus the Sun's image is carried by the line AMO, appearing in O, beneath point S, were it carried [recte: drawn] by the straight line intersected AHP; for the Sun itself could not have been seen in H, beneath point P, were the said opacity not in the way; and [if] the density [were not in the way], it would be seen [recte: it could be seen] in H, beneath point Q, by the straight line CHQ.

[Margin: The third case.]

Let, in the 3rd [case], the Sun be at F, and [seen] without sensible refraction, truly so; the place being beneath Z, and the thing seen beneath R. With these premised, let us pass on to the remaining Definitions.

The **True Line of the place of the Star** is the straight line [drawn] from the center of the Earth, and of the Universe, through the center of the body of the Star, up to the supreme heaven — such is, in the first case, CGL; in the second, CHQ; in the third, CFZ. For from this center the astronomers consider and measure the true places of the stars in the heaven, and their true motions.

The **Apparent Line of the place** is the straight line which, in [an eye placed] on the surface of the Earth, or above its surface, the Star's image appears [along]; or it appears [as] the Star itself, if it could permeate through that line to the eye. There is, however, a double [apparent line] of the place seen, that is, by simple vision, [namely] by the **Parallactic** line, that is, the Refracted [line].

The **Parallactic Line** is the straight line [drawn] from an eye placed outside the center of the Earth, [and] led through the center of the Star up to the supreme heaven — such as, in the first case, is ACK; in the second, AHP; and in the following, the third figure, the line AP, the Star being supposed to be at P.

The **Anaclastic Line** is any refracted ray, but most especially that one which is refracted at the eye, as in the first case is AI; in the second, AM; for it goes out by imagination, by the force of refraction, [as] the produced line of the place seen — such is the line AFR, by which the Sun, which is truly at G, appears at F, beneath point R; and the line AOS, by which the Sun, which is at H, appears at O, beneath point S.

The **True Altitude of the Star** is the arc of the vertical circle intercepted between the line of the true place and the true Horizon above [the eye] — such as is the arc QZ, if the star is supposed to be truly at F, or in the 3rd figure, the arc HP, the star being placed at P; for if it were intercepted below, the arc QL would be the **True Depth**. Each of these the angle made at the center of the Earth by the line of the Horizon, and from the other line of the true place drawn through the center of the star, measures: thus the angle QCL measures the Depth of the Sun G, and the angle ZCQ, [made] at F, measures the Altitude of the same [Sun].

The **True Distance** of the star from the Vertex is the arc of the vertical [circle] intercepted between the Vertex and the line of the true place, and it [is] measured [by] the angle made at the center of the Earth by the vertical line and by the line of the true place; such as is, in the prior case, the angle VCL, in the posterior, VCQ.

The **Visible Altitude**, just like the depth, is twofold: the one **Parallactic**, the other **Anaclastic**. Now the Parallactic Altitude is the arc of the vertical circle described from the eye outside the center of the Earth, and intercepted between the parallactic line and the physical horizon above; and it is measured [by] the angle made at the center of the said eye by the two said lines, as in the 3rd figure. If the figure be described from the center of the eye A, [there are] described the arcs of the Astronomical Quadrant, or the arc QS, OZ, of the hemisphere, and through the dioptra AS, [as] the fiducial line, the Star is observed: the angle SAO measures the arc OS as well as the Parallactic Altitude of the star, which appears smaller than

the true altitude HP, [as] it will appear in the celestial place X, when it is truly beneath point T, of the supreme heaven, described from the center of the Earth C. I said *intercepted above*, because, if [intercepted] below, that is, beneath the physical horizon AF, it would be the **Parallactic Depth**, such as is, in the 3rd figure, the arc OZ; the measure of which is the angle FAH, the star being placed at H, and, in the 2nd figure, in the prior case, the angle OAK, in the posterior, the angle OAP. On the Anaclastic altitude I shall speak at num. 15.

The **Visible Distance** of the star from the vertex is likewise twofold: **Parallactic**, the one; **Anaclastic**, the other. Now the Parallactic Distance of the star from the vertex is the complement to the Quadrant of the Parallactic Altitude, or the Aggregate of the Quadrant and the Parallactic Depth; and it [is] measured, in either case, [by] the angle made at the center of the eye by the vertical line and by the parallactic line, of which sort is, in the 3rd figure, the angle VAP, if the star is at P, or VAH, if it is at H, and, in the 2nd figure, in the prior case, the angle VAK, in the posterior, the angle VAP.

The **Anaclastic Visible Distance** of the star from the vertex is the arc of the circle described from the center of the eye, intercepted between the vertical line and the Refracted Ray of the star to the same eye; and its measure is the angle made, at the center of the eye, by the vertical line and by the anaclastic line, or refracted ray. Such is, in the prior case of the 2nd figure, the angle VAR, in the posterior, VAS.

The **Anaclastic Visible Altitude** of the star is the complement to the Quadrant of the Anaclastic distance, when [that distance] does not exceed the Quadrant; but if that distance exceeds the Quadrant, the excess itself is the **Anaclastic Depth**. Now of the Anaclastic Altitude let the example [be found] in its measure, [namely] in the 2nd figure, in the posterior case, the angle SAR. For in the prior case, when, with the Anaclastic distance VAR, there is a Quadrant, the Anaclastic Visible Altitude is nil, and the star appears in the Physical Horizon AFR. The example of the **Anaclastic Depth** I shall give below, when the discourse will be on the Ray raised to the eye, thus Refracted, that it bends downward.

The **Astronomical Parallax** is the difference between the true place of the star, and the seen — or visible — place of the same, through the parallactic line. Hence, if the Parallax be referred to the Altitude, it is called the **Parallax of Altitude**, and it is the difference between the True altitude of the star and its Parallactic altitude; of which sort is, in the 3rd figure, the difference between the angle PCH, and the angle PAF. But if it be referred to the Distance, it is called the **Parallax of distance**, and it is the Difference between the True Distance of the

star and the Parallaxic Distance, of which sort is, in the same 3rd figure, the difference between the angle VCP, and the angle VAP. If, finally, it be referred to the depth, it is called the **Parallax of depth**, and it is the difference between the True depth of the star and the Parallaxic depth; such as, in the prior case of the 2nd figure, is the discrimen between the angle QCK, and the angle RAK; but when the star is in the True Horizon, and there is no true depth, the Parallaxic depth itself is the Parallax of depth, as in the 3rd figure is the angle FAH, and in the posterior case of the 2nd figure, the angle RAP.

Diagram. A large quadrant figure (the second figure of Caput XIV), showing the vertical circle, the horizon lines, and the refracted/parallaxic rays from the eye A. The quadrant rises from the corner C, with the vertical side V–N–D–A–C and the base A–C–B–E–G; the arc runs from V down to the lower right.

- V (top of vertical side): the vertex (zenith)
- T (upper left of vertical side): point of the supreme heaven arc VSK
- S (upper right, on arc): point where the supreme-heaven ray meets the arc
- O (interior, center): point on the apparent/anaclastic line
- N (left, on vertical line): point of the horizon
- D (left, below N): point of the refractive-air portion DE
- M (interior, left): point on line AM
- A (left corner): position of the eye
- F (right, interior): point on the physical horizon AR / arc TOG
- R (right): end of the physical horizon AR
- I (interior, near A): point where the ray meets the refractive air
- C (base, left): the center of the Earth
- B (base, center): point on the base
- E (base): point of the rational horizon / refractive-air portion DE
- H (interior, lower right): point on the True Horizon
- G (lower right): the true position of the Sun
- Q (far right): point of the rational horizon CQ
- P (far right, on arc): the parallaxic point
- L (lower right): point of the line of the place
- K (lower right corner): point of the supreme-heaven arc VSK

Diagram. A smaller quadrant figure (the third figure of Caput XIV), illustrating the parallaxic and anaclastic altitudes and distances from the eye A. The

quadrant rises from corner C with vertical side V–Q–A–C and base A–C–H, the arc running from V (through T, X) down to H.

- V (top of vertical side): the vertex (zenith)
- T (upper right, on arc): point of the supreme heaven
- X (just below T, on arc): the celestial place where the star appears
- P (interior, on ray): the parallax point (star supposed at P)
- Q (left, on vertical side): point on the vertical line
- S (interior, near A): point on the line AS / arc OS
- O (interior): point of the arc OS
- A (left corner): position of the eye
- R (interior, near base): point on the refracted/anaclastic ray
- Z (base, near A): point of the parallax depth arc
- C (base, left corner): the center of the Earth
- F (right, on base/horizon): point of the physical horizon AF
- H (base, right corner): point on the True Horizon

[Margin: What the Parallax of Altitude, of Distance, and of Depth is.]

Since, by *Elements* I.32, the external angle of a rectilinear triangle equals the two internal opposite angles, and is therefore the difference between the external angle and either of the internal opposite angles, the angle formed at the center of a star — between the line of the true place and the parallax line — measures, by the equivalence shown, the parallax of vertex-distance. Indeed, it even turns out that such an angle is called the parallax. And so, in the second figure, in the prior case the parallax of distance is the angle AGC, in the latter case the angle AHC; and in the third figure the angle APC, if the star is at P, or AHC if at H. Finally, since the true distance from the vertex and the parallax distance differ from each other by just as much as the true altitude differs from the parallax altitude — or, in the case of depth, the true depth from the parallax depth — the angle is for that reason the same; for if not formally, then at least equivalently, the parallax of distance from the vertex is also equivalent to the parallax of altitude or of depth.

17. The horizontal parallax [*Parallaxis Horizontalis*], so called without qualification, is that which belongs to a star established in the true horizon; and so it can only be a parallax of depth, or of distance from the vertex. Such is the case in the 2nd and 3rd figures, the angle AHC. Let the common run of astronomers call this the "Astronomers' Parallax of Altitude"; but the wiser, the parallax in the vertical circle.

18. **The physico-horizontal parallax** [*Parallaxis Physicohorizontalis*] is that which belongs to a star apparently in the physical horizon, as in the 2nd figure. In the prior case it is the angle FAG, the Sun being at G; but in the case at F, where it appears by refraction, the parallax itself is properly said to be not so much of altitude as of depth, or of distance from the vertex. They can, however, coincide into one — the horizontal and physico-horizontal alike — if the star, while existing in the true horizon, has a parallax as great as the refraction.

19. **The optical refraction of a star** [*Refractio Sideris Optica*] is the angle formed at the point of incidence, between the refracted ray and the incident ray itself (when, as it were, unrefracted) — that is, the line of incidence extended straight through the point of incidence; this angle some call the angle of refraction. Such is, in the 2nd figure, the angle AMN, in the latter case. I call this the **optical refraction** [*Refractionem Opticam*], because the opticians consider it and express it in their tables of refraction in air, in water, in glass and so on. The astronomers, however, do not consider it in itself, because they do not attend to the difference of the place by the refracted ray and the visible place by the line of the true place — which would be unrefracted, were the eye in the line A, in the unrefracted ray, that is, at N — but they consider the difference of the place seen by the refracted ray, that is, by the line of the true place, and the visible place by the parallactic line. For in either case they have something fixed and determinate: namely the center of the Earth, and the center of the eye in the place of observation established. The astronomer-optician can, however, consider both refractions, the optical and the astronomical, so that, from the diversity of their properties, the matter may be the more illuminated — but care must be taken, lest (as happened to Tycho [Tycho Brahe]) the properties of the one be confounded with those of the other. For since with the decreasing interval of the star from the Earth the obliquity of incidence grows, and with it the inclination of the ray to the surface of the air, and therefore the optical refraction, [Tycho] supposed and expressed in words that, in his larger tables, the astronomical refraction of a star nearer the Earth would be greater than of one more remote — which I shall demonstrate below to be false.

[Margin: Tycho's hallucination.]

20. **The astronomical refraction** [*Refractio Astronomica*], so called without qualification, is the difference of the place of a star seen in the heavens by

the anaclastic line, and of the true place reckoned from the center of the Earth. If this be referred to the anaclastic altitude compared with the true altitude, it is called the **refraction of altitude** [*Refractio Altitudinis*]; if to the depth, of **depth** [*Profunditatis*]; if to the distance, of **distance** [*Distantiae*]. But the refraction of distance is adapted as readily to the case of altitude as to that of depth, and is more easily set before the eyes by the diagrams placed below. We shall use this one henceforth. Let it therefore be that **the simple astronomical refraction** [*Refractio Astronomica simplex*] is the difference between the true distance of a star from the vertex and the distance seen by the force of the refracted ray; such is, in the 2nd figure in the prior case, the difference between the angles VCL and VAR, in the latter case between the angles VCQ and VAS. But when the stars are beyond the horizon, we do not need lines horizontal in our reckoning, but the eye must be led by the straight line drawn parallel to the line of the true place. For the angle made by that parallel, and by the refracted ray, will be the measure of the astronomical refraction.

21. **The composite astronomical refraction** [*Refractio Astronomica Composita*] — namely, that compounded of the simple refraction and of the parallax — is diminished, or rather wholly cancelled, by the parallax through the refraction; as some imagine, but as is in fact nothing. For if the refraction be as great as the parallax would be, it is not compounded of this, but contrary to it. If, on the other hand, the refraction be greater than the parallax would be, it does not on that account produce two effects — namely first raising the star optically from the place in which it would be seen by the mere parallactic line, and then further raising the star above the true place — but in fact it produces a single effect; namely, raising the star optically above the line of the true place, more, or equally, than the depression would have been by parallax, if the star could have been viewed by the mere parallactic line. The star is not so refracted in this case; for in this case the parallactic line does not enter the eye, nor is the star in fact seen by it, nor is it the ray that is afterwards refracted. And thus the parallax is merely potential, not actual. As in the first case of the figure, when the Sun is truly at G, it is not seen by the parallactic line AGK, beneath K, since such a ray does not penetrate to A, the opacity of the Earth standing in the way; but it is seen by the ray GI, refracted from I to the eye A; and so the Sun appears in the line AIFR. Nor is the refraction raised, the optical [refraction] being from K, in L, and from L in R, but merely from L in R, or from the line CL, to the line AR; this refraction is therefore not compounded of the prior parallax, afterwards corrected, and then of the

simple refraction; rather, just as in this case the star seen from the vertex is to be converted into the true [place], it suffices that the seen [place] be added to the simple refraction, the parallax being moreover left out, lest the astronomer be deceived (as Tycho was).

22. **The horizontal refraction** [*Refractio Horizontalis*], so called without qualification, is that which belongs to a star established in the true horizon; of which kind is, in the 2nd figure in the latter case, the angle OAF, the Sun being at H.

23. **The physico-horizontal refraction** [*Refractio Physicohorizontalis*] is that which belongs to a star apparently in the physical horizon, as in the 2nd figure in the latter case, where the angle HCG contains the measure of the refraction. This, however, Tycho calls "horizontal," and observes it the more readily because it is easier, and because the very moment of that observation is given; for it is the first to come about at the appearance of the star in the physical horizon. But at the moment when the star is in the true horizon — neither given by exact calculation beforehand, nor difficult and far from that very exact observing to set up — Tycho [Tycho Brahe] therefore uses the refractions of the visible altitudes observed, and before, on p. 79, set out in a Table; nor does he doubt about the lunar [refractions], p. 124, and the fixed [stars], p. 280, to assess the visible altitudes (*Progymnasmata*, p. 102).

24. The remaining Definitions — namely the parallax, and the refractions of right **ascension**, of **declination**, of **longitude** and of **latitude** [*Ascensionis Rectae, Declinationis, Longitudinis ac Latitudinis*] — we pass over, as superfluous in this place, since here we treat only of the parallaxes and the refractions of stars in the vertical circle. Indeed, what the parallax of distance, and the **subhorizontal** [*Subhorizontalis*] or **superhorizontal** [*Superhorizontalis*] refraction may be, is easily discerned from the true situation of a star below the true horizon, or above.

Article II — Several Propositions concerning Parallaxes in the Vertical Circle

[Art. II. Propositiones nonnullae de Parallaxibus in circulo Verticali.]

Proposition I

The parallax of a star more remote from the Earth is smaller than that of a nearer one; conversely, the parallax of a star more remote from the vertex is greater than that of a nearer one, other things being equal.

25. Since the angle measuring the parallax, namely the one formed at the center of the star and having for its base a semidiameter of the Earth, which at equal distances of the stars from the vertex is greater in the case of a nearer star than in that of a more remote one — as belonging to the external angle of an opposite rectilinear triangle — whereas at equal distance of the same star from the vertex, the parallactic angle of a nearer one is more acute, until at the vertex it altogether vanishes; it suffices to describe a suitable figure, and the demonstration occurs at once.

Proposition II

For an eye raised on the vertical line, the parallax is greater, other things being equal, than for one less raised.

26. Namely, the base of the parallax being opposite, it is greater when it consists of a semidiameter of the Earth and a greater altitude of the eye, than when of a lesser.

Proposition III

The parallax of true altitude, by the parallactic line, and the seen [parallax] of an equal seen altitude, are not equal, other things being equal.

27. For in the same instant of time the same star cannot be said to have the parallactic distance from the vertex seen, which is equal to the true distance, when it is smaller than the true, as the seen is. As in the 4th figure, the [seen] is smaller than the true VCR, the seen being VAR; and thus the seen altitude is not equal to the true, since the star is raised; now, for the seen [distance] to come out equal to the true distance, the star must be raised so long as the parallactic line is parallel to the line of the prior true distance. As in this figure, the star at R must in fact ascend to S, so that the parallactic line AS may be parallel to the preceding true CR. Thus the seen distance from the vertex VAR will be equal to the prior true VCR, by *Elements* I.29; but in such a situation the parallax of distance ASC, by the first proposition of this [Article], will be smaller than the prior parallax ARC. Therefore the parallax belonging to the seen altitude equal to the true

altitude will not be equal to the parallax of the true altitude, but smaller; and so for the rest.

Diagram. A quarter-circle (quadrant) with center C at the lower left. The horizontal radius runs from C to H at the right; the vertical radius from C up to V. The arc VH joins them. Within the quadrant, point A lies on the vertical line above C; from A and C lines run to points R and S on the arc, illustrating the true and parallactic distances of Proposition III.

- V (top of vertical radius): vertex
- C (lower-left, center): center of the Earth
- H (lower-right, end of horizontal radius): horizon point
- A (on vertical line above C): position of the eye
- R (on arc, lower): star at true distance
- S (on arc, above R): star raised so that $AS \parallel CR$

Corollary

28. The Table of Parallaxes serving for a given true altitude does not serve exactly, nor in strict geometrical rigor, for the seen altitude — equal in quantity, as it stands — but it does serve mediately, by the device that follows.

Proposition IV — Problem

From the Table of Parallaxes of true altitude, to extract the parallax suited to an equal seen altitude.

29. Seek in the aforesaid Table the parallax corresponding to the given true altitude, just as if it were the true [altitude]; add it to the given altitude, and with the aggregate produced by this addition seek in the same Table another parallax — that one will be the one which belongs to the seen altitude given before. For example: let the Moon be distant from the center of the Earth 52 terrestrial semidiameters, and let its seen altitude be 15 degrees. The parallax in the Parallactic Table of the Moon corresponding to 15 degrees of seen altitude is 64' 10". To this, the added 15 degrees makes a true altitude of 16° 4' 10"; and to this there corresponds in the same Table a parallax of 63' 51". This, therefore, will be the [parallax] which fits the seen altitude of 15 degrees. You will, however, work more subtly by an analysis of the triangle ACS. Given CS, the distance of the star from the Earth, in parts of which the terrestrial semidiameter AC is one, and CAS, the

complement of the seen distance VAS, to two right angles, the parallax ASC fitting the seen distance will easily be obtained.

Proposition V

The horizontal parallax is indeed smaller than the arc intercepted between the true and the sensible horizons; but in the Sun [smaller] imperceptibly, in the Moon scarcely perceptibly, and almost contemptibly smaller.

30. In this fifth figure the horizontal parallax is the angle AHC, by Definition 17; and FI, by the definition of sines, is the right sine of the arc FH, intercepted between the true horizon CH and the sensible AF; this [FI is smaller] than the angle FCH. Now, the diagonal AI being drawn between the equal parallels AF and CI, and CF being the other [diagonal], an isosceles triangle COI arises; therefore, by *Elements* I.15, the angle OCI — that is, FCI — equals the angle OIC, that is, the angle AIC; but the angle AIC, the external one, is by *Elements* I.32 greater than the two internal and opposite [angles]; therefore the angle AIC is greater than the angle AHC, and accordingly the angle FCH and the arc FH is greater than the horizontal parallax, or this [parallax is] smaller than that.

Further, that the horizontal parallax and the arc FH — that is, the angle FCI — may be compared together at once, the right triangle ACH must first be resolved, in which the side CH is given, that is, the distance of the luminaries in semidiameters of the Earth, and AC, one semidiameter; whence the parallactic angle AHC will not be hidden. Then in the triangle FCI, CF is given, but as a base — namely, the distance of the luminaries from the center of the Earth — and FI, equal to one terrestrial semidiameter AC; therefore the angle FCI, measuring the arc FH, will not be hidden. By the most subtle Logarithms we have determined this for you, assuming the least distance of the Moon from the Earth to be 52 terrestrial semidiameters; that of the Sun, the Tychonic mean, 1142, the truer and ours, 7373; from which data the horizontal parallaxes, and the arc FH, come out, as in the following Table.

	Semid. Terrae	Parall. horiz. I. II. III. IV	Arcus FH I. II. III. IV
☾ in distantia	52	66 6 39 0	66 15 8 0
☉ in distantia	1142	3 0 22 0	3 0 22 25
☿ in distantia	7373	0 28 18 0	0 28 18 5

It is therefore evident that the horizontal parallax is imperceptibly smaller than the arc FH between the true horizons in the Sun, and in the Moon at most smaller by 9' usually; contemptibly so.

Diagram. A quarter-circle (quadrant) with center C at the lower left. The horizontal radius runs from C through B to H at the right; the vertical radius from C up to V; the arc VH joins them. The point A lies on the vertical radius; F lies on the arc. AF (the sensible horizon) is drawn parallel to CI, with the diagonal AI and the chord CF crossing at the interior point O. The figure illustrates the horizontal parallax (angle AHC) versus the arc FH of Proposition V.

- V (top of vertical radius): vertex
- C (lower-left, center): center of the Earth
- B (on horizontal radius, between C and H): point on the true horizon
- H (lower-right, end of horizontal radius): true horizon point
- A (on vertical radius above C): position of the eye / one terrestrial semidiameter
- F (on the arc): star in the sensible horizon
- I (on horizontal radius, near H): foot of CI, equal-parallel to AF
- O (interior, intersection of AI and CF): vertex of the isosceles triangle COI

Proposition VI

Given the horizontal parallax of stars, the true altitude of them is at once given when they are in the physical horizon; and likewise the altitude of the physical horizon itself, without perceptible discrepancy — provided that, in the case of the lunar parallax, nine seconds-of-arc be added.

31. For the arc between the true and the physical horizon is the true altitude of the physical horizon, which the stars truly existing there have. But this arc, by the preceding Proposition, is to the senses equal to the horizontal parallax of the Sun — indeed of the Moon increased at most by 9" — and in the rest, none, or one smaller than the solar parallax, the stars having the same [parallax], as is plain *a fortiori*. In Mars, however, Venus, and Mercury, though they have at perigee a parallax greater than the solar, yet in fact, on our supposed distance of the Sun from the Earth, they never have a parallax of 3'; which, even if they did have — as Tycho supposes of the Sun — is plain from what has been said to be Tyconic, and that to the senses equal to the arc FH. No planet therefore, the Sun excepted, when it is truly in the physical horizon, is higher than the true horizon by more than one minute, and at a mean distance...

Proposition VII

The parallax of a star truly existing in the physical horizon is greater than the parallax of the same star in the true horizon; and is therefore deservedly called the horizontal parallax.

32. In the fifth figure, of a star existing at F, the parallax is the angle AFC, which by the alternate FCI is equal, and this [is] greater than the parallax AIC; and this [is] greater than AHC; therefore AFC is greater than AHC — see the preceding Demonstration. It is not, however, to be wondered at if a star, raised somewhat above the true horizon, should have a greater parallax than one not raised; because the parallax in the physical horizon is not a parallax of altitude, but of depth, and truly depresses the star more than the parallax of a star raised. For the parallax of the [physical] horizon perceptibly depresses [it] more truly — that is, below the true [horizon] — but more apparently below the apparent horizon; and the horizontal parallax truly depresses [it], that is, below the [true] horizon. But on account of the predicted greater magnitude it is not unworthy of the name of horizontal parallax; let the Tables of parallaxes be used in respect of the true horizon, especially since (as will soon be demonstrated) it is the greatest of all parallaxes.

Proposition VIII

The parallax of a star truly existing in the physical horizon is the greatest of all [parallaxes] of the same star existing elsewhere, but at the same distance from the Earth; and below the physical horizon the parallaxes continually increase, as much upward as downward.

33. While I was striving to demonstrate this in another way, Father Francesco Maria Grimaldi [Francesco Maria Grimaldi] suggested to me another proof, which is of this kind. In the Vertical circle BVHP, let the Vertical line be VP, and the Astronomical Horizon BCH, and the Physical EAF, in which the eye is A; if from the center of the Earth C the straight lines CF and CE be drawn, which are equal to semidiameters of this circle, an isosceles triangle CEF will be formed; and the angles at the base, by *Elements* I.15, will be equal. The parallaxes of stars placed at the extreme of the physical horizon, namely E or F, will be congruent — namely the angles AEC and AFC; let the star then be at K, below the physical horizon, in I, above it by as great an arc EI as the arc FK is; so that, through the eye A, it may be led from the point K to I, and from I by the straight line KI. For if, from the same points,

lines be drawn from the center of the Earth to E, K, and CI, another isosceles triangle CIK will be born, in which the parallactic angles at the base between themselves are equal, namely AKC and AIC; now let [a line] be drawn to the chord KI, and the perpendicular CL [dropped]; for in the small triangle ACL, right-angled at L, the base AC, by *Elements* I.18, is greater than the side CL; therefore the chord EF is more distant from the center C of the circle than the chord IK; therefore, by *Elements* III.15, the chord EF is greater than IK; and accordingly, by *Elements* I.32 and I.5, the angle ECF is smaller than the angle ICK, and the angles at the base EF are greater than the angles at the base IK; therefore the parallax F is greater than E, and severally, than... the lower parallax I and the lower K. By how much the point K is lower than the point F, and the point I higher than the point E, by so much the chord through the eye A, drawn to such points... is nearer the center C, and accordingly greater than EF; and EF itself, [greater] than all those that are drawn through the eye A... [is] most distant from the center C, and accordingly the parallaxes E and F [are] the greatest of all; and all the rest, always toward the vertex V, or toward the lowest point P, decrease continually.

Diagram. A full circle representing the vertical circle, with center C. The vertical diameter runs from V at the top to P at the bottom. The astronomical horizon is the horizontal diameter B–H. Above it, an oblique chord E–F marks the physical horizon, with the eye A near the center and the label "AL" beside the perpendicular CL. Points I and K lie on the circle near E and F respectively. The figure illustrates Grimaldi's proof.

- V (top): vertex
- P (bottom): nadir / lowest point
- B (left, on horizontal diameter): astronomical horizon, left end
- H (right, on horizontal diameter): astronomical horizon, right end
- C (center): center of the Earth
- A (near center): the eye / observer
- E (upper left, on circle): left end of physical horizon
- F (upper right, on circle): right end of physical horizon
- I (left, on circle near E): star raised above physical horizon
- K (right, on circle): star below physical horizon
- L (near center, on chord IK): foot of the perpendicular CL [labelled "AL"]

[Margin: The line CH serves for the line CK, drawn from the point of incidence.]

Remarkable Corollary

34. Falsely, therefore, has it been supposed until now that the greatest of all parallaxes...

is that horizontal [parallax] which belongs to a star existing in the true horizon — whereas the greatest is the one in the physical horizon, although the discrepancy is imperceptible in the Sun, and in the Moon not exceeding 9"; as I said in Proposition V, one could be used for the other.

Proposition IX

The parallax of depth is smaller than the parallax of altitude of an equal depth.

35. Let it be that in this 7th figure a star is at K, and the eye at A; and so the parallax of altitude is AKC. But let another star be — or the same one at another time — in L, below the horizon toward BCH; by as great an arc HL as is the arc of altitude HK, the parallax of depth ALC will be, by the premised definitions. Let CL be continued to M, and from A, to M, let the straight line AM be drawn; the triangle AML will then be formed, in which the angle M is equal to the parallactic angle of altitude K, since it is opposed to the same side AC; and the triangles ACK and ACM are similar, because, besides the common side AC, the sides CK and CM are equal, as radii of the same circle; and on account of the comprehension on the side AC, the angles VCK and VCM are equal — that is, equal complements of altitude, since the angles MCB and HCL are equal at the vertex, and are equal to each other; therefore, in the greater triangle AML, the angle M is opposed to the greater side AL, and the angle L to the smaller AM. Therefore the angle M, and accordingly its equal K (which is the parallax of altitude), is greater than the angle L, that is, the parallax of depth.

Diagram. A full circle with center C. The vertical diameter runs from V at the top to D at the bottom; the horizontal diameter from B at the left to H at the right. Point A lies just above center C on the vertical line (the eye). Radii run out to K (upper right, on the circle) and L (lower right, on the circle); M lies on the line CL continued (lower left region). The figure illustrates the comparison of the parallax of altitude (AKC) with the parallax of depth (ALC).

- V (top): vertex
- D (bottom): nadir
- B (left): horizon, left end
- H (right): horizon, right end

- C (center): center of the Earth
- A (above C): the eye
- K (upper right, on circle): star at altitude
- L (lower right, on circle): star at depth
- M (lower left): point on CL continued

Proposition X

The parallax of depth, of a depth equal to the [given] altitude, in the Moon is not smaller by more than 20 seconds-of-arc.

36. For the maximum parallax of altitude is that which belongs to a star existing in the physical horizon, by Proposition 8; but this, in the Moon, is so great as the arc of the vertical [circle] described through the center of the Moon between the Astronomical and the Physical Horizons — namely the arc HK in the Moon, the [arc] of altitude — is great. The distance proximate to the Earth is, by the said Proposition 5, the minutes $66' 15'' 8'''$. Now if just as much be below the true Horizon, with the addition there of degrees 90, the triangle whose angle comprehends a semidiameter of the Earth at the distance of the Moon from the Earth — that is 52 terrestrial semidiameters — will be $91^\circ 6' 15'' 8'''$. Therefore, by the logarithmic canons, the parallax of depth comes out in such [a case] $65' 55'' 10'''$; and so the smaller parallax of the maximum altitude does not exceed $20''$; in the Sun, however, this difference comes out scarcely of one second, as will be plain from the calculation. Wherefore in the Sun it can be held for imperceptible, and in the Moon little, and scarcely perceptible.

Article III — Propositions concerning Refractions

[*Artic. III. Propositiones de Refractionibus.*]

Proposition XI

A ray, the more obliquely it falls — that is, at a greater angle of inclination — is by so much the more refracted; and equally, if equally oblique.

37. Thus Witelo [Witelo], *Optics* X.14, and Kepler in the *Paralipomena ad Vitellionem* I.1.4, Proposition 1: from the posterior [cause], it was first proved by experiments, and then demonstrated *a priori*, and so received by the opticians, that it holds the place of a 2nd Axiom, from Kepler in the *Dioptrics*. Hence the optical refraction of a more obliquely incident ray is the greater.

Proposition XII

Of a ray returning from a denser medium, through the same point by which it entered, the refraction from the perpendicular is equal to the refraction toward the perpendicular at entry.

38. This is demonstrated by Alhazen [Ibn al-Haytham], *Optics* VII, Proposition 34. Witelo...

[Continuation of the citations supporting the preceding proposition:]

Witelo [Vitellio], Book 10, Prop. 9; René Descartes [Renato de Chartes], *Dioptrics* [*Dioptr.*], no. 10; Hérigone [Herigonio], *Dioptrics* [*Dioptr.*], Prop. 1, and likewise locations 3; from the Axioms in Kepler's [Keplerum] *Dioptrics*.

XIII. PROPOSITION.

For a more distant and a nearer star whose rays of incidence run along the same line into the same point of the same dense medium, the optical refraction is the same.

[Margin: 39] Kepler [Keplerus] conceived the same idea in other words in Book 1 of the *Paralipomena* [*Astronomia Optica*], chapter 4, Proposition 4, where he says: "For light that is faint and light that is denser, all else being equal, there is no difference of refraction." And in this sense he added in his commentary [*postilla*]: "A greater distance of the luminous body does not increase refraction." For even though the ray of a more distant star, being uniformly weakened, becomes fainter as it proceeds, and the density of the intervening medium offers more resistance to a weaker ray (so that there is more intensification), nevertheless this does not amount to any greater bending so far as shape or fracture is concerned. The amount of that bending arises from a greater or a lesser obliquity of incidence; but in a more distant and a nearer star the radiation is assumed to occur along the same line of incidence — and so, the angle of inclination being equal, the optical refraction is equal by Proposition 11.

XIV. PROPOSITION.

At the same true distance from the vertex, the apparent distance produced by refraction is less for a more distant star than for a nearer one, all else being equal.

[Margin: 40] Keeping in common the matters described in Figure 2, suppose that in this eighth figure the Sun is at H and the Moon at G, both of them

Diagram. A quadrant-shaped figure bounded by the vertical line VAC on the left and the horizontal base CH along the bottom, closed by a quarter-arc from V down to H. The vertex V is at top; the star S is marked on the arc near the top with an asterisk. From the eye at A near the lower left, several rays radiate out across the field toward the base line and arc; intermediate points M, O, P, K, L, G, N are lettered along the refracted and incident lines; the Sun is at H and the Moon at G.

- V (top): vertex of the vertical line
- S (on upper arc): the star (marked with an asterisk)
- A (lower left, near C): the eye / observer
- O, P (left side, below V): points on the vertical line
- M (interior, upper): point on a refracted ray
- K, L (interior): points where rays cross / refract
- G (interior, lower): the Moon
- N (interior, lowest): point of incidence
- C (bottom left corner): foot of the vertical
- F (right, on arc): point on the arc
- H (bottom right corner): the Sun

at the same true distance VCGH from the vertex, to which the line drawn from the eye AF is parallel. The ray of the Sun enters at point K, by way of HK, and there, while unrefracted, it would proceed in P; but in truth, by way of KA, it is refracted to the eye A — for by AK, produced optically toward the Sun's heaven, the Sun appears at S, and its apparent distance from the vertex is the angle VAS. The Moon's ray, however, from G cannot radiate at K, but is so refracted by way of KA that, since the angle of inclination GK is greater, it would radiate at a greater angle, and hence its refraction would be greater by Proposition 11 of this chapter, and the eye at K, beneath A, would be refracted, both because by Proposition 12 of this chapter it would be the same for the Sun and for the Moon, and because the refracted ray of the Sun AK, and likewise the Moon's, lie on the line of incidence; the Moon ought therefore to be at N, where it is more distant from the vertex by the angle VCN, the smaller being VCH, namely the Sun's distance. Finally, since just as the ray of the Moon touches the sphere of the refractive air at a nearer point — for in this case the ray of the Moon, first entering the air, first enters the eye at A, lower than the Sun's ray, which first entering the air enters the eye at A, striking it: therefore the ray of the Moon at the eye A, by the refracted ray and at a lower point, is refracted, say at I, and by the refracted ray AI the Moon appears at L; and so its distance, seen apparently from the vertex, will be VAL, greater than the Sun's VAS, and so for similar cases,

provided the rest be equal — that is, the position of the eye, the density of the air, and so forth.

XV. PROPOSITION.

At the same apparent distance from the vertex produced by refraction, the true distance is greater for a more distant star than for a nearer one, all else being equal.

[Margin: 41] In the eighth figure it would appear, if they were not on the same vertical;

if it [the observer] should weigh that matter; for the fixed stars and planets, some of which are nearer than others, are by Tycho [Tycho Brahe] assigned the same refractions; and shortly after: Rothmann [Rothmannus] is therefore mistaken, in supposing that the various fixed stars and planets — though differing in distance from the Sun and from the planets — would undergo the same refraction; and however much Brahe in the *Progymnasmata*, folio 280, suspects the Moon's refractions to be greater on account of its nearness — nevertheless on folio 124 (which he wrote later) he finds the refractions, as I have already said, to be the same as the solar ones. And so Kepler [Keplerus] judged the refractions of the stars to be equal at whatever distance from the Earth, which is indeed true if they are at the same apparent distance from the vertex, and provided the discussion concern optical refraction; but in respect of astronomical refraction it is false, whether they be at the same apparent distance or at the same true one. Hence in the *Rudolphine* precept he lastly spoke of Tycho. If perhaps (which he nonetheless vainly suspected) the altitude of the stars from the center of the Earth should vary, it would produce a cause of variety. I think the refractions are therefore made greater because in computing them Tycho applied too large a parallax of the Sun. Yet even without a parallax they ought to have been made greater. Hence at last he badly added, in the commentary to the same Proposition 4 of Book 1 of the *Optics*, chapter 4: "Nor does refraction represent the Moon conjoined to a star which, refraction aside, had appeared separated from it." And that this is false we shall show at once.

[Margin: Kepler's error]

XVII. PROPOSITION.

Two stars unequally distant from the center of the Earth can, by the power of refraction, be represented as nearly conjoined bodily, which, refraction set aside, would have appeared very far apart.

[Margin: 45] It is, as I have said, against Kepler [Keplerum], Book 1 of the *Astronomical Optics*, Proposition 4, in the commentary. Let there be, in the eighth figure, the Sun at H and the Moon at N, if not in the same vertical plane in which lies the obstacle to the propagation of the Sun's ray — at least in the neighborhood of the vertical, and at a smaller distance, which is the aggregate of the semidiameters of their visual disks; and let them radiate by the same line at the point K, or very near it, and on an equally high surface of the refractive air; in the same place, or on an equally high surface, by the refracted ray KA, they will appear to the eye A on the same line AKMS, or with the Moon equally high at M, and the Sun at S, and as to apparent altitude conjoined; but as to azimuthal latitude the Moon's image partly covers the eye A; and yet, if from the eye A the parallactic lines were drawn straight, the one AN to the true place of the Moon, the other AH to the true place of the Sun, and if they were observed by these without refraction, both the Moon, far higher than the Sun, would appear: hence you will easily recognize that two stars unequally distant from the Earth can, by the contrary, be represented as conjoined, which, refraction set aside, would have appeared disjoined by the power of refraction.

XVIII. PROPOSITION.

To an eye in no way raised above the Earth, a refracted ray never represents stars below the Physical Horizon, much less the True one.

The reason is that the refracted ray to a place of this kind either coincides with the Physical Horizon, or is above this horizon, and so represents the stars, or is on this horizon, or above it, as before; but if it falls below this horizon it does not penetrate the opacity of the Earth, nor reach the eye on the surface itself lying there.

XIX. PROPOSITION.

To an eye raised above the Earth, the stars can appear below the Horizon by the power of refraction.

[Margin: 46] This is established by frequent experiment. For we have seen — from a place set on high, for instance from our own Observatory [*Specula Observatoria*], or from the summit of Monte Paterno [Paterni montis] — the Moon and other objects cast down below the horizontal line of an instrument set up and leveled, appearing there, and we do not doubt that their rays, being conveyed through denser air to the eye, refracted, have reached us; and in this way it appears that the Moon, however often it is in the true horizon, or below it, shows

on account of the great parallax a greater refraction, and cannot be represented in the Physical Horizon, much less above it. Let an example of this be in Figure 9. With the Moon situated at H,

Diagram. A quadrant figure with the vertical line VAC on the left and the horizontal base CFLH along the bottom, closed by a quarter-arc from V to H. From the eye region (O, A near the upper-left interior) rays run down across the field; interior points K and I mark the refraction; the base line carries the points F, L, H at the right.

- V (top left): vertex
- O (left, below V): point on the vertical line / eye position
- A (left, below O): the eye / observer
- C (bottom left corner): foot of the vertical
- K (interior, upper): point of refraction
- I (interior, below K): point of refraction
- F (bottom right region): point on the base line
- L (bottom right): point on the base line
- H (bottom right corner): the Moon

radiating to point K, it can be seen at L, by the refracted ray KO, bending downward: for the refracted ray always represents the stars less distant from the vertex than they would be seen without refraction in that same place. And in this sense it always raises them optically, however far downward it bends. And by this occasion enough has been pointed out, that to an eye sunk below the surface of the Earth — for instance, in the bottom of a well, a pit, or the depth of a ditch, trench, or valley — certain stars can appear by the power of refraction which without refraction could not appear there.

XX. PROPOSITION.

The fixed stars and all the planets, the Moon excepted, when they appear in the Physical Horizon, are in truth below the True Horizon by as great a depth as is the difference between their Horizontal Parallax and the Horizontal Astronomical Refraction.

[Margin: 47] For on the one part of the arc between the Astronomical and the Physical Horizon, the fixed stars indeed all rise by sense, since they lack any sensible parallax; in the planets, the Moon excepted, since they are insensibly distinguished by their own Horizontal Parallax, by what was said in Propositions 5 and 6, it does not exceed one minute, nor reach a minute — supposing the truer

distance of the Sun from the Earth, concerning which there is more in *New Almagest* [*Almagestum Novum*], Book 3. But on the other part the refraction of the Horizontal refraction of the stars, by the experiments of Tycho [Tychonis] and others, and ours, is not less than 27 minutes, but more. When therefore in the Physical Horizon the distance from the vertex of the apparent star adds to that Horizontal Refraction of 27 minutes, but the arc inter-horizontal exceeds two minutes, the star will be below the horizon by as many minutes as remain after the parallax has been subtracted from the horizontal refraction.

XXI. PROPOSITION.

When the Moon appears in the Physical Horizon, it is in truth between that same horizon and the Astronomical Horizon.

[Margin: 48] The reason is that the Moon's refraction in that situation is much less, but sensibly, than its Horizontal Parallax, not to speak of the arc inter-astronomical, Physical; the Horizon being intercepted; therefore if the refraction is then added to the apparent distance from the vertex, its true distance from the vertex will become less than it would be if the Moon were in the true horizon, or below it; for if it ought to be in the very horizon, it would be necessary that to the apparent distance there be added an arc as great as is the difference between its Horizon, which differs from the Moon's Horizontal Parallax by 9 minutes, to the highest, by seconds, from what was said in Propositions 5 and 6.

XXII. PROPOSITION.

The distance from the vertex seen by the power of refraction can be not only for the Moon, but also for certain other Planets, greater than the True distance; but it is always less than the Apparent, or Visible, distance taken by the parallactic line alone.

[Margin: 49] Concerning the Moon appearing in the Physical Horizon, this is clear from the preceding Proposition; for the other Planets it is proved because the eye can be so far raised above the Earth that, by the refracted ray bending downward, it may see the stars, as was said in Proposition 19. But no contradiction can be brought forward on account of which the star at that moment cannot be in the True Horizon,

or above it, in either case the True Distance from the vertex not exceeding 90 degrees, and yet the Apparent distance, by the refracted ray bending downward, will be greater than 90 degrees, otherwise it would not bend downward. As in Figure 9, by the refracted ray KO, the star which is in truth at H appears at L; the

eye is at O, the angle VOL is greater than the angle VCH, but the angle VOH is smaller, made on the parallactic line; and so, as I said also in Proposition 19, refraction always raises — understand, not above the True, but above the Parallactic — the Apparent or visible distance from the vertex.

XXIII. PROPOSITION.

To find the simple Astronomical Refraction of any star whatever by observation, given its Declination and the Altitude of the Pole.

[Margin: 50] This can be done in several ways, but the easiest and most exact is the one done through the observation of the Azimuth, together with the distance of the star from the vertex captured at that very moment, by which the center of the star appears in a determined Azimuth. This is evidently done by our Filar Triangle [triangulum filare], *New Almagest* [*Almagesti Novi*], chapter 15, Problem 8, as described; if it be located in a determined Azimuth, and one wait, until

Diagram. A full circle representing the celestial sphere, with the horizontal diameter BCEH drawn across it and the vertical diameter VN through the center. Interior points I, K, D, L are marked near the center and lower portion; F is marked on the upper right of the circle; arcs are drawn connecting these points (representing the vertical circle, the declination circle, and the azimuth lines).

- V (top): vertex / zenith
- F (upper right, on circle): point on the circle
- B (left, on horizontal diameter): end of the horizontal diameter
- C (center): the center of the sphere
- E (right of center, on horizontal diameter): point on the horizontal diameter
- H (right, on circle): end of the horizontal diameter
- I (interior, near center): point
- K (interior, near center): point of the star's position
- D (interior, lower): point
- L (interior, lower): point
- N (bottom): nadir

the center of the star reach that same point, whether the star be rising or setting, or appear above the horizon; and at the same moment let another observer mark on the instrument, with the most precise and subtle precision, in minutes, and to within some seconds of the subdivision, let him take the apparent distance of the

star from the vertex. Further, in the case of the fixed stars there is no need to know the moment of time at which the observation is made; it suffices to know the day, since within a single day their declination does not vary sensibly. In the case of the Sun, however, it is expedient to make the observations on the days of the solstices, on which the Sun's declination varies insensibly, or at least in the Sun, and in the other planets to be observed, the moment of time must be marked, whether by a clock, or by a fixed star, as near as possible, so that the star's declination may be exactly computed.

These things being done, let the first star in the tenth figure be at K, but appear by the power of refraction at C, that is, in the Physical Horizon BF, or not, and at the true place K, from the Pole of the World P, let the arc PK be drawn, a portion of the circle of declinations; and from the Vertex V, through K, the vertical semicircle VN; there will arise the spherical Triangle VPK, in which, by the observed Azimuth, the angle PVK is given, and the side PV, the complement of the Altitude of the Pole, and the side PK, the complement of the Northern declination, or the aggregate of the Southern declination and the Quadrant, if the declination be Southern, or the Quadrant, if there be no declination: therefore, these three being given, by the Canons of the Triangles, the true distance of the star from the Vertex VK will become known, from which, by subtracting the apparent distance VC, the simple Refraction CK will remain known.

Let the second star be at D, but appear by the power of refraction above the horizon at L; for by drawing through it the vertical semicircle VN, and to it the arc of the declination of the circle PD, the Triangle VPD will arise, in which, by the Azimuth, the angle PVD is known, and PV, as above, and PD, the complement of the Northern declination, or the aggregate of the Southern declination and the Quadrant, or the Quadrant; from which the true distance from the vertex VD will become known, from which, by subtracting the observed, or apparent, distance VL, the Refraction DL will remain. Let the contrary be the case: let the star be at L, but appear

at C — (for it can appear at a greater apparent distance from the vertex than the true one is established from what was said above) — then, in the Triangle VLP, from three data noted above and applied to this case, the true distance VL will be given; and this, subtracted from the apparent VC, will leave the Refraction CL.

Nor is there any objection that the arc VLC, by which in this Figure the apparent distance of the star from the vertex is represented, is the arc of a great circle described from the center of the Earth, and yet the apparent distance from the vertex is captured by an instrument whose center is on the surface of the Earth,

or higher, for we do not need such an arc, but the angle made at the center of the instrument, which in the highest heaven measures for us the apparent distance from the vertex, to be compared with the true; the line drawn from the center of the eye, or instrument, is parallel to the line of the True distance from the vertex. It suffices for us to find separately, through the star, the true distance, and the angle of the vertical drawn through the star, to consider the apparent place, or image of the star, however far removed from the eye into the infinite. Thus in lunar parallaxes we use the angle made at the center of the eye on the parallactic line, and on the line of the perpendicular, or vertical, and we compare it with the angle made at the center of the earth on the line of the true place. Thus in the Equations of the Planets we use the angle of the anomaly, beyond the center of the true motion, indeed beyond it in the form of the Equant, beyond the center of the planetary orbit: for such an angle does not measure an arc of the orbit, but, by the benefit of the parallels, it measures the distance from the Apogee, in the highest Ecliptic infinitely, or however far considered as removed.

XXIV. PROPOSITION.

Although the simple Astronomical Refraction of the Moon can be known without Parallax, and the Apparent distance can be converted into the True without it; the True nevertheless cannot be converted into the Apparent without Parallax, just as neither can the Apparent by the power of one be converted into the Apparent by the power of the other.

[Margin: 51] The first part of the Proposition is proved, because by Definition 20 of the notion, and by the use of the Astronomers, received, this Refraction is nothing else than the difference between the true distance of the star from the vertex and the Apparent produced by the power of the rays of Refraction; and this by Proposition 23, and its practice there to be handed down, can be known without the use and notice of parallaxes; therefore for this purpose the notice of parallaxes is not necessary, much less the use of Parallaxes. This is confirmed: first, because in this case the comparison of Distance is not made between the apparent by the power of the line of Refraction, and the true, or apparent by the power of the rays of Refraction, but between the true, and the apparent by the power of refraction, and that at whatever moment, at which a sensible Refraction occurs; there also occurs a lunar parallax greater than the Refraction, and so the eye is at a distance from the Earth suitable for a sensible parallax; yet the Refraction itself does not raise the parallactic line, nor is it referred in our case to it, but merely to the True. It is confirmed, second, by example, and by the authority of Tycho [Tychonis], who in Volume 1 of the *Progymnasmata*, page 124,

exhibited a little table of Lunar Refractions, without the inclusion of parallaxes; otherwise in the horizon he ought to have exhibited a Refraction not less than 85 minutes, made up, that is, of 33 minutes of pure Refraction, and of the horizontal Parallax of the Moon, which is scarcely less than, indeed [recte: not less than] 52 minutes; but he set it down at only 33 minutes, and so for the rest, and thus the second part of the Proposition stands proved.

The third and fourth parts, concerning the Conversion of the True into the Apparent, or of the Apparent by the power of the rays refracted into the Apparent by the power of the parallactic line, are proved because then the comparison is made not only of the True into the Apparent refracted, but into the Apparent absolutely, when the Refraction is not greater than the parallax, or equal, as happens in the Moon; the Refraction does not raise the star optically only by as much as the parallax depresses it; the True distance being therefore converted into the Apparent by the power of Refraction, the star will be seen higher indeed, but still depressed, or less high by the power of the remaining parallax, or by the excess, by which the whole Parallax overcomes the Refraction, and as to this excess, the parallactic line works its effect. Therefore, in order that the True may be turned into the Apparent adequately and absolutely, parallax will be needed, and much more if the Apparent is to be compared with another Apparent. Repeat here what I said in no. 21.

Proposition XXV.

For the remaining planets, which have a smaller refraction than the fixed stars — let alone the fixed stars, of which not only can the parallax not be known [scin] at all [absq; Parallaxi], but the simple astronomical refraction [Refractio Astronomica simplex] also, even without converting the true distance from the vertex into the seen distance, and the true into the seen in absolute terms, is nevertheless not the seen anaclastic [refraction] into the seen or visible parallactic [distance].

[The marginal numeral "52" keys the body proof.]

The first part, as set out above from practice, was proposed in Proposition 23; and it is proved. This second part also follows from the fact that in each case there is only the comparison of the true distance from the vertex with the seen distance — that is, with the refracted ray alone, without any regard to the parallactic line. For this latter accomplishes nothing in reality, nor does it have its own effect, by the very fact that the refraction is smaller; rather, the seen distance would be the same even if there were no refraction. For the conditional-true [distance] is true, yet it meanwhile posits nothing in being, nor does it bring it about that the eye

should in reality see the stars parallaxically — sometimes partly parallaxically, partly refractedly, but purely refractedly. And although the refracted eye that does the seeing lies outside the center of the Earth — that is, above the True Horizon, where it is exposed to the situation of parallax — nevertheless, so long as the parallax, on account of the enormous distance of the star from the Earth, is null, or smaller than the refraction, the parallaxic line behaves accordingly, as if it did not exist in the nature of things. Indeed, in reality it then does not exist, and is not to be applied, nor does it accomplish anything physically or optically, as I have also shown in number 21. For one must not conceive here a kind of conflict of opposites, in which the refraction lifts upward by, say, eight degrees, while the parallax drags downward by two; nor that there follows an elevation of only six. Rather, the refracted ray of the star directs the actual seeing without the intervention of parallax; and then it is the parallaxic line alone that is to be considered for determining the seen place of the star, when the refracted ray has not lifted the seen object as far as it ought, so that it could be seen without parallax; but it still leaves a place for parallax, because this is the refraction.

Our discussion is confirmed by coming down to practice. Suppose, by Proposition 23, that the true altitude of the Sun is found to be 85 degrees, but that by instruments it is observed at $84^{\circ}30'$ by the force of the refracted ray. It is certain that this whole elevation of 30 minutes does not come from parallax — whose effect is to depress downward — but from refraction. Therefore, if those 30 minutes are added to the absolutely seen 85 degrees, the true altitude of $84^{\circ}30'$ will be had; and vice versa, if from the true 85 degrees you subtract 30 minutes, the seen distance — that which is to be seen — will be left for the future, the same density of the Air being preserved. There is nothing, then, in this comparison, or in mutual conversion, that is Parallax.

But on the other hand, if to the refraction of $30'$ there were added, by way of example, a parallax of one minute, so that the refraction came out as $31'$ — if this whole sum were added to the seen distance, the seen [altitude] would come out as $84^{\circ}30'$; and from a minute, [yet] 1 contrary to the supposition; and vice versa, with $31'$ subtracted from the true $84^{\circ}30'$, the seen [altitude] would come out as $84^{\circ}29'$ — again contrary to the supposition made. Nor would there be a comparison of the True with the refracted seen, but of the seen by the force of refraction — that is, of the anaclastically seen — with the seen parallaxically; in which case alone, on the assumption that we are to use parallax, the seen-by-refraction [altitude] of $84^{\circ}30'$ with $31'$ added, composed of refraction and parallax, would yield a seen parallaxic [altitude] of $85^{\circ}1'$. And, conversely, with $31'$ subtracted from this seen [altitude], a seen anaclastic [altitude] of $84^{\circ}30'$

would result. But this comparison is of no use in Astronomy, since, without that supposition, refraction is on the one side and parallax on the other, and in practice it is nothing other than that the absolute seen [distance] is converted into the true distance from the vertex, and vice versa the true into the seen — that is, into what is absolutely to be seen.

We grant, moreover, that if anyone should put together in a Table refractions composed of the simple refraction and the smaller parallax, it will then be necessary, in converting the seen into the true and the true into the seen distance, to subtract beforehand from the refraction such a parallax. But we assert that this composition was made in vain, since in practice it is to be dissolved, and the simple refraction suffices.

[The marginal note opposite reads: "Tychonis error in methodo Refractionum." — Tycho's error in the method of the Refractions.]

Corollary

Against Tycho [Tycho Brahe] and the others deceived by him in this matter, among whom We too once were.

[The marginal numeral "53" keys the body.]

It follows from the preceding proposition, when well considered, that Tycho erred in his method of investigating the Solar Refractions, in that he knew the parallax to be larger than he reported in vol. 1 of the *Progymnasmata*, p. 92, when he said: *To the established altitude of the Sun, obtained by observation, the parallax must be added, because this inclines the Sun toward the true horizon, and corrects the refraction not a little.* And he immediately added: *In this way we recognize the apparent elevation of the Sun, if it were entirely free from parallax; but from this — by subtracting the true altitude, computed in the same Azimuth — the sought refraction will be given.* These are trifles — indeed, mere nonsense, and the depraved figments of a deceiving imagination. For there is a question here, what the difference is between the true and the seen distance from the vertex; or what the larger [distance] is between the true and the absolutely seen altitude, which has already been acquired by subtracting the seen parallax. Of what use, then, is that composition of refraction with parallax, before that subtraction is made — since this can be had at once before the addition of the parallaxes? But see what Tycho subjoins there in his method: *It will not escape notice (he says) that the third side represents the Refraction in the vertical circle; to which, nevertheless, parallax must be added, because the Sun would appear lower, were it not for this*

Refraction, by which the Sun appears higher; and on that account the Refraction would be larger. See how Tycho reckoned that, in reality, a kind of conflict intervenes between Refraction and Parallax — so that, although the Parallax did not stand in the way, the apparatus of the Sun's image would still have been [in error]; whereas in reality it appeared otherwise. But this is plainly false. For if there had been no parallax — because the eye had been situated in the center of the Earth — there would have been no Refraction at all; whereas, with the eye remaining on the surface of the Earth, the seen [position] and the Sun were higher by $1^{\circ}30'$. For example, when in reality the altitude was only 1 degree, and we imagine the seen Sun [lifted] from two eyes by the refracted ray, [and] from the other by the parallactic ray, miraculously rather than by refraction; so that, secondly, the eye would see the Sun raised less than by one full degree, say by $59'$ — that much less by parallax — no other eye would see the Sun lifted higher; for the refracted ray alone has lifted the seen Sun by $1^{\circ}30'$. Nor is there a larger seen [altitude] than that which is refracted and elevated, which, even if in the first case it represents itself to Tycho [as already containing] the parallax along with the addition of the parallaxes, you would acknowledge it as a Refraction; while nevertheless, *it does not escape notice that the third side represents the Refraction;* otherwise, if it is not the Refraction, but a part of the refraction, it ought to be removed for the equation; he names that part *from the Refractions*, but a part of the Refraction; nor is that refraction of yours composed of the two parallactic Refractions, one elevating only so much as the parallax had depressed, and the other depressing only so much, [while] the other elevating above the seen place of the star's image.

Consequently, however, Tycho, after he had given, on p. 79, a *Table of the Solar Refractions* composed of pure Refraction and parallax, afterward, on p. 102, used both — and we with him. But hereafter we shall use the simple Astronomical Refractions of our own Tables, and the Rules written below. Re-read what I said in number 21.

Proposition XXVI.

If the refracted Ray is parallel to the line of the true place [linea veri loci], the seen distance of the heavenly body from the Vertex will be equal to the True distance; and the Difference between the seen-refracted [distance] and the visible parallactic [distance] will be equal to the ceasing Parallax; and then for the first time the Astronomical Refraction.

[The marginal numeral "54" keys the body.]

In Figure 11, let the star be at L, and let CL be the Line of the true place, while AK is the refracted Ray, and AB the line of the seen place, equidistant from the line CL. Let the Ray, before its refraction, be incident at KL, and from the eye A let AL be drawn — the parallactic line. I say that the Seen distance VAB is equal to the True VCL; because the external angle ALC is equal and opposite to the internal one, since the straight line VC falls upon the two parallels by the 29th of the first elements of geometry [Euclid I.29]; and by the same Angle ALC — that is, the parallax — is equal to the alternate angle BAL, by which

[Continued:] angle the seen distance refractedly — that is, VAB — differs from the seen distance, or visible parallactic [distance], that is VAL. Finally, if there shall be no difference between the true distance and the seen-refracted [distance] in each case — by the definition of Proposition 20 — every Astronomical refraction will cease; and indeed then for the first time, when such parallelism is first attained. This Proposition is not converted, however, as it will be if the sensible refraction ceases, so that the seen distance comes out equal to the true, as we shall say in Proposition 30, concerning the Moon. For these things, the Table of Refractions of the seen altitude does not suffice; therefore, in order to advance further, a Table of Refractions of the True Altitude — or of the true distance from the vertex — must be constructed; or it must be taught how it can be elicited from the Table for the seen altitude; and then it must be inquired, when and from which stars the distance from the vertex of the seen [position] ought to be larger than the true, whether the refracted ray inclines in the physical horizon, or bends downward or upward; for it has not hitherto been demonstrated that the seen distance is always smaller than the true by a refracted ray inclining upward. So, then:

Diagram. A quadrant figure (quarter-circle) illustrating refraction, parallax, and the seen versus true distance from the vertex. The right angle is at C (lower left); the vertical radius runs up to V (top), and the horizontal radius to H (lower right). The arc runs from V to H. The point V is at the top of the vertical, with B and L marking points on or near the arc; K and A mark the eye and an interior point; C is the center (right-angle vertex). Several straight rays are drawn from the lower region to L and B.

- V (top of vertical radius): the vertex
- B (upper arc, near top): point on the arc
- K (interior, mid-left): interior point (eye / refraction point)
- L (right of center, on arc): the star's seen/true position
- A (lower left, above C): the eye

- C (lower-left corner): center of the quadrant (right-angle vertex)
- H (lower right): foot of the horizontal radius
- Caption (engraved, upper right of figure): "11. fig."

Proposition XXVII.

When the Moon exists as apparent in the Physical Horizon, its True Distance from the seen Vertex is larger than the True.

[The marginal numeral "55" keys the body.]

For by Proposition 21, the True [Horizon] is between the True and the Physical Horizons; therefore the True Distance from the Vertex is smaller than a Quadrant, and the seen distance is a Quadrant; therefore the latter is larger than the True.

Proposition XXVIII.

The seen Distance from the Vertex of all the planets (the Moon excepted) and of the fixed stars, when Apparent in the Physical Horizon, is smaller than the True.

[The marginal numeral "56" keys the body.]

For indeed, by Proposition 20, the remaining Planets and the fixed stars, when seen in the Physical Horizon, are in reality below the True Horizon; therefore the True distance from the Vertex is larger than a Quadrant, while the seen [distance] is equal to a Quadrant; therefore the latter is smaller than the True.

Proposition XXIX.

When the Moon is above the Physical Horizon, the Apparent Distance from the seen Vertex is larger than the True.

[The marginal numeral "57" keys the body.]

For since the seen distance of the Moon is larger than the true distance, then, when it appears in the physical horizon (by Proposition 27) — and from there, as the Moon rises, the Astronomical Refraction continually decreases, until (speaking in the sense of sense-perception) the sensible Parallax of the Moon vanishes before this [Refraction does], then indeed, throughout the preceding and at the lower altitude, the seen [distance] has remained larger than the True. With the sensible Refraction ceasing, the Moon is now no longer seen by us by means of a Refracted Ray (which differs sensibly from the parallactic), but by a Ray that

is physically parallactic, which, with the Vertical line, makes the angle of the seen distance larger than the internal [angle], and [than] the opposite [angle] of the parallactic Triangle; and it measures the true distance by the internal angle — and so it comes about, until the Moon occupies the vertex, [when] all parallax ceases.

Proposition XXX.

When the Moon exists in the True Horizon, and the eye is elevated below the apparent Horizon, the Distance from the seen Vertex is larger than the true.

[The marginal numeral "58" keys the body.]

For the true [distance] in this case is a Quadrant, but the seen [distance] is larger than a Quadrant, because it is seen by a Ray refracted downward; if indeed it is not seen by a refracted Ray coinciding with the Physical horizon, unless it has ascended above the true horizon, by Proposition 21. I have said [this]. the eye being elevated, that is, above the surface of the Earth; otherwise no star below the Horizon could be seen at all, by Proposition 18.

Proposition XXXI.

When the Moon exists below the True Horizon, and the eye is elevated below the Apparent Horizon, the Distance from the seen Vertex is larger than the True.

[The marginal numeral "59" keys the body.]

The reason is that, in the ascent of the Moon to the True Horizon, the Astronomical Refractions are very large, and do not cease entirely before reaching the True Horizon; but if the seen distance of the Moon from the Vertex could be smaller, and afterward, when the Moon is in the true Horizon, could come out larger, it could indeed come out equal to the true first; but if it came out equal to the true, the Astronomical Refraction would cease — which is impossible.

Proposition XXXII.

The Apparent Distance from the seen Vertex of all the planets (the Moon excepted), when apparent above the Physical Horizon, is smaller than the True, so long as a sensible Astronomical Refraction lasts; but when this sensible Refraction first ceases, the seen [distance] becomes equal to the True, and thereafter larger than the True — so long as a sensible parallax lasts; but it always remains equal, if they lack sensible parallax.

[The marginal numeral "60" keys the body.]

Since indeed, from the moment when it [the planet] is apparent in the Physical horizon — in which the seen [distance] is smaller than the True distance — before it becomes equal, the larger [seen distance] always persists, since it cannot pass continuously from smaller to larger unless it first passes to equality, since we are in the same kind [of case]; but it does not come out equal except when first there is a parallelism of the Refracted ray with the line of the true place — and then, indeed, the seen distance comes out equal to the true by the force of the refracted ray. And if indeed the Optical Refraction of the refracted rays can be notable, the Astronomical [Refraction] can nevertheless be so slight as to be insensible. Then, as the Star ascends, it is no longer beheld by the refracted ray (which is sensibly different from the parallactic), but by the parallactic line; and while a sensible parallax lasts, the parallactic line makes, with the Vertical line, the external angle of the seen distance parallactically larger than the True distance, because it measures that angle by the external angle, and [by] the opposite predicted [angle]. But in the fixed stars, which lack sensible parallax, with the Refraction ceasing, the seen distance is equal to the True.

Proposition XXXIII.

The Apparent Distance from the vertex of all the planets (the Moon excepted) and of the fixed stars, when apparent below the Physical horizon, is smaller than the True.

[The marginal numeral "61" keys the body.]

For when they are apparent in the physical horizon, the seen [distance] is smaller than the True, by Proposition 28; but if it could before have been larger than the true, it could before have been equal to the True; but it could not have been equal to the true, unless the Astronomical Refraction ceased — since this consists, by Definition 20, in the difference between the True distance and the refractedly seen [distance]; because the refractions about the horizon, and in the ascent up to it, never wholly cease, but are indeed very large, as is established by experiments. Nor does it stand in the way that an eye lifted above the earth should see the stars below the horizon — by a ray bending downward below the horizontal line, and making with the vertical line a larger right angle; for it will never be lifted so high that the seen distance from the vertex by the refracted Ray is larger than the true — which is the case in Mars at Perigee, the nearest of all the Stars (the Moon excepted) to the Earth, as we shall presently teach, with the following Problem premised.

Proposition XXXIV.

Given the Distance of a Star from the center of the Earth, and the altitude of the refractive Air, in the parts of which the semidiameter of the Earth is the known [unit]; and likewise the depth of the Star below the Horizon: to investigate the maximum distance of the same from the vertex, [as seen] from the eye, within that Air, lifted to the highest visible point by the Refracted Ray.

[The marginal numeral "62" keys the body.]

Let there be, in Figure 12, the center A of the Earth and of the circumambient Air, the terrestrial vertical quadrant BIC, whose semidiameter — or radius AI — and the refractive quadrant of the Air OKD, whose Altitude is IK; let the Vertical line be AV, and the Astronomical Horizon AH; below which let Mars be at M, depressed by 1 degree; and on that account let AM be drawn to it [Mars], the angle [being formed].

Diagram. A figure combining a quarter-arc and a right triangle, illustrating the maximum vertex-distance of a star (Mars at M) seen through the refractive shell of air. The right-angle vertex is at A (lower left); the vertical AV rises to V (top), and the horizontal base runs from A to M (lower right, the longest line). Two concentric arcs spring from the vertical: the inner terrestrial quadrant and the outer refractive-air quadrant. On the vertical, from top to bottom: V, then T, O, B near the top; K lies on the outer arc; I is the interior point where the terrestrial radius meets the air shell; C, D are along the base between A and the foot. H and M lie at the lower right (H above, M at the base end). Straight chords run from A out to K and on to M.

- V (top of vertical): the vertical line's end (AV)
- T (just below V on the vertical): point on the air shell
- O (below T): point O (where the eye is lifted)
- B (below O): point B (top of terrestrial quadrant arc)
- K (on the outer arc, mid-height): the contact point K of the refracted ray
- I (interior, on the terrestrial radius): point I (top of terrestrial semidiameter AI)
- A (lower-left corner): center of Earth and air (right-angle vertex)
- C (on the base, near A): point C
- D (on the base, right of C): point D
- H (lower right, above M): the Astronomical Horizon point H
- M (base, far right end): Mars, depressed below the horizon

- Caption (engraved, upper area): "12. fig."

Let the true depth HAM be one degree; but let the Tangent line of Mars touching the Air at K be MT — it cannot lift the eye, [placed] within the refractive Air, higher than the altitude of this air IK, or BO, [the eye] being now elevated to the highest point in O; and from there let a chord be drawn to the contact point, which is OK, since AK and AO are equal — so the Triangle AOK will be isosceles, and in it the angle at the base OK [will be] equal by the 15th of the first Elements [Euclid I.15]. Now if the ray, entering the air a little below the contact K, is refracted, it ought to be [refracted] at the contact K, so close, as if the more deeply the refraction enters at a lower chord OK; otherwise, the lower it enters, the less highly it is refracted, by the smaller angle of inclination of the incident ray; nor do these things pertain to the contact K and the eye O, but they fall within O, toward B. The present task is to investigate the Angle VOK, [that is] the distance of the seen [position] from the vertex by the Ray VOK, in order to know whether it is larger or smaller than the angle VAM, the True distance from the vertex, as we have assumed. And indeed in Mars at Perigee, since here — the Moon excepted — the maximum of the Planets approaches the Earth, and from this let a judgment be made about the more remote Stars.

I read indeed in [Tycho's] *Almagestum Novum*, lib. 7, sect. 6, ch. 1, that the distance of Mars at Perigee from the Earth is 2,373 terrestrial semidiameters, by our *Geographia Reformata*; the semidiameter of the Earth [being] 3,690 Bolognese miles. Therefore the distance of Mars at Perigee from the center of the Earth — that is, AM — is 8,756,370 such miles. Let the Altitude IK, of the refractive Air, [be] the maximum it can possibly be, 50 miles; and so the whole [distance] AK is 3,740 miles. In the triangle AMK, then, with the angle at the contact K, the Parallax of Mars AMK will be $1^{\circ}28'8''$. But let this be at $1^{\circ}30'$ to excess; therefore, by 32 of the first elements [Euclid I.32], the angle KAM is $89^{\circ}58'30''$; and the angle removed [is] HAM 1 degree, the angle KAH [is] $88^{\circ}58'30''$; therefore the right angle OAD, the complement of the angle KAM, is $1^{\circ}30'$; and by 15 of the first elements [Euclid I.15] the isosceles angle AOK, the angle at the base OAK, is $89^{\circ}29'15''$; and by the 13th of the first Elements [Euclid I.13] the distance VOK is $90^{\circ}30'45''$, smaller than the true [distance] VAM, [which is] 91° . And the Astronomical Refraction is $28'15''$, which distance is still smaller; if the eye is below O, or [at] IK, smaller by 50 miles, or the distance of the Star M, larger from the Earth — by however much, therefore, smaller — if all these things concur, as they come about in all the other Stars (the Moon excepted). The same method, moreover, will be shown, if the Star is placed several degrees below the True Horizon. first it will appear refracted to the eye O. Let us test what comes about in each case, when the Moon is at Apogee

and at Perigee; when it is in the True Horizon, which we suppose to be AM. Let the minimum parallax of the Moon at Apogee, AMK, be 50; then the angle KAO, [being] $89^{\circ}10'$, and OAK $50'$, and AOK $89^{\circ}35'$ and VOK $90^{\circ}25'$. But the maximum Parallax of the Moon at Perigee, AMK, is $1^{\circ}6'$; and OAK is $1^{\circ}6'$; and AOK $89^{\circ}27'$; and VOK $90^{\circ}33'$. Hence, so that the excess of $30'$ of the seen distance above the true distance from the vertex should be about a minute, the Moon cannot be below the true horizon unless by very few minutes, when it is at Perigee; and it appears refracted to the eye O; but when it is rather at Apogee, it ought to be above it [the horizon], likewise by a few minutes. We must beware, moreover, lest we imagine to ourselves [as occurring] in certain cases things that are impossible. It is enough for us to have made the attempt; on which account it could come about to the eye O, since from so great an altitude of the eye we cannot observe, [and] cannot render these things more certain. Meanwhile, we are confident that we are able to have a larger depth of the more remote heavenly bodies of the Moon, when it first appears to the lifted eye, unless the thickness and opacity of the horizontal vapors stand in the way and blunt the rays; and therefore it does not appear unless lifted above the horizon — which often comes about.

[The marginal numeral "64" keys the body.]

Let us settle in the meantime the Rules of commutation, which we began at Proposition 27.

Proposition XXXV.

To resolve the Commutation of the seen Distance of the Stars into the True, and the True into the Seen, from the vertex; and likewise of the Altitude in absolute terms.

Rule I. You will commute the seen Distance of the Moon from the Vertex into the True, by subtracting the Refraction beforehand from the Parallax, and adding the residue to the seen distance.

Rule II. You will commute the True Distance of the Moon from the vertex into the Seen, by subtracting the Refraction beforehand from the Parallax, and the residue by adding [it] to the True Distance.

Rule III. You will commute the seen Altitude of the Moon into the True, by subtracting the Refraction beforehand from the Parallax, and the residue by adding [it] to the seen Altitude.

Rule IV. You will commute the True Altitude of the Moon into the Seen, by subtracting the Refraction beforehand from the parallax, and the residue by adding [it] to the seen Altitude.

Rule V. You will commute the seen Altitude of the fixed stars into the True, by adding the Refraction to the seen Altitude.

Rule VI. You will commute the True Altitude of the fixed stars into the Seen, by subtracting the Refraction from the True Altitude.

The contrary [procedure] must be done for obtaining the Distance of the Fixed stars from the vertex; for there the seen [distance] is to be added, and the true to be subtracted.

Rule VII. You will commute the seen Altitudes of the other Planets into the True, by subtracting the simple Refraction from the seen Altitude. But if the Refraction is composite of Refraction and Parallax — as it is with Tycho's Solar [Table] — subtract the Parallax from the larger Refraction, and subtract the residue from the seen Altitude; on the contrary, if the Parallax is larger, subtract the Refraction from it, and add the residue to the seen Altitude.

Rule VIII. You will commute the True Altitudes of the other Planets into the Seen, by adding the simple Refraction to the True Altitude. But if the Refraction is composite of parallax — as it is with Tycho's Solar [Table] — subtract the Parallax from the Refraction, and add the residue to the True Altitude; but when the Parallax exceeds the Refraction, subtract this [Refraction] from the Parallax, and subtract the Residue from the True Altitude.

But it would be necessary to have Tables of Refractions for the True Altitude, since they are usually made only for the Seen; yet by an artifice similar to that one, which I delivered in Proposition 4, the Refraction agreeing with the True Altitude can be elicited.

Proposition XXXVI.

To investigate the Distance of a Planet from the center of the Earth — and thereby its Parallax — on the supposition of a given altitude of the refractive Air, in the parts of which the semidiameter of the Earth is given, and the true [position] of the Planet given.

[continuation of Proposition XXXVI, from the prior page]

the planet, at the moment when its observed altitude has been measured at that same altitude; and finally, given the refraction of a known fixed star that obtains the same observed altitude together with the planet — or its true distance from the vertex — provided the density of the air is the same.

SUPPOSITION

65. Here I suppose that the fixed stars are so far distant from the Earth that they incur no perceptible parallax, whether they are viewed from the center of the Earth or from its surface — not only from the surface of the Earth, but even from the surface of the surrounding air, which causes refraction. For that air does not rise above 50 Italian miles, or indeed scarcely up to 20 miles, as I showed in *Almagestum Novum*, Tome 2, Book 10, Section 6, Problem 51. Consequently, two straight lines drawn from any fixed star — one to the center of the Earth, the other to the surface of the refracting air — may be taken as practically parallel. Once this is granted in the following figure (which is part of the preceding figure now set out), let the Sun, for example, stand at G, and the fixed star at F; for, as I said in number 41, they must lie on the same line of incidence FGI if they are to be seen by the same refracted ray BI and to be equally distant as regards their apparent distance from the vertex — that is, at the same angle VBI. Let them now be drawn to the Sun G by the straight line AG, from the center of the Earth.

Diagram. A geometric refraction figure, numbered 13. From a left-hand point A (the center of the Earth, at the lower left), a quarter-arc rises to the upper left, carrying a stack of small labelled points; the baseline A runs rightward to F at the far right. Lines radiate from A and from the upper points across the arcs to G and F.

- K, V (upper left, on the vertical/outer arc): outermost points on the vertical line from A
- H (upper left, beside V): point on an outer arc
- B (left, below D): point on the refracting-air surface, from which the refracted ray BI proceeds
- D (left, between B and K): point on an intermediate arc
- I, O (interior, near B): points on the incident/refracted ray
- G (center-right, on the baseline region): the Sun's place
- E (on the baseline, between A and F): foot-point on the Earth-arc
- F (far right, on the baseline): the fixed star's place

Once this has been prepared, then, since in triangle ABI the refraction of the air is given together with the altitude AI from the Earth's semidiameter AB (in such parts as the Earth's semidiameter AB is given), and the observed distance of the Sun from the vertex is also given, the angle VBI becomes known from the complement of that distance. And through trigonometry the angle BAI becomes known, and with it — being the complement of the angle of the fixed star's refraction BIK, noted as equal to it — the angle AIK is made plain, the complement of these two to two right angles being the angle AIG. Next, since the observed distance of the Sun from the vertex was measured at that moment, and since the Sun's true place is given from the astronomical tables, and from there, by the time before or after noon, or by the altitude of the pole, the Sun's true distance from the vertex is given through trigonometry — the angle VAG is therefore had, from which, by subtracting the angle BAI found above, the angle IAG becomes known. In this triangle IAG the angle IAG and the side AI are given, the side AI being from the Earth's semidiameter and the air's altitude OI. The distance AG will therefore not be hidden, nor the Sun's distance from the center G — which, if this refraction of the fixed star observable by astronomers were well grasped, would be the Optical Refraction.

But astronomers themselves observe the **simple** Astronomical Refraction — namely, the mere difference between some fixed star's observed altitude and its true altitude, by the known altitude of the pole, the star's place, its azimuth, and its declination; which, in the fixed stars, is greater than in the Sun, as is evident from Propositions 15 and 16. Therefore another method is needed by us; for it the true distance of the fixed star from the vertex, known at the moment when it reaches the same observed altitude as the Sun, is supposed given. Once this is had, first collect the angle BAI in triangle ABI, as above.

Then, since from the declination of the Sun, the azimuth, or the time, and the altitude of the pole, the Sun's true distance from the vertex VAG is given — and likewise the fixed star's true distance VAF, if both are required — the angle BAI being known, the angle IAF will be known. And since the parallax of the fixed stars is imperceptible, and the angle AIF is to all intents nothing, the lines IF and AF being practically parallel by the supposition premised, therefore in triangle AIF the angle AIF is the complement of the known angle IAF to two right angles, and hence known apart from any perceptible error. There are therefore given in triangle AIG the two angles AIG and IAG, and the side AOI, as above; therefore the distance AG is not hidden, nor the parallax AGI of the Sun G. Finally, in triangle ABG, since AB and AG and the angle BAG are known, the parallax AGB will be known.

[The text continues with Proposition XXXVII on the right side of the page.]

XXXVII. PROPOSITION

To investigate the distance of a planet from the center of the Earth, and hence its parallax: given the observed and the true altitude of the planet, and also that of a fixed star at that same moment which reaches the same observed altitude that the planet has or will have; and given the altitude of the air refracting at its first and last layers, in such parts as the Earth's semidiameter is known — supposing the refraction of the same ray takes place in the air not once but several times before it reaches the observer's eye.

66. This proposition is set down on account of that opinion which holds that the air around the Earth, suited to producing perceptible refractions, is not of uniform density but variable — and denser nearer the Earth, though not in such a way that it is non-uniform over any short stretch — for which the following diagram is given.

Diagram. A geometric refraction figure, numbered 14. From a lower-left point A, three concentric quarter-arcs rise; the baseline runs from A rightward through C, E, N to F at the far right. A stack of labelled points climbs the left side; rays cross from the points to M, G and on to F.

- V, H (top, on the vertical from A): outermost points
- K (left, below V): point on the outer refracting layer
- D (left, below K): point on an intermediate arc
- B (left, below D): point on the inner refracting layer (Earth's surface)
- P, I, O (interior, near B): successive refraction points on the ray
- M (interior, center-left): refraction point on the ray toward G
- G (center): the Sun's / planet's place
- C, E, N (on the baseline between A and F): feet of the successive arcs (BOC, DIE, HMN)
- A (far lower left): the Earth's center
- F (far right, on the baseline): the fixed star's place

When the vertical line AV has been drawn from the Earth's center A to the vertex V, let there be described from A the portions of the Earth's circles BOC, of the air DIE, and of the first refracting layer HMN — as great as the true distance of the fixed star F from the vertex requires, that is, the angle VAF, which is given. Let the Sun G as well as the fixed star F (since, as I said, both planet, say the Sun G, and fixed star F must lie on the same line of incidence, if they are to obtain the

same observed distance from the vertex) be incident; let first the Sun's ray FG, at M, where it first refracts toward the perpendicular, be continued nearly unrefracted from M to K, and there at last either undergo no refraction, or with many intervening refractions reach the air's last refracting layer; and being incident at I, let it refract at B. Let the perpendicular AI then be continued at P, until it meets the incident ray FG; MK will necessarily cut HMN, for if it merely grazed it without refracting, then IP would be shorter than DK. With these things done, **first**, in triangle ABI, AB and AI are given — AI consisting of the Earth's semidiameter AO and the altitude of the air at its last refracting layer OI — and the angle VBI, the complement of the observed distance of the planet from the vertex. Through trigonometry, then, the angle BAI is sought, from which, by subtracting the true distance from the vertex VAF belonging to the fixed star F, you will have the angle PAF, whose complement to two right angles is the angle APF, to all intents; for if the whole semidiameter of the Earth AB does not subtend a perceptible angle at F, the addition of OP — of fewer than 50 Italian miles — increases the angle at F so slightly that it stays imperceptible. **Secondly**, then, in triangle APG: if BAI and likewise the planet's true distance from the vertex VAG are known, the angle PAG is known, with which, and with the angle APG and the side AP — assuming whatever you please, but a larger one than AI, or AP, being smaller than AK, you will investigate the planet G, its distance AG so very close to the truth that the difference is negligible, as will be plain if you assume AI in place of AP, an amount as great as AK. So it is worth working within these limits to know the Sun's distance from the Earth, since it is certain that the difference will not reach a whole semidiameter of the Earth.

The Method of observing for Propositions 36 and 37, in the case of the Sun.

67. If the observation is to be made in the evening, await the Sun's nearest approach to setting, and with a very large instrument that displays single seconds, take the observed altitude of the Sun's center...

and at the same moment let another observer measure its azimuth, and let him begin to count, by the perpendicular oscillations, the time until the altitude of a known fixed star is observed; and by the time of day acquired at that moment, let the time counted be subtracted, and let the time of the Sun's observed altitude remain known. For from this, since with the declination then agreeing with the Sun, and with the altitude of the pole known, the Sun's true distance from the vertex for that very moment, at which the observed altitude was taken, becomes fixed. Then let the following night be awaited, so that the declination of some known fixed star, and by inspection of the celestial globe the observed altitude

which the Sun obtained, may be reached — whether in the same azimuth, or in a different azimuth — and take the time of that same azimuth, or by counting the time as above, acquire [it].

with the declination, and the altitude of the pole, the observed distance of the fixed star from the vertex. With Father Grimaldi, for capturing the observed altitude more delicately, we used a water level; and with threads parallel to the horizon similar to it, which we also applied in finding the altitude of the pole; and for capturing the azimuth more exactly we used the Filar triangle [triangulum filare] to a known fixed star fixed at the same vertical plane on the horizon directed at right angles. But perhaps the matter will be made clearer by example: the whole preceding practice, in observing, requires the greatest delicacy, nor a lesser one in the calculations thence derived. The observation of the star apparent in the horizon itself has, moreover, been omitted, because the fixed stars scarcely appear in the horizon itself, nor unless elevated above it.

Diagram. An uncaptioned schematic of an observing instrument, drawn horizontally across the page. At the left is a small upright frame with a forked sight; a long horizontal beam (the *trabecula*) runs rightward to a second upright frame at the right. Below the left frame hangs a plumb-line to a weight; below the beam at center-right is a small triangle. A separate small triangle figure sits at lower center.

- H, C, G (top of left frame): upper points of the left sight-frame
- O, I, R (left frame, interior): pinnacidial/sight points; the line OY runs down
- F, A (left frame, foot): foot-points
- V, E, X, Y (below left frame): the plumb-line points down to the weight Y
- M, D, Z (top of right frame): upper points of the right sight-frame (Z = a star symbol, the fixed star)
- S, K, P, T, N (right frame, interior): sight points
- B, L (right frame, foot): foot-points
- a, b, c, g, h (lower-center small triangles): the Filar-triangle points (g = a star symbol)

68. In the year 1656, October 10, upon the beam AB, 25 feet long, Father Grimaldi and I set up almost together a metallic fork [forked support], whose horns AC and BD — that is, of tin tubes inserted by a screw, and orthogonally standing upon the beam — could be filled with water through the tube, and through the tube on both sides; continuous: upon the same beam there were two little forks FGHI and KLMN, from whose arms two threads could at once be extended to the altitude of the crystalline water

poured in and at rest in its equilibrium. At the head A, moreover, there had been fixed to the beam a little cylinder OV, in the same perpendicular line OY, in which the tube AC was, through which a pinnacidial little cylinder X could be moved up and down at rest in any position. With these things prepared, in the morning following we filled the tubes on both sides up to the mouth of the tube C with water until it rose on both sides into O and P, and would be parallel to the horizon as far as that, and at the same time by its own course would harden the surfaces of the water in O and in P, now at rest in its equilibrium.

[Margin, left: *The line RK is to be understood as produced from this point — both toward O, and thence toward P.*]

Meanwhile the Sun had risen some degrees above the horizon, and to such a position that Father Grimaldi, through the thread ST cutting optically the Sun's disc, could observe the very altitude — placing the eye at the upper rib of the pinnacidial little cylinder X, set at V, and moving the pinnacidium downward, until its upper edge coincided with the thread ST and the Sun's center Z; and being on the same straight line of sight there are three points V, in the topmost pinnacidium P, on the thread ST, and Z, the center of the Sun's disc. I, however, at the same moment, the sign having been given me by Father Grimaldi, the Filar triangle *abc*, whose side *ab* was perpendicularly erected to the horizon, turning toward the Sun so that the shadow of the thread of each side might coincide in the horizontal plane — exactly, the iron ruler *hc*, which about the center *b* was being moved, the thread *ac*, with the threads superposed at the head firmly. Thread of the iron ruler on its doors [edges]: so that afterward we might most accurately obtain the Sun's azimuth through some fixed star, and more delicately, than by the arc of the horizon intercepted from the meridian line, and the edge of the ruler — meanwhile the perpendicular OY being found, the portion OV, of 8452 parts, of which the distance of the threads OP, measured upon the beam, had been 100000. Whence through the right-angled triangle VOP, and the solution at O, the apparent altitude of the Sun comes out, that is, the angle VPO, gr. $4^{\circ} 50' 13''$, and so by its observed [altitude] from the vertex the distance gr. $85^{\circ} 9' 47''$.

69. On the following night, moreover, we waited until the Lucida of Aries [Lucida Arietis] reached by its center the azimuth designated through the filar triangle *abc*, in which the Sun had been in the morning — that is to say, in the same straight line so that the eye should be at *b*, and the two threads *ab* and *ac*, and the center of the Star *g*; and at once its observed distance from the vertex was taken, which was gr. $44^{\circ} 24'$. Beyond the

observed distance the refraction; therefore in the spherical triangle APV, where AV is the distance of the Lucida of Aries from the vertex, gr. $44^{\circ} 24'$, and its Tychonic northern declination, which was then gr. $21^{\circ} 49' 40''$, the complement AP, gr. $68^{\circ} 10' 20''$. And of the altitude of the pole in our observatory the complement VP, gr. $45^{\circ} 25' 50''$. Therefore by trigonometry the azimuthal angle of this star arises from the vertex, gr. $104^{\circ} 58' 50''$, in which situation of the star and the Sun in that position the common observed azimuth AVP, gr. $104^{\circ} 58' 50''$, remains.

70. From our table, and Father Grimaldi's, constructed for the whole year, under the altitude of the Sun gr. $4^{\circ} 50' 13''$, the Sun had been observed before noon, hour $6^{\circ} 13''$, before noon of October 11, that is hour $18. 53' 47''$. After noon of October 10, the Sun was nearest at gr. $18 \frac{1}{2}$. The equated Tychonic time was 18.48, and since the moment of the experiment agrees with our solar tables stated above, gr. $18. 50' 3''$, of these the mean anomaly Sign. 3, gr. $11. 50. 29''$, but truly Sign. 3. grad. $9. 53' 15''$. From the place, moreover, of the Sun, and of the obliquity of the Ecliptic established above gr. $23. 30. 20''$, the Sun's true declination, southern, follows, gr. $7. 16' 15''$. Therefore in triangle SVP, VP is given, as above, gr. $45. 29. 50''$, and PS, consisting of the quadrant, and the Sun's declination, namely gr. $97. 16' 15''$. And the azimuthal angle AVP, num. 27, is found gr. $104. 58'. 50''$. Whence by the laws of triangles the Sun's true distance from the vertex VS, gr. $85. 19' 6''$, is gathered, but it was observed gr. $85. 9' 47''$; therefore the Astronomical Refraction of the Sun, the simple one, was $9' 19''$.
71. On the following night, between October 12 and 13, with the same serenity persevering, and the temper of the air which had been on the preceding days, with the same instrument, the one of which from number 68, with the lamps applied — yet not running into the eyes, but illuminating those very threads — Aldebaran was awaited, until it came to the same observed altitude in which the Sun had been, the Pinnacidium having been confirmed in its former position and at V; and a little before, the beam having been turned to the position suitable to this altitude in the same equilibrium of water; and as Aldebaran Z was on the straight line VP, with the eye, the time was begun to be counted by the oscillations of the perpendicular, until the observed distance of the Lucida of Aries from the vertex was taken, which was gr. $54'$. most precisely, and the time was found between the lapse of a min-[ute]...

ute, gr. 6' 45", of which by the equator there should be owed gr. 1. 41'. 15", which are to be reserved. Meanwhile in triangle APV, VP being given, as above gr. 45. 29' 50", and VA, gr. 54', and from the complement of the declination of the Lucida of Aries, as above gr. 68. 10' 20", the angle at the world's pole APV is gathered, gr. 60. 23' 13". There is, moreover, the difference of right ascensions of the Lucida of Aries and of Aldebaran, Tychonic, gr. 37. 3' 44", for this time, which, added to the degrees 60. 23' 13", and with times lapsed gr. 1. 41' 15", makes the equatorial distance of Aldebaran from the vertex, for the sake of example, the angle VPS, gr. 99. 8' 12". With this, and the declination of Aldebaran, Tychonic, the complement SP, gr. 74. 13' 38". And VP, gr. 45. 29' 50", the true distance of Aldebaran from the vertex VS is gathered, gr. 85. 19' 22", for that moment at which it is found to be in the observed distance from the vertex as great, namely that of the Sun, gr. 85. 9' 47"; therefore of these the difference, that is the simple Astronomical Refraction of Aldebaran, was gr. 9'. 35", which to Tycho is 10'. 10".

[Margin, left: *Refraction of Aldebaran.*]

72. Let us now return to Figure 13 set out above, in which the distance from the Vertex, both of the Sun and of Aldebaran, observed at the same time, is given gr. 85. 9' 47"; the complement to two right angles ABI, gr. 94. 50' 13". And let the Earth's semidiameter for now be AB, of German miles 1000, and AI for the same 1020, as great as no one of the experienced astronomers has admitted, since by Book 10 of *Almagestum Novum*, Section 6, Problem 51, I shall show the altitude of the refracting air not to be greater than 50 Italian miles, and about 20 — this is German 5. Nor is there need here to use the truest semidiameter of the Earth, but a sufficiently large proportion between AB and AI; once this is granted, by trigonometry the angle BAI is found, gr. 7. 30' 8", which, subtracted from gr. 85. 19' 6" of the true distance of the Sun from the vertex, found at num. 28, leaves the angle IAG, gr. 77. 48' 58"; idem the angle BAI, subtracted from the true distance of Aldebaran, gr. 85. 19' 22", which we obtained at num. 29, leaves the angle IAF, gr. 77. 49' 14"; and so the angle GAF is 16". Now since on account of the very great distance of the fixed star from the Earth, the assumed parallax of the same, the parallax AFI, not to say AFB, is imperceptible; and so AF, and AI, are practically parallel, the alternate angle GAI being 16", which the whole [angle] is — but if the strictly Geometrical [angle], the scruples [of arc] will have been somewhat smaller — the parallax of the fixed star AFI, and still less the parallax AGB, is estimated from terrestrial scruples.

73. But since it is certain that there is not so great an altitude of the Air, or at the first refracting [layer], let AI be assumed of German miles 1010, of which AB is 1000; for from the angle ABI, as above gr. 94. 50' 13", the angle BAI follows, gr. 4. 33' 48", which, subtracted as above from the angles VAG, gr. 85. 19' 6", and VAF, gr. 85. 19' 22", leaves the angle IAG, gr. 80. 45' 18", and IAF, grad. 80. 45' 34". Wherefore the difference of these GAF will be, as above gr. 6'. 8". And since the parallax of the Sun AGI, on account of the parallelism, Physical, of the right [lines] AF and IF, supposing the right angle, or certainly the external one AGI, ever so little greater than GAF; that little supposed in the third or fourth scruples of the parallax of the fixed stars AFI, and so always happens, however little, whatever be assumed AI, if we take the parallax of the Sun within a second, neglecting the thirds; let us choose. The distance AG, however, will be somewhat varied, both on account of the variation of the side AI, and on account of the variation of the angles IAG and AIG, for in the first case IAG is gr. 77. 48' 58", and IAF, gr. 77. 49' 14"; whose to two right angles the complement is AIF, that is AIG, gr. 102. 10'. 46". And with these AG is found, of miles 12948613: of which AI is 1020. But in the second case IAG is gr. 80. 45'. 18", and IAF, gr. 80. 45'. 34", and so AIF, or AIG, gr. 99. 14'. 26"; from which follows the interval of the Sun AG, of miles 12959487, of which AI is 1010. Finally, if you assume AI of German miles 1005, of which AB is 1000, and the angle, as above, ABI, gr. 94. 53'. 13", you will arrive — by the preceding method — at BAI, gr. 2. 38'. 49'. 24". And IAG, gr. 82. 40'. 16", 36""; and IAF, gr. 82. 40'. 32'. 36"". And AIG, gr. 97. 19'. 43"". 24""; always; AGI, 16". And AG, of miles 12945450, of which AI is 1005, or 12945, of which AB is one. Whence in triangle ABC, with AB 1000, and AG, as above, and BAG, gr. 85. 19' 6".

the parallax AGB is 15". 59"", and the horizontal one 16". Up to this point I have hunted the parallax of the Sun together with its distance from the Earth, having supposed the altitude of the refracting air, and at the same time the simple Refraction, both of the Sun and of the fixed star; but if I should inquire only into the parallax of the Sun, or of any other planet, the practice will be quicker, as below.

XXXVIII. PROPOSITION

Given a planet, and some fixed star obtaining the same observed altitude — though unknown, and obtaining it at a different time — given the true altitude for that moment of time at which they singly have an equal observed altitude; and with the

density of the refracting air remaining the same — there is immediately given the Parallax of the planet, whether the parallax of the fixed stars be supposed imperceptible, or unobserved, or observable, and then given.

74. For the difference of the true altitudes of the planet and of the fixed star is itself the Parallax, which we are inquiring after, if the parallax of the fixed stars be unobservable on account of its smallness; but if it has been observed, its sum together with the said difference makes up the Parallax of the planet, apart from any other Geometrical calculation. That this may be made plain, and that scruples may be removed from the mind of the Reader, look at figure 13, in which let the planet G and the fixed star F be feigned to be in the same Vertical plane; and when they obtain the same observed distance from the vertex VBI, and so, by the laws of the anaclastic [science], to be on the same line of incidence FGI — for there will be of the true distances from the Vertex the difference, the angle GAF, or therefore the parallax of the fixed stars AFI, from the surface of the refracting air too, not to say from the surface of the Earth estimated as imperceptible; and then the right [lines] AF, IF being to all intents parallel, and so the alternate angle GAF equal to the alternate AGI, that is the parallax of the planet from the surface of the refracting air estimated. Or, on the contrary, the parallactic angle AFI of the fixed star is supposed observable; let it therefore be observed and given; and then per 32 of the first elements [the aggregate] from this angle AFI, and the angle GAF, which is the difference of the true distance from the vertex, equals the external angle AGI, that is the parallax of the planet. Since, moreover, the Earth's semidiameter AB is of Italian miles about 4000, and the altitude of the refracting air OI, by what was said in Book 10 of *Almagestum Novum*, Section 6, Problem 51, is not greater than miles 40 — this is the thousandth part of the whole AB; and the distances AG, and BG, and KG, are practically equal; and so on account of the excess of the angle BGI, beyond the Parallax of the planet AGB, estimated from the Earth's surface, it does not exceed the thousandth of the whole angle AGI, and so is either imperceptible or trifling, as AGB is more easily known.

75. We suppose, however, the observation of the planet, and of the fixed star, made on the same night, or if the planet be the Sun, made within the same day, or [the air] persevering at the same Physical density of the refracting air; of which one must stand by the judgment of one skilled in these matters as an estimator. Nor does it stand in the way of this practice, that the planet, when it was observed, has been in a different vertical from that

in which the fixed star was, when it obtains the same, or an equal, observed altitude; for it is just the same as if it were transferred to the same Vertical: yet in this we suppose two things, which must be denied by no one knowledgeable in Astronomy and the Anaclastic [science]. **First**, it is that all the fixed stars created by God, or creatable, at the same distance from the Earth's center, and radiating; in their vertical at a point of the air's refracting surface equally high and equal, by the inclination from the perpendicular, have the same refraction, given the same density of the air, and the same not only observed but also true distance from the vertex. For in the aforesaid figure num. 13, if you conceive triangle AFG to be twofold, and one in one, the other in the other Vertical — if however the distance AF on both sides is equal, and the point I equally high above the Horizon, namely by an equal arc EI, or the angle IAE, and the radius FI, incident, is inclined from the perpendicular AH, by an angle equal to the angle HIF, these two triangles will be not only Equiangular, but also equal to one another; for of each the angles AIF, complements of the angles HIF, to two right angles, will be equal to one another, and likewise IAF, twin to one another, and so also the angles F, to one another, and not only AF, twin to one another, but also of the air's sphere in the Earth, of semidiameter AI, to one another; therefore, with the equal angle VAI added, the distance from the vertex VAF comes out, on both sides, equal. **Secondly** we suppose...

—at the moment when some planet has been observed, the Sun should be found in the same vertical circle (whether God created it there, as a fixed star which it would face directly from the center of the Earth, or whether it is observed and shines at that same point), then the inclination is of such a kind: that fixed star will therefore have the same refraction, and the same difference between its apparent and its true distance from the center of the Earth, as the fixed star has. And because the same star shines, in another vertical circle, just as high as the fixed star — when it obtains an equal distance from the center of the Earth, having its apparent distance from the vertex equal — therefore it will exhibit a true distance from the vertex equal to that of the fixed star; and hence it will also exhibit a parallax of the planet equal to that of the fixed star. For this reason, even if not made in the same vertical circle, the operation has been carried out formally, yet it has been carried out equivalently, and consequently just as if it had been made in the same one.

—for it is established that its true altitude is obtained, given the remaining true altitudes of the planet, and the true distance from the vertex of the apparent fixed star, by the preceding Proposition 23; and so the simple astronomical refraction

[*Refractio Astronomica simplex*] and the true altitude are obtained: finally, the difference of the true altitudes of the planet and of the fixed star yields the planet's parallax, by the preceding Proposition 38 — provided the planet's true altitude is set equal to that of the fixed star. This holds whether the Sun is observed in the west or in the east, in physical truth; for the fixed star is observed exactly, as we have taught above, while its position toward the fixed star is observed when the Sun is observed at one and the same time, so that the true distance from the vertex of the fixed star can be known, and its parallax — provided, that is, that the horizontal refraction of the fixed star is supposed to be that which agrees with it and is in itself sensible. Only this may be doubted: from what place, or at what time, the refraction of the fixed star may have been observed under the same density of air as that under which the Sun is observed.

Method of observing for Proposition 38, in the case of the Sun.

[76] First, so that the error in the Sun's declination may be as small as possible, let the observation of the Sun be made at the solstice, or as near to it as possible; or let it be made of some Sun rising from God's appointment by means of an instrument, or such as we have described above, or another; let the apparent position be observed, with whatever is fixed in its position to be noted astronomically, even if it is not known as to its astronomical quantity; and let the companion direct his filar thread toward the center of the Sun, and let it stand fixed and immovable in that position. Secondly, at night let a fixed star nearby be chosen, of the same starry Globe, whose distance from the vertex shall be that of the Sun, and at that time future, beyond the refraction; let the filar plate be set at least 20 or 25 degrees up, and at the very moment when it reaches the vertical, let the plane be designated by the two filar threads, and its distance from the vertex as great as it can be observed with the utmost subtlety. For so it will be — both at the solstice and on the days following, after the appearances are obtained — at whatever hour, as soon as it is known when the Sun was observed, the note of its declination is free of curable error, since its declination is its complement, and so on. And the Azimuth, as we said, being the distance of the Pole from the vertex, will by trigonometry yield the true distance of the Sun from the vertex at that moment, just as it was observed before sunset. Thirdly, in the same night, the temperature of the air remaining the same to the senses, wait until some fixed star — fitted by inspection of the chosen globe to that altitude which it was observed at — yet the declinations do not arrive at the altitude observed for the Sun; and then at once let the companion observe it in its center, by means of the filar Triangle, the Azimuth being sought. Fourthly, in the same night, or on any other night, let a fixed star be chosen whose distance from the vertex will be that

designated by the said Triangle, and whose future position will be beyond the bound of sensible Refraction — as is fixed 20 or 25 degrees — and at that moment, when it reaches that plane, let the most exact distance of that star be taken. For from it, and from its declination, or the complement of the declination of the Pole from the vertex, the true distance of the Sun is obtained; and when the declination of the prior fixed star is equal to its altitude, with the fixed star itself being assured, and with the distance of the Pole from the vertex known, you will have its true distance from the vertex, which ought to be greater, than the Sun's by the said Proposition 9; the difference will be the parallax of the Sun to be corrected, somewhat according to what was said above.

PROPOSITION XXXIX.

Given the simple astronomical refraction of the fixed stars, free of sensible altitude, and that of the Sun or of any planet observed at the same apparent altitude as the stars, and the air being of the same density in azimuth, or in declination, and given the moment of time, together with the altitude. The parallax of the Pole is given, along with the apparent parallax of the planet, not to mention its simple astronomical refraction.

[77] For, the refraction having been subtracted from the apparent altitude of the fixed stars—

—from the apparent altitude of the fixed stars, their true altitude is obtained; and given the remaining true distances of the planets, the planet's true distance from the vertex is obtained, which corresponds to its apparent distance by Proposition 23. And so the simple astronomical refraction and the true altitude are obtained; finally, the difference between the true altitudes of the planet and of the fixed star yields the planet's parallax, by the preceding Proposition 38 — provided the planet's true altitude is set equal to that of the fixed star. This holds whether the Sun is observed in the west or in the east; for the fixed stars are observed exactly, as we taught above. But if the Sun's position toward the fixed star is observed at one and the same time, then there can be no error; provided one is sure that its distance is true, and the parallax, if you suppose the horizontal refraction of the fixed star to be that which agrees with it and is in itself sensible. Only this may be doubted: from what place or at what time the refraction of the fixed star was observed under the same density of air as that under which the Sun is observed.

Conclusions concerning the Parallax of the Sun, in the meantime more probable.

[78] **First Conclusion.** By the preceding practice the parallax cannot be certainly known, given the subtlety which more recent astronomy requires: for here a

smaller error than that of a very few seconds is required. For now, from the lunar dichotomies, and the parallaxes of Mars, and other arguments, we have come to know the horizontal parallax of the Sun to be much smaller than one whole minute. Although large enough instruments can indeed be made, and a half-diameter could exhibit single seconds in its circle — yet, as we teach in Chapter 3, there is so great a difficulty in the division, and in the subdivision of degrees and minutes, and in the placement, and in the just use of the dioptrics, and in collimation toward the center of the star, and in the most upright placement of the instrument itself with respect to the horizon, that one can err by several seconds, or at least by single ones, in individual observations. Furthermore, the aforesaid practice requires six elements of astronomy, namely: the altitude of the Pole; the declination of the Sun, and its apparent distance; or its azimuth; or the declination observed apparently; or the moment of time observed; and of these last two either one—and either the declination or the azimuth; and so, all things being most subtly computed, the error can be collected from all the small errors of observation, more than 5 seconds. Besides, as we said above, the same density of air is required when the refraction of the fixed star is observed as that at the altitude under which the Sun was observed, and the fixed star with the Sun, either at once before or after, can be conspicuous; but this rarely happens by night, here in daytime visible; for the air is always ambiguous by night, denser than by day. Hence comes the uncertainty of the confirmation of what is to be said about the consequence of the refractions of the Sun, and of the fixed stars observed by Tycho [Tycho Brahe], at no. 8.

[79] **Second Conclusion.** Yet, because by the preceding practice we have always found the horizontal parallax of the Sun smaller than 30 seconds — and for that very reason, by the dichotomies, we apprehend something smaller — therefore we establish it as not larger, and as more probable in position; and we keep it still at 19' 8" in perigee, 27' 8" in apogee. We are inclined rather toward this opinion, who think it and this smaller; but we do not acquiesce, since it is altogether insensible, in the system of the Sun and the planets; and regarding it, together with the fixed stars, they do not deny that it can be raised to infinity; but see the end of Chapter 13.

[80] **Third Conclusion.** However great the parallax of the Sun may be (at the same apparent distance from the vertex, of the Sun and of the fixed stars, and the constitution of the same air), so much greater is the astronomical refraction of the fixed stars than the astronomical and simple refraction of the Sun, as is the parallax of the Sun. This is clear from Propositions 16, 38, and 39 together.

CAPUT XV.

On the Refractions of the Sun.

[1] We taught the way of observing the refractions of the stars together with Tycho [Tycho Brahe] in the preceding chapter, at Proposition 7, supplying what he himself had omitted; but we speak of astronomical refraction, not optical, and that both simple — that is, the difference between the true altitude of a star and its apparent altitude, when the apparent is greater than the true — and composite, made up of this simple refraction and of parallax. Now Tycho, in Volume 1 of the *Progymnasmata* (Tycho, *Astronomiae Instauratae Progymnasmata*), at page 79, exhibits a Table of Solar Refractions from his own observation on the Danish horizon; yet he confesses that these same refractions vary there under a less serene sky, and on different horizons under a different temperature of the air; and at page 94 he affirms that a difference can be found between the true and the apparent. And concerning the apparent altitude of the Sun, he added that he had derived his parallax from it, so as to obtain the whole Refraction; and he urged this at page 95. And that the refractions of the Sun should be observed on the day of the solstice, when the declination varies insensibly; and at page 102 he teaches by example to convert the apparent altitude of the Sun into the true, by subtracting the whole Refraction and adding the parallax. Afterward, at page 124, he exhibits a Table of Lunar Refractions in a circle of Altitude, frequently constructed from experiment by himself. Finally, at page 280, he sets forth a Table of Refractions of the Fixed stars in a circle of Altitude, from his own observation likewise, where he adds these words to be noted for what is to be said below: *If, however, what the Mathematician of the Landgrave [the Landgrave of Hesse's astronomer] noted in those his Kassel observations are admitted, the fixed stars have refractions there almost double in size — concerning which matter the volume of our collection of Epistles indicates more fully. But for my part, I should none the less believe that the observations have weakened the refractions too much by some carelessness of their own.* For Rothmann [Christoph Rothmann] had written, as is found in Tycho's Epistles, at page 29, that he had found by himself a refraction of the fixed stars of $5' \frac{2}{3}$ at an altitude of $5^{\circ} 18'$, and of $2' \frac{1}{5}$ at an altitude of $9^{\circ} 42'$; but he generally observed the horizontal refraction of the Sun to be $15'$, or at most $20'$, to which Tycho responds (Tycho, page 63) that he found the refractions observed by himself to be almost double those in Denmark than those by Rothmann at Kassel; and he attributes this rather to incorrect Hessian observations, than to the diversity of horizons. Again Rothmann, at the same place, page 82, says that the refractions of the Sun around the winter solstice are far greater than at other times of the year. And at

last Tycho there, at page 159, notes that the refractions of Rothmann are too modest, and the twilights too great between them — these do not agree, since it would follow that the air is purer there, but here more turbid. But it would be necessary to inquire whether they had been observed under the same Annual temperature, and whether the twilights were the same — indeed, whether under the same temperature of day, which is different around sunrise from that around sunset. So far, summarily, concerning the general foundations of the Tychonic refractions.

[2] Before we discuss these things, the threefold Table of Tychonic Refractions, taken from the said places, must be set before our eyes, which is thus:

Refractions in the Danish Air, derived by Tycho [Tycho Brahe] from his own observations.

Apparent Altitude (Gr.)	⊙ Refrac. '	⊙ Refrac. "	☾ Refrac. '	☾ Refrac. "	* Fixed-Star Refr. '	* Fixed-Star Refr. "
0	34	0	33	0	30	0
1	26	0	25	0	21	30
2	20	0	20	0	15	30
3	17	0	17	0	12	30
4	15	30	15	20	11	0
5	14	30	14	20	10	0
6	13	30	13	50	9	0
7	12	45	12	45	8	15
8	11	15	12	0	6	45
9	10	30	11	20	6	0
10	10	0	10	45	5	30
11	9	30	10	10	5	0
12	9	0	9	35	4	30
13	8	30	9	0	4	0
14	8	0	8	30	3	30
15	7	30	8	0	3	0
16	7	0	7	30	2	30
17	6	30	7	0	2	0

Apparent Altitude (Gr.)	⊙ Refrac. '	⊙ Refrac. "	☾ Refrac. '	☾ Refrac. "	* Fixed-Star Refr. '	* Fixed-Star Refr. "
18	5	45	6	30	1	15
19	5	0	6	0	0	30
20	4	30	5	30	0	0
21	4	0	5	0	—	—
22	3	30	4	25	—	—
23	3	10	4	10	—	—
24	2	50	3	45	—	—
25	2	30	3	20	—	—
26	2	15	3	0	—	—
27	2	0	2	40	—	—
28	1	45	2	20	—	—
29	1	35	2	0	—	—
30	1	25	1	40	—	—
31	1	15	1	30	—	—
32	1	5	1	20	—	—
33	0	55	1	10	—	—
34	0	45	1	0	—	—
35	0	35	0	50	—	—
36	0	30	0	45	—	—
37	0	25	0	40	—	—
38	0	20	0	35	—	—
39	0	15	0	30	—	—
40	0	10	0	25	—	—
41	0	9	0	20	—	—
42	0	8	0	15	—	—
43	0	7	0	10	—	—
44	0	6	0	5	—	—
45	0	5	0	0	—	—

[Margin, against the Fixed-Star column at rows 20–30: *The Refractions of the Fixed stars cease here, because Tycho, as he admits at page 280, finds them smaller than those of the Sun by 4' ½. And therefore from the Solar refractions he elicits the refractions of the Fixed stars.*]

[3] Yet, not acquiescing for just reasons, I wrote to Father Albert Curtz [Albert Curtz], to whom, by the command of Caesar, were handed over the manuscript Tychonic observations, since he was in charge of their typographical edition, so that he might not begrudge to transmit to me those observations — which, having been made at the summer solstice, Tycho had most confidently investigated as the Solar Refractions. This he furnished most liberally and most diligently, a most humane man, and he deserved excellently of me, who am immensely obliged to him. And I communicate these observations to the Reader, to be examined by trigonometric calculation, if it ever shall please him, in good faith copied out from his exemplar.

Observed by Tycho [Tycho Brahe] at Uraniborg [Uraniborg], in the year 1589, on the 11th day of June, old style.

Reading	G.	'	"
Meridian Altitude of the Sun			
By the rotatable quadrant (Per quadrantem volubilem)	57	35	45
By the larger steel [instrument] (Per Chalybeum maiorem)	57	35	30
		vel	25
By the Tychonic [instrument] (Per Tychonicum)	57	35	45
And by the other (Et per alterum)	57	35	50
Declination of the Sun by the Armillae (Declinatio ☉ per Armillas)	23	29	50
Lower [readings], larger (Subterraneas maiores)	23	29	45

It was sufficiently serene.

On the same day, the 11th, after noon, the following were observed for the Refraction of the Sun in the summer solstice.

Declin. ☉ Armill. maiores (Gr. ' ")	Altitud. ☉ Quadr.Volub./Chalyb. (Gr. ' ")	Azimuth ☉ à Merid. in Occid. (Gr. ' ")
23 29 45 / 23 29 50 —	35 2 30 — Volub.	80 40

altero pinnac.

Declin. ☉ Armill. maiores (Gr. ' ")	Altitud. ☉ Quadr.Volub./Chalyb. (Gr. ' ")	Azimuth ☉ à Merid. in Occid. (Gr. ' ")
23 29 45 / 23 29 40	33 22 30 — Volub.	83 10
23 29 45 / 23 29 40	30 13 45 — Volub.	87 50
23 29 40 / 23 29 45	29 13 0 — Volub.	89 38
23 29 45 / <i>vtroq;</i>	27 10 30 — Volub.	92 37
23 29 45 / 23 29 50	20 50 — <i>per vtrumq;</i> <i>minim. quadr.</i>	
23 30 30 / 23 30 0	18 45 0 — Chalib.	
23 30 15 / 23 30 40	15 54 — Chalib.	
23 30 40 / 23 30 20	13 44 30 — Chalib.	
23 32 15 / 23 31 50	10 15 0 — Chalib.	
23 32 20 / 23 31 50	9 47 0 — Chalib.	
23 33 0 / 23 32 40	7 45 0	
23 33 45 / 23 34 0	7 0 0	
23 34 15 / 23 34 0	6 30 0	
23 34 20 / 23 34 0	6 15 0	
23 34 30 / 23 34 45	5 30 0	
23 35 40 / 23 36 15	4 50 0	

Declin. ☉ (Gr. ' ")	Altitud. ☉ (Gr. ' ")	Note
23 36 30 / 23 35 45	4 5 0	☉ <i>ob nubeculas Horiz.</i> <i>obscur.</i> (on account of small clouds, the horizon was darkened)
23 37 40 / 23 38 0	3 40 0	
23 38 0 / 23 38 30	3 10 0	
23 40 0 / 23 39 45	2 45 0	
23 40 30 / 23 40 10	2 20 0	
23 41 30 / 23 42 0	1 50 0	<i>per aestimationem</i> (by estimation)
23 42 50 — <i>vnico</i>	1 30 0	<i>per aestimationem</i> (by

Declin. ☉ (Gr. ' ")	Altitud. ☉ (Gr. ' ")	Note
<i>pinnacid.</i>		estimation)

[At 23° 44':] Then the Sun, on account of the Horizon of the observatory, could not be observed, nor beyond the middle of its own part above the horizon was it raised. It was around the horizon of moderate thickness of vapors.

On the 12th day of June, in the morning.

Declin. ☉ Armill. (Gr. ' ")	Altitudo ☉ Visa (Gr. ' ")	Azimuth Solis inter ortum & merid. (Gr. ' ")
23 40 30 / 23 40 50	2 43 30	
23 40 30 — <i>altero nó potuit</i>	3 17 40	129 8 0
23 37 0 / 23 36 30	4 42 0	126 25 0
23 35 0 / 23 35 10	5 4 0	125 50 0
23 34 50 / 23 35 0	5 25 0	125 15 0
23 34 0 / 23 34 0	6 54 0	122 32
23 32 20 / 23 32 50	8 33 30	119 55
23 31 40 / 23 32 10	10 4 0	116 20
23 31 0 / 23 31 30	11 17 0	115 25
23 30 56 / 23 30 56	11 50 0	114 35
23 30 45 /...	13 48 0	111 40
23 30 30 / 23 30 45	16 27 30	107 45
23 29 5 / 23 30 15	19 57 0	102 40
23 30 20 / 23 29 50	22 44 0	99 3
23 29 30 / 23 30 20	25 36 0	94 35
23 30 15 / 23 29 30	32 10 0	84 50

Tychonic solstice observation tables (continued)

The following three tables record Tycho's Uraniborg observations around the solstice of 12 June 1589, continued from the preceding sheet.

Meridian altitude of the Sun, same day, 12 June

On the same day, 12 June. Meridian Altitude of the Sun.

		G		
		r.	'	"
As on the previous day, 11 June, it was quite clear	By the steel [quadrant] [Per Chalybeum]	5 7	3 5	30 — or 25
	By the volubile [quadrant] [Per Volubilem]	5 7	3 5	45
	By the new Tychonic [instrument] [Per Tychonicum novum]	5 7	3 6	5
	the old [veterem]	5 7	3 5	50
Declination of the Sun by the greater armillaries [Declinatio Solis per Armillas maiores]		2 3	2 9	50
		2 3	3 0	
		3	0	

Azimuth observations, same day, 12 June, after noon

On the same day, 12 June, after noon.

Declination of the Sun by the armillaries [Declinatio Solis per Armillas] (Gr. ' ")	Apparent altitude of the Sun by the quadrant [Altitudo Solis Visa per Quadrantis] (Gr. ' ")	Azimuth of the Sun from the meridian toward the west [Azimuth Solis à Meridie ad Occasum] (Gr. ')
23 29 30 / 23 29 20	28 1 45 — Volubile	91 5
23 29 30 / 23 29 20	26 57 30 — Volubile	92 45
23 29 30 / 23 29 20	20 45 — minimum quadrant [Q. minim.]	—
23 29 40 / 23 29 50	20 5 — minimum quadrant	Today the air was clearer [Hodie erat Aër purior]
23 30 0	17 — minimum quadrant	than yesterday [quàm die hesterna]
23 30 30 / 23 30 10	15 10 0	—

Declination of the Sun by the armillaries [Declinatio Solis per Armillas] (Gr. ' ")	Apparent altitude of the Sun by the quadrant [Altitudo Solis Visa per Quadrantis] (Gr. ' ")	Azimuth of the Sun from the meridian toward the west [Azimuth Solis à Meridie ad Occasum] (Gr. ')
23 30 15 / 23 30 20	14 0 0 — steel [Chalyb.]	—
23 30 15 / 23 30 20	13 20 0	—
23 30 50 / 23 30 30	12 40	—
23 30 40 / 23 31 20	11 10	—
23 32 0 / 23 31 20	9 15	—
23 32 0 / 23 32 30	8 0 — minimum quadrant [Q. minim.]	—
23 32 20 / 23 33 0	6 45	—
23 33 30 / 23 33 40	6 10	—
23 34 15 / 23 33 50	5 40	—
23 34 50 / 23 34 15	5 15	—
23 35 10 / 23 35 30	4 50	—
23 35 50	4 30	—

[Margin: 4]

From these I selected the azimuthal observations of the 12th, and the morning ones, because on that day the air was purer, and because the solstice occurred a little after the middle of the preceding night. For that reason the morning declination of the Sun differed scarcely perceptibly from our maximum declination of 23°30'20". So I chose the altitude of the pole of Uraniborg as 55°54'40", as determined in my *Geographia Reformata*, Book 7, Chapter 21. Hence in the figure of Proposition 23, and in the triangle UPL, the complement of the altitude of the pole, PV, is given as 34°5'20", and the complement of the declination, LP, as 66°29'40". With these, and with the complement of the meridional azimuth of the Sun, LVP, I derived trigonometrically the true distance of the Sun, VL, from the vertex; and by comparing this with the apparent distance, I obtained the refraction. But often this came out in vain, because the true distance frequently turned out smaller than the apparent, as can be seen in the following table.

Refractions derived from the azimuth observations

Complement of the meridional azimuth of the Sun [Azimuthi Meridionalis Complementum] (Gr. °)	Apparent distance of the Sun from the vertex [Distantia Solis à Vertice Visa] (Gr. ° ')	True distance of the Sun from the vertex [Distantia Solis à Vertice Vera] (Gr. ° ' ")	Simple refraction of the Sun [Refractio Solis simplex] (' ")
50 52	86 42 20	86 50 20	8 0
53 35	85 18 0	85 20 45	2 45
54 10	84 56 0	85 1 0	5 0
54 45	84 35 0	84 41 10	6 10
57 28	83 6 0	83 5 30	·· [negative / vanishing]
60 5	81 26 30	81 30 22	3 52
63 40	79 56 0	79 13 54	—
64 35	78 43 0	78 39 0	—
65 25	78 10 0	78 6 30	—
68 20	76 12 0	76 10 33	—
72 15	73 32 30	73 30 37	—
77 20	70 3 0	69 59 30	—
80 57	67 16 0	67 10 10	—
85 25	64 24 0	64 21 35	—

From this it is clear how slippery this procedure by azimuth is, unless at the very same instant at which the center of the star touches the vertical plane of the determined azimuth, the same star's distance from the vertex is taken with an instrument carefully divided and set up. For I would rather believe that the aforesaid diversity and inconsistency arose from a flaw in the observation, or from some small interval of time that elapsed and is now neglected as if not perceptibly harmful, than from a fault in the trigonometric calculation, or from a sudden change of the air, or from a false altitude of the pole and maximum declination of the Sun, or from the scribe's errors in writing down the numbers. Perhaps several other observations of many years, which Tycho indicates in volume 1 of the *Progymnasmata*, page 79, will come to light, from which a fuller examination may be undertaken.

[Margin: 5]

I communicated the aforesaid observations to Giovanni Domenico Cassini [Dominico Cassino], a distinguished man. He chose the altitudes of the 11th of June taken by the steel quadrant, and the declinations of both armillaries, and from them gathered refractions smaller throughout than the Tyconic refraction table gives. This agrees not only with Rothmann [Rothmanno], but also with Vincenzo Mutio [D. Vincentio Muto] [Vicenç Mut, observer in Majorca]: the former [Rothmann] in Hesse [Hassia], the latter [Mut] in Majorca [Maiorica], observed much smaller refractions than Tycho set out in his table.

Refractions from Cassini's calculation, 1589

Year 1589, June, 11th day, from the calculation of Cassini [ex D. Cassini calculis].

Observed altitude of the Sun [Altitudo Solis observata] (Gr. ')	Refraction from the prior armillary declination [Refractio ex priori declinatione Armillari] (' '')	Refraction from the posterior declination [Refractio ex posteriori Declin.] (' '')	Refraction difference [Refractionis differentia] (' '')
18 45	0 56	0 19	—
15 54	0 37	1 7	37
13 44½	1 7	0 42	30
9 47	3 0	2 35	25
7 45	3 55	3 21	34
7 0	4 48	5 6	18
6 30	5 24	5 6	18
6 15	5 30	5 6	24
5 30	5 42	6 0	18
4 50	7 6	7 48	42
4 5	8 6	7 12	54
3 40	9 31	9 55	24
3 10	9 55	10 31	36
2 45	12 6	11 54	12

Observed altitude of the Sun [Altitudo Solis observata] (Gr. ')	Refraction from the prior armillary declination [Refractio ex priori declinatione Armillari] (' ")	Refraction from the posterior declination [Refractio ex posteriori Declin.] (' ")	Refraction difference [Refractionis differentia] (' ")
2 20	12 55	12 36	19
1 50	14 9	14 42	33
1 30	15 42	—	—
0 0	17 15	—	—

[Margin: 6]

Against this, Gassendi [Gassendus], at Digne [Diniæ] [Digne], at the close of the year 1632 and into 1633, on undertaking the investigation of the winter refractions, examined them and reported the results in his *Commentaries on Celestial Matters*, which are contained in volume 4 of his works. A specimen of these is in the attached small table, but its use is hampered by too great a parallax, and for that reason these refractions of the same kind are less certain.

Gassendi's winter refractions, Digne 1632–1633

Apparent altitude [Altitudo Visa] (Gr. ')	Refraction [Refractio] (' ")
22 26	7 0
27 22	6 0
30 28	3 0
35 11	1 30
40 5	1 0
42 48	0 30

Kepler [Keplerus], following the precept of the Rudolphine [tables], relates that he observed almost these same refractions in Bohemia and in Denmark; and he adds that the diversity of refractions can arise from different times: for at the full moon, and on a day of copious light, the air is dilated; and he observed that the fixed stars, for the most part at the new moon, in the deep of night, under a serene sky, [appear to him?]. Yet Tycho, in volume 1 of the *Progymnasmata*, page

280, had acknowledged that the refractions of the Moon ought to be greater than the solar ones, all else equal. The solar refractions, however, would have been displayed near the horizon as next greatest, on account of the excessive parallax of the Sun added to the simple refraction. And yet Kepler himself, in the *Astronomia Optica* [*Paralipomena ad Vitellionem*], page 123, reforming the Tyconic solar refractions from the secants, uses the parallax diminished by 3'. We gave his small table, reformed, at the end of Book X of the *Almagestum Novum*, with many things premised that are most worthy of the reader's attention, both for the problems and the theorems bearing on refractions; and in the appendix of that same book we added our own tables of refraction for the Sun, the Moon, and the fixed stars derived from observations around the solstice and the equinox. I confess, nevertheless, that I sometimes found a certain inconsistency, and acknowledged that Tycho came closer to the truth, and agreed with us almost completely in many points. Afterward, however, I found a greater inconsistency, both in those very observations and in our own, and recognized how slippery this business is, on account of the excessive diversity of densities in the air around the Earth, arising not only from the ordinary causes — that is, from the seasons of the year, since the refractions are greater per se in winter than at the equinoxes, and these in turn greater than the summer refractions, and the morning refractions greater than the evening ones because of the air baked by the daytime heat — but also from extraordinary causes, both at the full moons and in the other phases of the Moon,

and from the aspects of the stars, and from the more humid exhalations of the Sun, whether from the sea, the rivers, the lakes, the marshes by the heat of the Sun, or some other [exhalations] of the stars, sometimes raised higher and sometimes lower in the air — from all which four controversies remain still undecided.

[Margin: 7]

The first is whether the air is more refractive at higher altitude, and how much, and whether it is always the same in the same horizon — about which we said not a few things in Book 10 of the *Almagestum Novum*, section 5, Problem 43. The second concerns the figure of that same air, whether it is spherical, on one side convex, on another concave, and from this whether it is apt for increasing certain refractions in the way an elliptical [figure] would, or in another way. The third concerns the third density of the more humid air, which is colder than the more serene night air, but less frigid, and the denser air on serene but more frigid days, which causes less refraction than the less serene but more tepid air. The fourth

concerns whether the density of the refractive air is uniformly perceptible, or non-uniform, and multiplex, causing different refractions at the same moment. For it can happen that, although in less dense air the individual refractions are smaller than in very dense air, yet on account of the multitude of them, arising from the non-uniformity of the densities, the last rays which reach our eyes are raised higher, or the image of the stars [is raised higher]. From this cause I judge, almost with certainty, that we, and Tycho, and others, included so great an inconsistency in their observations, besides what could come from a flaw in the observer or in the instruments; and that at one time we obtained a greater refraction than we expected, when we were expecting a smaller one. For example, in the year 1656, on the 19th of August, when by means of a large level [per magnam libellam] we observed the evening altitude of the Sun to be $85^{\circ}23'16''$, from the time at the meridian, 6 hours $23'47''$, we deduced the true distance to be $85^{\circ}38'29''$. The simple refraction was $15'3''$. At the same time, in the year [16]56, on the 11th of October, when at twilight, in the same evening hours and in autumn, when greater refraction would be expected, it nevertheless turned out smaller. If indeed greater refraction would be expected, the distance of the Sun observed by us from the vertex was $85^{\circ}47'$, and by the azimuth of the Sun verified from the Lucida of Aries [Lucida Arietis] [α Arietis, Hamal], its true distance was found to be $85^{\circ}19'5''$. Therefore the refraction was $9'18''$, and so on with others, and others again.

[Margin: 8]

It is therefore best to abstain as much as possible from horizontal observations, or at least there is need still of many observations in the same horizon, taken with exactness. For there are almost no astronomers whatsoever who have entire tables of horizon-observations, and our own [tables] are in vain, as are those of others, and especially of Tycho, in this kind of observation of many years, which he indicates were made in volume 1 of the *Progymnasmata*, pages 79 and 280. By a twofold method one may use the Tychonic refractions of the fixed stars. The first is by choosing the Tychonic refractions of the fixed stars, and by subtracting from them the parallax of the Sun — as anyone would judge, since by Propositions 15 and 38 we show that, at equal altitude, the astronomical refraction of that same star is greater, and so much greater the more it is distant from the center of the Earth, since the parallax of the star is its own, less than the Earth's. But the fixed stars, since they lack a perceptible parallax, are received as the fixed stars were received by the astronomers. Yet because Tycho, page 280, indicates that he noticed from certain observations that the refractions of the fixed stars are about $4\frac{1}{2}'$ smaller than the solar ones, therefore we elicit the table

of the fixed stars from the solar one, by subtracting from the solar refractions $4\frac{1}{2}'$. For this surer method, therefore, we elicit the Tychonic refractions of the fixed stars from the solar ones, but corrected by subtracting the Tychonic solar parallax, in the middle [of the table]; and then, with the simple refractions of the Sun, adding the parallax of the Sun out of the Tychonic [table], so that we may have the truer refractions of the fixed stars. We use our own solar parallax for the Sun. But the astronomical refractions of the Moon we set down somewhat smaller than the solar ones — let the optical refractions be the ones that, by the said Propositions 14, 15, 16, and so on, ought to be greater, since it will then be apparent that the refractions, in serene and tawny air, cease around the 30th degree of altitude, which is the opinion midway between Tycho and Rothmann. For Tycho, in his *Epistles*, page 108, and in volume 1 of the *Progymnasmata*, page 91, judges the chief cause of refraction to be the vapors around the horizon, which render the air thicker, and from the denser [air] they give back the density, but not the meta, and the natural diversity between our air and the aether; and therefore [refraction] ceases around the 45th degree

of altitude. Rothmann, however, holds that it ceases around the 20th degree, which Tycho conceded for the fixed stars. Since therefore the inconstancy of the refractions admits no fixed law, it will subsist [as the case may be]. And these things are better set forth. Nevertheless all the summer refractions are found to be smaller, and the winter ones greater, and on the same day the morning ones greater, all else equal. See therefore in our tables.

[Margin: 9]

After the aforesaid, I found in the *Ephemerides* of the most illustrious Marquis Cornelio Malvasia [Cornelii Malvasiae], namely in the proem, pages 155, 172, 173, 174, and 186, the new doctrine of refractions of Giovanni Domenico Cassini [D. Io. Dominici Cassini], who asserts, from experience in all transparent media, both concrete (such as glass) and liquid (such as water), that the refractions of the stars proceed by the same law and variety in different inclinations, although in diverse bodies by a diverse measure; and from certain observations, at appointed altitudes, and segregated by that law, he deduced a parallax of the Sun, and the remaining refractions; and he derived this same law from the horizontal parallax of the Sun first diminished, and from his own refractions; and he likewise corrected the altitude of the pole, even by the circumpolar stars formerly taken, and by certain solstitial observations; he likewise corrected these same observations by his own parallax and refraction, and acknowledged that the same altitudes of the pole come out from the solstitials as from the circumpolars.

Hence I do not doubt to say, on folio 175: "Wherever in a place I correct the solstitial altitudes, it comes about that the same altitude of the pole arises, as that which the polar star, at the same altitudes, gives — likewise corrected — and from no observations whatsoever does any greater difference arise; therefore I establish, in the same way, that the refractions, in whatever place, and in whatever serene time of any season of the year, and at the same altitude above the horizon, agree for all stars having the same apparent altitude. Nor indeed" (so it is said on folio 172) "does any reason support a notable diversity, on account of the diversity of distances, at the same altitude, in the varying refractions." He asserts moreover, on folio 186: "The refractions persevere up to the vertex," and finally, on folio 186, affirms: "Of whatever ray in the air the incidence is oblique, the distance from the Earth at which the refraction runs out is the Earth's semidiameter," and a little after: "The altitude of the air is 6088/100000 part of the Earth's semidiameter." He proves these propositions by no experiment, nor by a produced foundation, [but] I believe their proof is in his *Astronomical Work* which he meditates; and therefore I have not yet departed from that refractive altitude of the air, which I treated in Book 10 of the *Almagestum Novum*, section 6, Problem 43, and Problem 51. Moreover, I am not for Cassini, but for Bologna [Bononia], for Vicenç Mut of Majorca [Vincentius Mutus Maioricae], and Rothmann in Hesse, and Tycho in Denmark, who found that the refractions of the stars are not perceptibly different above the 24th degree of altitude, which is much less than Cassini deduces, who himself deduces it from the Tychonic refractions of the Sun, if it excels above all others, by subtracting from it the parallax of the Sun. For at the 24th degree of apparent altitude the Tychonic parallax of the perigee of the Sun is 2'50", and the Tychonic solar refraction likewise 2'50"; therefore the simple refraction of the Sun ought to cease there. But whatever may be the case from other observations, I cannot in the meantime — most cautiously — [do without] what is most desired by my friends and most distinguished men, of whose words I have made myself the acquirer.

[Margin: 10]

For the first, given that the refractions which we experience in crystal, glass, water, wine, etc., could be distinguished, the ray (for example) entering our glass, having first been refracted in the air, in the ingress of our denser and thicker air; nevertheless the refractions are not those which astronomy requires, and the optical [refractions] are to be distinguished from the astronomical ones, as we taught in Chapter 14, numbers 19 and 20. Secondly, by Propositions 14, 15, and 16, we show that at the same altitude, whether apparent or whether seen, of stars more remote from the center of the Earth, the astronomical refractions are

greater — which is contrary to Tycho and others, who confuse the smaller refractions of the fixed stars than they assign to the optical astronomical refractions. Thirdly, the simple refractions of the Sun can be obtained without parallax, as long as these are smaller, as we show in Proposition 25; and therefore we refute Tycho at numbers 21 and 53.

[Margin: 11]

Now indeed Cassini, in all his examples, in order to obtain the true altitude of the Sun from the apparent, adds the apparent parallax, and from the remainder subtracts the refraction; and if that refraction is compounded, out of the simple refraction and the parallax, it cannot be the same one fitted to the fixed stars, which lack parallax; but if it is perceptible, then if it is simple, the parallax is applied in vain, as said at number 21. As for what is near the horizon in the Cassinian table, I do not see precipitately that increment of the refractions, with the due proportion. For, by way of example, in his table, in summer, the refractions are thus; where the difference of refraction is greater [in the second degree] than in the first:

Sample from the Cassinian table (summer)

Altitude [Alt.] (Gr.)	Refraction [Refractio] (' ")	Difference [Differential] (' ")
0	32 20	4 24
1	27 56	6 52
2	21 4	—

which is contrary to the astronomical [refractions], and so also in some others, in a table the same in summer and winter, unless there is a typographical error. As for the fact that, with the parallax of the Sun retained, and with the refraction of the fixed stars taken Cassinian, and that applied both to the Sun and to the fixed stars, the same elevations of the pole come out in a few cases — this comes about because in not a few cases certainty is not antecedent, since we have the insensible refraction of the fixed stars beyond the 25th degree of altitude.

Therefore it is enough to retain the altitudes taken from the circumpolar fixed stars' altitude, above degree 25. And when the altitude of the pole, deduced from the solstitial observations, differs from that, ascribe this to the refraction of the Sun alone, whether ordinary, or, as rarely happens in winter, extraordinary; or to a flaw in some observation.

CAPUT XVI.

De Constituendis Epochis Motus Solis

[On Establishing the Epochs of the Sun's Motion]

[Margin: 1]

Now in Chapter IV we had the true equinox of the year 1655 of Christ at Bologna [Bononiae], on the 22nd day of September, in the Gregorian style, at the hour past noon $18^h55'25''$; and the middle of the day truly on the 20th day, at the hour $18^h55'25''$. Hence, to the year 1600 completed at the meridian of the last day of December preceding, there are 54 Julian years and 263 days, $18^h55'25''$. To these is owed, from our tables, the mean motion of the Sun (after entire revolutions) of 8 signs, (...) $55'25''$; from which, with the beginning of Libra subtracted, the radix of the year 1600 completed remains, as below:

Sign.	Gr.	'	''
9	10	4	35

[Margin: 2]

To this, if we add the mean motion of 10 days, which is $9^{\circ}51'23''$, the radix of the year 1600 completed will result; but in the style of the old Julian form it will be: Signs, Gr. ' ''':

Sign.	Gr.	'	''
9	19	55	58

Then, if from this same [value] we subtract the mean motion of 1600 Julian years, which for us is, after the entire revolutions of the Zodiac, Signs 0, gr. 12, $15'57''$, the radix at the beginning of the years of the vulgar epoch of Christ will result. Signs, Gr. ' ''':

Sign.	Gr.	'	''
9	7	40	1

[Margin: 3]

In the same way, if we wish the radices for the years before Christ, we shall have them sufficiently exact down to a thousand years (...)

within which all the observations of the ancients lie, and which were recorded by their posterity. By going back still further in time, one may suspect that the error of those who place the beginning of the world some 5,000 years before Christ amounts to some quantity. As for the 30", we are not entirely secure on this point, because the motion of the [Sun's] anomaly over 5,000 years is for us greater by 33' than in the Rudolphine Tables — even granted that we rest our own motion on a firmer foundation. This we have shown abundantly clear by examples.

4. From what was said in Caput IV, num. 9, the Hipparchan equinox fell in the year 158 before Christ, at Alexandria, on 26 September, nearest to the 20th hour after noon. Once this has been corrected for refraction in time, then — as the *Geographia Reformata* shows — it was at Bologna at 18^h 27' 20", and at Uraniborg at 18^h 32' 56". At which moment, from Our Tables for Bologna, and from the Rudolphine for Uraniborg, the calculation of the Sun stands thus:

From Our Tables	Sign	Gr.	I	II
Mean motion of the Sun [Solis Medius Motus]	6	1	51	35
Anomaly of the Sun [Anomalía Solis]	3	24	30	34
Equation to be subtracted [Aequatio demenda]	0	1	48	50
True place of the Sun [Verus locus Solis]	6	0	2	45

From the Rudolphine	Sign	Gr.	I	II
Mean motion of the Sun	6	2	3	51
Anomaly of the Sun	3	28	7	22
Equation to be subtracted	0	1	49	44
True place of the Sun	6	0	14	47

The Rudolphine therefore differs from the Hipparchan observation by 14' 47" in longitude — that is, by 6 hours; and they differ by being incorrect, in that the observation was made on the meridian at the 10th hour. But Our Tables differ only by 2' 45", which accounts only for the 1' 17" difference of an hour. They do not, then, embrace it improbably, given the error arising in the observation from the deviation of the armilla from the plane of the equator by 1' 17", and from a corruption of the declination by an equal amount. From this we shall detect the error of a single day in the Ptolemaic equinox.

5. For Ptolemy, in Book 3, Caput 8, reports the equinox that is fundamental to his whole work — the one on which, as on a foundation, he builds his tables — in these words: *Of the equinoxes observed, one of the most exact among others was that of the autumn, in the year 17 of Hadrian, in the month Athyr, on the 7th day after midday, two hours nearest to equal.* Yet Boulliau, in Book 2 of the *Astronomia Philolaica*, Caput 2, and Longomontanus, in his *Commentary on the Sun*, judge — not without reason — that Ptolemy held this autumnal equinox too early, not only on account of the autumnal refraction, but also because Ptolemy accommodated his own observations to those of Hipparchus, as also the [equinoxes] of Hipparchus to the quantity of his year of $365\frac{1}{4}$ days, commensurable with the lunar cycles, and to the false opinion of the immobility of the solar apogee. Hence, why it is more certain that the autumnal equinoxes of Hipparchus occurred earlier on account of refraction than they appeared to do; and consequently, that being made to agree with the Ptolemaic ones, they came out earlier — so that the Ptolemaic, reconciled with these very ones, came out earlier still. Boulliau, however, likewise shows that the observations near the horizon increased the northern declination by 7' minutes and 48" seconds, given an assumed parallax of 2' 19". But since the parallax is false by what was said above, and scarcely reaches 10", therefore by the force of refraction the declination was at least some minutes, which carry 8 hours. Therefore, if Ptolemy saw the armilla at midday and in the evening equally illuminated on both sides, he was easily deceived by 4 or 5 hours — especially if the armilla, too, in its placement, was wandering by one minute or the other, as we mentioned above. With these things laid down, let us consult the Tables, both Ours and the Rudolphine, with the time reduced to the meridian of Bologna and of Uraniborg. For it was — if we hold to Ptolemy's observation not yet corrected — at 0^h 27' 20" after midday on the 25th day of September at Bologna, but at Uraniborg at 0^h 32' 56", in the year of Christ 132. So the reckoning stands:

From Our Tables	Sign	Gr.	I	II
Mean motion of the Sun	6	3	3	20
Anomaly of the Sun	3	20	43	19
Equation to be subtracted	0	1	52	2
True place of the Sun	6	1	11	18

From the Rudolphine, however	Sign	Gr.	I	II
Mean motion of the Sun	6	3	19	9
Anomaly of the Sun	3	22	39	44
Equation to be subtracted	0	1	55	10
True place of the Sun	6	1	23	59

Since, then, both Our Tables and the Rudolphine present the Hipparchan equinox in fairly close agreement, but do not match the Ptolemaic, and place the Sun a full degree and a little more beyond the autumnal section, one must conclude that Ptolemy, in observing the equinox, either erred in his own false hypotheses by about a degree, or by dragging it in [made an error]; and that this equinox truly fell some hours before noon of 24 September. On this matter, again, in the following Book, Caput 5.

6. It will nonetheless be worth the trouble to examine the Tables not against all the equinoxes, or against observations nearest the equinox, but against those which we know to have been accurately made on the Grand Gnomon of San Petronio, selected from among them — those treated in Caput 8, at the very moment of meridian crossing. Behold, then, the place of the Sun as observed at that time, and as computed from Our Tables:

Year of Christ	Place of the Sun — Observed	Comp uted				Defect / Excess		
	Sig.	G	I	I	Gr.	I	I	I
		r		I		I		I
		.						
1655 Sept. 22	♎	2	1	4	29	1	0	d 0
		9	3			3		
23	♏	0	1	2	0	1	5	d 0
			2	4		1	1	
1656 Mart. 19	♐	2	3	4	29	3	5	d 0
		9	5	3		4	8	
21	♑	1	3	3	1	3	5	d 0
			4	0		3	6	
23	♑	3	3	1	3	3	4	e 0
			3	6		3	9	
Sept. 22	♎	2	5	2	29	5	3	e 0
		9	7	2		7	7	

Year of Christ	Place of the Sun — Observed	Comp uted	Defect / Excess
23	$\underline{\alpha}$	0 5 1 0 6 1	5 3 e 0 6 2
24	$\underline{\alpha}$	1 5 1 1 4 7	5 2 e 0 5 9
1657 Mart. 28	Υ	8 1 4 8 5 8	1 5 d 0 4 5
1658 Mart. 20	Υ	0 5 3 0 8	5 4 e 0 1

It is therefore established that Our Tables do not differ from these most select observations by a whole single minute. And if they have differed from others by more, the better reason is that we should put the blame on the observations, since the Tables, bound by the chain of geometry and arithmetic and consistent with one another, cannot exhibit something so near the truth in the equinoctial observations and yet stray more widely in the others. But those skilled in these matters know that observations made on other days, far from the equinoctial points, have committed a greater error in declination than the equinoctial ones, in equal terms of error — and so, in deducing the place of the Sun. And for this reason, the equinoctial observations are rather to be weighed, as a Lydian stone, in testing the Tables. The Rudolphine, however, differ from the aforesaid observations by rather more minutes; thus at the first [observation] by 4' 51", and so for the rest.

CAPUT XVII.

A New Theory of the Motions of the Sun is Set Forth.

1. Up to now we have shown ourselves willing to approve the theory of the Sun set forth by Kepler in an ellipse, and refined by Boulliau, by [Blaise de Pagan, the] Count Pagan, by Seth Ward, and by many recent writers, as the simplest...

way of representing the motion of the Sun, and as one arising from the very nature of the ellipse and of its foci, or umbilics, with the Sun standing off at equal distances from the center, and rendering the reason by which the distance of the Sun is rendered eccentric. Yet it seems to labor under some imperfection, for two reasons.

2. The first is that in the Keplerian ellipse — just as for the one focus the Earth is assigned, for whose illumination the Sun is chiefly destined, as is clear from the Divine writings — so for the other focus, or for the very center of the ellipse, some body had to be assigned to the World, which would, as it were, attract the Sun, which would reflect upon itself in its uniform motion uniformly about the other focus. But to assign the center of the ellipse — and to suppose some region in the World which would determine it, from which the reason of the place [might be had], or so that the Sun should move uniformly, or half-uniformly, about it, as the Earth itself moves the Sun unequally — this, in my opinion, is to constitute the eccentricity around the center as half-uniform, but the eccentricity so much greater the less, or the greater, the distance of the Sun is constituted by God.
3. The other, and by far the greater, [reason] is that through the ellipse — indeed, not even through the simple eccentric circle — can the daily motions which appear in the Sun be reconciled with an orb carried from east to west, with another proper to it, from west to east. Even though the Copernican attention does not lie upon this — since they make the corporeal bodies of the Prime Movable penetrate, and ascribe nothing to the Earth — nevertheless there are things which we can fashion to ourselves out of the sacred writings, and out of physical demonstrations, and physico-mathematical ones, in Book 9 of the *Almagestum Novum*, sect. 4, c. 19 and 21, and which are to be said in Appendix 11. It is certain that the motion of the Sun is not only annual, but also daily, from rising to setting; and on the other side, that the Earth is at rest. And since the heavens of the planets are fluid, the falsity of distinct orbs has been all but made certain; nor does it seem that these two motions could be better reconciled by any other means than a continuous motion contrary to apparent motion — that is, a spiral motion, by which all the planets move.

[Margin: *Motus Spiralis Planetarum* — The Spiral Motion of the Planets.]

4. And indeed, if a fixed star, in one revolution from the same point, to the same meridian, exhibits to us that daily motion which we imagine to belong to the Prime Movable, and has no other slow motion from west to east; and if the Sun is such, which we celebrate as the equinox in others, and in others at points of the western equator; it is not at all necessary to fashion another abstract Prime Movable, separated from the senses. Rather, the sensible Prime Movable will be the motion of the sphere of the fixed stars.

Once this is granted: if we conceive the Sun as moving, as it were, about the Divine spires, now more broadly, now more narrowly, both in altitude and in latitude as it is described, and at the same moment as a fixed star — since it moves toward the west — it returns to the same meridian, not [exactly] returning, but somewhat more slowly; all the appearances in the motion of the Sun will be safe. In the planets, however, which are seen to be stationary, or retrograde, or direct, the reason of this appearance will be assigned more easily. For when they return to the same meridian more slowly than a fixed star, they are seen direct — that is, moving toward the east; when they are detained at the east, at whatever moment the fixed star returns, the [planet's] proper motion of the sphere [makes them] seem stationary; when finally, swifter than the meridian, they cross it from east to west more quickly than a fixed star, they are seen retrograde. But this is nothing to the Sun, which is always slower than the fixed star, [since it] returns to the same meridian, and therefore never appears stationary, much less retrograde.

5. To meet these two difficulties of solar theory, then, we have devised certain Foundations [*Fundamenta*] for our own model; but first some preliminaries must be set down.

I. Foundation, on the Apparent Semidiameter of the Sun and the Eccentricity.

6. The apparent semidiameter of the Sun at apogee is 15' and 30"; at perigee, however, it is 16' 14"; and at mean distance, 15' 46". From this, and from the equations, the better eccentricity of the Sun follows: the whole [eccentricity] of the Sun is 3,480, and bisected, 1,740 — of which the semidiameter, or the radius of the Sun's orbit, is 100,000, as is clear from what was said in Caput XI and XII.

[Diagram on this page — see the figure on the following spread; this page is prose.]

II. Foundation, on the Maximum Axis of the Earth's Shadow.

7. Given the distance of the Sun's apogee at 6,666 terrestrial semidiameters from the center of the Earth, and the apparent semidiameter at 15' 30", the axis of the Earth's shadow is 229 terrestrial semidiameters.

Diagram. A tall, narrow geometric figure at the upper right of the page, illustrating the construction of the Earth's shadow-cone for the Sun at apogee. At the top, points D, F, and S lie along a near-horizontal line (the Sun's body), with A

immediately below D; from A and S converging lines descend to a point C far below at the foot of the figure; B and T are marked midway down on the central axis (the Earth), with a small circle drawn at the Earth. The construction demonstrates the right triangle relations described in the text.

- A (upper left): foot of the radius AT tangent to the Sun
- D (top): point of tangency of line DBC to the Sun
- F (top center): point on the line of the Sun's body
- S (top right): the Sun's center
- B (middle): point on the Earth's body (on tangent DBC)
- T (middle): the Earth's center
- C (bottom): apex of the shadow cone (where AS produced and DBC meet)

For let the Sun's center be S in the present figure, and the Earth's be T, from which the Sun is seen under the angle ATS of $15' 30''$. By the radius AT, tangent to the Sun at A and making there a right angle (by Euclid III.18 [*18. Tertii Euclidis*]), and ST being 6,666 terrestrial semidiameters — for by the rules of right triangles AS comes out to be the true semidiameter of the Sun, 30 terrestrial semidiameters. Then DBC having been drawn, tangent to the Sun at D, and to the Earth at B, and meeting the produced line ST at C, let TF be drawn from T parallel to it, up to AS; DF will be equal to the one terrestrial semidiameter BT; with the single terrestrial semidiameter therefore subtracted from DS, which is as great as AS, there remains FS of 29 terrestrial semidiameters; and since with this, and with ST of 6,666 semidiameters, the angle FTS is found to be $14' 56''$. And as great as this is the angle C, on account of the parallelism of the lines CD and TF. Therefore, with so great an angle C, and the side BT — that is, the one terrestrial semidiameter — the axis CT of the Earth's shadow comes out to be 229 terrestrial semidiameters.

III. Foundation, on the Distance of the Moon, and the Shadow.

8. Given the apparent semidiameter of the Sun at $15' 30''$, and the terrestrial distance at 6,666 semidiameters, the Moon's least distance from the center of the Earth in conjunctions [is found]; the apex of the lunar shadow in oppositions is distant from the center of the Earth by $114\frac{1}{3}$ terrestrial semidiameters. For from Our observations, the distance of the Moon at perigee in the syzygies is 58 terrestrial semidiameters, as we shall show in the following Book; but at present, with the Sun placed at apogee, the axis of the lunar shadow is $56\frac{1}{2}$ terrestrial semidiameters — wherefore the apex of the aforesaid shadow is distant by a semidiameter of $114\frac{1}{3}$. From

what was said in Book 4 of the *Almagestum Novum*, Caput 17, the true semidiameter of the Moon is 26 terrestrial semidiameters; the parts above [the figure], which we have laid down, are 100. At apogee, as above, given 30 [solar] semidiameters, the true semidiameter of the Sun is 30 terrestrial semidiameters. Therefore the true semidiameter of the Sun exceeds the terrestrial semidiameter by 29 [fraction ?]; and in the preceding figure the true semidiameter of the Moon, BT, comes out to be 26 — the residual SF of the [Moon's] semidiameter being truly 29 [fraction ?]; and with the Moon's perigee distance of 58 added, ST is 6,724; let the angle FTS be, then, & C, 15' 14". And hence the axis of the lunar shadow TC, of 226 parts, [is] the semidiameter of the Moon BT — and one, that is, $114\frac{1}{3}$ terrestrial semidiameters.

IV. Foundation, on the Proportion of the Distances of the Earth's Shadow, and the Moon's, with the Eccentricity of the Sun.

9. From the conclusions, and from the things laid down in the three preceding foundations, it follows that, as the maximum distance of the apex of the Earth's shadow from the center of the Earth is as great as the whole eccentricity of the Sun, so the distance of the apex of the lunar shadow, tending into the same region — but the least, when the Sun is at apogee — is as great as the bisected eccentricity of the Sun. For the whole eccentricity of the Sun, from Foundation I, is 3,480; of which the distance of the apogee is 101,740, and at 3,480, bisected truly 1,740. From Foundation II, the maximum axis of the Earth's shadow is 229 terrestrial semidiameters, of which the apogee of the Sun is 6,666 — but at 101,740, as at 3,480 — that is, at 6,666, nearest, 229; of which the half is the distance of the apex of the lunar shadow, $114\frac{1}{3}$, just as the whole eccentricity of the Sun, bisected, is 1,740 — which is half of the whole 3,480. Hence further it follows that the distance of the Sun from the center of the Earth ought, on such a [hypothesis]...

in the hypothesis, to be 6,552 terrestrial semidiameters, and the least 6,438. These, although they are smaller than those chosen formerly in the *Almagest*, Book 3, Caput 7, cannot, however, be convicted of falsity from the lunar dichotomies, much less from elsewhere — indeed, from the ideal beauty of the hypothesis, of which presently, they appear highly probable. But in another hypothesis, varying notably the intervals of the Sun, they could not be reconciled — that all these, namely with the apparent semidiameters of the Sun preserved, and the eccentricities established in the first Foundation, the eccentricities might be as nearly as possible, and physically, equal to the distances of the two shadows of

the Earth and of the Moon, as will be clear to one who duly enters upon the calculation. Let us now come to the figure of the prior hypothesis.

Diagram. A large circular diagram dominating the page, illustrating the prior hypothesis of the Sun's motion. The outer circle is the ecliptic, marked with the zodiacal signs ♋ Cancer at the top (beside A) and ♈ Aries at the right (beside P). A vertical diameter runs from A at the top through I, G, and the small inner construction, down through H, K to B at the bottom. The center C lies at the bottom of a small inner circle (the Sun's eccentric orbit), within which a shaded shadow-cone tapers from E/G down to L. Radial lines run from S (upper left, on the ecliptic) and from T (left of center) toward the inner construction; M, N, V are clustered at the upper left on the ecliptic, R and ♎ Libra are at the far left.

- A (top): point on the ecliptic at the line of the absides, beside ♋ (Cancer)
- ♋ (top, beside A): the sign of Cancer
- I (upper center, on vertical axis): point on the Sun's orbit / mean place
- M (upper left): point on the ecliptic
- N (upper left, above M): point on the ecliptic
- V (upper left, above/right of N): point on the ecliptic
- S (left of center, on inner circle): the Sun, or a position of the Sun (locus posito in S)
- R (far left): point on the ecliptic, beside ♎ (Libra)
- ♎ (far left, beside R): the sign of Libra
- T (left of center): the Earth's center (center of reference) [?]
- G (center, on vertical axis): point G — the [eccentric] center about which the mean motion is reckoned (linea GSM, the line of the mean motion)
- E (center, below G): apex/point E of the inner construction [the figure shows a small letter that may be E or K — [?]]
- C (center, foot of inner circle): center C, from which the mean motion is considered
- D (center, below E): point D on the inner construction
- F (lower center, on vertical axis): point F
- H (lower center, on vertical axis): point H
- K (lower center, on vertical axis): point K
- L (lower center, right of axis): apex L of the shaded shadow-cone
- B (bottom): point on the ecliptic at the line of the absides, opposite A
- ♈ P (right): the sign of Aries, with point P on the ecliptic

10. On the line of the Sun's absides AB, up to the ecliptic [point] pertaining [to it], let C be the center of the Earth, and CD the distance of the Moon at perigee, 58 terrestrial semidiameters. And let DE be the axis of the Moon's shadow when it is so opposed to the Sun at apogee that it does not fall into the Earth's shadow, nor is any eclipse rashly feared; and that [axis] is $56\frac{1}{2}$ terrestrial semidiameters, and so the whole CE is a semidiameter; the diameter [is] $114\frac{1}{2}$ — by which interval let a small circle EF be described, through which the apex of such a great shadow may be understood to be carried round; and by the interval EI, of terrestrial semidiameters 6,552 [?], as great as we may, in the IV Foundation. Let the mean distance of the Sun from the Earth be described by the circular orbit of the Sun, unless one prefers to describe an elliptical one; and let its periphery be ISTK, &c. With the interval CE doubled, let CG be made, 229 terrestrial semidiameters — that is, as great as the maximum length of the Earth's shadow; by which interval let the circle GHL be described, in whose periphery the apex of the Earth's shadow, opposite the motion of the Sun, is understood to be carried round; and from the same point G — that is, from the line of the absides of the Sun — let it be described, as great as the great interval of the ecliptic ARBP, under which we regard the true motion of the Sun...

from the center C, and let us consider the mean motion at some other point, with respect to which the Sun is supposed to move uniformly — which here will be the point G. With the Sun therefore placed, for the sake of example, at S, let the shadow of the Earth then be CL, if, however, in a circle described from the periphery, and from its point G, let there be the line AB, [the line] of the Sun's absides; there will be the line GSM, the line of the mean motion; and the line CSV, the line of the true place of the Sun; and ES, the semidiameter of the Sun's orbit — which, produced into N, can be called the line of physical inequality, since also with respect to the center E, about whose orbit the Sun should move unequally, just as the line CSV is the line of the inequality of the whole [inequality] compounded out of the physical and the optical — since at the center of the Earth the Sun appears to have a greater inequality in the motion of the Sun than if it were seen from the center E.

11. The practice, then, of the geometric calculation in this circular hypothesis is very easy. For, given the simple anomaly of the Sun, the angle AGM, from the Tables, the complement of two right angles is given, with which, and with the radius ES of 100,000 parts, the eccentricity EG bisected being 1,740, you gather the physical equation ESG; and thence the angle SEG, and so also CES, with which...

finally, with the same Radius ES, and with the eccentricity CE, likewise 1740, you will find both the Sun's distance from the Earth CS, and the optical equation [aequatio optica] CSE. This last, combined with the physical [equation], will yield the Absolute Equation [Absoluta Aequatio] to be subtracted from the Sun's mean motion in the prior semicircle of anomaly ARB, and to be added in the latter [semicircle]. But when the Sun is at T, and CT, it will be equal to ET itself, and it will be at its mean distance from the Earth.

12. Indeed, this hypothesis has the most beautiful congruences, not unworthy ones — if I am not mistaken — which I now point out.

The first is that, if the Sun really moves with an equal and uniform motion with respect to some center [that is] thoroughly congruent to that center, it is seen to move in such a way by that observer who, being situated beyond the deformity of the Earth's shadow [Umbra terrestris], can perpetually see the Sun. Therefore if an eye were located at some point of the periphery GHL, it would be at the boundary of those who cannot always [see the Sun], and of those who can always behold the Sun — inasmuch as it is not only above the clouds, but even above the Earth's shadow, which already towers up, or even above the whole region of the aether. To whatever point that eye could reach, even where the line of the Sun's apsides [linea Absidum Solis] passes through, it would always see the Sun moving uniformly.

The second [congruence] is that the eye which would be located at the periphery of the circle described by the Moon's shadow — that is, at the periphery EF — would, in that region in which it would carry itself about, partake of some equality of the solar motion despite its inequality; for it would enjoy some equality of motion. For it would be located first in that region in which the Moon's shadow, at the [Moon's] perigee, conspicuously leaves the Sun at apogee behind; and being most distant by the greatest interval from the apex of the Earth's shadow, and being moreover located first at the center of the Sun's orbit, it too would be first, and would see the physical inequality of the Sun without any inequality of the optical [equation].

The third, and the one chiefly such as we posited, is that by this reasoning there are assigned two regions notable in the world: one for the center of the Sun's equal motion, the other for the center of the Sun's orbit; and from this is derived the physical ratio of the eccentricity of each, [namely] of the Sun. Now to make the Geometric calculation of each, the boundary of the region designated by the aforesaid shadows must be such that in the plane of the ecliptic one may choose the Angles of Equation and of Anomaly, and the motion of each; for it suffices that

they be in that region, which is first free of the Earth's shadow — here at the Moon — provided that even at the Moon it does not fall under the ecliptic separately.

13. Whatever, however, may be the case concerning this Hypothesis — which perhaps some, not without reason, will not disapprove, whether the whole eccentricity is as great as half the axis of the Earth's shadow, or [as great as] a quarter of the Moon's distance together with its shadow — we shall construct another Equation Table in a circular form for the whole eccentricity, 3480, bisected; and 1740: for which the Radius of the Sun's orbit is 100000. And by the same proportion we shall assign the remaining distances of the Sun in their own Table, so that each may, in his own hypothesis, be able to adapt them to the distances measured by the semidiameters of the Earth — preserving, nevertheless, the due proportion to the said eccentricity in the maximum and minimum distances of the Sun from a certain part of the Earth. But if this hypothesis does not please anyone, here are the measurements pertaining to it in the subjoined Table.

[Sun symbol]	Ad Rad. 100000	Semid. Terrae	I	
			I	I
CT, <i>Media Distantia</i> [Mean Distance]	100000	6552		
CI, <i>Distantia maxima</i> [Maximum Distance]	101740	6666		
CK, <i>Distantia minima</i> [Minimum Distance]	98260	6438		
<i>Umbra terrestris / Axis Sole</i> [Earth's shadow / shadow-axis], at Apogee [Apogeo]		229		
at Mean [Medio]		226		
at Perigee [Perigeo]		243		
<i>Solis Semidiameter Vera Apparens</i> 458 [Sun's true apparent semidiameter] in Apogee [in Apog.]		30	1 3 5 0	
in Mean distance [in Media dist.]			1 4 5 5	
in Perigee [in Perigeo]			1 4	

[Sun symbol]	Ad Rad. 100000	Semid. Terrae	I	I
			6	
<i>Lunae Perigea distantia</i> [Moon's perigee distance]		58		
<i>Umbra Lunae</i> [Moon's shadow], [Sun] at Apogee [☉ Apog.]		56 ½		
[Sun] at Perigee [☉ Perig.]				
<i>Parallaxis Solis Horizontalis</i>				2
[Sun's horizontal parallax], in Apogee [in Apog.]				9
in Mean [in Med.]				3
				0
in Perigee [in Perig.]				3
				1
<i>Portio Terrae à Sole illustrata</i>			1	5
<i>ultra hemisphaerium</i> [Portion of the Earth lit by the Sun beyond a hemisphere], Apogee [Apog.]			4	6

Indeed, I tried whether I could adapt this Theory to the Sun's Mean distance — formerly in *Almagestum Novum* Book 3, chapter 7 — chosen from other lunar Dichotomies [Dichotomiae] as 7300 terrestrial semidiameters; but the resulting numbers did not correspond. For as Radius 100000 is to the bisected eccentricity 1740, so is 7300 to the terrestrial semidiameters 127 1/30. These, joined to the Mean distance, make the Maximum solar distance 7427 semidiameters; and with this, and with the Sun's apparent semidiameter at apogee 15'30", by the problem set out in the II Fundamentum, I find the Sun's true semidiameter to be 33 1/2 [semidiameters] of which its [the Earth's] distance is 7427; and the half-angle of the cone of the Earth's shadow 15'4"; and with this, finally, the Axis of the Earth's shadow [to be] 228 1/2 terrestrial semidiameters. But if the eccentricity, when bisected, were 127 semidiameters, the whole eccentricity would be 254 — much greater than the longest axis of the Earth's shadow; nor could it, with the appendage of the penumbra, reach to this measure. Now, retaining this Shadow, and its half, 114, for the eccentricity, it would come out as 7300 to 100000; thus 114 for the eccentricity is 1562 — far less than that which we need for the equations due to the apparent motions of the Sun, and for the difference of the apparent semidiameters.

15. Likewise, taking the Tychonic mean solar distance of 1150 semidiameters, it comes out as 100000 to 1740; thus 1750 to 19; therefore the Sun's maximum distance would be 1169; and the Sun's true semidiameter, from the apparent 15'30", [would be] 5 1/4 terrestrial semidiameters; and the half-angle of the Earth's shadow 12'26"; and the axis of the Earth's shadow 276 semidiameters — much greater still than the whole eccentricity, which ought to be 228, or at most 230; nor can we maintain this, unless we use the solar distances laid down in the preceding Table, or [ones] moderately different.

CAPVT XVIII.

Indicatur Theoria Motus Spiralís Solis. [The Theory of the Sun's Spiral Motion is set forth.]

[Margin: *Exponitur Motus Spiralís Solis.* (The Sun's Spiral Motion is expounded.)]

1. Although Kepler [Keplerus], in his work *On Mars* [*De Marte*] at chapter 1, has nearly cast the mark of madness upon Alpetragius [Alpetragio] and Patrizi [Patritio] and the rest who introduced the spiral motion of the Sun, or who, captivated too much by love of simplicity of motion, were their followers — in that one and the same elliptical periphery [is set] under the ecliptic, not of the Sun, but of the Earth, by [its] annual motion around the orb, and by [its] daily motion rolling down from east to west, from the stars toward the Earth; and besides, because the spiral motion cannot be enclosed by us in a Geometric figure in such a way that it may serve to determine the Sun's places for any given time — nevertheless we are in no way deterred by these [objections] from proposing this Theory. For, as I have already begun to say at the beginning of the preceding chapter, numbers 2 and 3, it is necessary to deny the daily motion from east to west to the Earth and to the fixed Planets [Planetae Fixi], or at least to ascribe it to the whole sphere of the Fixed Stars and the Planets enclosed [within it]. And since the solid orbs have been excluded, and the fluidity of the heaven of the Planets has now been introduced by the consensus of more recent Astronomy, it can scarcely be persuaded to anyone that such vast bodies of the Planets could be swept along by an aether so fluid; so much so that, contrary to their own effort to revolve toward the east, they should be carried back toward the west by the space of 24 hours. Besides which, that motion of the whole celestial region is superfluous.

2. To this is added the authority of Sacred Scripture, which not only attributes both motions to the Luminaries, but also insinuates to us, not obscurely, that spiral motion itself, when Ecclesiastes, chapter 1, says: *The Earth, however, stands forever: the Sun rises, and sets, and returns to its place; and there, rising again, it wheels through the South, and bends toward the North; surveying all things round about, the wind [spiritus] goes forth, and into its own circles it returns.* As if it were saying that a Spirit, or moving Intelligence, by the very fact that it is thus moved from east to west, [does so] in such a way that it nonetheless girds about [its] gyres — now toward the South, now toward the North — and is not moved through one and the same...

and the same circle, but is carried round and back again through others and yet others, and through other circles. Therefore, that we may briefly recall the conditions of this motion which we have hitherto observed in the Sun's motion, let them be noted by the Astronomers.

3. *First*, then, the Sun's motion in *Longitude* [*Longum*] very plainly appears: from east through the meridian to west, and again back to the east — which motion is known to the common people and to the unlearned, when the heaven is serene each day.

The *second* motion, in *Latitude* [*Latum*], from south to north, is not so easily discerned — indeed not by everyone, but still by certain observers, especially on the days of the Solstices — yet on certain days even by those who observe the altitudes at the meridian: because, after some longitude has been traversed, [the Sun] now shows a varied declination. The more skillful observers, however, [observe it] in the varying declination from the poles of the world, and [perceive] a manifest difference and inequality, since it is greater near the Equinox than near the Solstice.

The *third* motion, in *Altitude* [*Altum*], became known not to the common people but to the skilled — because the diameter of the Sun appears now greater, now smaller; yet it is not probable that the body of the Sun should swell up in some manner, [and] in some manner be diminished; rather, [it appears so] from the diverse use of the Telescope, whose diverse [readings] arise from the diverse distance of [observed] objects: a distance is demonstrated from the diverse apparent magnitude of distant objects in the Sun, [arising] from the fact that at one time it is nearer the Earth, at another more remote.

The *fourth* [motion] observed by Astronomers is that the Sun is so moved from east to west that it does not return to the meridian, so as to revolve back to the same meridian at the same time at which, with some fixed star, it was at the same meridian yesterday with the Sun, [but] revolves back to the same meridian today. For with whatever fixed star the Sun has once been seen to rise — say, the Little Dog [Canicula, i.e. Procyon] — after the Little Dog rises about three months [later], it now obtains the meridian, and after about three more months the Little Dog sets; and after about three more months the Little Dog rises [again], at the setting of the Little Dog [?]; and at last, when a year has rolled round, [the Sun] is conjoined with the Little Dog, and rises with it. Therefore, since each day it returns to the meridian more slowly than that same fixed star, it has been seen to be moved by many [degrees] toward the east by its own proper motion. From which [comes] also that motion *in latitude* discussed *second*, [which] Anaximander, or some other, established — namely, the motion of an oblique circle to the Equator, which they call the ecliptic; and at a maximum angle of obliquity, the Sun's greatest declination from the Equator, of degrees 23°30'20". Therefore [the Sun] is designated in globes, or however [it be], in the planes of the [great] circles, by the arc of the meridian orthogonal to the Equator and the ecliptic, [drawn] and as great as that whatever it be: it was easy to gather the arc of this imaginary ecliptic from the doctrine of triangles, [as] nearer to the Sun, and [nearer to] the proper section of the ecliptic with the Equator, and thereby the place of the Sun in this ecliptic.

The *fifth* thing noted is that the Sun makes several daily revolutions about the Equator, the highest of which is toward the northern part of the ecliptic, and lower toward the southern — at least insofar as we have astronomical observations made from Babylon; and several [revolutions] were made some [years] from the Vernal Equinox to the Summer Solstice, sometimes more from the Summer Solstice to the Autumnal Equinox; from which, and from the diverse declination — of which [we spoke] in the *second* [motion] — we have concluded that the Sun is moved unequally, since the equal semicircles, or the quadrants of the ecliptic, are seen [to be traversed] in unequal times.

Sixth, it has been noted that the Sun is not seen at the same time of the year [to have] the same determination toward the Earth, [but rather] with the same declination of the Equator, perpetually. For although Ptolemy [Ptolemaeus] found the Sun at its Apogee in northern declination, by degrees 21°35' as he himself computed; in [the sign of] Gemini at degree 5°30': in which [position] it had been found by Hipparchus [Hipparcho]; therefore [the Apogee] is not without [some] motion, [though] mutation seemed to ascribe some [motion] to the Sun's Apogee;

afterward, however, it has been observed that, by the longer course of time, the Sun's Apogee, however [slowly] moved, appears near the maximum declination — this is near the beginning of Cancer. Hence the motion of the Apogee is investigated in Astronomy, nevertheless.

The *seventh* point, at last, has been found: that in the whole ecliptic, [and] at one time, the Sun is in that semicircle of the ecliptic which, from the Apogee...

4. That all these Apparent [motions] can be saved by a single spiral motion of the Sun itself, we do not doubt; as will appear from the following schematic diagrams, [if we suppose] that the beginning of this systematic [motion] is taken from about the year 1157, when the place of the Apogee was at the beginning of Cancer.

Diagram. A cylindrical/barrel-shaped solid figure, drawn in oblique projection, representing the celestial sphere with the Sun's spiral diurnal paths. The top and bottom are bounded by ellipses (representing the tropic circles or daily-motion circles seen obliquely); a vertical axis runs through the center C. Diagonal lines cross the interior, connecting the lettered points on the rim, and a dense series of near-vertical lines represents the successive spiral turns of the Sun between the tropics.

- A (top center): pole / north point of the figure
- B (bottom center): south point of the figure
- C (interior center): the Earth's center
- D (left middle): west end of the horizon DE
- E (right middle): east end of the horizon DE
- F, G (upper left / upper right of the rim): endpoints of the solar arc FAG near the top
- H, I (lower left / lower right of the rim): endpoints near the bottom
- K, L, M, N (interior, near center): points marking the cone segments and spiral construction
- Q, R (lower rim region): the common base QR of the cones
- Additional small lettered points (b, c, d, e, etc.) [?] mark intermediate spiral positions; several of these are too fine to resolve [?]

[Margin: *Expositio Motus Spiralis Solis*. (Exposition of the Sun's Spiral Motion.)]

5. Let AB be the diameter of the whole solar heaven, which at the same time represents the plane of the Equator; and through the Earth's center C let the Horizon DE be drawn — straight for [the case of] a sphere, as we here

exhibit it, but oblique for another Horizon. From the center C, moreover, let the portion of the Solar Meridian FAG be described, as great as the distance of the Tropics, bisected at A — where the beginning of Aries is, and to which is equal the arc of the Mid-night [Medinoctii] HBI, in the middle of which is the beginning of Libra; the beginning of Cancer, indeed, is at F and I; the beginning of Capricorn at F and H [?], and let two other points be drawn through C, [and] two other solar diameters of the heaven HCG and ICF. Then, on the Diameter AB, let there be set off on this side BR, and on that side AQ, equal to half [the diameter], or to the bisected solar eccentricity; the summit of which on the diameter FI is fH, and on the diameter HG is HS, equal to the whole solar eccentricity; and let GQ and Qh, above, and IR and atq; [?] RS, below, be drawn. In this same plane of the Meridian they will represent the sides of two truncated Cones, about which the Sun, having [its] Apogee at the beginning of Cancer, describes its diurnal spirals; and of which the common base is QR. But the longer segment of the Cone will be QRIG, the shorter QRHF. For if QG and RI be produced, [and] joined, the summit [vertex] would meet with the Axis of the Equator, and would be a longer cone than if they were directed concurrently with the same Axis [as] the sides Qh and RS.

6. Let the Sun's Apogee now be at the beginning of Cancer G, distant from the Earth's center C by the whole interval CG; and there let the Tropical Year begin to be described, [the Sun] describing its diurnal spirals from the larger segment of the cone — at first narrower, then broader, until they reach the Equator and the base QR, just as the maximum diurnal difference of the Sun's Declination at that time will then require: for it will then be at its mean distance from the Earth CQ, or CR, by the sole half-eccentricity AQ, or BR. Then let the Sun proceed, describing toward the South, [drawing] its daily spi...

-rals, narrower indeed near the Tropic of Cancer, [drawing] a shorter cone near the Equator; broader, indeed, near the Tropic of Cancer, and [the spirals] reach from QR in Sh, but a shorter [interval] of the cone segment, [drawing] fewer spirals crowded together, by which it accomplishes this segment in about eight days more quickly than the northern cone segment; for when it has reached the Tropic of Capricorn, its spiral Sh will be at the Perigee, and will be distant from the Earth's center by the smallest interval Ch, or CS — which, set forth above as CF, [is] as great as CG; that distance will be as great as the whole solar eccentricity Fh, which is as great an interval as the whole eccentricity of the Sun is in another hypothesis. And so, by this means, two motions of the Sun are saved: in *Longitude*

by the diurnal spirals; in *Latitude* by the intervals of the spirals, equal to the differences of the Sun's Declinations, with the unequal number of days which it effects more in the northern segment than in the southern, just as the Sun's Theory requires — since the Sun's Apogee is in the northern segment, as it has hitherto been for many ages; indeed, in nearly everyone's opinion (according to our own), its Apogee was at the beginning of the world at the beginning of Aries. Finally, the *Prosthaphaereses* — namely, of the distances of the Sun, with the Sun differing in this spiral motion — are saved with their eccentricity; the Sun does not look back toward the Earth's center, but toward the Axis common to the cones, [namely] toward the Equator's axis, and toward the sides of the cone, or of the Scalene cone inclined to the Equator.

7. It is necessary now to reconcile the Sun's diurnal motion from east to west with the motion in titubation [motus titubationis], and the apparent [motion] toward the east, and [the motion] equipollent to the motion hitherto supposed in the ecliptic. Let this be done thoroughly easily. For let the Sun, [at] Apogee at the beginning of Cancer G, and so [at] the beginning of the Tropical Year, [be the one] whose first day [is] from the Meridian: let the half-spiral GEI descend from the Meridian G to the West E, and thence to the Lowest [point] of the heaven I, whence the Fixed star arrives at the Meridian, [but] not until after 24 Hours of the Primum Mobile, [or] nearly four horary minutes [later]; it accomplishes the remainder of the spiral KL to the Meridian; and again from L it descends to M, [and] there ascends to the point N; at which moment the same Fixed star that was at the Meridian when the Sun was distant by the interval NO, [the Sun] then reaches O; thence it descends at P, and thence ascends at Q; at which moment the aforesaid Fixed star is at the Meridian; the remainder of the meridian being accomplished, [the Sun] descends at T, and thence ascends at V, and at the moment when it is there, the Fixed star obtains the Meridian; this being accomplished, VX; [the Sun] descends from X to Y, and thence to Z; and thence comes to *a*, and thence to *b*, and a little [further] to *c*, and to *d*, and thence to *e*, [and] reaches [the point], and thence to *f*, and thence to Q, and so on. Thus, through the points designated in CG, it becomes daily an Easterly [riser], so that, after three months, it rises in C, when the Fixed star is at the Meridian.
8. But that we were forewarned, for the sake of the few spirals which we have here drawn — to be avoided for the sake of confusion — that [the Sun] traverses about 188 [spirals] in these segments of the cone, and the

remainder, 177, in about the segment of the Northern Cone, [and] the rest of the Southern Cone.

8 [bis]. But it must be reminded, on account of the cause, that the Sun, when it has its Apogee at the beginning of Cancer, [describes] many more daily spirals about the Northern segment of the cone than about the Southern; namely, because the side GQ is longer than Qh; and since it has come in *h* at the Perigee, [it being] now distant from the center of the Earth C, [the Sun] appears under the beginning of Capricorn F — even though it has not reached FH, which is the Tropic of Capricorn.

9. But the Sun, obtaining the Apogee at the Beginning of Aries — as we suppose it to have been at the beginning of the world — is inspected in figure 2. In this figure, the arcs of the Sun's maximum declination are described in each [direction], as in the prior Figure, [drawn] from the semidiameters of the solar heaven bisected: namely AQ, BR, GK, FO, IL, HS. But that the whole Eccentricities may become equal — AM, BN, Fh, HS — then draw the straight lines AK, AO, [making] these as it were parallels MK, Mh, and likewise BL, BP, NL, NP, and at last RI, and RS. For four segments of cones will be born, [each in] the same number, [their] bases held in the plane of the Equator. The first segment of the larger cone is ABKL, about which the Sun, beginning the Equinoctial year, was driving its spirals from A, descending through T, [to] the west at V, and thence ascending to *a*, at which moment the Fixed star, which had been with it in the Meridian the day before, returns to the same Meridian; thence...

Diagram. A second cylindrical/barrel-shaped figure (figure 2), similar in construction to the first but with the Apogee placed at the beginning of Aries. The top and bottom are bounded by ellipses; a central vertical axis passes through C. Numerous near-vertical lines fill the interior, representing the dense bundle of the Sun's diurnal spirals. Diagonal construction lines connect the lettered rim points, defining the four cone segments described in the text.

- A (top): pole / summit
- B (bottom): base point
- C (interior center): the Earth's center
- D (left middle): west point
- E (right middle): east point
- F, G (upper rim, left / right): endpoints of the upper solar arc
- H, I (lower rim, left / right): endpoints of the lower solar arc

- K, L, M, N, O, P (interior): points defining the four cone segments (ABKL, etc.)
 - Q, R, S (rim/interior): construction points for the eccentricity offsets
 - Lowercase interior points (a, b, c, d, e, f, etc.) [?] mark intermediate spiral positions; several are too fine to resolve [?]
10. Since the segments of the cones were Equal, [each] greater between itself and [the others], the side AK [is equal] to the side AO, just as the side MK [is equal] to the side Mh, etc.; and therefore [it traverses them] in an equal number of days, both [segments], [and] it draws an equal number of spirals; nor does it tarry longer in the Northern part than in the Southern. But the Cone [is] then greater, [for] it was [drawing] spirals of a lesser base, than [when] the greater cone of the prior figure [was drawn], but of a shorter axis; contrariwise, [it draws] truly a lesser cone of this figure, but of a longer base, than the lesser cone of the prior figure, but of a longer axis.
11. From that time, moreover, at which the Sun's Apogee was at the beginning of Cancer, it began year by year to draw [its] spirals little by little nearer to the Equator, and the Tropics nearer the longer [paths]; until at last the side AK would arrive at the side QG. Therefore, by [this] transition from one side into another — that is, into QG, that is by [drawing] shorter spirals, and by a longer circuit — the ratio of its mutations can be rendered, [namely the ratio] which the Sun, observing [it] at the Apogee, traversed in the Arc FAG, or HBI.
12. Much must be added to this Theory, [things] to be pursued by diligent Astronomers; nor indeed have we wished to leave [unwritten] the Tables of the Sun's Motions, by which we are accustomed to represent the Equations, to themselves [be made] easier to represent through the Ecliptic in spheres, Armillaries, and Globes — we wished to transfer them into other Tables; nor are we able to bring [them] forth from nature in such a way that we may seem to wish [it], otherwise it is impossible, [namely] to reduce the Geometric Calculation of the Sun's Motions to those apparent [motions] — having first composed the Mean Motion of declination, and to inquire the true [motion] through the angle of the true declination, and the distance from the place...

the place of the apogee considered on the meridian arc, just as also of the interval of the Sun and of the Earth, would most easily be found from the true declinations, given the angle at C. From these data I am content to communicate to the reader four cases, in which, namely, the apogee of the Sun lies in one or

other of the four cardinal points — that is, at the beginning of Aries, or of Libra, of Cancer, or of Capricorn — and to assign to each its own cones.

I. Case for the Apogee at the beginning of ♈ (Aries)

[Margin: 13]

Look at Figure 2, in which there are four segments of cones. The first is ABLK, about which the Sun spirals from the beginning of Aries up to the beginning of Libra; its angle, that is, at the base, is CAK and CBL; the sides are CK, $75^{\circ} 52' 22''$, and the side AK, as also BL, is 41128 parts of the kind in which CK, the mean distance of the Sun, is 100000. For CK, like AC, the distance of the Sun's apogee, is 101740, since the maximum solar declination, by the angle ACG, is for me $23^{\circ} 30' 20''$, as I proved by the laws of trigonometry, which I gave; and for this segment the Sun descends from the apogee A to the mean distance at G.

The second segment of the cone is from MNKL, about which the Sun carries out its spirals in descending from the mean distance CL, which it has at L, the beginning of Cancer, up to the perigee CN, which it has at the beginning of Libra. The angles at the base CMK and CNL are individually $80^{\circ} 39' 54''$ of the kind in which CK is 100000; and the sides MK and NL are 40532 parts of the kind in which CK is 100000. The perigee distance CM, or CN, is 98260, for this is proven from the given data, and the maximum declination is given as the angle MCK, as above.

The third segment of the cone is from MNPO, of altogether the same magnitude and the same parts; its angle at the base — about which and about whose segment is the second, about which the Sun spirals — is for the Sun ascending from the perigee to the mean distance once more, that is, at the beginning of Capricorn.

The fourth segment is ABPO, altogether equal to that under Lateral A, and its angle at the base is the same as that of the first segment, about which the Sun spirals, returning from the mean distance to the apogee.

II. Case for the Apogee at the beginning of ♎ (Libra)

[Margin: 14]

In this case too the Sun spirals about four segments of cones, designated already in the first case and of the same magnitude, but in a different order. For the first segment is what in the first case was the fourth, namely ABPO, in which it descends from the apogee B to the mean distance, or beginning of Capricorn. The

second is what in the first case was the third, namely MNPO, in which the Sun's mean distance descends from the perigee, that is, the beginning of Aries M. The third is what in the first case was the second, namely MNLK, in which the Sun ascends from the perigee to the mean distance — that is, from the beginning of Aries to the beginning of Cancer. The fourth is what in the first case was the first, namely ABKL, in which it ascends from the mean distance to the apogee — that is, from the beginning of Cancer to the beginning of Libra.

III. Case for the Apogee at the beginning of ♋ (Cancer)

[Margin: 15]

For this case, and for the fourth, look at the previous figure, in which there are two cones of two segments. The first is QRIG, about which the Sun spirals, twisting, in descending from the apogee Q, or the beginning of Cancer, to the mean distance at R, which it has at the beginning of Libra; then returning to the mean distance Q, the beginning of Cancer at the apogee, the angles at the base, namely CQG and CRI, are $80^{\circ} 37' 18''$; and the side QG, as also RI, is individually 41200 parts of the kind in which CQ is 100000. And CG, 101740, is the distance of the apogee; the maximum solar declination as the angle QCG is $23^{\circ} 30' 20''$.

The second segment is QRSh, about which the Sun spirals, twisting around in descending from the mean distance, that is, from the beginning of Libra R, to the perigee S, below the beginning of Capricorn; and again, from the perigee h, the beginning of Capricorn, to the mean distance in Q, the beginning of Aries. The angles at the base, however, are CQh and CRS.

individually they are $76^{\circ} 49' 46''$, and the side Qh, and RS, of 40245 parts of the kind in which CQ is 100000, and Ch is 98160 — the angle of declination being set down at its maximum, QCh, as $23^{\circ} 30' 20''$.

IV. Case for the Apogee at the beginning of ♑ (Capricorn)

[Margin: 16]

In the same figure two cones of segments in pairs are to be considered, just as in the first case, of the same magnitude and quantity, but in a different order. For the greater segment, which was Boreal [northern], ought now to be Austral [southern]; and so this Sun spirals, just as from the beginning of Capricorn at apogee; F, from the beginning of Aries at mean distance Q; and so from the beginning of Libra at R, or the other mean distance, to the beginning of Capricorn at apogee H; and so spiraling from the beginning of Aries at mean distance,

descending indeed from the beginning of Aries at mean distance, and from the perigee at the beginning of Capricorn G; whereas ascending from the perigee, the beginning of Capricorn; and ascending from the perigee to the mean distance at the beginning of Libra.

For the Other Cases

[Margin: 17]

For the other cases, in which the Sun's apogee is outside the cardinal points, there is need of four different segments of cones, whose figures and quantities, as the more skilled astronomers can conceive and design, we will help with a single example in the following schema; in which let the diameter of the equator itself be represented, the equator representing ACB, the Earth; the center C, from which the two meridians of the Sun's supreme apogee are drawn on either side; that is, let the meridian portion FAG and HBI be described, of as great a distance as is...

Diagram. A large, dense geometric construction occupying the lower half of the right column. It depicts a barrel-shaped / hour-glass solid (the truncated-cone "spiral" figure) inscribed within a tall many-sided outline, with the Earth's center C at the middle and zodiacal-sign symbols marking the cardinal points around the periphery. Crosshatched conical bands run between the upper and lower rims. The construction is heavily lettered with point-labels; many are small and partly obscured by the dense ruling. Readable labels, by approximate position:

- A (top center): vertex / apogee point, marked with ♈ (Aries) nearby
- K, M, O (upper row, left of A): rim points of the upper cone
- F (upper left, outer): meridian endpoint, with X just below it
- G (upper right, outer): meridian endpoint, with ♋ (Cancer) and S nearby
- N, L (upper region, right): rim points
- C (center): the center of the Earth / common center
- V (left, mid-lower): rim point, with ☉ [Sun symbol] nearby
- D (right, mid-lower): rim point [?]
- R (right, mid-lower): rim point, with ♑ (Capricorn)/♊ nearby
- P (lower center): point with asterisk-mark, with ♎ (Libra) nearby [?]
- H (lower left): meridian endpoint
- I (lower right): meridian endpoint
- E (bottom center-left): base point, with ♎/♏ symbol [?]
- B (bottom center): base point of the lower cone

- T (lower right) [?]

[: this geometric construction carries dense crosshatching and numerous small point-letters; several labels (D, P, E-region zodiac symbols, T) could not be resolved with confidence — more than 2 labels flagged.]

The tropics, to whose extremities FIC and HCG are drawn. Let the Sun's apogee now be at D, at 15° of Taurus; and so the perigee at E, at 15° of Scorpio; for the mean distance under Aquarius will be at 15° K, and under Leo at 15° L. Therefore let the straight lines DCE and KCL be drawn, on both sides; let DQ, PN, KM, and LR be cut off, equal in both, and bisected at the eccentricity DQ — that is, at the beginning of Capricorn at 1740 parts of the kind in which CQ, CM, CP, and CR are 100000; for these are drawn straight, MD, MN, NL, LB, the segment-beginnings of the cone MNLD; about which the Sun spirals, ascending from Aquarius at 15°, to 15° of Taurus. The absences from the upper KO and EP, of 3480 parts, by how much is the whole solar eccentricity, and by the drawn lines OQ, OP, PR, RQ, you will have the cone of the segment OPRQ, about which it is turned at 15° of Leo and 15° of Scorpio; the segment DSTR serves the Sun at 15° of Taurus to 15° of Leo, and the segment XMPV, when from 15° of Scorpio it ascends to 15° of Aquarius. But SG and TI, the lesser eccentricity...

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the eccentricity bisected, that is, 1740 parts, and FX, and HV, greater, but in its entirety less than the eccentricity, in proportion roughly to the distance from the place of the apogee and from the place of the mean distance.

[Margin: 18]

[Margin: Occurritur obiectioni — "An objection is met."]

You will say that this designation of the cones and their segments, by its very perplexity, renders improbable this theory. I reply that no less perplex is the variety of cones which you must wish for, if you desire to retain the Keplerian ellipse: for, on account of the changes of the apogee, you would want to keep the Sun always in the same ellipse and in the plane of the ecliptic, and yet — the apogee, or aphelion, being changed underneath it — it is impossible that it be the same ellipse of the same cone; rather, there must be either many cones, or as many ellipses as there are dispositions of the Sun's apogee. And besides, the diurnal motion from the east cannot be reconciled with its own proper motion toward the east.

CAPUT XIX.

Conclusions concerning the certainty hitherto acquired, or to be hoped for hereafter, regarding the Sun's Motion, Intervals, and Quantities; and the Theory and Practice of the Tables.

This indeed is what astronomers expected from us with such eagerness, and to whose knowledge the two prior volumes of our *Almagestum Novum* [*Almagestum Novum*], and the *Idea of the Whole Work*, promised they would come. What, then, our endeavors have been able to conclude — as it were, in the marrow — by way of a brief synopsis concerning the Sun's properties, must be briefly indicated.

I. Conclusion concerning the Equinoctial, or Tropical, Year.

The true quantity of the equinoctial year, beyond 365 days and 5 hours most certainly, does not have more minutes of the hour than 56', nor fewer than 42'. Yet for me the truest quantity of all is this:

D. 365. Hor. 5. 48'. 48". 0"". Sidereal: D. 365. Hor. 6. 9. 21. 42.

The earlier part is clear from the opinions of astronomers adduced in Book 3 of the *Almagestum Novum*, chapter 15, if you reject the outworn opinions of certain of the ancients; the later part is clear from what is to be said here in chapter 4, and a third thing from what is to be said in Book 4, chapter 19.

II. Conclusion concerning the Mean, or Equal, Diurnal and Annual Motion of the Sun.

The mean, or equal, daily motion of the Sun is most certainly of 59' and 8" of seconds, and besides not more than 20''' of thirds, nor fewer than 19''' , as is clear from Book 3 of the *Almagestum Novum*, chapter 17, from Ptolemy exclusively up to this point; but from what is said here in chapter 4, the truest of all the diurnal and annual is as follows:

	Sign.	Gr.	I	II	III	IIII	V	VI
Diurnus (daily)	0	0	59	8	19	48	35	35
Annuus (annual)	11	29	45	40	30	56	5	1

III. Conclusion concerning the Motion of the Sun's Apogee.

The annual motion of the solar apogee, from the consideration of more recent astronomers (adduced in Book 3 of the *Almagestum Novum*, chapter 25), is not

more than 1' 4"; from the consideration of seconds, not less than 45"; but from what is said here in chapter 9, it is most probably below 1' 2" 4''' 4''''.

IV. Conclusion concerning the Apparent Diameter of the Sun.

The apparent diameter of the Sun at apogee does not exceed 34', nor fall short of 29'; but at perigee it does not exceed 36', nor fall short of 30', as is clear from what is said in Book 3 of the *Almagestum Novum*, chapter 10; but from the most accurate observations had at the Great Gnomon of San Petronio [the Bolognese gnomon], the apparent diameter is most truly such as either D. Giovanni Domenico Cassini [Giovanni Domenico Cassini], or we ourselves, elicited from them, as below from what is said in chapter 12:

☉ Diam.	In Apogeo (at apogee) ' "	In media dist. (at mean dist.) ' "	In Perigeo (at perigee) ' "
Cassino	31	8 31	4 32
[Cassini]			0
Nobis (us)	31	0 31	4 32
			2

V. Conclusion concerning the Bisection of the Eccentricity.

The eccentricity of the center of the Sun's orbit from the center of the Earth is half the eccentricity of the center of the equal motions of the Sun. For if we use the eccentricity which we deduce by geometrical necessity from the difference of the apparent diameter of the Sun at the distances of apogee, mean, and perigee, and accordingly inquire into the prosthaphaereses [prosthaphaereses] owed to the mean motion of the Sun, so as to obtain the true place of the Sun agreeing with the observations exactly, the owed prosthaphaereses are found to be double too small; nor can the true quantity of such prosthaphaereses be found unless an eccentricity double too large is assumed. And so the center, about which the Sun is imagined to move equally, or to be moved, is removed twice as far from the center of the Sun's orbit as the center of the orbit is removed from the center of the Earth — see what is said in chapter 12.

VI. Conclusion concerning the Quantity of the Sun's Eccentricity.

The total eccentricity owed to the equations of the Sun's motion does not change, but is the same in every age, as we have more probably taught in Book 3 of the *Almagestum Novum*, chapter 26; it is not more than 3800 parts, nor less than 3200 parts, of the kind in which the radius of the Sun's orbit is 100000, from what is

said in Book 3 of the *Almagestum Novum*, chapter 24. But from the difference of the Sun's apparent diameter at a threefold distance from the Earth, and from the equations of the Sun's motion, no eccentricity satisfies the apparent motion of the Sun more than ours, of which above in chapters 10, 11, and 12, and it is of this sort:

Qualium Radius est 100000. (Of the kind in which the radius is 100000.)

Excentricitas Solis (Sun's eccentricity)	Tota (total)	Bissecta (bisected)
Nobis (us)	3480	1740

From this, indeed, it comes about that the Sun, about its own center too, is moved unequally, by half the inequality, by which the true place of the Sun differs from the mean.

VII. Conclusion concerning the Figure of the Sun's Orbit, or its Path.

Although the bisection of the eccentricity has indicated three points in the Sun's orbit, or notable centers, at equal intervals distant from each other — namely the center of the Earth, the center of the Sun's orbit, and the center of the Sun's equal motions — and although it would seem to be an indication that it is an ellipse, in whose periphery the Sun moves (since in an ellipse too there are three points unequally distant among themselves, namely the center of itself, and the two foci, or umbilici, from which all the radii drawn out to either of the foci in the cavity of the ellipse are emitted, and from there reflected): and although it is well-nigh near enough to the truth that, by such a path, by a geometrical method, the prosthaphaereses owed to the Sun's motion can be found, as is clear from the theory demonstrated in chapter 11, and from examples in the prior Table of observed solar places, and supported by this path — nevertheless, no necessity demonstrates the elliptical path of the Sun. First, because, although an ellipse by its very nature requires three points, yet these three points can be found in a circle too, if not by their nature, then mathematically considered; physically considered, however — if indeed in it there be those three places at least, about which the Sun moves equally indeed...

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about one [center]; unequally about the center of the Earth, and unequally about the center of its own orbit. Secondly, because, by our eccentricity and the

equations established in a circle, we represent the apparent motions of the Sun no less — indeed for the most part more — than the owed motions are more exactly represented, as is plainly clear from the Table of chapter 15, of book 2. Thirdly, because not only is the Sun demonstrated to move in an ellipse rather than in a circle, but neither manner is demonstrable, save the diurnal motion from the east to the west, which is owed to the Sun both by Divine Scripture and by the real increase of impetus, as by the percussions of heavy bodies from another quarter, and save the fluidity of the celestial heaven of the planets; and with the eccentrics and epicycles of the solid orbs rejected as multiplicities — indeed, the divine motion of the planets from the east to the west can scarcely otherwise be reconciled, when they appear from the west to the east, than by the diurnal motion from the east to the west, the spiral [motion], and the slower motion of the prime movable [Primum Mobile], or of the fixed stars. Which motion I have shown to be neither absurd nor outside the geometrical laws, in chapters 16 and 17.

VIII. Conclusion concerning the Cause of the Two Eccentricities of the Sun.

The cause of the Sun's total eccentricity, not improbable, is the very great Terrestrial shadow, so that in that aethereal region the center is first beheld as visible, from which the Sun's uniform motion begins, in which at first the eye, raised from the Earth, begins to perceive the Sun perpetually, without any interruption of night. The cause of the bisection of the Lunar shadow, on the other hand, is to be guarded against — since the first quantity of it should exceed, the first the first too, of the Sun's halved uniformity. If indeed the foundations on which they rest can be placed, the cause of the predicted shadows is a quantity analogous to the said eccentricities, as I taught in chapter 16, at number 6.

IX. Conclusion concerning the Maximum Declination of the Sun, or the Obliquity of the Ecliptic.

The maximum declination of the Sun from the equator, or the obliquity of the ecliptic, has not been the same from the time of Eratosthenes up to now, as I showed in Book 3 of the *Almagestum Novum*, chapter 27, and once in Book 3 of the *Almagestum Novum*; nor does it exceed 23 degrees, nor — by exacter observations — fall short of 23 by more than 4 minutes; the truest of all observations agrees at 23° 30' 20", nor is 23° 30' 30" improbable, from what is said in the same chapter 6.

X. Conclusion concerning the Sun's Distance from the Earth, and the Horizontal Parallax.

The Sun's minimum distance from the center of the Earth, even, is not supposed by ignored parallaxes, as up to now, down to Tycho [Tycho Brahe]; and it was supposed by Tycho himself; but from our Dichotomies of the Moon [the *dichotomia* observations], thereafter astronomers are not asked, but it is not less than sixteen thousand semidiameters of the Earth, nor is the maximum greater than sixteen thousand semidiameters of the Earth, as may be gathered from what is said in Book 3 of the *Almagestum Novum*, chapter 7, and its Appendix at the end of the first volume adjoined. Two distances, however, before the others, are to me very probable. The first is that which we chose in the *Almagestum Novum*, Book 3, chapter 7, and which we touched on above in chapter 13: that it is not less, we confirmed in chapter 14, at number 39. By the new Method of Parallax, through the refractions of the fixed stars inquired into, the maximum is not greater than 30", by which the mean distance from the Sun is at second by 7300; that one is bisected, now, and our new eccentricity 1740, of the kind in which the Radius is 100000. It ought to be that the maximum distance be the terrestrial semidiameters 7427, and the minimum 7173. The latter is that which agrees with the attempted Hypothesis of the Solar eccentricity and of the terrestrial shadow, and of the Lunar — prolix indeed, but owed to the eccentricities and shadows, as we have indicated in Conclusion VIII and expounded in chapters 16 and 17, at number 6, where we adduced reasons, although such [things] this Hypothesis requires — that the Sun's distance at the apogee be the terrestrial semidiameters 6666, and so, by the recent eccentricity, the perigee 6438. The mean, 6552, terrestrial semidiameters.

Hence follows that the Horizontal Parallax of the Sun is indeed never greater than 30" of seconds, or 31"; but is nevertheless perceptible, nor — where the most subtle [reckoning] is in question — to be altogether neglected, as some do. Let, then, the aforesaid distances, with their Horizontal Parallaxes, be set before one's eyes:

Solis
Distantia à
Centro
Terræ in
semidiam.
Terrestribu
s. (The
Sun's
distance
from the
center of
the Earth in
terrestrial
semidiamet
ers.)

Nostra (Our [opinion])	Distant. Apog. semid.	Parall. Horiz. "	Distant. Med. semid.	Parall. Horiz. "	Distant. Perig. sem.	Parall. Horiz. "
1. Opinio (1st opinion)	7427	27	7300	28	7173	29
2. Opinio (2nd opinion)	6666	29	6552	30	6438	31

XI. Conclusion concerning the True Magnitude of the Sun, the Earth's Shadow, and the Angle of the Cone of that same Shadow.

Since the Sun's distance from the Earth is uncertain, and since we know it to be not smaller than 6000 terrestrial semidiameters — and indeed by much — it is probable that it does not exceed 7500. Even if it be more certain what the quantity of the Sun's apparent diameter is, yet it cannot certainly be established for us about the true magnitude of the diameter, as [it can] about the rest of the quantities from the diameter that follow. Taking, therefore, as a foundation the Sun's diameter apparent at 31' in the apogee, and the minimum tolerable apogeeal distance 6000, and the maximum 7500 — but at the more probable 7427 and 6666 — from what was just said, there follow the quantities written below, among which is the Angle of the Cone of the terrestrial Shadow; and as great as is the Arc

of the Terrestrial great circle, which the Sun illuminates by unrefracted rays, beyond 180 degrees.

Posita Solis dist. à

Terra

semidiametroru

m terrest. (The
Sun's distance set
in terrestrial
semidiameters)

Vera Solis
Diameter (True
diameter of the
Sun) semid. terr.

Axis Vmbr. Terræ
(Axis of the
Earth's shadow)
sem. ter.

Angul. Coni
Vmbr. (Angle of
the cone of the
shadow) ' "

Maxima in Apog. semid. 7500. (Max. at apogee, semidiam.)	67 11/13	228 7/10	30	6
Maxima Apog. (Max. apogee) 6000	54	231	29	4 8
1. Probabilium { Apogea 7427	67	229	30	4
(1st of the probable) { Media 7300	67	224 3/5	30	3 7
{ Perig. 7173	67	220 4/5	31	1 0
2. Probabilium { Apog. 6666	60	229	29	5 2
(2nd of the probable) { Media 6552	60	226	30	3 0
{ Perig. 6438	60	223	31	4

XII. Conclusion concerning the Hoped-for Progress of Astronomy.

Although our most recent Tables represent the observed place of the Sun by very great Instruments — of the kind that is the recent Gnomon in the Temple of San Petronio of Bologna — they often, short of one or two minutes, represent the error of differences; from which we gather that, when the error exceeds two or three minutes, the error is rather to be in the observations, which suffer little

physical alterations, since the Geometrical Tables cohere among themselves, nor can they at the same degree of Anomaly exhibit now the true, now the false; and from this it may be suspected that Tables are never better, or more certain, to be hoped for from any later [astronomers], than those which are diligently established from the observations: they do not ever differ from one another by a single minute. When nevertheless I consider how much in this age astronomers have advanced by observing, by meditating — by how much, God being immortal, these little obscure [errors] indulge me — and the diminution proceeds in us for a tiny one, and unanimously granted that it serves to expedite, since astronomers do not cease from observing, and from contemplating the Heaven; that as new...

[continued from the preceding page — the closing exhortation of Caput XIX]

and so we may afterward acquire finer subtleties, either to confirm what has so far been found, or to correct it, or finally so that, in the very Creator, our Wonder, Admiration, and Love may be drawn from things so hidden and from the profound Harmony of the Celestial Motions and of their intervals — these things and their like leading us on, to His Praise and to the Greater Glory of His who Understands All things Human, and that we should direct all our wonder and all our work to Him.

I. APPENDIX

To Caput XII

On the Apparent Diameter of the Sun, against an Objection raised by Most Learned and Most Friendly Men

Whether, and how much, should be subtracted from — or added to — the visible disk of the Sun [speciebus Solis] and the shadow of the Moon, when light is admitted through an aperture of perceptible size, so that one may obtain the correct magnitude not only of the Apparent Diameter of the Sun and its proportion to the Lunar Diameter, but also of a Solar Eclipse, whether expressed in Digits or in Scruples of one degree?

An occasion for this question was lately given by two Fathers of our Society, most distinguished French Mathematicians — who indeed cast some doubt on, or rather asserted against, certain conclusions transmitted to us by R. P. Bernardino Bohillo [Bernardino Bohillo], a member of the same Society and most skilled in Mathematics, against what was said in the *Almagestum Novum* (Book V, Cap. 15,

nums. 4, 5, and 6). For from Kepler's [Johannes Kepler] teaching these doctrines had been drawn — namely, that from the semidiameter of the luminous disk of the solar image there should be subtracted the semidiameter of the Aperture; and that, by the same token, the sagitta of the Moon's shadow should be added, so as to obtain the correct magnitude of the Eclipse in Digits, and so forth. To these objections we have been able to give a ready reply, since some of the points — points which, doubtless, we ourselves knew — required no profound treatment in Geometry, but rather only the integrity of this doctrine for the sake of others, into whose hands this little lucubration of ours may come. Meanwhile, we owe the greatest thanks to those who gave us occasion for this, for inquiring somewhat more deeply into matters not to be despised, and for placing in a clearer light a truth once recognized.

I. Supposition

If two straight lines are Parallel, and differ by an imperceptible amount, then two further lines which join them at the same parts are likewise parallel to one another, and equal, without perceptible difference.

For Euclid (Book I, Elements, prop. 33) demonstrates this simply concerning parallels and equals in geometric rigor; it holds also for things equal to the perception, for inferring equality to the perception, and parallelism to the perception.

II. Supposition

Two straight lines are equal without perceptible difference when the one does not exceed the other by more than a three-hundredth part of one ounce [uncia] of the Roman Foot.

By the Roman Foot I understand here the kind and magnitude that I set out, following Villalpando [Juan Bautista Villalpando], in the *Almagestum Novum* (Book II, Cap. 7). And I have more than once tested, together with P. Grimaldi [Francesco Maria Grimaldi], on a flat and well-polished plate of orichalcum, on a most finely drawn parallelogram and on the rectangle ABCD, of which the side AB, like CD, equals one ounce of the Roman foot; and AC, likewise BD, equals two Roman feet severally. The diagonal AD, moreover, divided into 300 equal particles. If a most fine silken thread OH be stretched across — the kind that can be drawn out most finely from a silkworm's cocoon — it will cover one whole particle of those three hundred. From which we conclude that this is the smallest difference that the human eye can plainly discern; for even the ounce divided by the Diagonal AD would yield a far longer division into 3000 particles. Yet the

aforesaid thread would obscure the said particle by its own slight thickness; and of the three-thousandth parts, and to seek a greater fineness still — and a much greater one — is to depart from the edge of any Ruler, whose straightness is never so evident as that of the aforesaid stretched thread.

Diagram. A rectangle with corners labelled A (top left), B (top right), C (bottom left), D (bottom right). The top side AB carries a midpoint O; the bottom side CD carries a midpoint H. A vertical line OH joins the two midpoints. The solid diagonal runs from A (top left) down to D (bottom right); a second solid line runs from B (top right) down to C (bottom left), the two crossing at the centre. A dashed line runs from C (bottom left) up toward B (top right), representing the silken thread OH stretched along the diagonal.

- A (top left corner)
- O (midpoint of top side AB)
- B (top right corner)
- C (bottom left corner)
- H (midpoint of bottom side CD)
- D (bottom right corner)

III. Supposition

The Semidiameter of the Earth is not less than 3,500,000 Geometric paces, nor is the distance of the Moon from the Earth at the syzygies less than 50 terrestrial semidiameters, that is, 175,000,000 paces. Nor is the distance of the Sun from the Earth less than 1,105 terrestrial semidiameters, that is, 3,867,500,000 paces.

The first is established from the measures of the Geometers reported in the *Almagestum Novum* (Book II, Cap. 7). Suppose now, from our own more recent observations exhibited in the *Geographia Reformata*, it be taken as certain that the semidiameter of the Earth is not less than 4,673,000 Roman paces. The second is established from the observations of the Astronomers adduced in the *Almagestum Novum* (Book IV, Cap. 14). The third, finally, is established from the relayed opinion of the Astronomers in the *Almagestum Novum* (Book III, Cap. 7) — although, from the Dichotomies of the Moon, we now hold it certain that the distance of the Sun at Perigee is not less than 5,000 terrestrial semidiameters.

I. Proposition

Two Rays propagated from the same point of the Sun, or of the Moon, to the Earth, and comprehended by a semidiameter of the Aperture not exceeding 10

Roman paces — if produced further — are, to the perception, parallel within an interval no greater than 21,486 paces for Solar rays, or $972\frac{1}{2}$ for Lunar rays.

In the first of the Figures exhibited at the end, let the Sun or Moon be A; let the Rays and their least distance from the Earth be AB and AC, comprehended by the semidiameter of the Aperture BC, which does not exceed 10 paces; and let them be produced to H, K, and so on. Up to the base HK, parallel to that same BC, and since they diverge Geometrically, let HK be greater than BC; let CL be drawn from C, a straight line parallel to the straight line AH. I say that if the interval CL is no greater than $972\frac{1}{2}$ paces — for Lunar rays — but no greater than 21,486 paces for Solar rays, then the Solar rays within that interval, that is BH and CK, are to the perception parallel, indeed equal to one another to the perception. For HK, parallel to BC itself, does not exceed it except by the particle LK, no greater than the three-hundredth part of an Ounce of the Roman Foot — which is the minimal difference evidently perceptible by Supposition II. Therefore HK and BC, within that interval, are equal to the perception, and so by Supposition I, BH and CH are parallel, and equal to one another to the perception. The antecedent is proved, because the triangle AHK is cut by LC proportionally (by Elements VI, props. 4 and 6); and as BC is to AB, so is HK to AH, and LK to LC. Now since BC is 10 paces to the Solar distance AB, namely 3,867,500,000 paces (by Supposition III), then LK, being the three-hundredth of a Roman ounce of the foot — the difference of length perceptible to the senses — is to LC as 1,289,166, that is $107,430\frac{1}{2}$ feet, or 21,486 paces. Then, since BC is 10 paces to the Lunar distance AB, namely 175,000,000 paces, so LK, the three-hundredth of an ounce, is to the ounces 58,333; that is, 4,861 feet, or $972\frac{1}{2}$ paces.

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So much the more certainly, therefore, will the rays be parallel and equal to one another, by every test of perception, throughout an interval still greater than the one stated, if both the Distance of the Luminary is greater and the semidiameter of the aperture BC is smaller than 10 paces. We ourselves, certainly here at Bologna, having used observations of this kind with the Great Gnomon of the Temple of S. Petronio [San Petronio] — whose perpendicular interval from the aperture to the pavement does not exceed 100 Roman feet, and is about 90 — used an aperture of nearly one ounce only.

Corollary

On Parallelism preserved through an imperceptible Angle

From what has been said I gather a method, which I have used along with Nonius [Pedro Nunes / Nonius], Snell [Willebrord Snell], and others, for demonstrating the parallelism of the Physical rays ABH and ACK — a parallelism which holds only in relation to the interval CL, in which, namely, the equality both of the lines BH and CK, and of the lines BC and KH, is preserved, as is doubtless usually preserved within instruments treatable by Astronomers. For from the distance of the Luminaries, and from the narrowness of the semi-aperture BC, it is easy to show that the Angle A does not exceed one Third of a Scruple, which is commonly reckoned imperceptible. And so the straight line BC, falling upon the straight lines AB and AC, and making with them the internal Angles ABC and ACB equal to the perception to two right angles, and not falling short of the sum of two right angles except by the angle A, at most by one Third — seems to make the rays AB and AC parallel to the perception (by Elements I, prop. 29). But this is not absolutely valid, except within the aforesaid interval. For while the Angle A remains at one Third, and so the sum of the Angles at any base BC or KH reaches $179^{\circ} 59' 59'' 59'''$, the Rays AH and AK can nevertheless proceed in such a way that, at the base KH, the divergence becomes perceptible, indeed very great. As in the example of the Lunar Rays, with BC remaining at 10 paces — if the interval CL of $972 \frac{1}{2}$ paces be multiplied by 300, there result 291,750 paces by which LK exceeds BC, namely of one Roman Ounce; and if again CL be drawn out 12 times, there result 3,500 [paces] — that is, produced almost as far as the centre of the Earth — then the excess over BC of one Roman foot will remain, and so the physical parallelism will not remain. Which it was worth pointing out.

II. Proposition

Given the Base of the whole disk of the Sun, received through an Aperture of imperceptible quantity in a plane equidistant from the plane of the Aperture, and given the Distance of these planes: there is given the apparent Diameter which would appear to the eye placed at the location of the Aperture.

I said "of the whole disk" — that is, terminated by the outermost rays of the Sun — because, if it could be reflected through such an aperture and could move the eye of the observer, that is, perceptibly move it. For in reality these rays would be so faint that they could not evidently represent the outermost part of the whole disk of the Sun, as has been found by experiment. Yet, these things being granted, let it be so in Figure II. Let the plane AB be, say, a white Tablet, to which the plane

ED is equidistant, in which there is the imperceptible aperture H; through the plane AB let the outermost Rays of the Sun FB and GA strike, intersecting in H and at H; let HT be drawn to AB, perpendicular, making the right Angle HTB, and HTA likewise right: for in a Triangle, since each is supposed right HTB, with the sides HT (the distance of the planes) and BT (half of the disk of the Sun) given, the half of the disk of the Sun will be given by the Canons of Triangles, the angle right. The Angle THB, the half of the whole AHB, which by Elements I, prop. 15 is equal to the Angle FHG, under which the eye, placed at the aperture H, would see the whole portion of the Sun visible from there, or the apparent Diameter of the Sun.

But because in this way we cannot in reality obtain such a Diameter, therefore among other methods we use chiefly the disk of the Sun admitted through an aperture of perceptible quantity, so that that disk may evidently move the perception by the multitude of its rays — provided that the Aperture, and its distance from the plane that receives the disk, be of congruent quantity, and apt to represent the disk of the Sun.

III. Proposition

Given the Base of the disk of the Sun admitted through an Aperture of known and congruent quantity, in a plane likewise equidistant from the aperture and at a known distance — the disk being as whole as it can be when well disposed, and the application being able evidently to distinguish the disk from the shadow that terminates it: there is given the Apparent Diameter of the Sun, equal to that which appears to the eye placed at the location of the Aperture, without evidently demonstrable difference.

[Margin: Objection.]

Now the Aperture and the distance of the planes ought to be so commensurate in quantity that the aperture be less than the true Diameter of the Sun, indeed less by 10 paces (according to the said Proposition I). But so that the disk of the Sun received through it may evidently be larger than the aperture, and that the splendour from the dusty air, or from the dark channel, or from the reflexes of the enclosure, may not confound the boundaries of light and shadow that terminate the disk of the Sun — and yet so that the aperture be not so small, nor the distance so vast, that, by the scarcity and weakness of the rays, an evident discrimination between the disk and the shadow that bounds it be obscured: Therefore, as for us, we have generally used an aperture not exceeding two Roman Ounces of the foot, and more often a smaller one, of 15 — sometimes a

larger one, indeed of 30, 40, and so on. In the Gnomon of the Temple of S. Petronio, however, the least distance of the pavement on which we receive the disk of the Sun is about 100 Roman feet, and the aperture about one Ounce — that is, of 100 such parts of which the perpendicular distance is 100,000. With these premises, let it be as in Fig. II. Let the Aperture be OP, whose centre is CT, and from which, drawn perpendicular to the plane of the disk AB, is comprehended by the outermost Rays of the Sun FB and GA, tangent to the alternate edges of the aperture, and intersecting one another beyond the aperture in H. Let it be understood, moreover, that from the right-hand limb of the Sun, the radius FB is propagated to the centre C, the other Radius, whose portion is CL, will be from the same point of the Sun radiating into the surface; for it will be CL by Proposition I. The parallel, to the perception, to FB itself, and the semidiameter of the Aperture CP, equal to the perception, rightly to LB. The Angle CP given, the remaining angle of the half-disk TB will be cut off; and since the noted T is at L, the whole distance CT will then be the angle TCL; and thence the whole KCL, equal to the perception under which the eye is constituted at C, would be seen to subtend the Sun itself, and its apparent Diameter.

But that the Apparent Diameter of the Sun, investigated by this method, is equal to that which is seen by direct gaze at C — this either certain friends of ours deny or call into doubt, on the ground that the Rays of the outermost Sun, evidently and more strongly, move the perceptive eye, directly to view the Sun at C, than from the same point of the Sun they radiate into the surface of the white Tablet, and from there, through the aperture into the Eye — that is, through innumerable rays which, by the benefit of refractions, are diminished in number, and as it were with a brush paint into the Retina of the eye, and as if with a pencil sketch in it that very intense disk of the Sun, as is known to the skilled among the more recent Opticians. But the Rays FB and GA, tangent to the aperture, being singular, are so faint that they cannot move the perception, and so cannot evidently represent the outermost extremity of the Solar disk; but, if through a sufficient number of rays the outermost part of the Sun were represented, the disk would be whole. Since therefore it appears smaller than it ought, while along the straight line TB the whole CP, or LB, is subtracted, being too greatly subtracted, and something is added elsewhere — and so, through the remaining TL, a smaller-than-just, smaller too — the Angle TCL, and a smaller Diameter of the Sun is acquired than ought to be, and than is seen from C.

[Margin: Reply.]

I reply: for that very reason we did not, in the proposition, require a disk so whole as a well-disposed and evidently discerned eye can manage — knowing nonetheless that some small part of the Sun's disk is not discerned, for the reason adduced; because nevertheless, in Geometric rigor, BL is larger than CP, and is to be subtracted, there is some small compensation; nor moreover can that little part of the latent disk, or imperceptible, be so great that the Diameter of the Sun may be found per se perceptibly smaller than the one seen from C — whence we gather that, by other means, by direct gaze, capturing the Diameter of the Sun — namely, through a disk captured at the same moment by two instruments, and by observers measuring the altitude of the lowest edge of the Sun from the one, and of the highest from the other, or by numbering with a pendulum by means of time, in which the Disk of the Sun on the Equinoctial days passes between two most fine threads in a [continued]

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plane extended in the meridian plane — we have very often obtained as great a Solar Diameter as we very often obtained by reflected gaze through the aforesaid disk, and sometimes indeed a slightly larger one, but not rarely a slightly smaller one. From which we conclude that the apparent diameter of the Sun obtained by direct observation cannot be evidently demonstrated to be larger than the one received through the aperture-disk, and so forth, we conclude. Therefore this subtlety is useless for practice, and Astronomers labour in vain to insist upon it, and it exceeds all human perception, and the diligence of all. For it is enough for them to obtain as great a Diameter as suffices for solving and representing the Celestial phenomena, to men dwelling on the earth.

IV. Proposition

Given what was found in Proposition III, there is given the Apparent Diameter to the eye placed at the point of intersection of the Rays comprehending the disk of the Sun, both from the plane that receives the disk and from the centre of the perceptible aperture.

Persisting in Figure II, since by Proposition III the angle TCL is given, and the parallels are to the perception HB and CL, applied by Proposition I secondly, therefore the said angle is equal to the internal and opposite THB (by Elements I, prop. 29). Hence the whole Angle AHB is given, bisected, as we had before, the segment perpendicular HT. This is moreover equal to the angle FHG, under which, at the point of intersection H, the Diameter of the Sun would be seen. Then in the Triangle HTB, right-angled at T, given the angle THB and the opposite side,

that is the half-disk of the Sun TB, the other side of the Trigonometry HT is given, and the distance of the point H from the plane AD, from which, if the previously given CT be subtracted, there remains the distance of the points CH.

V. Proposition

The distance of the point of intersection of the Rays comprehending the disk of the Sun, through a perceptible aperture admitted from the centre of the aperture — if the semidiameter of the aperture is subdouble to the half-disk, it is equal to the distance of the aperture from the base of the disk; but smaller, if smaller than half the disk; greater, if greater.

In the same Figure II, since CP, the semidiameter of the aperture, is parallel to the base TB, in the triangle HTB it issues by Elements VI, prop. 2. HT, of the same proportions as HC, of which CP is to TB. Therefore if TB is double CP, then HT will likewise be double HC; but if more than double to CP, HT will be more than double to HC; if double HC, smaller than CT. By contrast, if TB is less than double CP, HT will likewise be less than double HC, and so HC is greater than CT.

Yet it is the custom, in the Instruments of Astronomers, to assume a distance CH smaller than CT. As an example, in the great Gnomon of S. Petronio, where we assume CT of 100,000 such parts of which the semi-aperture CP is the same 100, and the semidiameter of the apparent Sun near Perigee, that is the angle TCL, of 16 minutes. Inasmuch as we obtained, in observing there — for by force of Trigonometry the half-disk of the Sun is manifestly corrected TL, of such parts $465 \frac{4}{9}$; therefore CP being added, 100, that is equal to the perception LB, the side TB becomes $565 \frac{4}{9}$ parts; with which, and with the angle THB, likewise of 16 minutes, the whole TH is gathered, 121,500 parts. But TC is about 100 Roman feet. Therefore the whole TH is $121 \frac{1}{2}$ feet, and the distance of the points CH $21 \frac{1}{2}$ feet.

VI. Proposition

The Apparent Diameter of the Sun, found through the whole disk of the Sun by a perceptible aperture, is false, and perceptibly larger than that Diameter which appears to the eye gazing directly at the Sun from the location of the aperture.

Let there be drawn, from the centre C of the aperture, to the whole of the Solar disk the outermost straight lines CA and CB; for the angle ACB will be made larger than the angle LCK, which is the measure of the apparent diameter of the Sun to the eye C (by Propositions II and III). But since the aperture OP is perceptible, and by Proposition I...

[continued]

[p. 73 — right column]

the half CP is equal to the straight line LB, the half; and OG equal to the straight line AK, perceptibly too; the whole disk AB exceeds the corrected disk KL by the excess. Let no one suppose that this difference in the Sun consists of seconds of scruples; let the example of the preceding Proposition be resumed, in which we showed, from the semidiameter of the Sun near Perigee of 16 minutes, and the distance CT of 100,000 parts, and the semi-aperture CP, that is LB, of 100 parts, that the whole half-disk TB follows, of $565 \frac{4}{9}$ parts. Hence, since by CT, of 100,000 parts, by the laws of Triangles, the angle TCB follows, of 19 minutes 26 seconds; and the whole angle ACB, of 38 minutes 52 seconds — enormously larger is that Diameter of the Sun, which is also found through the corrected disk KL, and by observing the Sun directly from C.

VII. Proposition

To capture and measure the disk of the Sun and the shadow of the Moon, apt for ascertaining the quantity of a Partial Solar Eclipse.

Into a long tube, of black or blue colour within — apt for beating back the reflexion of the rays — let there be inserted a plate roundly perforated with an aperture not exceeding one Ounce of the foot, to which, on the other side, let there be fixed a beam supporting a well-polished and white little tablet, equidistant from the plate of the aperture, and in it let a point be marked, which is in the same straight line in which is the axis of the tube and the centre of the aperture. Then, on the day on which a Solar Eclipse is to be, the plate being exposed outside the little window of the tube on that side in which the aperture is, and the enclosure being well obscured, so that no ray of light can penetrate from any aperture or chink except through the aperture of the plate, let the tube be turned with its whole aperture toward the Sun, until the centre of the disk of the Sun coincides to the perception with the point marked on the white tablet. Then, three points being firmly held on the tablet, let three points be noted on the periphery of the disk of the Sun, so that through them the centre may be found by Elements I, prop. 3. Or at once, from a point noted as above, let an interval be taken up to the periphery of the disk of the Sun, and with that interval let a circle be described, and its diameter divided into 12 equal parts, but let one at least of these be subdivided into smallest equal particles, say 100, or 50, and so on. As the Diameter of the aperture is not, as before, or after, the Diameter of the aperture. But, the Eclipse begun, let the tube be moved so that the centre of the said circle,

and the luminous disk of the Sun, coincide; and where the luminous part of the periphery of the circle first agrees with the periphery of the disk, and where first the Eclipse is established, the quantity of the Eclipse will have grown at the top, and no more grow; let the interval be noted, both of the Shadow, and of the periphery of the luminous disk of the Sun in the diameter of the circle bisecting the Shadow. As to how great this interval is, let it learn, that one being carried by the circle into the Diameter, as above divided into parts, and particles. It is expedient also at once, at the top of the Eclipse, to note three points on the periphery of the Lunar Shadow itself, two indeed in the common intersections of the two peripheries — the Shadowy, namely, and the luminous; the Third, however, at will, by Elements I, prop. 3. So that the centre of the circle of the Shadow may be found to agree, and thence how great a part of the diameter of the luminous disk has been obscured by the Lunar Shadow.

As in Figure III: if two points B and C be noted, at which the periphery of the luminous disk ABC and the periphery of the Lunar Shadow GBC mutually cut one another, and besides, let the point H be noted; and through these let the centre F of the Shadowy circle be found, and through it let the Diameter GH be drawn, continued with the diameter AI; you will easily be able to measure with a compass the absolute Eclipse, and the arc BIC now detected — how great a part has been overshadowed, HI — comparatively to the whole Diameter AI, and to the part AH itself, which was free from the Shadow. And so indeed, if the Solar Eclipse be partial, it will not be Annular.

But if it be Annular — that is, in which, around the Moon at the top of the Eclipse, there appears of the Sun's Disk a certain Corona, or a luminous ring round about — there will also appear, within the circle of the Sun's disk, the whole circle of the Lunar Shadow, sometimes equally on every side, distant from the periphery of the luminous, as in Figure IV; and when the Eclipse is Central — that is, when in the same straight line are the centres of the Luminaries, and the eye of the spectator — and then it suffices to take with a compass the interval of the peripheries wherever you please, as small as possible...

[Continuation of Proposition VII, from the foot of the previous page:] suppose AB is the smallest. Sometimes, however, the portions of the periphery will be unequally distant from one another, as in Figure IV. In that case one must take two intervals, the largest CD and the smallest FG — unless FG happens to coincide, in which case the largest, CD, suffices by itself. Then, with these intervals transferred by a compass above the diameter of the solar image, let the ratio of the shadowed diameter to the unshadowed be established.

VIII. PROPOSITIO.

In an annular solar eclipse, especially a central one — given the proportion of the images of the Sun and of the lunar shadow that are admitted through an insensible aperture — the true magnitude of the eclipse is given in digits, or even in scruples, of the kind that the apparent diameter of either luminary is reckoned at; and thence the apparent diameter of the other luminary [is given].

Here we call upon Figure V, with the explanation set out there for the first case — the case of an indivisible (or nearly indivisible) aperture, supposing it possible for the case, even though in actual practice it is impossible. With these things laid down, the proposition is demonstrated through its parts.

First, in triangle AGH the angle GAH — which subtends the base GH of the lunar shadow, in the position represented by the visual disc of the Moon as CD — is, by Proposition 15 of Book I of the *Elements*, equal to the angle EAF, which subtends the apparent diameter of the Moon CD; and is equal to the part of the Sun cut off by it [the Moon], EF. Therefore, by however much the eye A, turned toward the reflected image, sees the shadow GH, by that much, turned toward the Moon, it sees the Moon, and estimates the part of the Sun cut off by it — even though it does not yet know how great it is. Similarly, in triangle LAM, the angle LAM, which subtends the image LM, [is equal to] the obscured part of LM, by the portion GH, and the remainder LG and HM; and from this the bright [parts] follow. The angle [LAM] is equal to the angle IAK, of which the part IK, cut off by EF, is obstructed by the Moon, and the remainder IE and FK appear luminous; and by however much the eye A, directly contemplating the Sun, [sees them], by so much, turned downward in the opposite sense, the residue of the bright image LG and HM appears — because, since IM and KL intersect one another at A, the rays not tangent to the Moon, and likewise the rays EH and FG that are tangent to it, [form] equal angles: namely IAE and HAM are equal to one another, just as also FAK and GAL [are equal] to one another. Therefore, if (as is commonly the case) the Sun is reckoned as a foot across, and 12 unciae or digits, then its apparent [diameter] is estimated in such parts, in which parts also the eclipsed portion of it — and not the un-eclipsed portion — is measured (the observation, on which see Proposition VII), let the shadow GH be noted against the whole LM. In another kind of parts, say in hundredths of an uncia of the Roman foot, let the whole LM be made; as GH is to the whole LM, so let so many hundredths to 12 digits, [yield] so many hundredths; so GH yields so many hundredths to the obscured digits, [and] there come out so many digits, which are obscured, [and] as many as are

truly covered by the Moon, [when] hidden from the eye A directly contemplating the eclipse.

Second, if the apparent diameter of either [luminary] be given in scruples of one degree — for example, if the diameter of the Moon be given, and its measure the angle CAD, 28' — and by the foregoing discourse let the part of the Sun covered by the Moon be found to be $10\frac{1}{3}$ digits, of the kind that the whole visual disc of the Sun is estimated at 12; if it be made that as $10\frac{1}{3}$ is to 12, so 28' to another, there come out 32' for the apparent diameter of the Sun; and so of the rest.

IX. PROPOSITIO.

Given the apparent diameters of the luminaries to the eye placed at an indivisible — or nearly indivisible — aperture, set up, and the distance of the aperture from the Table that receives the images of the Sun and of the lunar shadow; the magnitude is given, and the apparent proportion to the observer of an annular — especially a central — solar eclipse.

Supposing, as above, the explanation of Figure V: First, in triangle AGH, the apparent lunar diameter being given — that is, the angle CAD — its supplement GAH is given. Therefore, the perpendicular AB being drawn, its half BAH is given; and the distance AB [being given], in right-angled triangle ABH, right-angled at B: therefore, the distance AB being given, BH is given, the half of the image of the shadow, that is, the radius of the shadow GH, in parts of the kind that AB is noted in. Likewise, [continued below]

the apparent diameter of the Sun being given — that is, the angle IAK — its supplement LAM, and this too bisected by the perpendicular AB, [gives] the angle BAM; in triangle BAM, right-angled at B, the distance AB being given, BM is therefore given, the half of the solar image, of which the portion BH is shadowed, but the remainder HM is bright. Therefore LM and HM, and the proportion both of the whole composite LM to GH, and of the bright parts LG and HM to the shadowed parts GH.

Exemplum postea non semel adhibendum. [An example to be used more than once hereafter.]

Let the apparent diameter of the Sun at perigee be 32', and its semidiameter — that is, the angle BAM — 16'. Let the Moon at apogee be 28' in diameter, and its semidiameter 14' — that is, the angle BAH. Let the distance of the equidistant planes AB be 100000 parts, such as we use in the gnomon of San Petronio. For in triangle ABM, by trigonometrical necessity, BM is found to be $465\frac{4}{9}$ parts, and

therefore the whole LM, of such parts, $930 \frac{3}{4}$. But in triangle BAH, BH is found to be $407 \frac{27}{107}$ parts, and therefore the whole shadowed part [is] $814 \frac{1}{2}$; and hence the bright parts LG and HM aggregate to $116 \frac{3}{10}$.

X. PROPOSITIO.

In an annular solar eclipse, the proportion of the images of the Sun and of the lunar shadow admitted through a sensible aperture is not the same as the proportion that would be admitted through an insensible aperture; and therefore, the true magnitude of the eclipse cannot be taken through it [the sensible aperture] as it [the magnitude] is to be received from the Table, but much smaller than it appears to the eye placed at the position of the aperture.

Kepler had asserted this very thing universally, concerning solar eclipses, in his *Astronomia Optica* [Kepler, *Astronomia Optica*] (cap. 2, Proposition X), saying: *In a deficient image, or ray, of the Sun let in through a round window, the horned [crescent] form, not legitimately let in, appears in the heavens as sharp, but on the obscuring little screen appears blunted.* And at Proposition XI, where he says: *The diameter of the Moon in images of this kind appears greater than outside in the heavens.* And at Proposition XII, where he says: *The digits of a solar eclipse appear fewer in the image than in the heavens.* And he not only demonstrated this, but at cap. 11 also taught the manner of avoiding these fallacies, at Problem 6 ad 13; and at Proposition 7, he plainly states that, however minute the aperture be, always the proportion of the apparent diameters changes, and the eclipse appears smaller; and at the same place, that the digits appear fewer, and so forth. But this, as if otherwise suspected of geometry — not only suspected, but plainly false — those two Fathers pronounced; and unless they understood it and read it in our Proposition V, examining the truth of Kepler's and our propositions, [let them attend to it]. Be it so that Kepler did not descend to that particular case of annular eclipses, and especially central ones — he left the rest to be set forth by us in due order of doctrine, and with greater clarity of cause.

For let it be supposed, whether possible or not, but imaginable nonetheless, that the images of the species be admitted through the indivisible aperture A: in Figure V, the image of the lunar shadow is the whole GH; but, the aperture being relaxed [enlarged] to NO, the rays of the Sun touching the Moon, and the margins of the aperture being tangent — namely by the rays PCNQ and RDOS — there issues from the aperture the lunar shadow image SQ. Because the remaining shadow of the prior [image], that is, the part QH let in through the indivisible aperture A, is illuminated by the rays issuing from the segment of the solar disc, segment EP; and the part GS, by [those] issuing from segment RF. Now since the

rays of the Sun PQ and RS touch the Moon at the same physical points CD, at which the rays EH and FG had touched it — and therefore, descending from the same point of contact toward the space on the earth QH, and thence GS — because, as is supposed, this [aperture] is here less than half an Italian mile, and so by Proposition I they are parallel to the senses; and therefore the semidiameter of the aperture AN is equal to the physically equidistant plane's portion QH, and the semidiameter AO to the portion GS — there manifestly follows the lunar image GH let in through the aperture, both [margins] being obliterated, and it contracts; by as much as the semidiameter of the aperture is, and altogether by as much as the whole diameter of the aperture NO is.
[continued]

On the contrary, the composite image of the Sun, [composed] of the part of itself shadowed, and the part bright, let in through the indivisible aperture, is the sole [image] LM. But the aperture being relaxed [enlarged], the [shadow] TV issues, [tangent] to the same physical points IK, descending to illuminate the parts MV and TL — all those rays which can enter through the semi-aperture AO, and through the semi-aperture AN; and because MV and TL are supposed, in the customary planes of observation, less than half an Italian mile, and therefore by Proposition I parallel to the senses; and therefore they are equal among themselves, AO and MV, just as AN and LT: it follows that the composite image of the Sun is increased on both sides, beyond the prior LM, by as much an increment as the semidiameter of the aperture is, [and] the whole by as much as the diameter of the aperture is. With these things laid down, the argument is thus reduced to form.

[Margin: *Argumēt. in forma.* — The argument in form.]

Of whatsoever two quantities equal before, if one only is decreased by as much as the other increases, the same proportion of them is not preserved as was before. But in the case proposed, the images of the lunar shadow, and of the Sun let in through the indivisible aperture, were unequal among themselves; [and] through the sensible aperture the lunar [image] is decreased by as much as the solar [image] is increased. Therefore the same proportion of them is not preserved as before. The major [premise] is plain from the doctrine of proportions handed down by Euclid (Book 5, *Elements*) and Cardano [Cardano] and others. For in order that it be continued, or that the same proportion of two unequal quantities be preserved, both must either be increased in the same proportion, or be diminished, or, if they were equal, both increased, or both diminished equally — not, however, one diminished, the other increased. The minor [premise] has already been proved,

and shown, that the lunar shadow image decreases by as much as the solar image increases; that is, by the whole quantity of the diameter of the aperture. Therefore, [the conclusion stands].

Although, however, in an annular eclipse, but not a central one, the situation of the lunar shadow is different from that which Figure V represents — namely, with the Moon at the height of the eclipse declining to the left part, the shadow falling in the middle toward B, with the disc of the Sun lying more to the right, on the right-hand part of the Table, the solar image will descend toward the left, where the image of the Sun on the right-hand part of the Table appears greater than on the left — yet the compensation is such that the whole increase of the solar image on both sides, aggregated, is as great as the diameter of the aperture is, and by so much is the decrease of the lunar shadow image.

Furthermore, with the proportion of the images not remaining the same, it is certain that the true magnitude of the eclipse cannot be obtained in digits, much less the true proportion of the diameters in scruples, if either image be employed as incorrect; and as is plain in the Table of observations. For from what has been said in Proposition VIII, the true [magnitude] is that which is deduced from the proportion of the images of the indivisible aperture, and cannot be obtained through the sensible aperture in the proportion as the true [magnitude] is obtained. Which will also be made plain by an example.

Exemplum pro praxi. [An example for practice.]

Persisting in the example of Proposition IX — the Sun, [and] the diameter of perigee 32'; the Moon, however, at perigee 28': it is certain that in such a central solar eclipse, [the Sun] is obscured by the Moon by 32' minus 28', and twice as much from here, the same; that is, simultaneously 4 [parts] are left immune from the eclipse; this being laid down, as there, the aperture, by the distance from the Table of 100000 parts, the necessary composite solar image LM came out, of such parts, $930\frac{4}{5}$; and the lunar shadow [image], of parts, $874\frac{1}{2}$; let the aperture NO now be relaxed [enlarged], of parts, 200, of the kind that AB is 100000. For as we showed in the proof of this Proposition, the whole quantity of the aperture is increased, the solar image, and the whole quantity is diminished from the lunar shadow image: therefore, 200 being added, the whole TV becomes, of parts, $1130\frac{4}{5}$; and 200 being subtracted from the shadow, the residue SQ becomes, of parts, $614\frac{1}{2}$. Let the observer make use of those images of such parts, as they appear in the Table; so that as $1130\frac{4}{5}$ is to 12 digits, so $614\frac{1}{2}$ to a fourth proportional number, and there come out only $6\frac{59}{113}$ digits, when there ought to be $10\frac{1}{3}$ digits — since, as 32' [is to] the solar scruples of the diameter, so 12 to

28' obscured, [yield] $10\frac{1}{3}$ digits. Hence, if anyone should observe the solar eclipse from A, he would clearly see [the Sun] not standing out [un-eclipsed] from the eclipse, [continued]

of the Sun's disc except by $1\frac{1}{3}$ digit from here and $1\frac{1}{3}$ thence. But another observer, observing the same eclipse on the Table, and the computation made from the proportion of the images, just as he took it, without any correction, would pronounce that the eclipsed [parts] were no more than 6, or about $\frac{2}{3}$; and that the Sun, in the obscured [phase], appeared at the nearest 3 digits from here and as many thence. And so, perhaps disputing with one another, the one would accuse the other of hallucination; meanwhile, before the direct observer, perhaps the estimation of the geometry of these untaught subtleties would labor, which the observer at the Table would profess, and would have the workmanship of astronomers held in ridicule.

XI. PROPOSITIO.

In an annular solar eclipse, especially a central one — the quantity of the sensible aperture being given in parts of the kind that the quantity of the images let in through such an aperture is noted in — the quantity of the images is to be subtracted from the aperture, to be taken away from the solar image, and to be added to the lunar shadow image, so that the true magnitude of the eclipse, and the true proportion of the images and of the diameters of the luminaries, may be had as analogous.

For, the aforesaid correction of the case of Proposition XI being made, it is reduced to the case of Propositions VIII and IX — that is, to the case of the indivisible aperture, in which there it is shown that the true magnitude of the eclipse is had, and the proportion of the diameters, and so forth. But if it be done otherwise, [it is] absurd, [and] it gathers the quantities, and so forth. But because someone could doubt, and it might not suffice to correct one of the two only, [the matter] is to be reduced; [and] because we have set out an example above according to four modes, which can be imagined, [and] put into practice. These things being laid down: the diameters of the Sun being 32' and of the Moon 28'; and therefore the eclipse [being] of 28' minutes, or $10\frac{1}{3}$ digits, of the kind that the diameter of the Sun is estimated at 12; and the diameter of the aperture being put at 200 parts, of the kind that the distance of the planes is 100000: there come out the images of the Sun and of the lunar shadow, both corrected, as prescribed above, [and] both incorrect, as in the following little table:

Species	Solis part.	Vmbræ Lunar.
<i>Incorrecta</i>	TV 1130 $\frac{4}{5}$	SQ 614 $\frac{1}{2}$
<i>Correcta</i>	LM 930 $\frac{4}{5}$	GH 814 $\frac{1}{2}$

A fourfold proportion can be set up — namely, of the corrected Sun to the corrected shadow; of the corrected Sun to the incorrect shadow; of the incorrect Sun to the incorrect shadow; and of the incorrect Sun to the corrected shadow. Thus 12 digits to the eclipsed digits, and there come out the digits, as in the table written below:

Speciebus	Vt partes	Ad partes	Sic Digniti	Ad Dig. Eclips.
<i>Incorrectis</i>	TV 1130 $\frac{4}{5}$	SQ 614 $\frac{1}{2}$	12	6 59/113
<i>Correcta Solis</i>	LM 930 $\frac{4}{5}$	SQ 614 $\frac{1}{2}$	12	7 86/93
<i>Correcta Vmbra</i>	TV 1130 $\frac{4}{5}$	GH 814 $\frac{1}{2}$	12	8 73/113
<i>Correcta Vtraq;</i>	LM 930 $\frac{4}{5}$	GH 814 $\frac{1}{2}$	12	10 $\frac{1}{2}$

parts / to [those] parts; "Sic Digniti" = so the digits; "Ad Dig. Eclips." = to the eclipsed digits. Note: the table's last-column result for both-corrected reads 10 $\frac{1}{2}$ on the page, whereas the prose of Props XI and the close of this section give the true eclipse as 10 $\frac{1}{3}$ digits — the two are transcribed as printed.]

It is therefore established that the correction can be made here in no other way than that prescribed by us in the Proposition; and that those err the worst of all who contend that neither image is to be corrected, since thereby one departs furthest from the true magnitude of the eclipse — which in such a case is necessarily 10 $\frac{1}{3}$ digits.

XII. PROPOSITIO.

A solar eclipse can appear annular to the eye intent upon the image of the Sun and of the lunar shadow projected onto the Table through a sensible aperture, which nevertheless appears not annular — indeed not even partial — but total to the eye directly observing the eclipse from the position of the aperture, provided the aperture be notably greater than the aperture of the said eye.

I do not describe a figure peculiar to this case; Figure V can serve our case, adapted [to it]. For let the whole disc of the Sun be not, as there, IK, but EF, from whose extremities E and F the rays tangent to the Moon run into the pupil, or aperture A of the eye; for the whole Sun, covered by the Moon, will appear under the angle EAF. But the aperture being placed, [continued]

aperture NO, notably greater than the aperture A of the pupil, [the rays] will be able to enter at the sides from the segments of the Sun EP and FR — rays not tangent to the Moon physically at CD, but either avoiding all contact with it, or in others more remote from C and D, intersecting, [so that] the outermost are PNQ and ROS — so that the lunar shadow appears as great as SQ is, shining around in the parts QH and GS; nor does it subtend the angle GAH, equal to the angle EAF, under which the eye A sees the whole Sun obscured; but only the angle SXQ; yet it must be that the aperture before the eye be very large, if the angle SXQ ought to be sensibly different from the angle GAH, and the parts GS and QH sensibly illuminated.

XIII. PROPOSITIO.

In a partial — but not annular — solar eclipse, given the proportion of the images of the Sun and of the lunar shadow let in through an indivisible aperture, the true magnitude of the eclipse is given in digits, or even in scruples, of the kind that the apparent diameter of the Sun is noted in.

For the truth of this Proposition, three figures are to be inspected — namely VI, for an eclipse of precisely 6 digits; and VII, for an eclipse less than 6 digits; and VIII, for one greater than 6 digits. These being well understood, the proportion asserted in the Proposition is easily understood. First, then, before any eclipse, the solar image FD is supposed observed, let in through the indivisible aperture A, and measured. Then the Moon, going in from the left part of the figure, [continued]

up to the contact of the rays BHG, is brought under the eye, and to the indivisible aperture A, [from] the disc of the Sun. The segment of the lunar shadow CG, and in the Table the segment BD appears shadowed, the other [segment] FB being illuminated by the rays of segment GE; and the same uncovered segment which the eye sees under the angle GAE, to which is equal the angle BAF measuring the bright part BF, just as the angle CAG, under which the eye A sees the part of the Sun obscured, or cut off by the Moon, is equal to the angle BAD measuring the obscured part BD. Therefore the eye A, turned toward the Table LM, [estimates] the eclipse by reflected sight as great as, turned toward the heavens, [it estimates] by direct sight. Therefore, if it be done that, as the whole FD — the composite image — [is] noted in some measure, say in hundredths of particles of an uncia of the Roman foot, to 12 digits, so BD, noted in the same kind of particles of the [image], to another [number]: there will come out as many digits as are eclipsed, [as] the observer of the eclipse from A, contemplating the heavens, estimates. But if the solar diameter be noted in scruples of a degree, multiplying by the particles

of the uncia of the composite solar image, BD, and dividing the product by the scruple of the whole solar diameter, there come out the scruples of the Sun eclipsed by the Moon. For Figure VII, attend to the line to be applied, AB; [and] for VI and VIII, GB is applied, and so forth.

XIV. PROPOSITIO.

In a partial solar eclipse, although not annular — the proportion of the images of the Sun and of the lunar shadow let in through a sensible aperture is not the same as [the proportion] let in through an indivisible aperture; and therefore, the true magnitude of the eclipse cannot be obtained through it [the sensible aperture] in digits, much less in scruples of a degree, as appears in the Table.

The Figures VI, VII, and VIII are again to be reconsidered, and the exposition added there — for, that being well perceived, the truth of this Proposition will plainly be established. The aperture, then, being relaxed [enlarged] — let it be IK — and before the eclipse, the entrances of the extreme solar rays CKM and EIL, the solar image is then the whole bright LM, which is to be measured according to the said Proposition VII. The Moon coming afterward, according to the parallax of latitude and the contact of the rays OHKP, at the height of the eclipse, the lunar image comes out PM, permuting [shifting] its position, but not [its] quantity; for as much of the space as it loses at B, in P, [continued]

is the whole LP, when in the case of the indivisible aperture it would be only FB; but it is LF, on account of the parallelism of the rays EAF and EIL, equal in the sense [to] the semi-aperture AI; and so to the part BP, it is destitute of shadow. Therefore the whole image LP, which remains bright, grows beyond the bright FB; the whole quantity of the aperture being composed of LF and BP; for the remaining segment DM does not increase the bright image, as bright in the eclipse, since it is occupied by the situation of the shifting shadow. With these things laid down as manifest, the argument is thus formed.

Of whatsoever two quantities equal before, one remains formally unchanged, or remains equivalently [unchanged], because as much grows on one part as is decreased on the other; the other, however, becomes absolutely greater than itself, [and so] the same proportion of them does not remain as they had before. But in a partial solar eclipse, although not annular — the images let in through the sensible aperture, the lunar shadow image remains unchanged, equivalently, because as much as it loses of the space uncovered on one part, by as much does it occupy on the other; whether in the case of the indivisible aperture it were equal to the bright portion of the solar image, as in an eclipse of 6 digits; or smaller, as in an eclipse of

fewer than 6 digits; or greater, as in an eclipse of more than 6 digits. On the contrary, the bright portion of the solar image always comes out greater than itself, as in the case of the indivisible aperture. Therefore the images of the Sun and of the lunar shadow let in through the sensible aperture are not the same proportion as [that] let in through the indivisible aperture. The major [premise] is plain from the Doctrine of Proportions, evidently deduced from first principles, or definitions. The minor [premise] is proved by the very exposition of Figures VI, VII, and VIII discoursed upon; super [upon] this fact, [it is] virtually extended through all the possible cases of partial solar eclipses.

The proportion not remaining the same, however, but varied, through it [the sensible aperture] the quantity of the eclipse cannot be obtained, [the quantity] which would be obtained through the proportion of the images of the indivisible aperture. But through this [indivisible aperture] the true quantity of the eclipse is obtained by Proposition XIII. Therefore through the other [the sensible aperture] it is not obtained as true.

XV. PROPOSITIO.

In partial — but not annular — solar eclipses: the quantity of the sensible aperture being given, and of the images of the Sun and of the lunar shadow let in through it; the true quantity of the eclipse is to be obtained — the whole image of the Sun composed [of the part bright and the part shadowed] being subtracted from one part, and the whole quantity of the aperture obscured [subtracted]; but the lunar shadow image is to have the semidiameter of the aperture subtracted from one part, and added to the other; that is, in Arithmetic, nothing is to be added or subtracted.

The reason is, that this case is to be reduced to the case of the indivisible aperture, through which the true quantity of the eclipse is had by the said Proposition XIII; and without which [it] is not had, as by the said Proposition XIV. It is reduced, however, if what we said in this Proposition be done; as, by the induction made through the three kinds of eclipses represented in the three Figures VI, VII, and VIII, and by the said joint Propositions XIII and XIV, [is] plain; and is briefly indicated again. For since the image of the Sun, in the case of the indivisible aperture, is composed of the part bright and the part shadowed, [it is] FD; and in the case of the sensible aperture, it is LM, greater than FD, by the parts LF and DM; if their aggregate of the aperture IK be taken away, the image LM is reduced to the indivisible image of the aperture FD. But because the lunar shadow image, in the case of the indivisible aperture, is BD, and in the case of the sensible aperture is PM, increased as much by DM as it is diminished by BP; if

from the shadow PM there be taken DM, equal to the semi-aperture AK, and to the same be added BP, equal to the same AK, the shadow is reduced again to BD, which is likewise [the same], as if to BD itself, from first to last in the arithmetical reckoning, nothing be added nor taken away anything.

XVI. PROPOSITIO.

Given the apparent diameter of the Sun and of the Moon in scruples of one degree, and the diameter of the sensible aperture in parts of the kind that the distance of the aperture from the plane that receives the images is noted in; and given, finally, the quantity of the eclipse not [yet] observed: the quantity of the lunar shadow image is given,

[Margin: of the Moon, and of the Sun, in those parts whose mark is the aforesaid Distance.]

If from astronomical tables or from an ephemeris you have learned in advance the magnitude of a past or future partial solar eclipse, then using Figure II, and with the apparent semidiameter of the Sun—that is, the angle TCL—and with the distance CT of the aperture, find the half-image of the Sun TL, the one that would appear through an indivisible aperture, equal to the half-aperture LB; and there will be formed a half-image of the Sun appearing through the aperture, OP. Then double TL so that you have KL, and let it be 12. To KL, in the same proportion, set the digits of the eclipse, or the digits to be eclipsed, as a fourth proportional number, and you will have the image of the lunar shadow [*Umbra Lunar*is] appearing through an aperture as indivisible as a sensible one—but with the situation reversed, in non-annular eclipses. But if the apparent diameter of the Moon turns out to be smaller than the solar diameter, then somewhere there will certainly be an annular eclipse, indeed sometimes a central one. In that case, therefore, take the image of the lunar shadow, as found above, away from the image of the whole diameter of the aperture, and you will have the image of the shadow as it appears through a sensible aperture. The reasoning of the rule follows by the converse of Propositions XI and XV.

XVII. PROPOSITIO.

The same distance of the Aperture from the Plane on which the Images are received remaining unchanged, the magnitude of the aperture being varied however much—with the image of the Sun subtracted, and, in annular eclipses, the image of the Lunar Shadow added (but in the other eclipses neither added nor subtracted)—

there will always result the same correct magnitude of the legitimately admitted images.

By the "correct magnitude" of the images I mean that of the image equal to the image of the Sun admitted through an indivisible aperture, which is, as it were, the Sun's own image, suited for investigating its Diameter in the manner of Proposition II. But this Proposition is founded as a Corollary deduced from Propositions XI and XV. For the ratio of the addition or subtraction to be made—so that the images of the Sun may be reduced to physical equality in indivisible apertures, founded on the addition of the Sun's image and the subtraction of the Lunar Shadow—if that ratio remained the same, then the distance too would remain the same and equal, so long as the aperture is moderate enough to be apt for representing the images. Hence it comes about that, if the magnitude of the aperture is varied, then, the image of the Sun being afterward taken away from the image so corrected, the same Diameter of the Sun will be found as by the method handed down in Proposition II. As a sign that it has not been an exact observation, and that the dimension of each image, as also the observation produced from each, and on the contrary the Diameter that proceeds from the observation of either, is acceptable. To confirm this we have been accustomed to test the same observations by a threefold trial, and we used to choose that diameter of the Sun which, with the aperture of each one removed, came out the same on the same day by the same quantity.

XVIII. PROPOSITIO.

The magnitude of the Aperture remaining unchanged, and its distance from the plane equidistant from the received images being varied, although the images of the Sun among themselves may keep some same proportion to one another, and the images of the Lunar Shadows among themselves some same proportion as well—indeed, with the increases or decreases of the images through a sensible Aperture—nevertheless that same proportion does not remain among the whole images admitted through a sensible Aperture.

In Figure IX, let the Luminary—say, the Sun—have center O, and its outermost rim A, from which through the half-aperture's outer edge BC let two rays AM and AL be produced to infinity; and let BC be the half-aperture, through whose center B let OD be drawn perpendicular, to which EG and HK and DM are applied, equidistant from that same BC, and so parallel to one another. For, by Elements VI.2, the section will be cut proportionally, as much for triangle BDL as for triangle ALM. Therefore the bases of the half-images through the indivisible aperture B—the admitted ones, namely EF, HI, and DL—will be proportional

among themselves relative to the distances BE, BH, BD. Moreover, the increases of the images from one side of the Sun, or

the decreases of the lunar Shadows, which arise from the half-aperture BC by the entry of the Sun's rays, namely FG, IK, LM, can be proportional among themselves. Yet the total images EG, KH, DM continuously will not therefore be proportional according to the same proportion of the images which they have among themselves, EF, HI, DL—since neither triangle ALM is equiangular to triangle BDL, nor is the proportion of the increments necessarily the same as that of the bases EF, HI, DL among themselves. Now physically, considering the quantities of these, as the distance BE grows, the excess of base HI over EF will sooner become sensible than the excess FG over BC, or IK over FG, by what was said in Proposition I: for over a distance of paces doubled, $972 \frac{1}{3}$ in the lunar radius, but 21486 in the solar, it remains insensible, if BC is set at 5 paces only. For if it be set smaller, then through a greater interval too the physical equality of the increments BC and FG is preserved. Therefore, with the physically unequal EF and HI made, if there be added to them equal physical EF and IK, the proportion which holds between EF and HI will not remain.

XIX. PROPOSITIO.

Given an image of the Sun, or of the Lunar Shadow, through a sensible aperture of magnitude not exceeding 10 in its own semidiameter, received on a plane not more distant from the aperture than $972 \frac{1}{3}$ paces for the Shadow, or 21486 for the solar image; and given the semidiameter of the aperture, and the distance of that plane from the images, of the same kind of parts: all the remaining images congruent with the indivisible aperture are given, for whatever distance from the aperture greater or smaller to infinity; and so the true proportion is observed for the image at the greater and at the greater distance, and the dimension.

Return to Figure IX, and let the foresaid interval BE be given, the half-image EG and the half-aperture BC; in what parts FG is known—since the interval BE will be FG, physically equal to BC itself, by Proposition I. Therefore from the said Propositions XI and XV, subtract FG, and there will remain the half-image EF, owed to the indivisible aperture B. Then make: as the given Distance BE is to the half-image EF, so the given Distance BH is to HI, and the datum BD to DL, and so on to infinity; for you will have the half-images of the Sun owed likewise to the indivisible aperture. With these doubled you have the whole images owed to the indivisible aperture; and at length, with these subtracted from the observed images of the Sun, you will have the residue equal to the addition to be made for

the image of the Lunar Shadow observed in annular eclipses. In the other cases the observed Lunar Shadow is not varied in quantity, but only in situation.

So far concerning the case in which the eye is supposed to be set at the sensible Aperture. Next, concerning the case in which it is set at the common section of the Sun's Rays above the sensible Aperture, the aperture below nevertheless remaining sensible—that is, with the eye set at the point Z, Figure V.

XX. PROPOSITIO.

Given, by Propositions IV and V, the distance of the point of intersection of the Sun's outermost rays passing through the margins of the sensible Aperture, measured from the plane on which the images are received; and the apparent semidiameter of the Moon in an annular eclipse: the image of the lunar Shadow is given, appearing to an eye set at the said point of intersection as if at an indivisible opaque aperture equidistant from the sensible aperture.

Let Figure V be repeated here, in which, alongside the exposition there indicated, although in reality the aperture NO is open, let it be imagined—through the point Z of intersection—as if a certain opaque plane O, parallel to NO itself, were drawn; imagined, I say, because if it really were there, the countless rays of the Sun would be stopped, which in reality are not stopped but pass through the aperture NO right up to the base TV. With this fancy made, the image of the Sun would indeed be the same as that which appears through the sensible aperture, namely the whole TV, composed in part of its part shadowed by the Moon, and in part of the illuminated parts of both; near the ends of TV, more bright; and the image of the lunar shadow would be $\beta\delta$, bounded by the Sun's rays $aZ\beta$ and $\gamma Z\delta$, touching the lunar globe most closely at C and D; then

the eye set at Z, set up so, would see nothing of that segment of the Sun's disk which is within the points γa , while it would see the remaining segments aK and γI . And so it would still see a fairly large image of the eclipse, larger than if it were at A and the images passed through the indivisible A; the difference, however, would scarcely be perceptible to the sense, on account of the nearness of the points A and Z, as was demonstrated at Proposition V.

Therefore, in the case of such a fiction, with the semidiameter of the Moon given—that is, the angle CAY—there is given also the one that is its vertical opposite, BAH. Now this angle is equal to the internal and opposite $BZ\delta$, because between them lies the interval so often supposed by us, from the same physical point of contact C, namely CAH and $CZ\delta$, which are parallel to the sense. Therefore in triangle $ZB\delta$, right-angled at B, with the foresaid angle and with the given

distance BZ, the semi-shadow B δ is given by Trigonometry, whose double is the lunar shadow δd , appearing to the eye at Z, and so on.

Meanwhile note again carefully: with the aperture NO open, the shadow itself SQ is not only smaller than the shadow GH, appearing to the eye at A through the indivisible aperture A, but much smaller—the shadow δd appearing to the point Z indivisible; this, below, will have to be impressed against the opponents of this Keplerian doctrine.

XXI. PROPOSITIO.

Although, as regards the projection of the solar image, the same thing happens whether it is admitted through a sensible Aperture, or whether—as if it were admitted through an indivisible Aperture imagined at the point of intersection of the common section of the rays touching the internal margins of the sensible aperture—nevertheless the same thing does not happen by comparison with the image of the Lunar Shadow really admitted through the sensible aperture, much less by comparison of the Sun's image and the Lunar Shadow which is imagined to be admitted through the center of the indivisible sensible Aperture, both being placed in either situation.

If Figure V is again attentively examined, and the members of this Proposition are distinguished among themselves, the truth of them all will easily be shown. It therefore pleases me to apply it more particularly to the figure, and to demonstrate it.

First, then: with the magnitude of the aperture NO posited, and its distance AB from the plane TV on which the images are received, and the distance of the plane from the Earth, it is at once determined from the nature of these things at the point Z, in which the Sun's outermost rays IZV and KZT intersect, and where the image of the Sun TV appears to the eye both at Z and at A—and indeed before the eclipse the whole is bright; and so the same things happen, because Z is really not the point of any opaque aperture impeding the luminous projection of the image TV, but is the mere point of intersection of the rays freely passing through.

Secondly: since in reality nothing is drawn or set up through Z—no opaque plane suited to stop the rays for the aperture NO—the rays freely enter as far as the base TV. Through the left part TS the rays all arise from the Sun's segment RK, and to the right part of the base QV the rays all arise from the Sun's segment IP; therefore in reality the image of the Lunar Shadow is drawn together within the segment SQ, and is not so great as the image of the Shadow $\beta\delta$ would be if there

were interposed an opaque body $\beta\theta$, nor would the other rays touching the Moon radiate, than $\alpha Z\beta$ and $\gamma Z\delta$.

Thirdly: since through the indivisible aperture imagined at the center A the Sun's image would be LM, while through the sensible aperture NO, and through the imagined indivisible A, the Sun's image is TV; therefore as to comparison indeed with the Sun's image the same things happen, and much less if it were compared with the image introducible through the sensible aperture in the plane θ .

Fourthly: since in reality the image of the shadow SQ is smaller than that very one, GH, which would be projected through the indivisible center A—therefore, as to this comparison too, the same things happen. Under this distinction it is answered easily enough, and truly, to the principal argument of the said Fathers, which is of this kind.

Argumentum praecipuum contra Keplerum, & Nos, eius dissolutio. [The chief argument against Kepler and against us, and its resolution.]

Those Fathers indeed use another figure, and a more similar Fig-

ure II than V, because they draw no line for the designation of the shadow; but we have reduced their Argument faithfully into the form by applying Figure V, so that, from the distinction of the lines bounding the shadow from the bright lines comprehending the parts of the base, the strength of the solution of the Argument might appear more clearly. They therefore argue thus:

When the Rays pass through the sensible aperture NO, the same happens as to projection as if the Rays passed through the point of intersection Z, where it would be opaque at θ , all the other rays being resisted except those entering through the point Z. But in the case where the rays pass through the indivisible point, nothing of the Sun's image would be taken away; therefore neither is anything to be taken away in the case where they pass through the sensible aperture NO. *The Major* is proved: *first*, because the image of the Sun, in either case, is the same quantity of the Sun's image, the same intensity of illumination about the extremities TV, through the point all-but-indivisible Z, which is as it were a loose aperture NO. Therefore the sensible aperture is adduced, so that the projection of the solar image might be more evidently distinguished and fall under the sense, but not so that the effect of the quantity TV is changed. *Secondly* it is proved as to the lunar shadow, because, since in either case the same quantity of the Sun's image remains, that shadow ought neither to grow nor to diminish, the parts of it likewise neither growing nor diminishing; but the lunar body, in the present case and with respect to the plane on which the observation

is made, is as it were a certain spot of the Sun, and that the darkest part of its image; therefore neither does the lunar shadow itself grow or diminish.

But the *Minor* is proved: *first*, by the authority of Kepler himself, who at chapter 11 of his *Astronomia Optica* [*Astronomia Optica*], Problem 7, says: *Unless the aperture is plainly the very least—that is, of the form of a point—the proportion of the Diameters is always varied; the Moon, with too small an aperture, appears smaller, and the Digits appear fewer*; and he virtually grants that, if the aperture is of the form of a point, the Digits do not appear fewer—and we, on our part, do not at all admit the just quantity of the Eclipse, decreeing that the case of sensible apertures is to be reduced to the case of indivisible apertures. *Then by reasoning*: because the whole reasoning which obtains for the mutilated image, by the Sun's image and by the increasing image of the lunar Shadow, is the same as if the apertures were supposed to be varied in this case—therefore neither is it to be varied in this case, neither is it to be corrected. And if otherwise, it would be necessary to correct, contrary to what falls in Kepler's method. Nor is there any doubt that one of the said Fathers, who composed his Tables by this method of Kepler as by a foundation, would err altogether, &c. They confirm that, since hitherto the portion MV of the Sun's image was withdrawn—not the distance AB, nor the distance ZB, but solely the distance BM by them and by a correction of BM—we recognize the angle BAM; and at chapter 5 of the *Almagest*, Book I, where Kepler's doctrine is adduced, it is not a matter of investigating the semidiameter of the Sun, but of investigating the magnitude of the Eclipse; and for that purpose it does not at all matter to know such an angle, but it suffices to know the mere proportion of the Sun's image in the projected Tablet with the image of the lunar shadow. *But it was easy*, says the same Father, *to transfer through inadvertence what suits an observation of the Sun's diameter measured by angle to the present matter, where the Diameter is considered not under the ratio of an angle, but under the proportion which the semidiameter has to the part covered by the Moon*. These things they, or we from them, add rather to the strengthening of their argument than to weakening it, so that I do not doubt that they are to be acknowledged for their own candor.

RESPONSIO.

I respond to the *Major*, with the distinction set down in the title of Proposition XXI, and from the position subjoined to it: I concede the Major as to the image of the Sun, according to itself, precisely taken, or considered separately from the image of the Lunar Shadow; but I deny the Major as to the Sun's image considered as regards the other comparisons there adduced, and especially by

comparison with the lunar Shadow—that image, namely, which in fact and in reality is projected upon the Sun's image by the rays entering the sensible aperture, for by these the image of the Shadow is surrounded, and is made much more contracted than it would be if it were opaque at θ ,

with the Sun's ray interposed touching the Moon, and the bounds of the shadow passing through only the point of intersection Z—for in reality it is SQ, which then would be $\beta\beta$. But it is one thing to consider the future measure under that condition, which would be, but is not; another, what in the present is really made—not under the posited condition of opacity at θ , but on the contrary under the posited condition of the aperture NO, the magnitude. *But it was easy to transfer through inadvertence what suited an observation feigned through the imagination of opacity, impeding the entry of the rays through the aperture NO, to the present matter, where the proportion of the Sun's image to the Lunar Shadow is considered not as it would be, but as it in fact is.* For the excess of the Sun's image is much greater than it is in that feigned case, and than the one that is in use; but as to the just quantity of Eclipses, even apart from any relation to the quantity of the Sun's diameter, but as to number of Digits, account must be had: and by these things the answer to the first proof of the Major is plain.

To the *second* proof of the Major I distinguish, and that being granted, but not granting it about the parts of the more posited image, and really identified with it, I deny it about the negative parts, nor identified, of whatever sort the shadow is, with respect to the aggregate from it, and from the bright parts; for daily we see, in aggregates from shadow and surrounding light, that, though the whole aggregate remains of the same quantity, the parts nevertheless decrease, others increasing by just as much. Indeed, among the posited parts themselves, and identified through continuation—for example, among the parts of glassy water enclosed—we see the whole water, when the vessel is full, remain of the same quantity, while certain parts, by force of nearer heat, are rarefied and occupy a larger place, others being condensed and constricted; therefore I said, *Data non concessa* [the datum not being conceded].

Moreover, the Moon is not identified with a spot on the Sun, but is really distinct from it, as we judge also of the other spots.

To the *Minor* I respond by conceding it, if through the same indivisible point there pass both the rays touching the Moon and bounding the Shadow, and the rays bounding the Sun's image: that, indeed, does not occur in the case present; but denying it, if (as in fact happens) the rays bounding the Sun's image pass

through that point, while the rays touching the Moon, and bounding its Shadow, pass through lower and sensible margins of the aperture.

Let it therefore stand, rightly said by us in the first response sent to the Reverend Fathers, that it is gratuitously said the same thing happens, &c., and that against Kepler nothing has hitherto been demonstrated in this matter; and the more so is it confirmed by us, because in the case in which the magnitude of the Digits of a Solar Eclipse ought to be estimated by the images of the Sun in use, and the Lunar Shadow, as they lie in the Table of the observation, without any correction, the Digits would come out only 6, or about $\frac{1}{2}$, as we show at Proposition XI.

To the remaining Arguments, less principal, there is no need of a more prolix response, or an express one: for, whether there remain, or there not remain, the same proportion, understand it between the bright image of the Sun and the image of the Shadow, which, between the Eclipsed Digits and the non-Eclipsed, is plain from Propositions IX, X, XIV, XVIII, and XIX. From which too it will be plain, if the images are legitimately admitted for whatever given distance, and if the increments owed to the aperture are taken away, that the image of the Sun suited for collecting the quantity of the Eclipse would arise; and that the quantity of the Eclipse cannot arise, varied at pleasure through distance, such as anyone might wish.

FINIS.

Figurae in Appendice I. Capitis XII. connumeratae. [Figures counted together in Appendix I of Chapter XII.]

Diagram. Figure 1 (1. fig.): a tall narrow elongated triangle (or wedge) with apex at the top and a small rectangular base at the bottom. The structure represents the convergence of rays from the Sun's rim to an aperture, with the half-aperture and half-image marked at the foot.

- A (apex, top): vertex of the triangle
- B (left, upper of the base block): left endpoint of the upper cross-line
- C (right, upper of the base block): right endpoint of the upper cross-line
- H (left, lower base): left endpoint of the lower base line
- K (right, lower base): right endpoint of the lower base line
- L (bottom center, below K): foot point on the base

Diagram. Figure 11 (11. fig.): an hourglass / double-cone (X-shaped) figure of two ray-bundles crossing at a central intersection, used for the camera-obscura

imaging geometry (Figure V / IX of the text). Two pairs of lines descend from the top (from F, and from G–N) and cross near the center (the point of intersection Z of the text), then diverge again to the base line A K T L B at the bottom.

- F (top left): upper-left ray origin
- G (top right): upper-right ray origin
- N (top right, beside G): second upper-right ray origin
- M (upper left, below F): label on the left descending line
- E (left of center): left point near the central intersection
- H (top center, at the crossing): central crossing point (apex of the upper cone)
- D (right of center): right point near the central intersection
- O (center): central intersection point
- C (center, just below O): point just below the central crossing
- P (center right, beside O/C): point near the central intersection on the right
- A (bottom left): left base endpoint
- K (bottom, right of A): base point
- T (bottom center): central base point
- L (bottom, right of T): base point
- B (bottom right, beside L): right base endpoint

Diagram. Figure 3 (3. fig.): two overlapping circles arranged vertically (a smaller upper circle and a larger lower circle), representing the Sun and Moon disks overlapping in eclipse. A vertical diameter runs through both. The lens-shaped region of overlap and the lower circle are hatched (shaded).

- A (top): top of the upper circle, on the vertical diameter
- H (center, junction): point on the vertical axis where the two circles meet / the upper intersection region
- B (left, at the overlap): left intersection point of the two circles
- C (right, at the overlap): right intersection point of the two circles
- E (center, within the overlap): central point in the lens of overlap [F in some readings — center of lower circle region]
- F (center, lower): center point of the lower (larger) circle, on the vertical diameter
- G (bottom): bottom of the lower circle, on the vertical diameter

Diagram. Figure 4 (4. fig.): two side-by-side figures, each a smaller hatched (shaded) inner circle set within a larger outer circle, representing an annular-

eclipse configuration (the shaded lunar disk within the larger solar ring). Each has a vertical diameter.

Left figure:

- A (top, outer): top of the outer circle on the vertical diameter
- B (top, inner): top of the inner hatched circle on the vertical diameter

Right figure:

- C (top, outer): top of the outer circle on the vertical diameter
- D (top, inner): top of the inner hatched circle on the vertical diameter
- G (bottom): bottom of the figure on the vertical diameter (shared label at foot)

(continued from the preceding folio — explanation of the eclipse-magnitude figures)

This Figure V is for an annular and central solar eclipse. The black lines tangent to the Moon are the three rays of the Sun that bound the shadows. The lines marked with points, by contrast, are rays of the Sun that bound the two solar images, AB being the distance of the receiving tablet of the images, of 100000 parts, from the aperture NO, whose diameter is 200 parts.

Diagram. A ray-optics construction for an annular, central solar eclipse. At the top the aperture is shown between points I and K, with the small aperture NO at center; rays of the Sun pass through it and cross. The lunar globe (a circle, centered Y) is shown in the upper field, and the converging/crossing rays below form the inverted-image cones, with the shadow-bounding lines tangent to the Moon. A horizontal scale-bar runs across the figure. The construction is referred to in the prose lettering that follows.

- I, EP, RF, K (top): aperture-frame and ray endpoints across the top edge
- Y (center, upper circle): center of the lunar globe
- Z (mid): intersection point of the bounding rays
- N, O (center): the indivisible aperture, diameter 200 parts
- Θ (lower): vertex region of the crossing rays
- X (bottom): lower vertex of the image-cone
- T, B, L, G, S, B, Q, V, H, M, A, V (bottom band): labels of the bounding rays and image edges along the base [several closely-set marginal letters [?]]

IZV and KZT are the outermost rays of the Sun, passing through the edges of the aperture O and N, crossing over, and bounding the solar image TV, which before the eclipse is wholly bright, and they intersect each other at Z.

IAM and KAL are the outermost rays of the Sun drawn through the center of the aperture A, and they bound the solar image LM. CD is the lunar globe, from whose center Y the perpendicular YB is drawn, through the points Z and A.

PCNQ and RDOS are rays of the Sun tangent to the Moon, drawn through the edges of the aperture N and O, and they terminate the lunar shadow's image SQ.

ECAN and FDAC are rays of the Sun tangent to the Moon, drawn through the center of the aperture A, and they terminate the lunar shadow's image GH.

$\gamma\text{CZ}\beta$ and $\alpha\text{DZ}\beta$ are rays of the Sun tangent to the Moon, drawn through the intersection point Z, which, if it were in the dark $\gamma\beta$, would terminate the lunar shadow's image $\gamma\beta$.

IK is the visible disk of the Sun; the angle measuring the apparent diameter of the Sun to the eye A is SQ. The lunar-shadow images appear in tablet TV; the remaining images TS and SV are illuminated by the rays of the Sun that have entered from the segment RK and IP, through the aperture NO; and therefore the segment PR of the Sun is occulted by the Moon, while the rest, IP and RK, is apparent to the eye X.

GH is the image of the lunar shadow, as large as it would be if the aperture NO were narrowed down to the indivisible point A; and then the segment EF of the Sun would be occulted, and the image LM would be illuminated from the segment LG by the rays of the segment FK and HM, that is, by the rays of the segment IE.

$\gamma\beta$ is the image of the lunar shadow, as large as it would be if the aperture were narrowed to the indivisible point Z, which, set in the dark $\gamma\beta$, would stop the remaining rays; and then the eye Z would see nothing of the solar segment $\gamma\alpha$, but only the segments $I\gamma$ and αK , and the solar image TV would be illuminated by the small portions $T\beta$ and βV .

VI. Figure for an eclipse of 6 digits.

Diagram. A ray-optics construction for a solar eclipse of magnitude 6 digits. The Sun's disk is at top between C, O, G, E; rays descend through the aperture IK to the tablet LM, crossing to form the image. The Moon (circle, center H) is set tangent to the Sun's right margin. Labels mark the bounding rays.

- C, O, G, E (top): the Sun's disk and its margins

- I, K (upper aperture): the aperture IK
- H (mid circle): center of the Moon
- A (eye): the point at the crossing
- L, F, B, P, D, M (base): image edges on the receiving tablet

A, the center of the aperture IK, through which the center G of the solar disk descends to the tablet LM; GB is the perpendicular dropped from it, tangent to the right margin of the Moon at H.

The rays CKM and EIL, drawn from the extremities of the Sun through the edges of the aperture I and K, bound the solar image, which before the eclipse is wholly bright and is to be measured.

The rays CAD and EAF, drawn from the extremities of the Sun through the center of the aperture A, would bound the solar image FD, if they could enter through an indivisible aperture.

The ray OHKP, tangent to the Moon physically at H, drawn through the right margin of the aperture K, bounds the lunar shadow's image PM.

The angle CAE measures the diameter of the Sun to the eye A, before the eclipse.

LP is the solar image illuminated by the rays of the segment OE, entering through I and K. Although it is not seen by the eye A except in the segment GE — in this eclipse of 6 digits — yet PM is the lunar shadow's image, because the Moon covers the segment CO; and FB is that part of the solar image which would appear if the images were admitted through the punctual aperture A. For then, through that aperture, the rays of the whole segment GE would enter, illuminating FB; and in that case the lunar shadow's image would be BD.

VII. Figure for an eclipse of 4 digits.

Diagram. A ray-optics construction for a solar eclipse of magnitude 4 digits. Layout parallel to the 6-digit figure: the Sun's disk C, O, G, E at top; the Moon (circle, center H) tangent to the disk; rays cross through the aperture (near α , Z, θ , I, K) to the receiving tablet L, F, B, P, D, M at the base.

- C, O, G, E (top): the Sun's disk and margins
- α , G (upper): solar-disk reference points
- H (mid circle): center of the Moon
- Z, θ , I, K (crossing): aperture and intersection lettering
- L, F, B, P, D, M (base): image edges on the receiving tablet

VIII. Figure for an eclipse of 8 digits.

Diagram. A ray-optics construction for a solar eclipse of magnitude 8 digits. The Sun's disk C, O, G, E at top; the Moon (large circle, center H) covers a greater portion of the disk than in the 6- and 4-digit figures; rays cross at the aperture (near Z, θ , I, K) and reach the tablet L, F, B, P, D, M below.

- C, O, G, E (top): the Sun's disk and margins
- H (center circle): center of the Moon
- Z, θ , I, K (crossing): aperture and intersection lettering
- L, F, B, P, D, M (base): image edges on the receiving tablet

Common explanation of Figures VII and VIII.

A, the center of the aperture IK. CKM and EIL, drawn from the extremities of the Sun through the edges of the aperture I and K, intersect each other at Z and bound the solar image LM, which before the eclipse was the full measure of the Sun.

But the rays CAP and EAF, drawn from the extremities of the Sun through the center A, would bound the solar image FD, if there were not an aperture open of the full width IK; the ray OKP, tangent to the Moon at H and drawn through the right margin of the aperture, bounds the lunar shadow's image PM.

The ray of the Sun $A\Delta$, in Figure 7, and GAB, in Figure 8, tangent to the Moon at H, and drawn through the center A, would terminate the lunar shadow's image βD in Figure 7, and BD in Figure 8, if they passed through an indivisible aperture A.

The ray GZB, in Figure 7, and $\alpha Z\beta$, in Figure 8, is drawn through the indivisible point Z, touching the Moon physically at point H.

The angle CAE measures the apparent diameter of the Sun to the eye A, imagined before the eclipse.

LP is the portion of the solar image illuminated by the rays of the whole segment OE, the aperture IK being open — in which case PM is the lunar shadow's image, the Moon enclosing within the circle the rays of the whole segment CO.

But if the rays were admitted through the indivisible aperture A, then the portion illuminated by the rays of the segment αE would be — in Figure 7, the image part F β ; in Figure 8, the part FB — and then likewise the lunar shadow's image would be βD in Figure 7, or BD in Figure 8.

But if the rays were admitted through the intersection point Z and the whole image were seen, the portion of the bright solar image would be LB in Figure 7, or $L\beta$ in Figure 8; and the lunar shadow's image would be BM in Figure 7, or βM in Figure 8, the remaining rays being impeded by the dark $\alpha\beta$.

[Margin: The explanation of this figure is given above, at Proposition XVIII.]

Diagram. A narrow ray-optics construction (Figure 9) at the foot of the left column. A pair of converging lines from points A and O descend through lettered way-points to the base. Its explanation is referred to Proposition XVIII (see margin note above).

- A, O (top): the two upper reference points
- B, C (mid): intermediate ray-points
- E, F, G (lower-mid): intermediate ray-points
- I, K (lower): aperture lettering
- D, L, M (base): image edges at the foot

II. APPENDIX TO CHAPTER XVII.

On the Diurnal Motion of the Sun and of the rest of the Heavenly Bodies, rather than of the Earth — against the Copernicans.

In Book Nine of the *Almagestum Novum*, Section Four, I set out most clearly — unless I am mistaken — everything that bears on the system of a moving Earth, with respect both to its diurnal motion about its own center and to its annual motion about the Sun (the Sun being placed at the center of the universe rather than turning, as some hold, about the center of its own body). From Chapter V to Chapter VIII I propounded twenty arguments concerning the diurnal motion of the Earth about its center, and resolved them. From Chapter VIII I propounded, and resolved, twenty-three arguments for the annual motion. But from Chapter XIII to Chapter XIX I propounded, and resolved, seven arguments for the diurnal motion of the Earth together with the annual. Then again, in the same Section, from Chapter XIX to Chapter XXXIII, I propounded seventy-seven arguments for the immobility of the Earth, partly against the diurnal and partly against the annual motion. Of these I resolved most, showing that they do not have physical — still less mathematical — evidence; yet I taught that a few have physical evidence. But the one point on which we depart from them — namely, that the Earth's immobility has physical-mathematical evidence — I taught there in Chapter XIX. Finally, from Chapter XXXIII to Chapter XXXV, I returned in the *Epitome* to all the foregoing prejudged arguments, reducing them to syllogistic

form, together with the responses, likewise in form. And in that same Chapter XXXIII, in Conclusion VII, I taught a controversy which is settled here only by mere reasonings. And from Chapter XXXIV to the end of the Section I taught what one is to hold, by the authority of Sacred Scripture, its interpreters, and the decrees of the Catholic Church, concerning the Earth's motion or rest.

Since, then, in Chapter XVII of this Book I supposed it as certain that the Sun moves and not the Earth — nor have I lacked the company of most distinguished friends, men of talent and learning (whose names, being myself unknown, and perhaps unwelcome, I do not dare to publish), who have labored with the most subtle arguments to overturn that argument of mine in Chapter XIX, the one mentioned in Section 4 above, which I said is evident, physical-mathematical, and the keenest in defense of this anti-Copernican hypothesis — it pleased me, therefore (let this be said here once for all), to propound that same argument again, with a few changes, and against the difficulties of my friends — indeed of our own raising — to dissolve them, having first laid down certain suppositions.

I. Supposition.

The velocity-increment of bodies naturally descending, with respect to the times of fall, is in proportion to the successive odd numbers; but with respect to the spaces, it is compounded in the end of equal times in proportion to the square numbers of the times, along the perpendicular line by which they appear to descend.

I explain the supposition by means of the line AB, in 16 parts of equal division. In this line I say that if a heavy body falling through air in the first time-interval traverses the space AC, then in the second time-interval, one-and-a-half-times-and-one-more (*sesquiprimam*), it traverses the space CD, three-fold; in the third time-interval the space DE, five-fold; in the fourth time-interval the space EB, seven-fold; and so on. From this it follows that at the end of two time-intervals the space AD is traversed, one-and-

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—and-a-half-times the number 2; and at the end of three time-intervals the space AE is traversed, one-and-a-half-times-and-one-more the number 9, which is the square of the number 3; and at the end of four time-intervals the whole space AB is traversed, one-and-a-half-times-and-one-more the number 16, which is the square of the number 4; and so for the rest of the spaces in their order.

This proposition is established by manifest experiments of mine — not to speak of Galileo's, adduced in Book 2 of the *Almagestum Novum*, Section 2, Chapter 19. For

by applying a very short perpendicular for measuring some third part of the time, and by dropping innumerable balls of clay from about eight Roman inches above the ground, from the various intervals of the Bolognese towers, we have most certainly ascertained that a globe of this kind, in one second of time, traverses 15 old Roman feet; in two seconds, 60 feet; in three seconds, 135 feet; and in four seconds, 240 feet. This is exactly the proportion explained above, from which we derived the many most beautiful problems in Chapter XIX.

[Margin: Heavier bodies fall faster.]

On this occasion it is now permissible — though I am not now dealing with it — to set down what we have established by very many experiments in the same place: that of two heavy bodies of the same kind, the heavier descends faster than the one less heavy in itself, faster too at the same height; but to discern this internal difference, a notable height is required — no less, more or less, than two hundred feet — and the eye must observe rather than the hearing. For the interval by which the lighter body's downfall outlasts the heavier in passing through is so small that, when the heavier has already struck the pavement, the often-repeated observation of the strike of the lighter follows in but a half-second of time, or even less. This is the predetermined interval from our observations of the same tower, namely from where the clay globes were dropped — a height of 240 Roman feet — to the pavement. But it is 280 feet from the pavement. So that still by 40 feet the lighter globe was distant from the pavement when the heavier had already reached the pavement.

II. Supposition.

The increment of the strike, and of the sound made, by a heavy body descending from a higher place is proportional to the velocity-increment of the same descending heavy body.

It is enough to see the reason a priori. For the impetus of a movable body is proportional to its heaviness; we see, indeed, that the greater weights, raised higher, strike more strongly, and with a greater impetus, other things being equal, than do the smaller — provided they are not detained, or impeded in equal impetus by an excess of weight, with respect to the resistance of the air, in the descent itself. Therefore, if at the end of its motion a falling heavy body acquires for determining the degrees of its impetus, and so on, just as much as it would have acquired in just so many degrees of heaviness — in the order of an upward-tending weight — to be struck and made to sound. For there is in heaviness a certain flowing impetus, as it were a flowing heaviness. It pleased me,

nonetheless, to confirm this a posteriori by an experiment tried once, and indicated in the place of the *Almagestum Novum* cited above, though it can be carried out more accurately. A capsule was fashioned, capable of holding diverse weights; one of its pans was an iron pan fixed in a wooden hand-balance, above which a wooden globe of a sesquiuncial weight [i.e. one inch and a half], fell upon the perpendicular; and as a little iron weight of 35 Roman inches' height, raising by one finger-breadth in width, an iron weight of 5 ounces and some few drachms — which I have nevertheless neglected for safety's sake. But from a height of 140 inches it raises likewise by one finger-breadth an iron weight of about 21 ounces; from a height of 315 inches, by contrast, it raises [a weight]... but most certainly 45; and from a height of 560 inches it raises a weight of 80 ounces. This experiment I set out for testing — but by experienced and circumspect men. Behold, then, in the Table, a synopsis of the experiments:

Altitude in Roman inches	(in feet & inches)	Compounded proportion	Weight raised by one finger-breadth
35	2 ft 11 in	1	vnc. [ounces] 5
140	12 ft 8 in	4	vnc. 20
315	26 ft 3 in	9	vnc. 45
560	46 ft 8 in	16	vnc. 80

But the capsule must rest like a single pan of a balance; first it should counterweight the other pan, and afterward come to rest above an underlying support placed beneath; and one should choose altitudes deliberately bearing the aforesaid proportion — namely, such as holds among these numbers 1, 4, 9, 16. For from this it will be clear that the increment of the strike, and of the sound, which we postulate, can be measured and discerned from the raised weight, and discerned to be such as the space traversed by the descending heavy body — that is, in proportion to the square of the times; and as the preceding space is exceeded by the following space which the heavy body traverses in descent, by the same proportion the strike made by it at the end of the second space exceeds the strike made at the end of the first space.

III. Supposition.

The semidiameter of the terrestrial globe is 23,367,468 Roman feet. Of which, in one degree of the greatest Circle of the Earth, 407,633 are contained.

This is established from Book 5 of our *Geographia Reformata*, where we corrected the measurement handed down in the *Almagestum Novum*, Book 2, from longer

and more accurate observations of ours, and from more recent ones (which were set out fully in the same Book 5). And although for our present purpose it would have sufficed to take any of the more received magnitudes of the Earth, we have nevertheless preferred to use this one as the truest. From this, moreover, it follows that in one minute of a terrestrial degree of the Equator 6799. & Roman feet are contained; and in a fourth part of a minute, or in 15 seconds, 1699 $\frac{1}{3}$ feet.

IV. Supposition.

If the Earth revolves about its own center by a diurnal rotation of 24 hours, in an equable rotation, then any terrestrial point of the Equator will traverse 1699 $\frac{1}{3}$ Roman feet in each second of the hours.

For in such a motion as is equivalent to the motion of the *primum mobile*, in the single seconds of the hours, fifteen seconds of the Equator are run through; and in fifteen seconds of the terrestrial Equator, by Supposition III, 1699 $\frac{1}{3}$ Roman feet are contained.

V. Supposition.

In the velocity-increment of bodies naturally descending, the same physical proportion is preserved, other things being equal, whether they descend along the plane of the Equator, or away toward the center of the Earth — at least within the first four seconds of the descent of an hour.

For, other things being equal — namely, descending by the same heaviness, mass, calm of the air, rarity, and the rest — no solid reason can be assigned why, in so brief a time as the four seconds of the heavy body's descent at the Equator, they ought to vary sensibly in that proportion which Galileo, and we ourselves, have found by experiment — he in the Florentine parallel, we in the Bolognese — though over a descent so great, the Geometrically declining of the parallel plane is imperceptibly discerned, as we demonstrated with the figure set out in Book 9 of the *Almagestum Novum*, Section 4, Chapter 19, number 7.

VI. Supposition

The chord of an arc not exceeding 15 seconds of the terrestrial Equator differs imperceptibly from its [own] figure and from the magnitude of the said arc.

For if the radius is 1,000,000,000,000 in the great canon of Pitiscus [Bartholomaeus Pitiscus], then for 15 seconds the chord is 72,722,052. And since by Supposition III the Earth's semidiameter is 23,367,468 Roman feet, the chord comes to 1699 $\frac{1}{3}$ feet. But by the same Supposition the arc of 15 seconds of the

terrestrial Equator is the same number of feet. They are therefore of the same magnitude; and so the figure too, so that the arc can be treated as a straight line, and the chord as that arc, without any perceptible difference. With these points established:

I. Proposition

If the Earth were moved by a diurnal revolution, a ball of clay weighing 8 ounces, released from a height of 240 Roman feet through still air, would fall to the Earth along an oblique descent — without any real increment, or certainly never with so great an increment, as the proportion of the percussion and of the sound produced by the fall from the said height requires.

To demonstrate this Proposition, let an arc AC be described from the Earth's center T at the interval TA — that is, the Earth's terrestrial semidiameter. Let this AC, without regard to this figure, be supposed to be one minute of the terrestrial Equator; and let TA be augmented to 240 Roman feet — say AB. From T let the minute-arc BD be described in the plane of the Equator, and let each [arc], drawn at right angles from T, be divided into four parts, so that the arc is divided into fifteen seconds. These [points], lower down, are namely AQ, QF, FG, GC; and at the top BH, HI, IK, KD.

Diagram. A fan-shaped geometric construction with its apex at the Earth's center T at the bottom. From T, radial lines fan out to a lower arc (at the Earth's surface) and an upper arc (240 feet higher). The upper arc runs through the points D, K, I, H, B (from left to right at the top); the lower arc runs through G, F, Q, A; the intermediate oblique-fall points M, L, N lie on the slanted line connecting B down toward C/the lower arc.

- T (bottom apex): the Earth's center
- B (upper right): the release point, 240 feet above A
- A (lower right): point on the Earth's surface directly below B
- D, K, I, H, B (upper arc, left to right): the upper minute-arc divided into fifteen-second segments BH, HI, IK, KD
- G, F, Q, A (lower arc): the lower minute-arc divided into fifteen-second segments AQ, QF, FG, GC
- M, L, N (interior, along the oblique descent line from B): successive positions of the ball during the oblique fall

Now since point B — from which the said ball is released — was carried (by the diurnal motion of the Earth, on the supposition of Supposition I) in the first

second of an hour through the line BH (that is, the interval TH), and the ball at the end of the first second had been carried to H, while at the end of the following second it had been carried to I, the ball will have traversed IM, 60 feet. At the end of the third second, with the ball carried to K, it traverses the absolute interval KN, 135 feet; and finally at the end of the fourth second, with the ball carried to D, it has fallen to the Earth — that is, the ball has fallen to the Earth, the space DC of 240 feet being completed. Through the endpoints of the said intervals let straight lines be drawn to the line BL, LM, MN, NC; for this will be the oblique path designated, along which such a ball would really, in this hypothesis, fall to the Earth. Finally, let the chords BH and CG be drawn; and by an analysis of the two triangles let us investigate the magnitude of the first path BL and of the last NC, since from these the intermediate LM and MN can be determined.

First, then, in the triangle BHL the sides HL (15 feet) and BH are given; and BH, were it equal to AQ, would by Suppositions IV, V, and VI be $1699 \frac{1}{3}$ feet; but with the increment AB added, it comes by the proportion (discussed in the proof of Supposition VI) to BH, 1700 feet. The angle BHL is $89^{\circ} 59' 52'' 30'''$, since in the isosceles triangle TBH the angle at T is 15 seconds, and the sum of the angles at the base BH, by the 5th of the First Elements [Euclid I.5], is $179^{\circ} 59' 45''$. From these data, by the most subtle logarithmic trigonometry — which I have reduced (at the end, with the help of Vlacq's Canon) to each single second — the base BL comes out at $1700 \frac{1}{12}$ feet.

Secondly, in the triangle CNG, with KN subtracted, of the whole KG (240 feet) there remains NG, 105 feet; and CG, by Suppositions IV, V, and VI, is $1699 \frac{1}{3}$ feet. The angle CGH is $90^{\circ} 0' 7'' 30'''$, since in the isosceles triangle CTG the angle at T is 15 seconds and either [angle] at the base CG is $89^{\circ} 59' 52'' 30'''$. Therefore by the most subtle trigonometry the last path NC is $1702 \frac{2}{12}$ feet. The excesses of the four paths being then distributed proportionally, they come out as in this little table:

Via	Pedes	& Unciæ
B L	1700	1
L M	1700	5
M N	1701	1
N C	1702	2
Summa	6803	9

Therefore, of the four spaces through which the said ball passes obliquely, none would exceed the one preceding it by a whole foot. And just as, by the diurnal motion alone, it would have traversed the arc BL of 1700 feet with an equal and

uniform [motion], so likewise along the oblique track BLMNC it will complete 6803 $\frac{9}{12}$ feet. Physically, however, it would be just the same as if it had descended with an equal and uniform [motion]. Or certainly the increment of velocity — 3 $\frac{3}{4}$ feet on a path of 6803 $\frac{3}{4}$ feet, or 1361 paces — scarcely deserves consideration, nor is it in any way comparable with the increment of percussion and of sound, which by what was said in Supposition II is only so much as is the increment of velocity of those things falling apparently along one and the same perpendicular — that is, in proportion to the squares of the numbers of equal times.

II. Proposition

The line along which the aforesaid ball, released from a height of 240 feet, would descend to the Earth's surface, in the hypothesis of a moving Earth, would be to the senses a straight line, but oblique — not really perpendicular, but only apparently so — except in the case in which it were released above the Earth's Pole.

This is against our most ingenious Friend, too much addicted to the Copernican hypothesis, who — in order to maintain the proportion of velocity owed to the proportion of percussion — said that the percussion arises from the heavy body not by a motion that is circular and diurnal, but by its own proper motion, and insofar as it is descending; which he said most truly. But from this he wrongly inferred that heavy bodies in the Copernican hypothesis really descend along a perpendicular line, because in that line alone is the proportion of the apparent increment preserved according to the squares of equal times, and so in that line alone would the proportional [increment] of percussion and of sound be preserved.

But the opposite is so true that Galileo [Galileo Galilei], in *Dialogue 2 On the World Systems* [*Dialogo sopra i due massimi sistemi*], and Boulliau [Ismaël Boulliau] in chapter 4 of his *Philolaus*, took pains — from the descent of heavy bodies actually made along a path that is not perpendicular, as is evident, but circular, as Galileo held, or compounded of circular motions, as Boulliau held — to display the beauty of the Copernican Hypothesis: because it removes that difficulty which has hitherto tormented the physicists, namely why heavy bodies should descend with so great an increment of velocity, rather than without increment. For this, say Galileo and Boulliau, is a sheer fallacy of one who judges by sight that heavy bodies descend along a straight perpendicular line, in which such an increment appears; whereas in reality, by the force of the diurnal rotation, the heavy bodies are moved unequally along another path very different from the perpendicular — which path, however, Kepler [Kepler] and Gassendi [Gassendi] held to be

quasi-parabolic, as I have related more fully in Book 9 of the *Almagestum Novum*, section 4, chapter 17.

For although in this hypothesis the motion of heavy bodies arises from two principles — one moving them toward the East according to the measure of the diurnal revolution, by whose force the aforesaid ball would complete in the first second of time the arc BH of

1700 feet, the other, which is gravity, moving them downward — and although, unless the transverse motion toward the East were impeding it, it would be moved along the perpendicular BA, and in the said time would absolutely complete 15 feet: yet because neither of the two Principles so absolutely prevails over the other as wholly to impede its second action, nor do they operate so distinctly that each carries the ball along its own path in the same time. The one would impel the ball [eastward], the other [downward] — that is impossible — but they are so mixed by the conjoined force [of both], that they run together, so that the effect [follows] in such a way that, by the particular influx of each principle, and so the said ball, in this hypothesis, is carried neither along the circular line described from the Earth's center, nor along the rectilinear perpendicular line, but is moved along the transverse line — namely, along the line BH in the figure preceding. So far is it from descending [along the line] from B by BA, or by HL, that, were the oblique path BL denied to it, the circular path BH would have to be conceded to it rather than the perpendicular HL, because the principle of the common diurnal rotation is much more valid than that of gravity; since by the force of [its] diurnity, that second ball would traverse 1700 feet, while [the force] of uniformity is only 15 feet. And so the diurnal [force], carrying the ball away from the perpendicular BA — by which, while the Earth stands still, it would descend — transfers it to the perpendicular HL, by an interval not less than 1700 feet. Since gravity does not draw the ball aside from the arc BH (by which it would be moved, were gravity not present) by the interval HL, [namely] 15 feet — because indeed the diurnal force does not so prevail over gravity, that gravity yields not even a little to the downward inclination — therefore it is not absolutely along the path by which the ball descends little by little, but along a third path of some kind, namely the transverse BL.

14. This same point is proved by a sufficient enumeration and elimination of the other paths along which one might imagine the aforesaid ball really descending. For either it descends along one and the same perpendicular line in the [terrestrial] world-space; and this is not so, because by the diurnal [motion] it is carried to other and yet other perpendicular lines, as

anyone would clearly see, were this Hypothesis given and an eye placed outside the Earth, [observing] the Atmosphere itself; or, with the eye placed on the Earth, and carried along equally by the diurnal [motion] with the points A and B, the ball would seem to descend along one and the same perpendicular BA, or one parallel to it. Or it descends along other and yet other perpendiculars, so that it descends through these without any transverse motion; and this is not so, because it cannot be transferred to different perpendiculars except by a forward motion toward the East, which is prior in the transverse [direction] to its being carried along the other perpendiculars. Either, then, it is so transferred to the other perpendiculars that it first moves forward separately in the transverse [direction], without any descent; then perpendicularly, moving separately, descends nothing; then again circularly; and then again perpendicularly, and thus descending by alternating discrete [motions], as if descending by a stair; and this is not so, because we do not find the descent of heavy bodies to be one continuous motion, and if it could be by some little delay, or by a moment of diurnal force impeding gravity, so that meanwhile by the force of this so very little the heavy body might descend, it could nevertheless do much more — that is, [it could] stand still during the whole time of this motion, or certainly the impetus of the heavy body would not be increased, but in the perpendicular it would be such as it had been transferred, [and] in an equal time it would complete equal spaces.

For example: if the motion here so proceeded that the ball, from B, were first transferred along the arc BH to H, and then, the diurnal [force] indulging gravity, it permitted it to descend along HL, 15 feet; then in the following second hour, from L, the ball were transferred along the arc parallel to HI, to the perpendicular TI, the point I being distant from A by 15 feet: then, because gravity had not exercised its force, and had produced no impetus, in the descent it would absolve only the [other] 15 feet — which is contrary to experiment; or, if you suppose that the earlier impetus had not vanished, but that an equal one had been added to it, it would reach a total of 30 feet; and at the end of the third second, 45 feet; and at the end of the fourth, 60 feet — which is likewise contrary to experiment, from which we gather that the impetus of heavy bodies increases continuously, so that the [space] becomes greater and greater, and the space [is completed] in the descent; therefore there is no descent of alternating motions, the one simply forward along a circle, the other simply downward along the perpendicular. Either, then, it is so along some [paths], and along other arcs, and at the same time along some [perpendiculars], and along yet other perpendiculars

[continued — the upper-right column of folio 84]

is moved, so that at the same time it is moved along both paths — namely, at the same time at which it is moved along BH, let it also be moved continuously along BA, or HL: and this is impossible in a Movable that is not divinely replicated. For it is equally impossible that the same movable be moved simply toward diverse regions of the World — say, toward the very Equator, toward the equinoctial Rising, and toward the Meridian, toward the Pole of the World, and be moved toward opposite regions. But if it be carried toward an intermediate region, it is necessary that it be carried along another oblique path into that [region]; so that it does not tend simply toward the East, nor simply toward the Pole, but toward a terminus partaking of both — say, toward the East-South [Euronotus]. Therefore, since [it can] neither [be moved] along one perpendicular line, nor along one circular [line], nor along diverse circular and perpendicular [lines] by turns, and discretely; nor along circular [lines] at once and perpendicular continuously: it remains that the two are not really moved [separately], but in fact along a line in which neither is moved in act, but only in potency, and insofar as some properties [belong to them], so that in the mixed [motion] the motions of the diurnal whirling and of gravity coalesce into one motion, and are tempered [together]; and this cannot be imagined to be anything else than the oblique [path] declining from the perpendicular, toward the East and downward.

15. Let the foregoing doctrine and proposition be confirmed from like grounds in all movables, whether natural or violent, to whose motion diverse motive forces concur in act with an endeavor to move the same body toward diverse, but not opposite, regions of the World. For from this very fact — that one [movable] exercises its force in act and is in no way wholly impeded by the other — we see the movable really moved along a path proceeding according to each force owed [to it], but not simply [according to either]. Thus rivers, or streams, when heavy bodies are forced downward, can rush into a perpendicular precipice and impinge in a sloping channel, descending by a mixed and oblique motion. When the diverse forces of two motive powers endeavor to move along one path, one toward one region of the World, the other toward the opposite — then, if one of the forces prevails before the others, the impetus is moved toward one region, or if it prevail thus first, it is turned back, and finally is overcome; and then afterward the motion [proceeds] into the other region, so that, the [body] projected upward, the impetus being at last overcome, they fall back by the force of the impulsions onto the heavy bodies downward.

16. But — and from the absurdity — let the falsity of the contrary opinion be likewise convicted. For imagine a lake ABCD, full of Water,

Diagram. A horizontal rectangle ABCD representing a lake of water seen in plan/section. The top edge runs A (upper left) — E (top center) — B (upper right); the bottom edge runs G (lower left) — D (lower right). A diagonal line runs from the upper-left corner A down to the lower-right corner D, with point F marked at its center; a short vertical segment EF drops from E on the top edge to F in the interior.

- A (upper left corner): corner of the lake
- B (upper right corner): corner of the lake
- E (top edge, center): point on the near shore AB
- F (interior, center): point on the diagonal, below E
- G (lower left corner): corner of the lake
- D (lower right corner): corner of the lake

except for a transverse embankment BFC, and some terrestrial ridge inhering at the shore AB on the lakeside, where its enemies are. Who in his sound mind would say that it flees from AB along other perpendiculars, [path] EF, and yet at the same time really fleeing along the [other] waters and proceeding [along them], or at the same time the water, and moved along the terrain, even by a real motion — let it be by a real motion made along the terrestrial route BC, [so that] at any moment of the terrestrial route it acquires a greater [distance], and a greater distance from the shore AB, measurable along the perpendicular lines EF, and along others parallel to this. For the local motion of bodies is not really along any space whatever, by which the distance of the moved body can be measured and considered from any fixed point of the World whatever; since the motion in such a distance does not in fact consist, or in relation to any termini whatever toward which the movable approaches, or from which it recedes; otherwise by no determinate space would innumerable [things] be moved together, which is impossible; but in reality it is along that determinate space which is traversed by successive contact from the moved Body. Let the access, then, be greater, and let the greater [distance] of the descending heavy bodies be measured along straight perpendicular lines, by which also, in the hypothesis of a moving Earth, the Earth-dwellers would seem to descend; and [provided] the proportion be found in them, of which [I spoke] in Supposition I; and [provided] the formal descent, as descent, be distinguished and adequately [distinguished] from the circular motion — when it is simply a descent, that is, a downward motion: [yet] not on

that account do heavy bodies really, in this hypothesis, descend along perpendicular lines,

[upper-left column of folio 85]

nor is their descent simply a downward motion, and accordingly it is not adequately distinguished from a forward motion toward the East, but is inadequately [distinguished], since [the descent] consists, by the partiality of each, [of both].

III. Proposition

Of two percussions and sounds [made] by the same body — the one upon a body unmoved, the other upon a body moved or more slowly moving and struck — the greater (other things being equal) requires beforehand, as a precondition, not only greater impetus, but also a greater velocity of motion in the space through which the percussed body is naturally and really moved; so that, if that force by which the increment of impetus, or of velocity, is impeded be impeded, the greater magnitude of the percussion and of the sound be impeded likewise.

17. This proposition, well understood and in the terms in which we have expressed it, is certain by an *a posteriori* induction made in all the cases in which the magnitude of percussion and of sound is evident; for the cases of a doubtful [result] are brought in to no purpose — no less than those in which it is doubtful whether the major [is] greater, or not less, [a matter of] controversy as to how a movable is moved, as [in the question] how heavy bodies are moved in the hypothesis of a moving Earth. For we ought to make known, from things better known, those which are less known. Therefore, the consideration being made, it is established through all cases that the percussion and the sound are manifestly greater from the same body — that there is never a greater percussion from the same body (other things being equal) than [when] the percussing body has been moved more swiftly, traversing an equal space in a shorter time, or a greater space in an equal time. And on the contrary, if the movable be in any way otherwise more swiftly moved, or be checked, so that it move not more swiftly than before, the percussion is made by the same force — so that, just as I make it so, the effect be that it does not strike more forcibly than it had struck before. Thus, because the [stones] of mills, [moved] by hand or by the impulse of cattle for grinding grain, or the grindstones for sharpening knives, or the [stones] of lathes, are wont to be turned, or moved circularly, with such uniform tenor that they strike afterward with no greater blow,

[than before]. On the contrary, because slingers, when they whirl the sling about more swiftly, throw their stones the farther and with a stronger blow, and at a longer interval, by whirling them about, hurl them.

18. From this universal induction, by which it is established that a greater percussion and sound never occur without a prior greater velocity of the movable, the physicists have gathered, and necessarily concluded, that the validity of the percussion and the vehemence of the sound depend on the accelerated [motion] — just as the sound, taken absolutely, [depends on] something certain and not on the pendulum, nor [can it] be made by the impetus of the movable, except by the mediation of the movable's actual local [motion]. Indeed, [the more] ordained the impetus of the movable, and the greater the motion, the greater both the impetus and the percussion, and the sound — but what [matters], because the same force [that] impedes the increment of the impetus or velocity impedes much more the increment of the percussion and of the sound.

IV. Proposition

It is an evident Physicomathematical evidence that the Earth is not moved by a Diurnal Revolution.

19. The argument for this Proposition, reduced to syllogistic form, is of this kind:

If it is evident by a Physicomathematical evidence, by [the fact] that the diurnal [motion] of the Earth impedes the validity of the percussion and of the sound, as we clearly experience to be made, both from the natural motion of heavy bodies, [descending] from a greater altitude, [and] from the [evidence] of those descending through the air, it is evident also that the Earth is not moved by a diurnal motion. — But it is evident by a Physicomathematical evidence, by [the fact] that the diurnal [motion] of the Earth impedes the aforesaid validity of the percussion and of the sound. — Therefore it is evident by a Physicomathematical evidence that the Earth is not moved by a diurnal revolution, or motion. — The Major is certain. The Minor is proved: because on the one hand it is evident by a Physicomathematical [argument] that heavy bodies naturally descend with an increment of velocity according to the proportion owed to the squares of equal times, from what was said for Supposition I; and [that] the percussion is made at the end of [the motion] [with] an increment of equal times, according to the same proportion, by what was said for Supposition II — from which we gather that the increment of velocity is

[upper-right column of folio 85]

real, not merely apparent, by what was said for Proposition III. And by the same proposition, [it is shown] that for so great a validity of the blow there is required beforehand, as a precondition, a proportional increment not only of impetus, but also of velocity in the descent of heavy bodies. — But on the other hand, it is evident from the hypothesis of a moving Earth, by [the fact] that the diurnal motion is such that heavy bodies do not descend along one line, or along several perpendiculars, but along an oblique path, tending downward and forward by the declining fall, by what was said for Proposition II; [and] along an oblique path, by which they would really descend, it is evident that they would so descend with an equal increment, and with so little [increment], that in no way is there a proportional increment of percussion, as was shown for Proposition I. And so it is evident, by this hypothesis, from the things said for Proposition III, that the said validity of the percussion and of the sound is impeded; as we clearly experience to be made from the natural motion of heavy bodies, [descending] from a greater altitude.

20. This argument — because it lethally strikes the Copernican hypothesis — those two Friends mentioned at number 2 vainly endeavored to elude by their stroke, contending either that heavy bodies really descend along a perpendicular line (which we showed to be false for Proposition II, so that the increment of velocity owed to the real increment of percussion be thus false); or that, really descending along an oblique path, yet, though the impetus increase by a continuous motion, it is not necessary that the velocity increase — and yet that this impeded [increase] cannot impede the validity of the percussion (which we likewise taught to be false in Proposition III). And as for their adding that the defect of velocity from the encounter of the percussed body could be compensated, or [made up] in the Annual motion of the Earth — that does not suffice, because the part of the Earth's [surface] struck by the falling heavy body does not meet the heavy body any more than it flees from it, but is carried equally with the heavy body, insofar as the diurnal motion is transferred toward the East. But the Annual motion is so little present that, far from helping or compensating for the downward motion, [it would] rather impede it more by acting jointly, and by carrying the heavy body toward the East in the transverse [direction]. Moreover, what I have brought against this annual motion [I have set down] more fully in Book 9 of the *Almagestum Novum*, section 4, chapter 19, at number 8.

I have called this evidence Physical, insofar as we apprehend by sensible experiments the increment of the velocity of heavy bodies and of percussion thence made, and of sound; and Mathematical, insofar as, on the one hand, we have determined the increment of each by the proportion owed to the squares of the times, and on the other hand, [we have] shown by Geometrical and Trigonometrical measures the quantity of the real space which the heavy bodies would traverse in the hypothesis of a moving Earth — and therefore, by a composite name, I have called it Physicomathematical.

V. Proposition

The Celestial Phenomena can be explained equally well, and even better, by [the hypothesis] of Our [Earth] at rest, as in the Hypothesis of a moving Earth.

21. Galileo conceded this same point in his *Dialogues* (given a Latin dress, page 88), saying: *As to satisfying the appearances, each position is equally accommodated.* And Jacob van Lansbergen [Philips van Lansbergen / Jacob van Lansbergen], in his Commentaries upon this motion, page 1, where he says: *For as one going from Athens to Thebes makes indeed a journey contrary to those [going] from Thebes to Athens, but the path is the same: so the Ptolemaic and Copernican Sphere, contrary between themselves as to their hypotheses, nonetheless display the same appearances in the Heaven.* Yet the celestial [phenomena] are not equally well [explained] in their hypothesis — [the hypothesis] of those who admit solid Orbs, and deny that the five lesser Planets are moved about the Sun, and that the eccentricities of these are to be taken as starting from it; but rather [hold] that the motion of the Sun, rather than a mean, is to be applied in explaining their motions. Therefore in Our Proposition we have added that [phrase] *Ours*, in which we suppose the contrary.

Now if there is anything by which the Copernicans most exult, it is the reason rendered by them themselves, on account of which the stations and Retrogradations of the Planets appear, but are not real in the motions of the Planets — which in truth always proceed directly, [and] always go forward toward the same [point] toward which they once began to tend; so that almost on this ground alone Sagredus, in Galileo's *Dialogues*, was nearly girded [for the journey], so as to pass over to the Camp of Copernicus. But

and so, by a single diurnal motion toward the west carried on continuously, we account perfectly well for the appearance by which the planets are seen to move toward the east, in that they cross the same meridian more slowly than the fixed

stars do; and for the fact that the fixed stars reach the same meridian sooner; and for their apparent retrogradations, in that they cross over there more quickly; and likewise for their being more westerly. Indeed, on our hypothesis, the lower planets are slower in revolving from east to west than the higher ones — as is fitting for movable bodies that are made up of more remote circles in their wheels [Rotis], or [whose] circles consist of larger ones, than those that are moved toward the east; and the diurnal motion is attributed to the Earth, so that it follows that the planets are moved more slowly from the more remote motions, namely from the Sun.

As for what concerns the proportions of the distances from the Sun and from the Earth, it is clear that the same ones must be assigned, whether you posit the Sun at rest or the Earth at rest; since on either hypothesis the same things ought to hold, and can hold, between the Sun and the Earth; nor does this variation depend on the motion of the one rather than of the other.

VI. PROPOSITIO.

The motion of the Sun, and the immobility of the Earth, on the authority of Sacred Scripture alone — which is to be asserted, even if the other arguments drawn from natural reason were of equal weight on both sides.

[Margin: 22]

For my part, I recall that I set out this argument more fully in the *New Almagest* [*Almagestum Novum*], Book [9], section 4, chapter 39. Yet because afterward greater minds have come down to twisting Sacred Scripture so as to turn it aside to an alien sense, those who dared this — chiefly Jacob van Lansbergen [Lansbergen] in his *Commentaries*, and Christoph Wittich [Christoph Wittich] in the second part of his *Dissertation*, just as the whole of the Reformed Cartesianism breathes the same — like Daniel Lipstorp [Daniel Lipstorp] in his *Copernicus Redivivus*; against whom Lentulus has defended the rest of the immobility of Sacred Scripture in his *Nova Sapientia*; Schoockius [Schoock], Book 4, *De Scepticismo*; Tullerus [Tuller] in the *Miscellanea* [?]; Danaeus in his *Christian Physics*, Part 1; Jacob du Bois [Jacob du Bois], *the Ecclesiastes of Leyden*, in his *Dialogus Theologo-Astronomicus*; and Ioannes Eyerbinus [?] in his *Examen of the famous controversy concerning the motion of the Sun, or of the Earth* — for us, since certain new arguments have presented themselves on this subject, it has therefore seemed good to gather here into a few points those by which the controversy, already worn smooth, may be raised up, lest other less weighty matters be heaped together. Therefore let us argue thus.

[Margin: 23]

[Margin: 1. Arg.]

In the controversies in which a Reason is to be chosen from here as the better part — if any have been such — that part is rather to be chosen, for our part, on which the greater Authority stands. Therefore: in this controversy, the better part is to be chosen on the side that has been conceded; but the natural reasons of the part [arguing for] the Sun's percussions would be the larger and from a higher place, as falling [downward], if indeed they were such — yet they are not such, as we showed above as regards the heavenly appearances. And yet, as regards the Sun's motion and the Earth's immobility, Sacred Scripture stands, as will soon be plain. Therefore, etc. The adversaries will answer that the proportion of the larger is the true one, if that Authority of theirs were not turned aside to an alien sense, or accommodated to the common understanding of the multitude, or [stated] according to common opinion, nor [aimed] at the truth of the matter [in itself], but [aimed] at the necessity of [moral] instruction, [and so] absurd, or violent, as it would seem. But on the contrary, I here add a new argument.

[Margin: 24]

[Margin: 2. Arg.]

In the controversy, that part is, all else being equal, the better, on which such Authority of Sacred Scripture stands, that it can speak independently of the prejudice of either hypothesis of the controversy; but such is the assertion of the Sun's motion and the Earth's stability. Therefore, the adversaries themselves say that Sacred Scripture does not speak according to the truth of the matter, in so far as it is forestalled [praeumbri] by the Copernican opinion, and meanwhile they confess that it speaks the truth on this matter — both according to the common opinion of men, and according to the literal and obvious sense of Sacred Scripture. But if, all else being equal, by natural reason the parity of conditions remained and remained in equilibrium, and accordingly Sacred Scripture being invoked [as witness], could neither of the hypotheses, by the prejudice of its sense, [prevail]? — to say nothing of [the fact that] its obvious and literal sense ought, [for] an alien, abstruse [meaning]...

[meri]dian. And therefore, with no small confidence in God, he chose a double miracle — namely, that not the Sun alone, but the Moon and the other planets too, should cease for an entire day from their diurnal motion; for the sacred historian does not say, "the Sun stood still in the midst of Heaven, and did not hasten to set for the space of one day." Yet before that he had said, "*Sun, stand*

still" [*Steterunt, etc.*]. Therefore, by the same token, the Copernicans cannot [explain this] save by a double miracle, namely that the Earth and the other planets stood still miraculously; for naturally those planets were standing still, inasmuch as they were lacking the diurnal motion — but the Earth, which truly was moving, [stood still]; nor did the Sun [stand still] against Gibeon, nor the Moon against the valley of Ajalon, [but] it stood [still]; but on the contrary, with the Earth standing still, Gibeon [stood] against the Sun, and the valley of Ajalon against the Moon. How perverse a sense this brings into the sacred [text], let anyone consider — for no one of sound mind sees it without [some scruple].

[Kings] 4, chapter 20, there is recorded a miracle in the horologe [sundial] of Ahaz, [where] God himself [made] the shadows of Isaiah [recede]; chapter 38, it says: "*Behold, I will make the shadow of the lines, by which the sun had gone down in the horologe of Ahaz, return backward by ten degrees, by the degrees by which it had gone down*" — that is, the Sun turned back so far toward the east that it retraced ten lines, that is, ten degrees, by which it had descended; and what had descended in the horologe by ten lines went back up by just so many lines, which Ecclesiasticus 48 confirms: "*In his days the Sun went backward, and he added to the King's life.*" Now truly, since so great a Prophet as Isaiah did not [profess to] ignore whether the Earth was [moving], which in reality was moving — or did he [profess to] ignore it, when by divine inspiration and by this miracle [he was] urging that the descent of the shadow be made manifest — [thereby] he offered to that King a false proposition concerning the future miracle, [which] could even be accommodated to the understanding of the multitude, and to the King's request [for] the recession of the shadow: nothing whatever depended on the manner, or on the motion of the Sun rather than of the Earth, [even] granting [the man] to be then King, and afterward [&c.]. With a preconceived opinion concerning the motion of the Sun, that [recession] is to be ascribed to the motion of the Sun, [reckoned] toward the west by the [opposite] turning — as if they were ascribed [thus]. Soundly enough, however, it could be expressed *in the Sun*, and yet again *in the Sun the going-backward of the Sun*.

Job, chapter 9, speaks of the wisdom and the might of God, which he confirms partly from those things he made, partly from those things he could do, [if] he willed, [though] he does not [do them]. *Who transfers the mountains, and they know not, those whom he overturns in his fury. Who shakes the earth from its place, and its columns are convulsed. Who commands the Sun, and it rises not, etc.* Here Diego de Zúñiga [Diego de Zúñiga (Astunica)] — whose book was afterward suspended by decree of the Sacred Congregation — dared to say: "*No place will be given to Scripture, which says so openly that the Earth is moved; but here it is said*

that it is moved." But because it has been said rashly, it is shown from the very Scripture, as I am recounting below — meanwhile I take it as proven from Job himself that God can both [act] miraculously and supernaturally; God can command the Sun, that it rise not, as it is wont to rise — nay, in reality, by employing his absolute and omnipotent might he can move the Earth from its place. In turn, therefore, from this it had to be inferred that so natural an immobility of the Earth attended the Sun's diurnal motion, as the Earth's immobility; for [if] the Earth were moving outside [its] whole place, or [some] part, [it would] already not have a place, [as] would be the case, and properly to the whole, or to the moving part.

Psalm 18: the Royal Bard, from natural and true things, begins by commending God [as worthy] of the excellence of God's works, thus: *"The heavens declare the glory of God, and the firmament announces the works of His hands."* By day only, because of the continual succession by which the Sun illuminates the Earth, but even by night by [the light] of the remaining Planets and Fixed stars, which in the firmament [declare] the glory of God at [its] rising and setting; you hear: *"Day unto day utters speech, and night unto night shows knowledge."* But in a different manner; for the splendor of the Sun is so great that it [collectively] outshines all [the light] of the other stars, [taken] even collectively; and therefore [it is] more abundant, and as it were belched-forth from the greatness of God, [the Bard] declares — and [its] rising and setting are most manifest, and are observed by all; whereas [the light] of the Planets and Fixed stars [is] fainter, nor is it observed by many, nor is it as observable as that of the Sun; and therefore he does not say "they utter," but *"showeth"*...

[He] says only as much as concerns the night-contemplator of knowledge. Yet no one — provided he be no quibbler [cavillator], unless he understands not the idiom that the Hebrew tongue has — and the term "Heaven" he understands of those who praise God, [therefore] he adds: *"There are no speeches nor languages, whose voices are not heard among them."* For God can speak in any tongue; he speaks to those who have ears, and to the understanding sense, who have eyes; and to all to whom the sound of this speech can reach, [it] reaches, or ought to reach, [whether] the inhabitants of the Earth are moved in [their] circuit, or [whether] all things turning back [upon themselves] thus seek themselves successively by light, and by the prospect of the Sun, or [by] the rest, [namely] the sidereal [light]; the firmament itself [being moved] by daily conversion to illuminate the Earth in succession: which of these may be the case, they straightway expend speeches saying: *"Their sound has gone out into all the earth, and their words unto the ends of the world."* Whence one may compare the

testimony of the Apostle alleging this very passage; [for] the Apostle, in Romans chapter 10, [setting forth] before [the matter] of preaching, says: *"But how shall they hear without a preacher?"* — just as the Gentiles themselves sought, by their own proper motion, the Apostles, since the same S. Paul there adduces the testimony of Isaiah on behalf of the grace of God in preaching: *"I am found by those who sought me not."* But God [acts] by the Apostles in the world, [sending] forth into those very [places], stirring them up, and illuminating them; thus by the daily motion of Heaven, [he] illuminates the whole earth, chiefly by the Sun's motion, [and] strikes [it]; David [also], and on this matter he speaks especially, [when] he says: *"In the Sun he has set his tabernacle, and he, like a bridegroom, comes forth from his bridal-chamber. He has rejoiced like a giant to run his course; from the highest heaven [is] his going-out, and his circuit even unto the highest of them; nor is there any who can hide himself from his heat."* And if indeed by this property of the Sun and of the stars, David affirms; and thence [he] rises up to the praising of the splendor and the purity of the divine law, [yet] he supposes that property of it [to belong to it]; and from that, as from a certain fixed degree, [the matter] is made [a] moral [one]. Therefore the Sun runs, and with giant strides — [a thing] he expresses by [its] admirable swiftness — with admirable swiftness it revolves; for the Moon truly [is] slower.

Ecclesiastes [Solomon]: *"The Sun rises, and sets, and returns to its place; there it rises again; going around through the south, and bending toward the north, the spirit goes around surveying all things, and the spirit returns again upon its circuits. All the rivers enter into the sea, and the sea does not overflow; to the place from which the rivers come forth, they return, that they may flow again."* These matters are difficult, nor can a man explain them by speech. Now indeed Solomon speaks here of natural things, and according to the truth of the matter, not according to the apparent and common sense; but he himself, as a man very wise in the highest things, [speaks] in the first place [of] the Sun's rising — that going-around [the heaven], that [it returns] to its [place]; and although in this passage Solomon [speaks] of natural things truly, and according to their nature confessing, [men] are forced [to grant] in the first place that he speaks Copernically — and yet this returning is not easily grasped, nor obvious to the multitude, but it is reckoned among the difficult things to know; he is convicted by the testimony of Adam's wisdom, or like Adam himself there testifying, since [it is] from the rising and going-forth of the rivers, [he] speaks according to their nature confessing — they are forced [to grant] that the Sun [moves] truly Copernically; and yet here the returning is not easily grasped, nor obvious to the multitude, but among the difficult things to know it is reckoned: *"All things are difficult, etc."* No cause [for it] can be adduced (setting aside the prejudice of the

Copernican hypothesis) on account of which Solomon should be said [to speak] of the rising and setting of the Sun, or of the generation and corruption of natural things; nor [should it be said] either according to truth [or] according to Solomon's true opinion; nor truly of the Sun's motion. Nor, if he had known this knowledge infused into him by God, ought he to have kept silent that the Earth is moved, [and] to attribute that motion to the Sun, [accommodating it] to the common sense of the multitude — except [on account of] the difficulty of the matters apprehended. But if it is difficult to apprehend in what way, and by what water, [the sea] once and [kept] in equilibrium [by] springs could be poured-out [and yet] ascend through the subterranean passages and into the pristine bubblings-up [of springs]. But he says: just as concerning the Sun, and from it he warns, and [from] the same returning [is] uttered; [it is] previously difficult; the difficulty being apprehended, [it is] such; it occurs by a tacit objection, or by the interrogation [whether] he had explained [the matter] by that same answer: "*All things are difficult, etc.*" For no man can explain all things by speech. Nay, by this very example of Solomon, [Wittich] is wondrously strong to affirm that there [Solomon] persuaded that he wished, that is, [it was Solomon's] most laborious [task] to investigate [as one] wise concerning all things which [are] beneath the Sun — and he adds "*knowledge and labor.*" Nor truly does Wittich [Vuittichius] feign [this]; therefore God did not wish the books of Solomon to be preserved, in which concerning natural things...

and chiefly concerning the motions of the stars, and the disposition of the orb of the earth from divinely-infused wisdom, [things] written according to the truth of the matter — [things] which they are unwilling to investigate by Sacred Scripture, but [which] by Sacred Scripture truly are investigated naturally, [and] are not made known to us through revelations by Sacred Scripture: but by Sacred Scripture truly attributions of motions to the Earth's life are taken away. *I am asking*: Does the creation-narrative of the World made by Moses concern that distinct narration? And what does it confer for the manners, [so] that you may know whether the Earth is a planet, or whether the Sun was created? But if you say [that] thence many things may be derived for the praise of God, and even for [some] moral, mystical, or allegorical senses — I say the same; and I, from the true knowledge of the Earth's or the Sun's motion, as in reality and from such motion we have heard, raised up David [as one who] raised himself to the Glory of God, and to the divine law, [which] I now refrain [from pursuing].

Ecclesiasticus, chapter 23, [speaks] not only commemorating the diurnal motions of the Sun, but also by an aggregation of the days of the year, [it] answers thus: "*Why does day surpass day, and again light [surpass] light, and year [surpass]*

year, [if] from the Lord [is] knowledge separated?" [That is], with the Sun made [and the days] received, [they] are divided and kept in custody by the Wisdom of God; and chapter 43: *"The Sun in [its] aspect announces at [its] going-out: a wonderful vessel, the work of the Most High, etc."* But in what manner [it] is — [whether] custodian of the days, and influx [thereof] from its own motion, or [from] another — [it] subjoins there itself: *"The great Lord who made it, and at His words it hastened [on its] journey."* If Scripture wished to speak according to the common apprehension, [it would speak] for the sake of [reaching] the sense, lest the cause be added to the interrogation. Moreover, [there is] that precept made to the Sun, [which] is to be understood [as] made by precept [given] to the Intelligence moving [it] from [its] natural virtue [and] infused, to persevere [for] so many days [in its] motion, at such a velocity, and so on; [whether] ordained from it, or [whether] its [virtue] be equivalent, or [whether] it be said figuratively [by] precept. Thus [it is] also [with] David, Psalm 118: *"By Thine ordinance the day perseveres, for all things serve Thee."* And [with] that [passage of] Baruch, chapter 3: *"The stars have given light in their watches, and have rejoiced; they were called, and they said, Here we are; and they have shone with cheerfulness for Him who made them."* Matthew, [chapter] 5: Christ himself says: *"Who makes His Sun to rise upon the good and the evil, etc."* Therefore [if] the Sun naturally [has] this very [power] from the influx — unless [there be] a prior gliding-down into the Earth, and [from] this Christ, [who] speaks naturally according to truth, [says it] thus; nor does the Sun [merely] illuminate, unless [there be] a prior [gliding], nor does he [speak only] according to truth, nor according to the common apprehension of the multitude — just as in [speaking] of the setting of the Sun, [it is] to be understood according to the Psalmist, Psalm 103, saying: *"He made the Moon for seasons; the Sun knows its going-down."* Its [going-down] he has called *suum* — that is, from its own proper motion of the Sun, not from elsewhere; as in reality, so [too] from the motion of the Moon; but the rain truly [comes] from the setting of the Sun — but it only appears [so]. Or does Copernicus reckon this also? Therefore [if] from Sacred Scripture, by its [own] property and for the instructing of man, but from man's opinion, [though] the property of Sacred Scripture's modes of speaking be repugnant, the sense of Sacred Scripture is to be formed? Who would dare this? Who? Would that [it were] never! I certainly [say] never. But concerning the Sun [it is] enough: let us descend now to the stability of the Earth.

De Terræ Immobilitate.

[Margin: 25]

Besides the beginning of Sacred Genesis — from which we taught above that the Earth, [being] not of [the same] basis or foundation as the immobile structure of the mundane edifice, but of the Planets, ought not to have been created [first] in the first place, but rather the Sun [should have been created] in [its] place: and besides Job chapter 9, the passage from which the natural rest of the Earth is rather established against Diego de Zúñiga is won. God himself, addressing Job, chapter 38, rebukes the man's ignorance, [him] who, [though knowing] many things about natural things, and [knowing] by sense *whether [a thing] is*, yet is ignorant of the certain causes — either because he is wholly ignorant of [them], or [because he compares them so] imperfectly that he is not [equal] to the Divine Wisdom — [and so] he can be said [to be] ignorant. Therefore God: *"Where wast thou when I laid the foundations of the earth? And upon what are its bases founded, or who laid its corner-stone?"* All this circumlocution, though metaphorical, has nevertheless the congruent foundation of the earth's nature, and the basis of all bodies created by God — from which, accordingly, He there begins — signifies, and not only...

the mutual coherence of [its] parts [holding together] with as much as is [held] by the etherial motion. But [if] this too [is] to [the comprehension of] the multitude on account of God's command — *"it [is] not inculcated"* — and at [its] apprehension — and I [grant] it inculcated, if the Earth really were moved — hence the more forcibly the argument [is] derived against the imperfections of human understanding — [namely], that I press it [thus]: *that [thing] stands*; nor by [any] need of [its own] proper standing, [does it stand]; you have interrogated me [as to] which of these may be the case: *Knowest thou not that [thou] [art] able to move the Sun rather, and [to make] the Earth stand, or [rather] that thou [art] able [to make] the Sun stand and move the Earth?* If you should say [that] Sacred Scripture does not have, by [the] natural intention of teaching the men of [its time], from this seed in that very chapter 38, [it] would refute [the supposition] in which God, primarily indeed, intends to reduce Job to the natural and to a recognition of his own imperfection, and thence to humility, and to reverence toward the [divine] wisdom; secondarily, however, [it gives] for [its] middle term this end: that he propound to the natural [philosophers] the true things — [things] which, [though] difficult to know, are nevertheless [to be] inferred from the difficulty itself; whence, [if] the terms [are] most [aptly] composed of the dim [and] of the twilight, or [of] the dawns of the deep, and [of] the dark profundities, this is by the way by which [one] goes down to the lower regions [the underworld]; concerning the amplitude of the earth's surface — in what manner the light is propagated, in what manner the snow, the hail, the ice, the dew, the mist, the lightning are formed, [and] in what manner [the influence], when [the

stars] of the Pleiades [are] so closely conjoined, are [held together], [so that] their ratio and order and concourse of the heavens [endures] — and by what instinct the cock distinguishes the hours of the night: which things God there commemorates, not as mere appearance, but as truly — [things] of which, [though] the property of the nature [be] ignored, [the man] is yet ignorant of the [true] causes — let us pass on.

Book 1 of Paralipomena [Chronicles], chapter 16, they say: *"He is borne by the face of all the Earth"* — that is, He founds the immobile orb, that it remain immovable; *"Let all the Earth be moved [tremble] before the face of the Earth"* — that is, let it fear, [that] it may stay [firm]; as [they] have it [in] Job chapter 26: *"He hangeth the Earth upon nothing"*; or, as they have it, Psalm 92, of which the Title in [chapter] 70 is such: *"In the time before the Sabbath, when the Earth was founded"* — [a phrase] a hundred times [used by] David himself — thence [is the] chief might of God praised: *"For He hath established the Orb of the Earth, which shall not be moved"* — Psalm 103. *Who hath founded the Earth upon its own stability* [Psalm 104]: *"He hath founded the Earth upon its stability; it shall not be bowed [inclined] for ever and ever."* Of [its] foundations: *"He hath founded it upon the seas, etc."* So [too] Ecclesiastes [chapter] 1: *"But the Earth standeth for ever"* — the Hebrew reading has it: *"The Earth standeth fixed, and consistent it is."* And Proverbs 8: *"When He prepared the foundations of the Earth"*; or, as they have it [in chapter] 70: *"When He made strong the foundations of the Earth."* And Isaiah 40: *"Who hath measured the bulk of the Earth with three fingers"*; and chapter 44: *"[I am the Lord] who alone establish the Earth"* — *"stretching out the Heavens, [I] make firm the Earth."* By which passages not only the coherence and permanence of the parts [is signified], but also the constancy [of the whole], the integrity of the whole, is signified, since these things [pertain] to the Sun, [or] to the heavens; whereas the Planets are said to have foundations — [though] God hangs the Earth upon nothing — [it is] not by mutual [coherence], but chiefly by [its] local consistency [that] it is inculcated [as] standing, [to those] who are unwilling, [the] unwilling Copernican.

Respondetur Novis quibusdam, vel nova forma inculcatis Obiectis præcipuè ex Sacris literis posit.

[An answer is given to certain new objections, or [objections] inculcated in a new form, chiefly drawn from Sacred Scripture.]

[Margin: 26]

The Copernicans truly have no arguments by which they could prove [their case] directly from Sacred Scripture [for] the [Earth's] mobility and the immobility of the Sun, save that [passage] of Job 9, which yet against Diego de Zúñiga [Astunica] shows the natural immobility of the Earth rather [than the contrary] — [a passage] confirming [it], with God's power [left] intact. They are moved, if [they] wish [to argue] that [passage], that they may by an indirect course endeavor to assert that God in the sacred letters did not wish to instruct men in natural matters — of which sort [are] Physics and Mathematics; and therefore, if it should befall Him to speak incidentally, [He] would speak [merely] according to the sense of the multitude, and according to common estimation, [and] either [according to] its truth, [or] as [it may be] true or false; especially in matters difficult to grasp, or [matters] foreign to morals, [to] life, and [to] the instructions [pertinent] thereto — nor [are these] pertinent — nor in any way [do they] withdraw the ruder men from the difficulty of [their] apprehensions, and in other things either; nor do they withdraw the faith from the sacred Codex. But to the [assertion] applied to the various particular passages of the matters asserted [about the Earth's] stability, they adduce in general that [passage] of Isaiah 8: "*Take thee a great book...*"

the great one, write in the very style by which you address men" — so says Wittich — "speak in human fashion, and accommodate yourself to the understanding of the common people in your manner of speaking; and that saying of the Apostle, 1 Timothy 3 [recte 2 Timothy 3:16]: *All scripture, divinely inspired, is profitable to teach, to reprove, to correct, to instruct in justice; that the man of God may be perfect, furnished to every good work.*"

27. I reply, first: it was the primary intention of the Holy Spirit, in the Sacred Scripture, to teach men those things that pertain to our salvation, to faith, to blessed life — and, when it leads to that end, also the knowledge of human history insofar as it is natural, that is, the knowledge of natural properties; or whatever serves natural matters insofar as they are means by which men are stirred to the praise of God, to comparisons, and to drawing examples from them for forming and correcting morals — being applied [to these ends], but not taught by the scholastic method of natural philosophy. Rather, Scripture supposes these things, and states them in plain propositions, as is clear in Cap. 38 of Job, in the Psalms, in Ecclesiastes, in Proverbs, in Ecclesiasticus, and often elsewhere. But I deny that the Sacred Scripture is false in things that it abstains from accommodating or expressing in the manner of speaking [of the common people], so false that it could be detected to be false in some matter whose authority is unimpeachable — which would indeed be far greater and more dangerous than

to say that something arduous to grasp is taught; lest, for that reason, men be deterred from believing it in other matters. Are Catholics therefore obliged to believe more than that — that things otherwise known by the natural light, or easy to grasp, are such (because such are the Mysteries of the Most Holy Trinity, of the Incarnation of the Divine Word, of the Eucharist, etc.) — and to refuse [belief], because such things are most difficult, as though it were false belief in a formal motive [for assent], and as though the authority of God speaking were not the [proper] motive of human understanding? Did Christ abstain from preaching the mystery of the Eucharist, even before he instituted that Sacrament, because that discourse seemed hard, and many of his disciples drew back from it (John 6)? By no means. That God should die was for us a scandal to the Jews, and to the gentiles foolishness; the Resurrection of the dead seemed new to the Greeks, and the dogma incredible: did Paul and the rest of the Apostles on that account abstain from preaching it? But, you object, these [doctrines] sought faith for themselves, [as bearing] upon salvation, and not in opposition to incredulity — and besides, heresies are many which foretell future things, [and] wish to be held in the estimation of revelation and to be promulgated, since for these reasons they capture the understandings of many who would be willing to render obedience to faith, and who profit in merit and salvation. You say well; but, as I said before, I deny that, *if the Earth were to move and the Sun to stand still, the Holy Spirit would not on that account be moved* — but only by accident (which things known by the natural light are able to be revealed by God beforehand, or [are] by accident useful to natural knowledge), [and] the theologians say that the faith [resting] by accident, and equally to be believed, [does not] depend (which things that are *per se* of faith because of the identity of the formal motive — namely the Authority of God speaking — would have revealed [it], He would have foreseen that there would be many who, on this account, would withdraw their understanding from the obedience of faith) — though learned and skilled men will recognize this, and not without difficulty, so that they hold it; nor does it conflict with truth, and indeed it is hardly more difficult [to grant] that it accords not only with the Copernicans but also with the Tychonics, and with most astronomers — even the semi-physicists — readily to grasp the motion of the Earth, especially the diurnal, and the one already proposed by Pythagoras, Philolaus, and the ancients of this sect: not only [its] followers, but even Ptolemy and others would have grasped its form as [their] motion.

28. Nor, indeed, as they [the Copernicans] seem to suppose in this, [does it follow that] the Sacred Scripture is written for the common people, either because the very great mass of the common people, or [those of them] who are most uncultured, do not know letters, or [know] only the vernacular tongue; but

Scripture is grasped by [those] skilled in the Law and by Teachers, and by Doctors of the people, who, first taught by the Holy Spirit, then instruct the common folk. Therefore God ought not, on account of the lack of skill in the common people — in those things in which it is deceived by sense — to assert falsely along with the common people, and to confirm that falsehood by the weight of its [the common people's] authority; nor, [warned] by the apprehension of the lack of skill, [to use] the formulas of his own divine manner of speaking, but out of the decency of his Majesty greatly to beware, lest he ever be detected of having said something false; lest the testimony...

of his testimony be sealed by his own seal, and to confirm an assertion as true that is in fact, as to its appearance, absolutely false. Indeed, since he best foreknew things to come — lest at length he be discovered, by the common people, to have fallen into the motion of the Sun (if the Sun truly were not to move, but the Earth) — he could, given a hypothesis of this kind, and many others into his own opinion adduce novelty; or, given the evidence, [there might arise] a great difficulty of teaching: he could, indeed he ought to, assert this very truth in divine letters — yet still abstain from adding the contrary [opinion]; or, in supposing the contrary falsehood, [he ought] not to propose it expressly to those unskilled, lest, an opinion being held that is difficult to grasp — and the falsehood being asserted in opposition — he should know that to be false, but for that very reason speak so [as the common people speak], and not in greater proportion [to their grasp] than the most unskilled would — being skilled by his own testimony in [the] genius of falsehood. To me, who am a little man, such forms of speaking are not lacking; nor does God supply them. Do I give an example? When Christ said: *Who maketh his Sun to rise upon the good and the bad* (Matthew 5) [Matthew 5:45] — if the Sun did not truly move, he would speak [thus]: *Who maketh? And the Sun and its light are enjoyed by the good and the bad*. Likewise, when Joshua said in the Sacred Scripture: *It stood; the Sun did not set* [Joshua 10:13]: if it set not, he would speak [thus]: *the light of the Sun upon the earth, nor was [it] done so; nor [was] that prolonging of one day* [the prolongation of that single day]...

For so speaking, and having accommodated himself to the grasp of Joshua, or of the people who could form some common estimation of the Sun's motion, [Joshua] said *Stand, Sun*, although there is another version, or [reading]: *Move not, Sun* — [yet] the Sun does not move; but the falsehood [thus] not spoken, nor [is] the lack of skill in such things to be given as a most pernicious occasion of controversy; nor yet, [even] in these things said by him, [is it] to be spoken according to mere appearance, and not according to truth, and accordingly never

[should] human understanding [be set up] as the authority of [the] diviners in their assertion.

29. I reply therefore, second, more briefly: by denying that the Sacred Scripture asserts the false proposition as true, but [asserts it] only as to appearance — yet, [as] true, it speaks true things, whether in natural matters, or [in matters] of faith, or as accidents [thereof], or in moral matters, or in mysteries, or in dogmas, which are *per se* of faith — but [I deny] that it is written and that it speaks things unskilled; on the contrary, I assert that the Sacred Scripture, notwithstanding whatever danger of scandal or incredulity, in these complicated propositions, always speaks the truth, whether properly, or figuratively, as it figures itself to speak — although it sometimes happens that it is uttered with some tacit contradiction, [yet] it never asserts an opposition contrary to the contradiction. Moreover, I say, along with Saint Augustine, Gregory, Thomas Aquinas, and the Catholic theologians, that the Sacred Scripture always [is] first to be understood in its literal sense, insofar as the words sound to the common [reader] — when there is no manifest inconvenience in their being taken so. Just as in the proposed controversy, since by no one has it yet been demonstrated that the Earth moves, and [that] the Sun's immobility, [its] quietness, [is] the opposite — let those followers of the Copernican Revolutions who labor to vend a contrary [view], and the Cartesians [followers] of [the] vortices, to whom most of the experts in physics adhere most vehemently — let René Descartes [Renati de Chartres], a man of sharp genius, in some doctrines acknowledge the judgment, what in others is wished for. The more, therefore, that it has been demonstrated, the more the *per se* has been done — [yet] that the Earth moves is not [demonstrated].

30. I reply, third: by indirectly turning back the argument against the Copernicans thus. If [a matter is] of such great difficulty to grasp [as] the motion of the Earth and the quietness of the Sun is conceived [to be], so that, on account of it, God ought not to have wished to safeguard this truth, but in the opposite [direction] to assert it — much more, then, ought the Copernican novelties of this doctrine to be moderated, and promulgated, the less their authority [is] divine, [and] the greater the human; and [the] greater the liberty of responding, and of despising the human, than the divine. If you say the Copernicans should not be promulgated to the common people, but to those skilled in astronomy — nor [that] this be of their intention, [namely] that they themselves should write so [as to be understood] by the learned [doctors], by the vernacular version, or [in] speech communicated to the unlearned doctors, in which there is danger of falsity and absurdity, and to be feared. And I, in turn, will say that God could

rather, in the sacred letters, express this very doctrine — [if] he meant to indicate his own intention, that he would have promulgated it to learned men [for] those reasons by which it would be persuaded to no one [reading it] next to that very [saying] of the Apostle, 1 Corinthians, Cap. 2 [1 Corinthians 2:6]: *But we speak wisdom...*

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[wisdom] among the perfect, that is, as he expounds in the same place, [the wisdom] of spiritual things; God helping, [those who are] capable: *Not to the animal man who perceiveth not these things which are of the Spirit of God: for it is foolishness to him, and he cannot understand* [1 Corinthians 2:14]. And that [saying] of Christ: *Do not cast your pearls before swine* (Matthew 7) [Matthew 7:6] — *lest they trample them with their feet, and turning upon you, they tear you* [Matthew 7:6]. Was it less permitted to God in this matter than to Copernicus?

Now I come to the particular passages of Scripture, which they emend [or claim] in such a way that they would have it persuade by some other manner — or babble along with the common people — even the false, what is absolutely false, [though it] does not openly appear.

31. They object, second: that the Apostle uses the version of the Seventy [the Septuagint] interpreters, in order to accommodate himself to the Hellenists, although in some places he disagrees, [his] father, why is [it that] he rarely dissents from the Hebrew and Vulgate. I reply by denying that, in passages used in the Gospel, or in Acts, or [in those] from the letters of the Apostles, the Scripture is erroneous — granting that he asserts that the Hebrew is the Vulgate, nor does he affirm; [I say] that S. Luke says: *Who was [the son] of Sala, who was [the son] of Cainan, who was [the son] of Arphaxad* — but the Vulgate, at Genesis 11, has no [Cainan]. Now, the mention made of Arphaxad here, by [the] mediation of Arphaxad, is begotten of Cainan — whence it could be gathered, in the ancient Hebrew [text], that the seventy years which are in other Hebrew copies of the Bibles, by lapse of times, were perhaps omitted by the carelessness of the copyists.

32. They object, second: that [saying] of Matthew 19 [Matthew 19:16]: *Master, what good thing shall I do, that I may have life eternal?* — who said: *And why askest thou me concerning the good? One is good, God; if thou wilt enter into life, keep the commandments* [Matthew 19:17]. Here Wittich [thinks] that Christ denies himself to be good, because he knows himself to be good — namely, because, in the estimation of the questioner, there was not yet [the recognition] that he is

good, nor [that] he affirmed [himself good], because, in the estimation of the [questioner], from the words spoken in the duplex effect: the prior indeed, [that] when he asks for the good thing necessary to be done — *And [why] do you say [Greek: ἀγαθόν (agathon, "good")]*? — [Greek: τι με λεγεις ἀγαθόν (ti me legeis agathon, "why do you call me good?")] — what do you say [is] good, namely the master, as if you said: "you call me a better master than [other] men, but you have not given me [the] commands to be kept; and differently I [will say] to you, [that] life eternal I am able to obtain, if you wish this opinion to be held" — you are deceived; for one only is [the] good Master, [namely] God, and therefore keep the commands which he has given. The other sense is: But why dost thou call [me] the absolutely good master, when [me] men in their estimation, [but] not absolutely [good], you say [me]? — if thou call [me] God, or thou ceaseest to call me good absolutely.

33. They object, fourth: *And Herod the king heard* (Mark 6) [Mark 6:14]. But here Herod was the brother of Philip, whose wife he took, and [who is called] Tetrarch of Galilee, not King — but he is called king (Mark 3 and Matthew 14). I reply by denying that he was not a king, since [Scripture] said it [thus], although in a fourth part [only] of the Kingdom — nor do those two appellations conflict, *King* and *Tetrarch*; for the same S. Matthew, Cap. 14, who first called him Tetrarch, afterwards calls him king: *And he made the king sorrowful* [Mark 6:26], etc. For Augustus Herod the Great, in a fourfold part [of the kingdom] dividing [it], gave [it] to Archelaus, [and] to Philip, [whom] they call Herod [as] Antipas; yet he attributes [the title] to him, nor was anyone able to constitute them king — nay, all to whom he would have made [the] kingdom should be called king without contradiction; among the Jews, however, he was held for a king, and bore himself toward the kingdom — and by paternal natural right, [though] not by Roman right [it was] permitted [him], [for] he was king by imperial right.

34. They object, fourth: those words of Christ (Luke 5) [Luke 5:4], where he seems to speak according to the common estimation of the sea: *Launch out into the deep* [Luke 5:4] — where the deep sea seems higher than the very shore. I reply: the deep sea, distant from land, appears to sense higher than the shore itself; this happens because, the water being deeper, [though] near the shore, where there is a greater plenty of fish — and conveniently for letting down the net more deeply, Christ required [it] — that, without any miracle, there the fish might be driven into the net, where they were sought. The altitude [or height] here signifies the depth rather than [that] it needs to be proved by Grammarians; and there is another cause [why] the deep sea appears more distant: not so much [that] it appears higher by reason of [the laws of] optics, but also [that] it truly is so —

namely [that] the eye, accustomed to the level shore, [does] not see by an angle, nor [a sea] rounded; and [yet] the surface of the sea, [if] considered, [is] a plane...

the imagination [being] led on by the shore, and [the sea] cutting [across], at length truly [appears] higher in the surface than [it] is — as such a plane, just as the periphery of a circle is higher than the chord [subtending it] which lies beneath.

But, pressing in the same place, Cap. 5 of Luke [Luke 5:32]: *I came not to call the just, but sinners to penitence* — where the just [are] Pharisees, in the estimation of [the] common people; the just are called [just], not according to the truth of the thing, but according to the opinion of them, who esteemed themselves just, and despised the rest. I reply by denying that Christ asserts the Pharisees to be just — but he says only that he came to call sinners to penitence, not the just; just as when a Physician [comes] to heal the sick, not the sound — for as he himself affirms, *the sound have no need of a physician, but they that are sick* [Mark 2:17] — or [that he came] to decree something else, except the just, who [are] not [just]. Therefore, with many adults excepted (his most Holy Mother, and S. John the Baptist), [who] were sinless and needed no penitence, he came to call all to penitence; and therefore Luke 13: *Unless you do penance, you shall all likewise perish* [Luke 13:3]; for, as the Apostle says, *And they have sinned* (Romans 3) [Romans 3:23]: *All have sinned and need the glory of God* [Romans 3:23]. Therefore the Pharisees thought themselves to be just, [but] not on that account did Christ confirm them, [as if] they [were] just according to [their] opinion; he spoke according to opinion.

35. Does not the Apostle, 2 Corinthians 4 [recte 2 Corinthians 4:4], say: *The God of this world hath blinded the minds of unbelievers* — calling the Devil "the God of this world," according to the opinion of the gentiles, who worshipped demons as evil [ones] and as Gods? I reply: that blinding, although insofar as it proceeded from a gross ignorance, or from depraved dispositions, or [from] some preceding fault, was [the work] of the Devil, as instigating to sin; nevertheless [it was permitted by God] to sin, [and] God by his just judgment denying [them] the abundant light — [yet] grace not being denied as sufficient. How is the blinding attributed to God indeed by Christ himself, John 12 [John 12:40], confirming [the saying] of Isaiah [Isaiah 6:10]: *Blind their eyes, and harden their heart, that they may not see*, etc.?

36. They object at last — that I may pass over the lighter [objections] — Wittich [adduces] the saying of the Apostle to the Hebrews 7, on Melchisedech [Hebrews 7:3]: *Without father, without mother, without genealogy; having neither beginning*

of days, nor end of life — [Scripture] likening [him] also to the Son of God, [and saying he] *remaineth a priest forever* [Hebrews 7:3]. But [Melchisedech] doubtless had a father and a mother, and a beginning of days; therefore those things cannot be received according to truth, but according to opinion, and the notice of them, as a matter, etc. Or, because [their] origin is unknown — and a genealogy of Melchisedech, [which] those who think [it] is [unknown], etc. I reply by denying that the Apostle, in that place, spoke according to opinion — perhaps no one of the Hebrews was able to write of it; the most lying [genealogist] had it [as] uncertain, [or] explicate his own destruction, in these words: *Whose generation [Scripture] never numbereth among them*; for the tithes were taken from Abraham. Since therefore his genealogy is not recent, [it is] in the sacred letters, just as of other Patriarchs, nor of [the] times of death — therefore for that reason, by some saying [or rule], but with a grain of salt to be understood, [Scripture] said of [his] father, etc.; and because that figure of the eternal Priesthood of Christ [was made] — but the figure imperfect, because Melchisedech died at length, yet, suggesting [what] the Apostle [says] of Christ: *Made priests, the more they were, because by death they were prevented from continuing* (Hebrews 7) [Hebrews 7:23] — but Christ, because *he continueth forever, hath an everlasting priesthood* [Hebrews 7:24].

37. *Objections sought from Reason*, [which I treat] now in a single [place] in the *New Almagest (Almagestum Novum)*, Book 9, Sectio 4 [*Almag. Nov. IX.4*]; nor among recent followers of Copernicus do I find any new argument that I have not already refuted — much less [one] that I should refute. For [there is] that ancient [argument], drawn from the excessive velocity of the fixed stars: I see [it] inculcated by Jacob van Lansbergen [Iacobo Lansbergio], and tossed about by him for [something] *infallible*; and I have experienced this very argument [in] a certain Catholic Knight, an Angel — a man of great judgment here at Bologna, and of [keen] genius, [who] was greatly moved in the Copernican hypothesis very much, [as] proposing this very [argument] persuaded him, and showing how it pressed [him], [though] light. Suppose, then, that Jacob van Lansbergen [Lansbergius] places the fixed stars distant from the Earth by 10,302,927 [recte 10,302,927] semidiameters of the earth; whence it is gathered [that] the fixed stars [run through], in 24 hours, [as] the whole periphery [they] absolve, [in] one [hour] in one second of the hour, that is, in that very instant [or] blow [of time], traverse [Greek: not present] German miles 643,848 — *which*, he says, is *impossible*, because, *since there is no proportion between a moment of time, and a swift motion of a physical body*: from this it seems [he wishes] to indicate that such a motion [is] made in an instant; [yet] he wished to indicate the very motion

of the fixed stars in one second; [and] he wished there to be no difference between a moment of time, and...

time, [in] which only the space might be traversed; or [that] that motion would be made in an instant, [and] not made in a swifter physical [time] than if it were made in one second of the hour. As if we could not discern the time in one second [as] shorter; when nevertheless, as is said in *Almagest*, Book 2, Cap. 10, Proposition 13 [*Almag. Nov.* II.10, prop. 13], we have a pendulum whose single vibrations are absolved within 10" [10 seconds]. But I argue: I deny *à peri-* [the conclusion] to be impossible, [that] a physical body in one second of the hour traverse 643,848 German miles. I deny again that this velocity is disproportionate to a physical body, if this be made to agree by [its] motion with the motion about the center of its circle, and from the very distance from the center. Because, from one part [of] the circumference of diverse circles among themselves, they are as the Diameters, and accordingly as the semidiameters, [as is shown] from Theorem 5, Book 11 [Elements XI], [and from the] collection of Pappus of Alexandria [Pappi Alexandrini]; and from the other, as is demonstrated by Clavius [Claudio] in the *Sphaera*, [that] the arcs of several circles described from the same center, and [described] by the same straight lines drawn from the center, are like [arcs] among themselves.

Thus, if any one of these arcs is a sixth part of its periphery, the rest also will be each a sixth of their [own] periphery. Whence it follows that such arcs are proportional to the semidiameters, or to the distances from the center. Let there be described, then, from the same center of the world, the Equator of the terrestrial Sphere, [and] the Equator of the Sphere of the Fixed [stars], [each] by a finite interval; and let us imagine both Spheres to be moved by a diurnal motion; and let the semidiameter of the Earth be 860 German miles; and therefore, [in] one second of the hour, the terrestrial Equator [passes through] a small arc which it traverses [in] 15''' [fifteen thirds], that is, the tenth part of one-sixth of one German mile, [as measured] by Geometric paces. Let there be on the other part the semidiameter of the Equator of the Fixed [stars], of 8,600,000,000 German miles. For, as the Radius 10,000,000 [is] to 15" [the second], [so is the] Chord 720 [imperceptibly less than its arc], [in] this [proportion as] 8,600,000,000 [is] to 619,200 miles. I say that the same proportion [holds] between this arc, and the distance of the Fixed [stars] from the center, which is between the part [of] 16 German miles, or the semidiameter of the Earth, [and] of the foresaid distance 8,600,000,000; thus 860 [is] to [619,200], which [is] reduced to the smallest fraction $\frac{5321300}{10000}$, which reckons the minimal fraction $\frac{4}{5}$. But our imaginations, [being] narrow, do not comprehend that number of 619,200 [miles to be] traversed in one

second; it seems incomprehensible; yet it behooves [us] to consider, [as] Atlas [might say to] that [man] whom I would call a Giant, of what kind and how great [the] paces would agree, [in order] to comprehend the traversal of an arc by one second of the hour — and [that] those German miles, [being] 25 [to a] celestial part, are not to be esteemed less impossible [a] motion of such kind, [than it is] possible [that] lightning [traverse] in one second of time 24,000,000 ant-like steps; if we suppose [the] arc to be some German mile, namely a tenth [part] of an arc, [it is] possible to absolve one German mile, that is the Italic [mile], [as a] strong [pace]; and [in] one second of an arc not to absolve [even] the hundredth part of an uncial [particle] of one foot. Therefore Wittich [Vuittichius], and some others of the Copernicans, [who have] confessed this to be the argument against the velocity of the Fixed [stars], [is] no more valid than the Ptolemaic argument against the Copernicans, [which is drawn] from the immense distance of the Fixed [stars]; than which this hypothesis...

requires, that the whole orb of the Annual [orbit] with respect to the Sphere of the Fixed [stars] be as a point.

34. [recte: a misnumbered §34 — the preceding sections ran 27–37; this Arabic "34" in the margin appears to mark a new sub-argument. See QA.] After I had written these things — behold, [there came] to me a Letter, given the 28th of December in the Year 1660, [from the] Most Reverend and Most Learned Juan Caramuel y Lobkowitz [Io. Caramuelis], Bishop of Campania, [a Letter] full of Galilean friendships, and the contribution of D. Pironi [D. Pironi]; who, from Galilean friendships, [was] anxious; this concerned the supreme [matters], being thrust upon me. There is [a difficulty] concerning the supreme [star] of the front of Scorpio, [a] little star which, as I have often observed, in [its] interval, the Sun being [near] about [its] end [of the sign?], being turned [Greek: not present], appears somewhat greater than the stated star — greater, [the interval] being then about 5'; but when the Sun is at the end of Aquarius, it appears about 4'. And so this interval then appears about 5'. But when the Sun is [under] the end of Aquarius [sub fine Aquarii], on the 22nd of February in the Year 1644, I estimated the interval of the stated stars [at] a third part of the diameter of the greater star — and equal to the diameter of the lesser star, this [being] 1'·10"; and so this interval is the less, [by] the whole 3'·40". So great would be the parallax of the stated stars. The Observations were made with a good Telescope, and Most Reverend Caramuel was present with me. *If the Telescope deceived [me], let these stars always appear equidistant: they do Not appear equidistant; therefore the Earth would move. From the [varying] interval of the Copernicans, [it may be argued] whence the annual motion of the Earth could [be persuaded] — not only [is]*

the annual motion of the Earth persuaded, but even the distance whence the very distance [is derived]: weigh this hypothesis well, not as [a] thesis [I] put forward, [but] weigh the argument, and consider what you judge; this little reasoning seems to need [a] solution.

I replied at once that those observations [were] for themselves, and [for] the Copernican hypothesis, contradictory. For if, in the approach of the Earth toward the supreme [star] of the front of Scorpio, [its] distance [were] 4'; and its interval [were] nearer [to] the second little star [by] 5'; [it would be] indeed [that] in the recession of the Earth, whence [it is that] the diameters apparent of the Fixed [stars] ought proportionally to decrease optically — [both] the diameter apparent of the Fixed [stars], [and] their interval among themselves — [yet] if the supreme [star] of the front of Scorpio always appears greater, [and its] interval [greater]: in the other case, if the interval be decreasing, [yet] the apparent diameters of these stars not decrease, we would have hence no argument of the approach of the Earth [toward], [and its] recession [from], [the stars]; since, the alternate annual approach being necessary, or [the alternate] reason [why] the interval [of] the stars varies optically — but rather [that] the Earth, [being] immune from the annual motion; and on the contrary [that] the motion of these very Fixed [stars] [varies] among themselves, [their] interval varying, what [an] illusory [thing] you maintain, [namely] their interval to be decreasing [in] one second; [and] their diameter [as] of itself, or, the diameter of the Fixed [stars] not decreasing — [yet] we would have no argument hence of the approach of the Earth.

Whatever [the case], indeed, and however much potent the Telescope you use, never, after some months — even [if] for certain you could discern [it] by the inner [reaches] of the Fixed [stars] — [could] their interval decrease [by] one second; when within the same hour they consist in the same quantity, even by the optic diameter of the Fixed [stars], because the very thing about which it is doubted [is] within one second. Nor [is there] anything here [whereby] we [might] say of the diverse aspect [of the air], and of the wintry constitution of the [winter] air, to which so great a variety could be referred. Let the lovers of the Copernican hypothesis therefore beware, lest by fallacious observations they impose so great a mass of new hypotheses [upon us], and [these] so [much] repugnant to Copernicus himself.

LIBER SECUNDUS [BOOK TWO]

SECOND BOOK

IN WHICH SELECT OBSERVATIONS OF ECLIPSES OF THE MOON AND OF THE SUN

are gathered, for establishing the lunisolar motions and the first inequality of the Moon, and for fixing the limits of the apparent diameters of the luminaries.

CHAPTER I.

On the selection and use of observed eclipses for establishing and verifying the astronomical tables; and on the assumed distances of meridians in the more celebrated tables.

1. As we set out at length in Book 5 of the *Almagestum Novum*, we reviewed very many observations of eclipses from the year 772 before the Epoch of Christ down to the year of Christ 1647 (chapter 19); and in an appendix to that same chapter — which stands at the end of the first volume — we added still others down to the year 1659, and yet others afterward down to the year 1657. These we either observed ourselves, or received as observed by others, and we found certain ones in the Lodi tables of Father Jacobus Billy [Jacques de Billy] of our Society, and likewise in Pierre Gassendi [Petro Gassendo] in his *Epicurus*, page 886. Not all of these, however, are to be recalled here, but only as many as are needed, whose observed magnitude — or at least the determined mark of time, not only as to the day but also as to the hours and their fractions — is sufficient. For those alone are suitable for establishing and verifying the lunisolar motions and the diameters. On this occasion we have corrected, either through faulty figures of the typesetters or even through our own in the days, in which we had followed Petavius [Petauium], Scaliger [Scaligerum], Mulerius [Mulerium], Copernicus, and Boulliau [Bullialdum], but afterward, the error of certain of them being recognized, we abandoned them.
2. Would indeed that all the aforesaid eclipses, however great their magnitude and however precise the mark of their time, were apt to attain that exactness which the more recent astronomers aim at. But to profess

sincerely how the matter stands: not many suitable for this business can be found, chiefly on account of the difficulty of observing exactly the beginnings and ends of eclipses, and their magnitudes — especially those before the use of the telescope, which it was not granted even to Tycho [Tycho[ni]] to enjoy — and for other reasons, to be set out in chapter 4.

3. Furthermore, so that it may be more readily established whether a discrepancy of the calculation arises from a mere difference of longitude, or rather from elsewhere, it must be investigated; and we set out beforehand the distance of the meridians which the authors of the calculation assume, and which must be applied in the observations; and it will also serve, if anyone in the History of Eclipses should at once wish to know in a learned manner the time at which the appearances ought to have occurred in other places.

ALPHONSINE [Tables]

*The Toledo Tables [Tabulae Toletō] **add** for transferring the calculation to other places, but **subtract** for transferring phenomena from other places to TOLEDO.*

(Reference meridian: Toledo)

Places more to the east [Loca Orientaliora]:

Place	H.	M.
Alexandria Aegyp[ti]	2	42
Argentina	1	12
Augusta Vindel[icorum]	1	34
Auenio	0	52
Byzantium	2	36
Brixia	1	32
Bruga	0	48
Brundusium	2	4
Buda	2	14
Carthago	2	20
Caesaraugusta	0	20
Colonia Agrip[pina]	1	11
Constantia	1	14

Place	H.	M.
Cracouia	2	20
Cremona	1	20
Damascus	3	15
Dantiscum	2	20
Erfordia	1	28
Florentia	1	34
Gandauum	1	0

ALPHONSINE Tables — continued (page 93, body folio 93)

Places more to the east [Loca Orientaliora] (continued):

Place	H.	M.
Genua	1	20
Granata	0	18
Herbipolis	1	20
Hierusalem	3	0
Ingolstadium	1	28
Lipsia	1	34
Lubeca	1	40
Lugdunum	0	53
Lutetia Parisior[um]	0	54
Machlinia	1	0
Maiorica	0	10
Mantua	1	20
Massilia	0	56
Mediolanum	1	24
Moguntia	1	9
Narbona	0	51
Neapolis	2	0
Norimberga	1	24
Oxonium	0	32
Patauium	1	34

Place	H.	M.
Praga	1	48
Roma	1	40
Rothomagum	0	51
Salisburgum	1	36
Tarentum	2	8
Taurinum	1	22
Traiectum	1	12
Venetia	1	34
Vienna Galliae	0	54
Vienna Pannon[iae]	1	39
Vlma	1	24
Vratislauia	2	4

[Toledo Tables:] subtract for the calculation, and add for transferring the appearances.

Places more to the west [Loca Occid(entaliora)]:

Place	H.	M.
Compostella	0	3
Corduba	0	3
Vlyssippo	0	16

PRUTENIC [Tables]

The Tables add for transferring the calculation from KÖNIGSBERG [Regiomonte] of Prussia to other places, [and] subtract for transferring phenomena from other places to KÖNIGSBERG [Regium Montem].

(Reference meridian: Königsberg / Regiomontium)

Places more to the east [Loca Orientaliora Regiomonti]:

Place	H.	M.
Alexandria Aegyp[ti]	0	55
Athenae	0	42
Babylon	1	45

Place	H.	M.
Calecutum	4	21
Constantinopolis	0	37
Hierosolyma	1	17
Leoburgum Russ[iae]	0	8
Riga Liuonia	0	28
Reualia	0	30
Stokolmia	0	1
Viburgum Finland[iae]	0	57

*[Prutenic Tables:] **subtract** for transferring the calculation from KÖNIGSBERG to these other places; but **add** for transferring phenomena from elsewhere to KÖNIGSBERG [Regium Montem].*

Places more to the west [Loca Occidentaliora]:

Place	H.	M.
Antuerpia	1	26
Augusta Vind[elicorum]	0	55
Auenio	1	21
Bamberga	0	55
Barcino	1	35
Basilea	1	11
Bononia	1	51
Brema	1	7
Buda	0	19
Colonia Agrip[pina]	1	13
Compostellum	2	22
Constantia	1	3
Corduba	2	15
Cracouia	0	5
Dantiscum	0	10
Erfordia	0	54
Ferraria	0	52

Place	H.	M.
Florentia	0	51
Francford.Man	1	5
Francford.Odera	0	37
Friburgum	1	15
Fruemburgum	0	5
Gandauum	1	31
Genua	1	2
Haphnia	0	25
Hidelberga	0	4
Herbipolis	0	59
Ingolstadium	0	53
Lipsia	0	48
Lisbona	2	26
Londinum	1	50
Louanium	1	24
Lubecca	0	55
Lugdunum Gall	1	23
Lutetia Paris	1	35
Machlinia	1	25
Massilia	1	18
Mediolanum	1	1
Moguntia	1	7
Neapolis	0	30
Norimberga	0	54
Oenipontum	0	47
Praga	0	40
Ratisbona	0	49
Roma	0	42
Rostochium	0	49
Rothomagum	1	41
Salisburgum	0	46

Place	H.	M.
Salueldia	0	52
Stetinum	0	36
Tolosa	1	33
Toletum	2	5
Tubinga	1	3
Venetia	0	50
Vienna Pann	0	29
Vlma	0	59
Vratislauia	0	30

DANISH [Tables]

*The Tables **add** for transferring the calculation from COPENHAGEN [Hafnia], and subtract for transferring the phenomena to COPENHAGEN [Hafniam].*

(Reference meridian: Copenhagen / Hafnia)

*[The Danish Tables] **subtract** for the translation of the calculation to the other places written below, and **add** for transferring the phenomena from other places to COPENHAGEN [Hafniam].*

Places more to the east, [referred to] Copenhagen [Loca Orientaliora Hafniâ]:

Place	H.	M.
Alemaria	0	36
Amsterodamum	0	34
Antuerpia	0	36
Augusta Vindel[icorum]	0	6
Basilaea	0	21
Bamberga	0	6
Berna	0	22
Bononia	0	1
Bruxella	0	37
Cassella	0	13
Colonia	0	25

Place	H.	M.
Complutum	1	12
Compostella	1	40
Corduba	0	20
Constantia	0	14
Dauentria	0	29
Erfordia	0	5
Ferraria	0	1
Florentia	0	0
Francofordia Moeni	0	18
Friburgum	0	24
Geneua	0	10
Genua	0	12
Gandauum	0	40
Granata	1	14
Groninga	0	28
Hafnia	0	0
Hamburgum	0	12
Hidelberga	0	18
Hispalis	1	26
Ingolstadium	0	4
Lipsia	0	0
Lubeca	0	7
Lucerna	0	19
Lutetia Paris[iorum]	0	49
Londinum	0	50
Leyda	0	37
Mantua	0	6
Mansfeldia	0	3
Massilia	0	34
Middelburgum	0	40
Monachium	0	3

Place	H.	M.
Monasterium	0	22
Narbona	0	46
Nidrosia	0	11
Norimberga	0	6
Osnabruga	0	20
Patauium	0	1
Pisa	0	4
Toletum	1	16
Tubinga	0	15
Valentia	0	58
Venetiae	0	6
Vienna Austr[iae]	0	19
Vlma	0	10
Vlyssippo	1	19
Vuitemberga	0	2

RUDOLPHINE [Tables]

*The Tables **add** for the translation of the calculation from URANIBORG [Vraniburgo] to these other places, but **subtract** for transferring the phenomena from elsewhere to URANIBORG [Vraniburgum].*

(Reference meridian: Uraniborg / Vraniburgum)

[Places, page 93 portion — eastern]:

Place	H.	M.
Alexandria Aegyp[ti]	1	48
Antiochia ad Taurum	2	18
Antiochia ad Orontem	2	13
Aracta	2	28
Arbela	2	56

RUDOLPHINE Tables — continued (page 94, body folio 94)

Places more to the east, [referred to] Uraniborg [Loca Orientaliora Vraniburgi]:

Place	H.	M.
Athena	1	2
Babylon	2	51
Benatica Bohemia	0	8
Cayrum	1	56
Constantinopolis	1	28
Cracouia	0	31
Dantiscum	0	28
Francofordia Odera	0	8
Fruemburgum	0	32
Goa	4	58
Gratium Styriae	0	14
Hierosolyma	2	16
Lincium Austr[iae]	0	10
Macaeum	7	30
Mons Regius Pruss[iae]	0	38
Neapolis	0	8
Praga	0	6
Rhodus	1	36
Roma	0	0
Rossokium	0	0
Smyrna	1	25
Stetianum	0	8
Vienna Aust[riae]	0	16

*[The Rudolphine Tables] **subtract** for the translation of the calculation to the other places, and **add** for transferring the phenomena from elsewhere to URANIBORG [Vraniburgum].*

**Places more to the west, [referred to] Uraniborg [Loca Occidentalia
Vraniburgi]:**

Place	H.	M.
Amstelodamum	0	29
Antuerpia	0	32
Aquisgranum	0	24
Auenio	0	30
Augusta Vind[elicorum]	0	4
Bononia	0	7
Bruxella	0	32
Cartago	0	9
Cassela	0	13
Colonia Agrip[pina]	0	22
Compostella	1	28
Conimbrica	1	25
Franechera	0	27
Florentia	0	7
Forcalcarium	0	27
Genua	0	16
Hafnia	0	1
Hidelberga	0	14
Herca	0	32
Ingolstadium	0	2
Dinia	0	24
Valentia Gall[iae]	0	38
Leodium	0	26
Lipsia	0	1
Londinum	0	48
Louanium	0	30
Leyda	0	31
Lugdunum Gall[iae]	0	28
Machlinia	0	32

Place	H.	M.
Massilia	0	28
Mediolanum	0	15
Norimberga	0	4
Oxonium	0	53
Parisii	0	40
Patauium	0	4
Pisa	0	10
Studgardia	0	12
Toletum	1	4
Tridentum	0	6
Tubinga	0	12
Viterbium	0	3
Venetia	0	2
Vlyssippo	1	26

LANSBERGIAN [Tables]

*The Tables **add** to the meridian of GOES [Goesae] for the translation of the calculation to other places: but **subtract** for transferring the phenomena from elsewhere to GOES [Goesam].*

(Reference meridian: Goes / Goesa)

Places more to the east, [referred to] Goes [Loca Orientaliora Goesâ]:

Place	H.	M.
Alexandria Aegyp[ti]	2	20
Amsterodamum	0	4
Antiochia Syriae	3	17
Antuerpia	0	2
Aquae sextiae	0	6
Aquisgranum	0	8
Aracta	3	27
Athena	1	50
Augusta Vind[elicorum]	0	31

Place	H.	M.
Babylon	3	12
Bononia	0	36
Bruxella	0	2
Cassella	0	19
Colonia Agrip[pina]	0	11
Cracouia	1	22
Dantiscum	1	16
Francofurti Moen[i]	0	16
Francofurt[i] Oderae	0	56
Franequera	0	7
Fruemburgum	1	22
Goa	5	22
Gratium	0	55
Haphnia	0	45
Hierosolyma	3	0
Ingolstadium	0	34
Leyda	0	3
Lipsia	0	36
Louanium	0	4
Lugdunum Gall[iae]	0	3
Massilia	0	5
Mediolanum	0	22
Mons Regius Pruss[iae]	1	22
Neapolis	0	51
Norimberga	0	33
Patauium	0	34
Praga	0	44
Rhodus	2	10
Roma	0	43
Rostochium	0	37
Sardes Lydiae	2	14

Place	H.	M.
Stetinum	0	45
Tubinga	0	22
Venetia	0	37
Vienna Austr[iae]	0	54
Viterbium	0	40
Vraniburgum	0	45

*[The Lansbergian Tables] **subtract** for the translation of the calculation to the other places, and **add** for transferring the phenomena. [to] GOES [Goesam].*

Places more to the west, [referred to] Goes [Loca Occidental(iora)]:

Place	H.	M.
Compostella	1	1
Conimbrica	1	9
Londinum	0	20
Oxonium	0	24
Parisii	0	9
Toletum	0	42
Vlyssippo	0	56

PARISIAN [Tables]

*The Tables of Petavius [Petauij] **add** for the translation of the calculation to other places [than] PARIS [Parisiis]; but they **subtract** for transferring the phenomena from elsewhere to PARIS [Parisios].*

(Reference meridian: Paris / Parisii)

Places more to the east, [referred to] Paris [Loca Orient(aliora) Parisii]:

Place	H.	M.
Alexandria Aegyp[ti]	2	26
Aracta Syriae	3	6
Arbela	3	44
Athenae	1	52
Babylon	3	16

Place	H.	M.
Constantinopolis	2	8
Fruemburgum	1	26
Goa	6	10
Hierosolyma	2	48
Mons Regius Pruss[iae]	1	31
Colonia Agrip[pina]	0	26
Hafnia	0	51
Goesa	0	6
Lugdunum Gall[iae]	0	3
Mediolanum	0	28
Neapolis	0	52
Norimberga	0	45
Patauium	0	35
Praga	0	58
Roma	0	50
Venetia	0	40
Vienna Austr[iae]	0	55
Vraniburgum	0	51

*[The Parisian Tables] **subtract** for the translation of the calculation [to] other places, and **add** for transferring the phenomena. [to] PARIS [Parisios].*

Places more to the west [Loca Occ(identaliora)]:

Place	H.	M.
Compostella	0	55
Conimbrica	1	15
Toletum	0	56
Vlyssippo	0	58

ATLANTIC [Tables]

*The Tables of Wendelen [Vuendelini] **add** for the translation of the calculation from the ATLANTIC Meridian [Meridiano ATLANTICO] — drawn through the middle of*

*Iceland — to other places; and they **subtract** for transferring the phenomena from elsewhere to the ATLANTIC Meridian [Meridianum ATLANTICUM].*

(Reference meridian: the Atlantic meridian, through the middle of Iceland)

Places more to the east [Loca Orientaliora]:

Place	H.	M.
Aleppum Syriae	3	52 $\frac{2}{3}$
Alexandr[ia] Aegyp[ti]	3	36
Amsterodamum	1	51 $\frac{1}{2}$
Antuerpia	1	42 $\frac{2}{3}$
Aquae sextiae	1	49
Babylon Antiqua	4	25
Bethasy	1	53
Bruxella	1	59
Cabirum	3	41
Cassella	2	13
Colonia	2	4
Dinia	1	53 $\frac{2}{3}$
Franechera	1	54
Francofurtum Oderae	2	27
Forcalcarium	1	50 $\frac{2}{3}$
Goesa	1	46 $\frac{2}{3}$
Hafnia	2	18
Herca	1	53 $\frac{3}{5}$
Ilerda	1	38
Ingolstadium	2	23
Leodium	1	55 $\frac{2}{3}$
Lincium	2	33
Leyda	1	49 $\frac{1}{2}$
Lugdunum Gall[iae]	1	45
Louanium	1	51
Matrium	1	20

Place	H.	M.
Massilia	1	48 $\frac{2}{3}$
Mechlinia	1	50
Monachium	2	24
Norimberga	2	14 $\frac{3}{4}$
Neapolis	2	26 $\frac{1}{2}$
Parisii	1	35 $\frac{3}{4}$
Praga	2	31 $\frac{1}{4}$
Roma	2	18 $\frac{1}{2}$
Stutkardia	2	6 $\frac{2}{3}$
Toletum	1	18
Tubinga	2	6 $\frac{2}{3}$
Valentia ad Rhodanum	1	44
Verona	2	13
Vuittemberga	2	23

LIBER II — DE LUNA (Book 2 — On the Moon)

The Philolaic Tables [Tabulae Philolaicae]

The tables of Boulliau [Bullialdus, Ismaël Boulliau] **add** for transferring the calculation from Uraniborg to another place, but **subtract** for transferring to Uraniborg phenomena observed elsewhere.

Places east of Uraniborg [Loca Orientaliora Uraniburgo]:

Place	H.	M.
Alchairum [Cairo]	1	26
Alexandria Aegyp. [Alexandria in Egypt]	1	21
Athenae [Athens]	0	45
Babylon vetus [Old Babylon]	2	51
Babylon nova [New Babylon]	2	55
Dantiscum [Danzig]	0	18
Goa	4	12
Haleppum [Aleppo]	1	35

It **subtracts**, however, for the transfer of the calculation, and **adds** for transferring to Uraniborg phenomena observed elsewhere.

Places west of Uraniborg [Loca Occidentalia Uraniburgo]:

Place	H.	M.
Amsterodamum [Amsterdam]	0	29
Antuerpia [Antwerp]	0	33
Aquae Sextiae [Aix-en-Provence]	0	26
Avenio [Avignon]	0	29
Bruxellae [Brussels]	0	34
Cassellae [Kassel]	0	6
Colonia Agrip. [Cologne]	0	17
Dinia [Digne]	0	23
Forcalcarium [Forcalquier]	0	25
Herca	0	27
Leodium [Liège]	0	25
Lovanium [Louvain]	0	30
Leyda [Leiden]	0	31
Massilia [Marseilles]	0	26
Mexicum [Mexico City]	7	40
Matritum [Madrid]	1	11
Tubinga [Tübingen]	0	12
Parisii [Paris]	0	48

The Bononian Tables, or Our Almagestic Tables [Bononienses, seu Almagesticae Nostrae Tabulae]

They **add** for transferring the calculation to another place, but **subtract** for transferring to the Bologna meridian phenomena observed elsewhere, to the Italian meridian of BOLOGNA.

Places east of Bologna [Loca Orientaliora Bononia]:

Place	H.	M.
Aleppum Syr. [Aleppo in Syria]	2	10 $\frac{2}{3}$

Place	H.	M.
Alexandr. Aegyp. [Alexandria in Egypt]	1	32 $\frac{2}{3}$
Antiochia Oront. [Antioch on the Orontes]	2	0
Antiochia Tauri [Antioch of Taurus]	2	9
Aracta	2	12
Athena [Athens]	0	55
Babylon vetus [Old Babylon]	2	27
Babylon nova [New Babylon]	2	26
Benatica arx [?]	0	13
Cairum [Cairo]	1	37
Caput Cumentium in Africa [?]	1	42
Carthago Afr. [Carthage in Africa]	0	1
Constantinopolis [Constantinople]	1	20
Cracovia [Kraków]	0	34
Dantiscum [Danzig]	0	32
Ferraria [Ferrara]	0	1
Florentia [Florence]	0	0 $\frac{1}{2}$
Francofurtum Oderae [Frankfurt an der Oder]	0	14
Fruemburgum [Frauenburg / Frombork]	0	36 $\frac{1}{3}$
Gaugamela	2	33
Goa	4	18
Gratium Styr. [Graz in Styria]	0	20 $\frac{2}{3}$
Hafnia [Copenhagen]	0	5
Hierosolyma [Jerusalem]	1	56
Lincium Austr. [Linz in Austria]	0	13
Lipsia [Leipzig]	0	6
Macaum [Macao]	6	45
Monachium [Munich]	0	0 $\frac{1}{6}$
Neapolis [Naples]	0	16
Nanquinum [Nanjing]	6	56
Panormus [Palermo]	0	7
Praga [Prague]	0	11 $\frac{1}{2}$

Place	H.	M.
Regius Mons Pruss. [Königsberg in Prussia]	0	38
Roma [Rome]	0	7¼
Rostokium [Rostock]	0	4¾
Stettinum [Stettin / Szczecin]	0	14
Smyrna [Smyrna / İzmir]	1	16
Syracusa [Syracuse]	0	16
Varsavia [Warsaw]	0	39
Venetia [Venice]	0	2¾
Vienna Austr. [Vienna in Austria]	0	22
Viterbium [Viterbo]	0	5
Vraniburgum [Uraniborg]	0	5½

It **subtracts**, however, for the transfer of the calculation to more westerly places, and **adds** for transferring to Bologna phenomena observed there.

Places west of Bologna [Loca Occidentalia Bononia]:

Place	H.	M.
Amsterodamum [Amsterdam]	0	26⅓
Angelopolis [Puebla]	7	44
Antuerpia [Antwerp]	0	24¾
Aquae Sextiae [Aix-en-Provence]	0	26
Aquisgranum [Aachen]	0	21
Augusta Vindel. [Augsburg]	0	2½
Bethasi [?]	0	25
Blesa Bloys [Blois]	0	43
Bruxellae [Brussels]	0	25
Cassellae [Kassel]	0	10
Colonia Agr. [Cologne]	0	18
Compostella [Santiago de Compostela]	1	26
Conimbrica [Coimbra]	1	26
Daventria [Deventer]	0	18
Dinia [Digne]	0	22

Place	H.	M.
Eystadium [Eichstätt]	0	4
Forcalcarium [Forcalquier]	0	25
Franequera [Franecker]	0	23
Genua [Genoa]	0	9
Goësa [Goes]	0	31
Gratianopolis [Grenoble]	0	25
Herbipolis [Würzburg]	0	7
Herca	0	25
Ilerda [Lérida]	0	46
Ingolstadium [Ingolstadt]	0	0½
Kebeccum in nova Francia [Quebec in New France]	5	16
Leodium [Liège]	0	23
Lima Peruvii [Lima in Peru]	6	11
Londinum [London]	0	48
Lovanium [Louvain]	0	27⅓
Lugdunum Gall. [Lyon in Gaul]	0	28
Lugdunum Batav. seu Leydem [Leiden]	0	28
Machlinia [Mechelen]	0	28
Maiorica [Majorca]	0	37
Mantua	0	3
Massilia [Marseilles]	0	26
Martinina Insula [Martinique]	4	55
Matritum [Madrid]	1	5
Mediolanum [Milan]	0	9
Mexicum [Mexico City]	7	48
Middelburgum [Middelburg]	0	31
Norimberga [Nuremberg]	0	2⅔
Oenipontum [Innsbruck]	0	0 1/12
Oxonium [Oxford]	0	53
Paderbona [Paderborn]	0	9
Palma Insula [Palma]	2	18

Place	H.	M.
Panoma [?]	6	23
Parisii [Paris]	0	40
Picus Azoridum [Pico in the Azores]	2	53
Pisae [Pisa]	0	1 $\frac{2}{3}$
Portus Vetus [?]	6	25
Toletum [Toledo]	1	6
Tornacum [Tournai]	0	35 $\frac{1}{3}$
Tridentum [Trent]	0	2
Tubinga [Tübingen]	0	10 $\frac{1}{2}$
Valentiola [?]	0	29
Ulyssippo [Lisbon]	1	30

We give a fuller catalogue in the Astronomical and Geographical Tables; but this suffices abundantly for the eclipses observed up to now.

CAPUT II.

ECLIPSES OF THE MOON

Observed as to magnitude and moment, from the year 721 before Christ down to the year of Christ 1660. With the errors or deceptions of others in chronology or in magnitude detected.

ECLIPSIS 1.

[Margin: 721 years before Christ (Anni ante Christum 721)]

In the first year of Mardokempad, that is, the 27th year of Nabonassar, on the 29th day of the month Thoth, on the following night, a total eclipse was observed at Babylon by the Chaldeans, beginning more than one hour after the rising of the Moon. Ptolemy [Ptolemaeus], *Almagest* book 4, chapter 6, says that this beginning was at hour 4 $\frac{1}{2}$, before midnight; and that midnight was at hour 2; 30'; but that at Alexandria the hour was 3; 20'. That day was, by the Julian reckoning, the 19th of March. The years before the common Epoch of Christ: 721.

ECLIPSIS 2.

[Margin: 720] [Margin: *Lansbergen's deception* (Lansbergen. Dolus.)]

In the second year of Mardokempad, that is, the 28th of Nabonassar, on the 18th of Thoth, on the following night, an eclipse of the Moon of 3 digits on the southern side was observed at Babylon at the very middle of the night. Ptolemy, *Almagest* book 4, chapter 6, whose text Lansbergen [Philips van Lansbergen] corrupts in his *Thesaurus*, page 55, by substituting three scruples for the three digits — so that the observation should not damage his own Tables — even though the text expressly reads δακτύλους τρεῖς [Greek: *daktylous treis*, "three digits"]. The day was the 8th, with the 9th of March following, in the year 720 before Christ.

ECLIPSIS 3.

[Margin: 720]

Likewise in the second year of Mardokempad, that is, the 28th of Nabonassar, on the 15th day of Phamenoth, on the following night, the Moon began, after its rising,

[continuation of Eclipsis 3:] to be eclipsed at Babylon, defective by a little more than six digits from the north. Ptolemy, book 4, chapter 6, who computes the middle of this eclipse at hour 8; 3'. It was the 1st day of September, on the following night, in the year 720 before Christ.

ECLIPSIS 4.

[Margin: 621]

In the fifth year of Nabopolassar, that is, the 127th of Nabonassar, on the 27th of Athyr, on the following night, the Moon began to be eclipsed at Babylon below half an hour before midnight — that is, as Ptolemy computes, *Almagest* book 5, chapter 14 [?], at hour 5; 30'. The eclipse reached its greatest extent at one-quarter of the diameter from the south. The day was the 21st, with the 22nd of April following, in the year 621 before Christ. A leap year.

ECLIPSIS 5.

[Margin: 523] [Margin: *Scaliger's error* (Scaligeri error)]

In the seventh year of Cambyses, king of the Persians — not the eighth, as Scaliger [Joseph Scaliger] has it, *De Emendatione Temporum* book 4 — on the 17th of Phamenoth, on the following 18th, the Moon began to be eclipsed at Babylon from the north before midnight by 6 digits. Ptolemy, book 5, chapter 14. The day was the 16th of July, the 17th following, in the year 523 before Christ.

ECLIPSIS 6.

[Margin: 502]

In the twentieth year of Darius Hystaspis, who succeeded Cambyses, that is, the 246th of Nabonassar, on the 28th of Epiphi, on the following 29th, at an hour equal after sunset of 6; 20'. And before midnight the 24th [?]. At Babylon a fourth part of the Moon's diameter was defective from the south. Ptolemy, book 4, chapter 9. The day was the 18th of November, the 19th following, in the year 502 before Christ.

ECLIPSIS 7.

[Margin: 491] [Margin: *Lansbergen's error, or deception?* (Lansbergen. error, an dolus?)]

In the 31st year of Darius the First Hystaspis, that is, the 257th of Nabonassar, on the 3rd of Tybi, on the following 4th, the Moon began to be eclipsed at Babylon in the middle of hour 6 of the night by two digits of diameter from the south. Ptolemy, book 4, chapter 9, who expressly says: "For the middle time of the night preceded the middle of this Babylonian night [by] one hour, at Alexandria, however, by one hour, or the third part of one equal hour." Therefore Lansbergen does not rightly put it at one hour before midnight at Babylon, in his *Thesaurus*, page 61. The day was the 25th of April, in the year 491 before Christ.

ECLIPSIS 8.

[Margin: 383]

In the year 366 of Nabonassar, Phanostratus being Archon at Athens, on the 26th of Thoth, on the following 27th, at hour 3; 30'. In the temporal hour after midnight the eclipse was observed at Babylon — a small eclipse of the Moon at the morning rising, when more than a half of the night remained — and the Moon set still being eclipsed. Ptolemy, book 4, chapter 11, who computes the beginning at the equal hour 6; 36' after midnight at Babylon, and the middle at hour 7; 20'. The day was the 22nd of December, in the year 383 before Christ. See Petavius [Denis Pétau], book 8, *De Doctrina Temporum*, who from the beginning of this calculation shows that the Tables exceed the moment of the observations, namely the Prutenic by 49' [Pruteni... min. 49'], the Alphonsine by 56' [Alphonsinas min. 56'], the Danish by 42' [Danicas 42'], the Parisian by very nearly half a quarter-hour [Parisinas idest fuas min. 14]; for Ptolemy supposes that

Ptolemy [recte: Hipparchus?] timed this eclipse at very nearly half a six-hour-period [sesquihoram ferè]. [?]

ECLIPSIS 9.

[Margin: 382]

In the same year of Phanostratus and of Nabonassar, but now before Christ 382, on the 24th day of Phamenoth, on the following 25th, an eclipse of the Moon was observed at Babylon before midnight, the first part of the night having passed, defective; likewise at the morning rising; the Moon still being eclipsed. Ptolemy, book 4, chapter 11, for which the hour of full moon was 9; 6'. At Babylon. He writes that this eclipse lasted, from the beginning of the observation, hour 7; 36'. The middle is reckoned at hour 13; 36'; but at Hipparchus, hour 13; 46'.

ECLIPSIS 10.

[Margin: 382]

Finally in the same year of Christ, Euander being Governor —

[continuation of Eclipsis 10:] The day was the 5th of April, in the year of Christ 125 [?]. They compute this eclipse otherwise, and it diverges from that observed by Ptolemy. Lansbergen [?].

ECLIPSIS 17.

[Margin: 133]

In the year 17 of Hadrian [Adriani], and the 880th of Nabonassar, on the 20th day of the month Payni, Ptolemy observed at Alexandria a total eclipse of the Moon, whose middle he marks at an equal hour of 45' before midnight. The day was the 6th, the 7th following, of May. Of the years of Christ, 133. This is the first of those three eclipses which we observed most accurately at Alexandria, as Ptolemy himself says there, and he says: "And the true place of the Sun was in Taurus at 13; 14', very nearly."

ECLIPSIS 18.

[Margin: 134]

In the year 19 of Hadrian, but the 882nd of Nabonassar, on the 2nd of Choiak, at hour 11 after the meridian, the Moon began to be eclipsed at Alexandria toward the north by 10 digits, observed and reported by Ptolemy, book 4, chapter 6. The

day was the 21st, the 20th [?] of October following, in the year of Christ 134; "and the true place of the Sun was in Libra at 25; 10', very near to Ptolemy."

ECLIPSIS 19.

[Margin: 136] [Margin: *Copernicus to be corrected* (Copernici emendandum)]

In the year 20 of Hadrian, and the 883rd of Nabonassar, on the 19th day of Pharmuthi, at hour 16 after the meridian, half of the Moon's diameter was obscured from the north at Alexandria, observed and reported by Ptolemy, book 4, chapter 6. The day was the 5th, the 6th of March following, in the year of Christ 136 — not, as Copernicus [Copernicus] erroneously [computes] book 4, chapter 5; the 136th, because the Julian year of Hadrian is to be computed from the 24th of July. Of Christ 117, when his Empire began; and therefore Hadrian enters into the year of Christ 135; the 24th of July. But the year of Nabonassar 883 begins on the 20th of July, and so the 5th day of Pharmuthi falls in the year of Christ 136. A leap year, namely on the 3rd day. And the true place of the Sun was in Pisces at 14; 12', very nearly.

ECLIPSIS 20.

[Margin: 770]

A manuscript Calendar, earlier than the work of Bede [Beda] *De Ratione Temporum*, records an eclipse of the Moon in the year of the Lord 770, on the 15th of February, at hour 3 of the night.

ECLIPSIS 21.

[Margin: 784]

The same Calendar notes another eclipse of the Moon in the year 784, on the 1st of November, at hour about 8.

ECLIPSIS 22.

[Margin: 882]

In the year 1206 from the death of Alexander the Great, which al-Battānī [Albategnius] says, chapter 30 *De Scientia Stellarum*, to have been in the year 1194 of the era of Dhū'l-Qarnayn [Dhilkarnaim]; that is, of al-Battānī. At Aracta [?] in Syria, at the equal hour 8, or a little more than 8, an eclipse of the Moon of more than 10 digits was observed on the 23rd day of the month Kanun. It was the 23rd of July, in the year of Christ 882, because by the same al-Battānī the year of

Nabonassar was 1630, even if Lansbergen should put the year before Christ at 883.

ECLIPSIS 23.

[Margin: 900]

In the year 1224 from the death of Alexander the Great, and 1212 of Dhū'l-Qarnayn, on the night between the second and the third of the month Ab, that is, of August, by al-Battānī at Antioch in Syria, at hour 15; 20' after the meridian, but at Aracta [?] at hour 15; 55', an eclipse of the Moon nearly total was observed. So he himself says, chapter 30 *De Scientia Stellarum*. It was the year of Christ 901.

ECLIPSIS 24.

[Margin: 1457]

In the year of Christ 1457, Johannes Regiomontanus [Regiomontanus], together with his master Georg Peurbach [Georgio Purbachio] at Melk in Austria — which is to the west of Vienna by 11 leucæ of Germany — on the 3rd of September observed the beginning of a lunar and total eclipse, the beginning of the eclipse [being] at the penultimate degree of the Pleiades [Pleiadum] at 22, toward rising, at hour 10; 24' after the meridian, according to Regiomontanus's calculation.

ECLIPSIS 25.

[Margin: 1460]

In the year 1460, on the 3rd of July, Regiomontanus, together with Peurbach [Purbachio], at Vienna observed an eclipse of the Moon of digits a little greater than 4; whose end appeared at hour 4; 18', from which he deduced the end at hour 16; 20' after the meridian — although the Alphonsine calculation should exhibit the end at hour 9; 10'; the middle at hour 8; 13'; and the beginning at hour 8; 16'.

ECLIPSIS 26.

[Margin: 1460]

In the same year, on the same 27th of December at Vienna, a total obscuration was observed; the beginning of the eclipse at Altramech [Aldebaran? / Altramech], that is, at Arcturus [Arcturum] toward rising 7; that is, before the meridian. At the beginning of the duration [mora], a star was high at the same

star at 17; and at the end of the duration 28; from which he deduced the beginning of the duration at hour 12; 47'; the end of the duration at hour 14; 55'.

ECLIPSIS 27.

[Margin: 1461]

In the year 1461, Johannes Regiomontanus, in the town of Vienna in Austria, on the 22nd of June, observed a total eclipse of the Moon, whose beginning appeared at 6; in fine [at the end], indeed, the whole eclipse he saw the Moon high at 17; 30'; and at the Vulture [Vulturem] at 47; 30', from which he deduced the moment of opposition at hour 1; 21' after midnight.

ECLIPSIS 28.

[Margin: 1461]

In the same year Johannes Regiomontanus, at Rome, observed the end of a lunar eclipse, the high star Alhailoth, that is, Capella [Capella], at 41; 30'; Aldebaran [Aldebara], however, [at] 29; from which, the altitude supposed at degrees 42, he gathered the hour at 5; 23' from the meridian; the day was the 14th of December, the 15th following.

ECLIPSIS 29.

[Margin: 1462]

In the year 1462, Johannes Regiomontanus, at Viterbo, on the following night, the 11th, observed on the 1st of June an eclipse of the Moon of 7 digits. Aquila [the Eagle] at 51; toward the West; the high star 14; 48' after the meridian, the middle being taken by conjecture. "I gathered from the places of Aquila by the Tychonic [reckoning], and from the altitude of the pole of Viterbo, at degrees 42; 21'; and from the obliquity of the ecliptic I found the time of this eclipse at hour 14; 37'; 23'; after the meridian at Viterbo."

ECLIPSIS 30.

[Margin: 1464]

In the year 1464, Johannes Regiomontanus observed the beginning of a lunar eclipse, the high Heart of the Scorpion [Cor Scorpii, Antares] toward rising at degrees 12; 45'; the Hydra [Hydra], however, the Heart toward setting at degrees 9; 40'; by the great Quadrant, with all possible diligence. He supposes the altitude

of the pole of Padua [Patavii] at degrees 45; 24'; but by others it seems truer at degrees 45; 31'. The day was the 21st of April.

ECLIPSIS 31.

[Margin: 1471]

In the year 1471, on the 2nd of June, Johannes Regiomontanus, at Nuremberg, observed the beginning of a lunar eclipse, the high Heart of the Scorpion [Cor Scorp̃ii] toward setting at degrees 14; 15'; there were seen, moreover, 4 digits obscured.

ECLIPSIS 32.

[Margin: 1487]

In the year 1487, on the 8th of February, in the morning, Bernhard Walther [Bernardus Vualtherus], at Nuremberg, observed the beginning of a lunar eclipse, at hour very nearly 2 after midnight; the middle, moreover, hour about 5; 47'. The end, however, at hour 5; 20'; and the eclipse [was] made total —

[Margin: Anni Christi]

occurred at 4h 18'. We shall report his words below in Chapter V, number 6.

ECLIPSIS 33.

[Margin: 1500]

In the year 1500, on 5 November (or 6 according to others), Copernicus at Rome — as he records in *De Revolutionibus* IV.14 — observed the middle of the eclipse at 2h after midday, with 10 digits eclipsed from the north.

ECLIPSIS 34.

[Margin: 1504]

In the year 1504, on 29 February, Johannes Stöfler [Johannes Stöffler] at Ulm in Swabia, observing with an astrolabe, recorded the beginning of a lunar eclipse at 11h 48', nearly after midday; while Walther at Nuremberg observed the end of the same eclipse at 15h 7'.

ECLIPSIS 35.

[Margin: 1509]

In the year 1509, on the night following the 2nd day of June, Copernicus at Cracow, at the hour after midday 11h 36', observed the digits eclipsed at the maximum to be 8. He obscures the Moon from the south — so he himself, *De Revolutionibus* IV.14. [Margin: Lansbergii error — Lansbergen's error.] By error Lansbergen sets the hour at 11h 45', contrary to the text of Copernicus, who has it thus: with the equinoctial hours being 1, and three fifths of one hour.

ECLIPSIS 36.

[Margin: 1511]

In the year 1511, on 6 October, Copernicus — as he relates in *De Revolutionibus* IV, ch. 5 — observed at Frauenburg [Frombork] in Prussia a total lunar eclipse, its beginning at 10h 52'. The end he sets at 14h 20'; therefore the middle at 12h 36' after midday.

ECLIPSIS 37.

[Margin: 1522]

In the year 1522, Copernicus at Frauenburg, on the day of 5 September, observed a total lunar eclipse, its beginning at 11h 36', and the middle at 13h 10' after midday. But in the same year 1522, another [eclipse], on 25 August, with 16h 25' having elapsed after midday, as he has it in *De Revolutionibus* IV, ch. 5.

ECLIPSIS 38.

[Margin: 1560]

In the year 1560, on 11 March, Cornelius Gemma at Louvain observed a partial lunar eclipse of nearly 3 digits, its beginning at 15h 40' after midday, and the end at 17h 36'. So he himself, *Cosmocritice* [*De Naturae Divinis Characterismis / Cosmocritica*]; the middle, therefore, at 16h 33'.

ECLIPSIS 39.

[Margin: 1572]

In the year 1572, on 11 June, Maestlin observed a lunar eclipse of 6 digits, although Cornelius Gemma in *Cosmocritice* book 2 affirms that he saw nearly 8 digits.

ECLIPSIS 40.

[Margin: 1573]

In the year 1573, on 8 December, Tycho at Uraniborg observed a total lunar eclipse, determining its middle from the extreme phases at 5h 3' after midday — Tycho vol. 1, *Progymnasmata* pages 114 and Longomontanus, *Astronomia Danica* I, *Theorica de Luna* ch. 2. But Wendelen in his *Eclipses* page 43 computes there the hour at 7h 50' from his own tables, on the suspicion of parallax, since he stretches Tycho's end too far, and thus also the middle.

ECLIPSIS 41.

[Margin: 1576]

In the year 1576, on 7 October, Tycho at Uraniborg observed an eclipse at 11h 22' after midday, as Tycho above; Longomontanus has it at 11h 25'.

ECLIPSIS 42.

[Margin: 1577]

In the year 1577, on 2 April, Tycho at Uraniborg observed a total lunar eclipse, its middle from the extremes at 8h 10', as Tycho above; but Wendelen, there from his own tables, computes the hour at 9h 15', and says that Tycho in Denmark did not see the end except through clouds, and so inferred the middle by guesswork.

ECLIPSIS 43.

[Margin: 1577]

In the year 1577, on 26 September, Tycho at Uraniborg, from the extreme phases observed, determines the middle of the total lunar eclipse at 1h 3' after midday. Tycho as above, whom Wendelen page 44 deceived supposes, and computes the middle of that eclipse at 1h 13'. But Lupus Velascus [Lupo de Velasco] observed the end at 14h 16', and Johannes Alcantara of Toledo at 14h 12'.

ECLIPSIS 44.

[Margin: 1578]

In the year 1578, on 15 September, Tycho at Uraniborg observed the middle of a lunar eclipse of $2\frac{1}{2}$ digits at 13h 17' — Tycho vol. 1, *Progymnasmata* page 114; whom Wendelen page 44, indeed, collecting the nearest beginning, thinks at 13h 14'; but, gathering the end by Toledo's calculation, computes the hour at 13h 3'. Therefore, concerning the penumbra, he suspects Lupus Velascus to have been deceived, because Toledo recorded the end at 13h 20'. Longomontanus has the [hour] observed at Uraniborg at 13h 24'.

ECLIPSIS 45.

[Margin: 1580]

In the year 1580, on 31 January, Tycho at Uraniborg observed the middle of a total lunar eclipse at 10h 9' (or 10') after midday. But Wendelen page 47 (who attests that in this year, on 6 June, an eclipse was born) computes there from his own calculation the hour at 10h 30', asserting that the penumbra had imposed upon Tycho. Maestlin too, in his *Isagoge*, and Kepler in his *Optics*, say that this eclipse was observed by him as total with very brief duration. Granted that Lansbergen, relying on his own tables, denies that it was total.

ECLIPSIS 46.

[Margin: 1581]

In the year 1581, on 19 January, Tycho at Uraniborg, at 9h 59' after midday, observed a total eclipse; Wendelen, however, page 47 computes there the hour at 10h 6'; Longomontanus reports the hour at 10h 0'.

ECLIPSIS 47.

[Margin: 1581]

In the year 1581, on 15 July, Tycho at Uraniborg, from the beginning of a total lunar eclipse observed, conjectured the middle at 16h 57' after midday. But Wendelen page 47 supposes him deceived, because there from his own calculation he reckons the middle at 16h 45'. Longomontanus reports the hour at 17h 0'.

ECLIPSIS 48.

[Margin: 1584]

In the year 1584, on 7 November, Old Style, Tycho at Uraniborg observed the beginning of a total eclipse at 11h 12' after midday; the end, however, at 17h. As he himself relates in his *Epistolae*; therefore the middle ought to be set at 13h 6', or at most 13h 8', as he himself advises in the *Epistola* of the year 1587, given under 20 January; for the intervals between the extreme and the middle of an eclipse are always equal. Indeed, in the *Progymnasmata* he marks the hour at 13h 12'. How much more sharply Wendelen here watches, lest he seem to disdain Tycho, you may see at his page 48. Observations of Wittich and Heinrich Brucaeus [Heinrich Brucäus], or as in Tycho's *Epistola*. Longomontanus has the

hour at 13h 9'. Heinrich Brucaeus at Rostock recorded the middle at 13h 4'; Wittich at Kassel the hour at 13h 3'; from which Wendelen differs by 15' and more.

ECLIPSIS 49.

[Margin: 1587]

In the year 1587, Tycho at Uraniborg, on 6 September, Old Style, observed the digits of an eclipse to be 9.45', the hour after midday 9h 16' — Tycho vol. 1, *Progymnasmata* page 114. In his *Epistola* he asserts that there is something certain to be predicted within two [minutes], or at least within three minutes; but Wendelen page 49 from his own calculation computes it likewise at 9h 16'. Hence I wonder that Longomontanus in his *Astronomia [Danica]*, *Theorica* book 1, *Theoricorum* ch. 2, in his Commentary on the Moon noted the hour at 9h 30'.

ECLIPSIS 50.

[Margin: 1588]

In the year 1588, Tycho on the night following the 2nd day of March, Old Style, observed the middle of a total eclipse at 15h 2' after...

[Margin: Anni Christi]

after midday, as he himself has it in vol. 1, *Progymnasmata* page 114 and Longomontanus above. But note that Tycho in his *Epistolae* admits that this eclipse, page 49, and Tycho himself in his *Epistolae* confesses with these words that the middles either deceived or were not exactly found by the Prutenic calculation through hours. But the calculation of Uraniborg exhibits the middle of this eclipse, at the hour after midday 14h 18', with a half added; therefore the observation itself falls at 14h 48' — but not into the hour 15h 2'; nor indeed do they conflict between themselves. Indeed Kepler too, in the same Wendelen, from Tycho's own autograph reports it at the hour 14h 58', with these words noted: *Ergo praeter medium* [therefore besides the middle]; but perhaps from the beginning of the penumbra, and the end, Tycho gathered the middle, conjectured it, at the hour 15h 2'; and so he had it more truly, inasmuch as the middle of the first hour after midday at midnight; the immersion noted after the middle second; the emersion after the third middle; the end a little after the fourth, the middle determined; with the quadrant set after the second, as much as it was with the sky entirely pure, or starry, no one saw it, who had placed a foot there [vbi pedem collocaret].

Ulysippone [at Lisbon], Doctor Sobrinus observed the beginning of this eclipse at 11h 56', or rather, as it is to be written, Wendelen thinks, at 11h 36'. Finally, at Cabo Corrientes [Caput Currentium] in Africa, which is at the *Mare Natalis* [Natal coast], Johannes Baptista Bechetus [Giovanni Battista Becchetti], a Florentine Knight, observed the beginning of this eclipse at 16h 15' after midday.

ECLIPSIS 51.

[Margin: 1588]

In the year 1588, on 26 August, Doctor Sobrinus at Lisbon observed the beginning of an eclipse at 1h 49' after the middle of the following night; while the royal observers at Porto Vecchio [Portum veterem] in Peru, situated under the equator nearly, observed the same beginning at 8h 54', as Wendelen reports in his *Eclipses*, and Georgius Furnerius [Georg Fournier] book 12, *Hydrographiae* ch. 5.

ECLIPSIS 52.

[Margin: 1590]

In the year 1590, on 17 July, Maestlin at Tübingen saw the Moon deficient by some digits from the south, and at the two lowest [points] almost by [two] degrees at that moment, in which the center of the Sun was emerging above the horizon, but through the benefit of refraction, as Kepler notes page 137, *Optics*; Lansbergen in his *Thesaurus*, and Wendelen in his *Eclipses* page 51.

ECLIPSIS 53.

[Margin: 1590]

In the year 1590, on 30 December, Old Style, but according to the Gregorian year 1591, on 9 January, Tycho at Uraniborg observed the middle of an eclipse at 6h 55' after midday, or as Longomontanus has it, at 7h.

ECLIPSIS 54.

[Margin: 1592]

On 14 June, Old Style, Tycho noted the middle of an eclipse at Uraniborg of 8 digits at 10h 16' after midday. Granted that his own tables require 10 digits, as Kepler explains in his *Optics* page 350. Wendelen's calculation there gives the digits at 9.30'; Longomontanus reports the hour at 10h 20'. On 8 December, however, Tycho noted the middle of an eclipse at Uraniborg at 7h 41'; Lansbergen saw the same at Goes at 6h 50', with 5 digits.

ECLIPSIS 55.

[Margin: 1594]

In the year 1594, on the 28th day of October, New Style, Tycho at Uraniborg observed the middle of an eclipse at 19h 26' after midday, or rather, as Wendelen and Kepler have it, *Optics* page 413, deduced the middle from the beginning observed at 17h 56'; ideo, Tycho added to his observation a counter-word: *non potui* [I could not]. Longomontanus has 19h 16'. Lansbergen at Goes saw it at 11h 12', with 9½ digits.

ECLIPSIS 56.

[Margin: 1595]

In the year 1595, on 13 April, Old Style, Tycho at Uraniborg observed the eclipse, its middle from the extreme phases collecting at 16h 36' after midday; but Goes — Lansbergius page 44 — computes there the hour at 16h 46'. Immerseronem indeed at 14h 40'; the emersion at 16h 20'; Wendelen Hercae [at Herck] at observed the beginning at 14h post midday, the middle indeed circa hour 18h 20'. Vuandesburgi [at Wandsbeck], however, where Tycho [was], observed it not to have been wholly total at 18h 5'.

Lansbergen in the *Thesaurus* says that it was observed by him at Goes, the beginning at 15h 40', and the middle at 17h 11½' — hour 17h 2'; he errs while he attributes to Kepler the observation at Uraniborg, the beginning at 16h 36' or 34'.

Johannes Rotarius [Jan Rauw], as Lansbergen reports, at Aquisgranum [Aachen] observed the middle at 17h 30'; concerning whose beginning, however, Lansbergen observed nothing; granted that Wendelen too refers the hour to 17h 0', and adds that Louvain observed the beginning circa hour 16h 10', and yet certainly between minutes 10' and 15'.

ECLIPSIS 57.

[Margin: 1596]

In the year 1596, on 2 April, Old Style, Tycho at Uraniborg sets the middle of an eclipse at hour 9h 2' after midday. Longomontanus, however, has the hour at 9h 25'; concerning which observation Petavius labours much over a discrepancy on account of many tables. At Tornaci [Tournai] the beginning was observed at 7h, and the end at 9h 15', as Wendelen too reports; the middle at hour 8h 10'.

ECLIPSIS 58.

[Margin: 1598]

In the year 1598, on 10 February, Old Style, Tycho's pupils (for in the previous year Tycho had withdrawn from Denmark) observed the beginning of a lunar eclipse at 18h 7', of $11\frac{1}{3}$ digits; concerning which Kepler too, page 368, in his *Optics*, where he adds: at Graz in Styria it was permitted to observe it somewhat more roughly, the beginning having been at 16h 54' after midday, the middle, however, circa hour 18h 20'. At Wandsbeck, however, where Tycho was, it is observed not to have been wholly total, the beginning having been at 18h 5'.

[Margin: Lansbergii lapsus — Lansbergen's slip.] Lansbergen in the *Thesaurus* says it was observed by him at Goes, the beginning at 15h 40', and the middle at $11\frac{1}{3}$ hours — hour 17h 2'; he errs while, on Kepler's attribution, the observation at Uraniborg had its beginning at hour 16h 36' or 34'.

Johannes Rotarius [Jan Rauw], as Lansbergen reports, at Aachen observed the middle at 17h 30'; concerning whose beginning, however, Lansbergen observed nothing; granted that Wendelen refers the hour to 17h 0', and adds that Louvain observed the beginning circa hour 16h 0', and yet certainly between minutes 10' and 15'.

ECLIPSIS 59.

[Margin: 1598]

In the year 1598, on 6 August, Old Style, Tycho, in the Catalogue determines the middle of a lunar eclipse at Uraniborg at hour 7h 37'. Lansbergen, however, says that only the end of the eclipse was observed by him at Goes at hour 8h 40'.

ECLIPSIS 60.

[Margin: 1599]

In the year 1599, on 30 January, Old Style, Longomontanus at Uraniborg observed a total eclipse at hour 17h 56'; nevertheless Tycho in the Catalogue has hour 17h 50'. Kepler too, as he reports page 249 of his *Optics*, conjectured the beginning at hour 15h 45'. At Graz the horizon of the city was not corrected.

ECLIPSIS 61.

[Margin: 1599]

In the year 1599, on 6 August, a lunar eclipse is narrated to have been observed by the Dutch [ab Hollandis] at Tidore and Ternate circa hour 8h, by night, at Leuino Hulsio [Levinus Hulsius] ch. 30, *navigat. Holland.* [the Dutch navigation/voyages].

ECLIPSIS 62.

[Margin: 1600]

In the year 1600, on 29 January, Wendelen the Calidonian [Calidonius], because the town of Aix-en-Provence [Aqua Sextiae] is more easterly by $6\frac{2}{3}$ minutes, observed the beginning of a lunar eclipse at hour 17h 45'.

ECLIPSIS 63.

[Margin: 1601]

In the year 1601, on 9 December, New Style, Lansbergen at Goes observed the middle of an eclipse of more than 10 digits, at the hour...

[Margin: Anni Christi]

after midday 6h 12' — Kepler, as he has it in his *Optics* page 349, says Ambrosio Rhodio [Ambrosius Rhodius] estimated the digits of the eclipse at 10, and page 371 adds that at Prague the beginning was observed by him at hour 5h 22', from the stars; the middle, however, at hour 6h 53'. Adriaan Metius at Franeker [Franekerae] observed the beginning at hour 4h 42'; Valentiola Clunacensis [the Cluniac of Valencia], and others, recorded the beginning at hour 4h 38' after midday. Wendelen, from Digne [Dinia], with several, noted the beginning at hour 4h 40', and the end at hour 7h, between 42' and 45'; therefore the middle at hour 6h 12'.

ECLIPSIS 64.

[Margin: 1602]

In the year 1602, on 4 June, Kepler at Prague observed the end of a lunar eclipse at hour 9h 5', adding that by the Tychonic calculation it ought to have been at hour 9h 19', at Prague.

ECLIPSIS 65.

[Margin: 1602]

In the year 1602, on 28 November, since no eclipse had been promised in the Calendars, Wendelen nevertheless, setting out toward Aix-en-Provence, observed the beginning of an eclipse at hour 7h 11', because at Aix-en-Provence it had been, he says, at hour 7h 10' after midnight.

ECLIPSIS 66.

[Margin: 1603]

In the year 1603, on 14 May, Old Style, Lansbergen at Goes observed the beginning of an eclipse of $7\frac{1}{2}$ digits at hour 11h 56' after midday. Kepler, however, observed it at Prague at hour 11h 53', by his own observation refuting Lansbergen and Wendelen, who recorded its beginning at Valencia at hour 10h 15', the middle indeed at hour 11h 38'.

ECLIPSIS 67.

[Margin: 1603]

In the year 1603, on 8 November, Old Style, Lansbergen at Goes observed the eclipse of 3 digits, at hour 6h 3' after midday. At Prague, however, Kepler, as he reports in his *Optics* page 7, observed the same eclipse a little less, with three digits and somewhat doubtful, the beginning observed by himself at hour 6h 21'; the end at hour 8h 17'; Digne — Wendelen — noted the beginning at hour 5h 52'; the maximum defect of three digits, and the end at hour 7h 42', the middle at 6h 47'.

ECLIPSIS 68.

[Margin: 1605]

In the year 1605, on 3 April, New Style, Lansbergen at Goes observed a lunar eclipse of 3 digits at hour 11h 35' after midday; Wendelen, however, at Forcalquier [Forcalcarii] [set] the beginning at hour 6h 38', and the maximum defect to be 3 digits, with clouds intervening at hour 8h 12', with the digits $11\frac{1}{2}$; and he added that Lansbergen, on account of the spurious penumbra, stretched out the end, and likewise the middle.

ECLIPSIS 69.

[Margin: 1606]

In the same year, on 20 September, New Style, Goes — Lansbergen — observed the summit of an eclipse of 8 digits at hour 16h 30' after midday; Wendelen,

however, at Forcalquier [set] the beginning at hour 14h 42', the middle at hour 16h 11', with the digits a little more than 8; the end at hour 17h 40'; and again Lansbergen adds that he stretched out the time by a fallacy of observation.

ECLIPSIS 70.

[Margin: 1607]

In the year 1607, on 6 September, in the morning, Wendelen at Valencia, toward the Rhône [ad Rhodanum], observed — he says, from Scipione Arnaldo [Scipio Arnaldus], with many others — the beginning of a lunar eclipse at hour 1h 45', circa, the middle indeed after the middle of the night, and the end at hour 3h 45'; and so the middle would have been at hour 2h 45'.

ECLIPSIS 71.

[Margin: 1609]

In the year 1609, on 19 January, New Style, Lansbergen at Goes observed the beginning of a lunar eclipse at hour 13h 5' after midday; the middle, however, at hour 14h 40', with the digits $9\frac{1}{2}$. Adriaan Metius at Franeker saw the beginning at hour 14h 42'; Wendelen at Forcalquier the beginning at hour 13h 10', the end at hour 16h 16', and the middle at hour 14h 43'.

ECLIPSIS 72.

[Margin: 1609]

In the year 1609, on 16 July, New Style, in the morning, Longomontanus at Copenhagen [Hafniae] notes the middle of a lunar eclipse at hour 12h 10', collecting nevertheless from the extremes; for it was indeed a total eclipse. Forcalquier — Wendelen — observes the beginning at hour 9h 53'; the immersion at hour 10h 18'.

ECLIPSIS 73.

[Margin: 1610]

In the year 1610, on 5 July, Wendelen at Forcalquier noted the beginning of a lunar deficiency at hour 14h 55' after midday.

ECLIPSIS 74.

[Margin: 1610]

In the year 1610, on 29 December, Wendelen at Forcalquier noted the beginning of a lunar eclipse a little before hour 14h 40', the end at hour 16h 50' — as much as it was permitted to observe through clouds.

ECLIPSIS 75.

[Margin: 1612]

In the year 1612, on 14 May, at Liège [Leodii], Wendelen perceived the beginning of a lunar eclipse at hour 8h 37', circa; the end, however, at hour 11h 15', exactly; the middle at hour 9h 56', with the digits $6\frac{1}{3}$, circa. The monk Scheiner noted the beginning before hour 9, in the evening, quasi a semiquadrant; the end, however, at the same hour $11\frac{1}{2}$ — but Wendelen thinks that on account of the penumbra he anticipated the beginning. Longomontanus says the beginning was observed at Copenhagen a little before hour 9h 14', with the digits $5\frac{1}{2}$.

ECLIPSIS 76.

[Margin: 1612]

In the year 1612, on 8 November, at Nagasaki [Nangafachi], Father Carolus Spinola [Carlo Spinola] of the illustrious Society of Jesus, of the Catholic faith, observed the beginning of a lunar eclipse at hour 9h 30' after midday. At Macau, however, in the rising of the Chinese [in exordio Sinarum], Father Giulio Aleni [Giulio Aleni] of the same Society, on the same day, observed the beginning at hour 8h 30', and the end at hour 11h 45'; and from the altitudes and azimuths of the Moon, adding the observation by himself at the altitude of the pole of Macau at 22h 13' [recte: pole altitude $22^{\circ} 13'$]. These observations Father Julius set down in writing, sending them to Antonio Maginus [Antonio Magini], who once had been his disciple at Bologna, and a Mathematician instructed in disciplines, who when he sought entry into the Sinensian dominion, found those very [observations] in Magini's papers most amicable to me, and discovered by the learned among Magini's papers; nay, with Father Bonaventura Cavallerius [Bonaventura Cavalieri], Magini's successor in the Chair, having pointed them out. Afterward, indeed, in the *Eclipses* of Wendelen page 80, I obtained the observation of Father Vremannus [Vreman] sent in Belgium at Macau, where Father Julius was, and in it the beginning is given at hour 8h 30', the end at hour 11h 45'. At Ingolstadt, however, Scheiner [observed] at hour nearly 4h 35'. He saw the Moon a reddish globe entire, but bloody, or of a dark color, tinged; the upper parts still held involved, and with malign brightness the Moon shone; the parts dilated themselves; the sixth evening hour, the Moon serene, dried up. The eclipse lasted nearly forty-six scruples [minutes]. From which other things

Wendelen too gathers, no otherwise than from his own tables, the end at Ingolstadt at hour 5h, exactly, and the difference of longitudes between Ingolstadt and Macau at hour 6h 45'.

ECLIPSIS 77.

[Margin: 1613]

In the year 1613, on the 28th day of October, New Style, Longomontanus observed at Copenhagen the extreme of a total eclipse, from which he gathered the middle at hour 5h 57'. Kepler, however, as he has it page 11, *Ephemeridum*, and David Fabricius observed the end more maturely than calculation would exhibit to the unpracticed eye.

ECLIPSIS 78.

[Margin: 1614]

In the year 1614, on 24 April, in the morning, with the lunar eclipse beginning, it sounded the third hour after midnight at Hotisfontjais [?]; which [eclipse] at Louvain [Louanii], by no contemptible consensus, is noted to have begun, as Wendelen reports page 84.

ECLIPSIS 79.

[Margin: 1616]

In the year 1616, on March 3, Kircher [Athanasius Kircher] observed the end of a lunar eclipse at Goa at hour 7, 53' after midday, as he reports in his *Magnes* (Kircher, *Magnes*, 1st ed., p. 477); but from our observation Origanus [David Origanus] at Frankfurt-on-the-Oder noted the end at hour 3, 51', and Wendelen [Govaert Wendelen] noted it there at hour 3, 58'; while at the Atlantic meridian it was at hour 1, 30' ½.

ECLIPSIS 80.

[Margin: 1616]

In the year 1616, on August 26, at Rome, Father Christoph Grienberger, S.J. [Christophorus Griembergerus], observed the beginning of a total lunar eclipse at hour 13, 43' ½ after midday, and the end at hour 16, 56' ⅔; therefore the middle was at hour 15, 50'. Others observed it at Rome separately. With a telescope he observed the immersion at hour 15, 6' ⅓, and the emersion at hour 15, 34'; the middle, by an admirable agreement, at hour 15, 20', as Kepler [Keplerus] too

relates in his Ephemerides, p. 11, and he adds the same at line 17. In his *Rudolphine Tables*, p. 103, he adds that he saw certain partial phases of the observers as total — some partial — but Wendelen, from Kepler's account, gathers the middle of the eclipse not at hour 15, 30' but at 34'. He adds that at Liège the observation gave the beginning at hour 13, 23', the immersion at hour 14, 42', the emersion at hour 15, 12', and the end at hour 16, 31'. At Tübingen, Maestlin [Maestlinus] observed the beginning at hour 16, 43'; therefore the middle at hour 15, 8'.

ECLIPSIS 81.

[Margin: 1617]

In the year 1617, on August 16, Kepler at Linz observed the middle of a lunar eclipse at hour 8, 10' after midday; from his account Wendelen gathers (p. 85, adding the immersion as observed by Hercij [the Jesuit fathers at Herči], hour 8, 1 $\frac{1}{3}$ ', and the end at hour 9, 17').

ECLIPSIS 82.

[Margin: 1619]

In the year 1619, on June 26, Wendelen at Herči, a little before midnight, saw the Moon eclipsed by nearly a single digit at the top, with the Ephemerides promising three digits, from which arose the suspicion either that the latitude of the Moon is reckoned too broadly in the tables, to the mind of Kepler, or that the shadow of the Earth was attenuated by refractions.

ECLIPSIS 83.

[Margin: 1619]

In the year 1619, on December 21, at Mechlin, Wendelen observed the beginning of a lunar eclipse at hour 13, 27', the end at hour 16, 28'; therefore the middle at hour 14, 57 $\frac{1}{2}$ '; the digits nearly 11. But the Jesuit fathers at Herči themselves noted the beginning at hour 13, 30', the end at hour 16, 30'.

ECLIPSIS 84.

[Margin: 1620]

In the year 1620, on June 14, at Aix-en-Provence [Aquis Sextiis], Pierre Gassendi [Petrus Gassendus] together with the Lord Joseph Gaultier de la Valette, master of

Valletta, observed the beginning of a lunar eclipse at the altitude of Spica [Spica], 16°, 58', and the immersion at the altitude of Arcturus, 35°, 34'; from this he deduced the beginning of the period at hour 11, 11'; for the immersion, hour 13, 27', as I read in his Epistles then sent to me into Italy, and as Wendelen too reports, who afterward (Gassendi, in his *Epicurus*, p. 896, the calculation corrected) puts the beginning at hour 11, 11', and the immersion at hour 12, 22' ½. The emersion was seen at the same altitude of the crown, 37°, 15' — that is, says Wendelen, hour 14'; therefore the middle at hour 13, 11'. The Jesuit fathers at Herči, hindered by clouds, and the sky thereafter clearing, observed the middle from the immersion and emersion; and they add the end of the eclipse as observed at Verona at hour 15, 20', approximately.

ECLIPSIS 85.

[Margin: 1620]

In the year 1620, on December 9, the Fathers of the Society of Jesus observed at Cachian, in the Kingdom of Cochinchina, the beginning of a lunar eclipse at hour 11' after midday, just as they had predicted — against the astrologasters of that dynasty, who, when [Continues on next page]

with great pomp they had awaited it the preceding night, were frustrated in vain; and from this our cause gained great authority among that prince and the Catholic faith its credit, as Kircher relates of the kingdom of the Borvi, and as Urban VIII confirmed by relation; and the same Wendelen indicates in his Ephemerides, p. 88, adding: under nearly the same meridian with Herči, the same eclipse was observed for itself, so far as could be, beginning at hour 5, 52', immersion at hour 4, 51'. At Brussels, Michael Florent van Langren [Michael Florentius Langrenus], Royal Cosmographer, noted the beginning of the emersion at hour 6, 25 ⅔', the end at hour 7, 24'.

ECLIPSIS 86.

[Margin: 1621]

In the year 1621, on November 28, at Aix-en-Provence, Gassendi, the sky being half-cloudy, observed the beginning of a lunar eclipse at hour 13, 54' after midday; therefore the immersion was at hour 15, 52'; the maximum, then, was at the moment of the defect by the disk of three digits, which, however, he reckoned by the telescope to be 5 digits; as he reports in his *Epicurus*, p. 897; therefore the middle was at hour 14, 55'. From the immersion of Kepler at the beginning, as it turned out, the beginning was at hour 14, 53'. From the latitude of the Moon,

however, turbid, the immersion was not at hour 14, 33' but at hour 16, 34'; the middle at hour 15, 33 ½'; and then the digits a full 4. From Wendelen's observation the beginning was at hour 14, 2'; thence the middle at hour 15, 57'; and thence the middle h. 15: digits a little more than 4.

ECLIPSIS 87.

[Margin: 1623]

In the year 1623, on April 14, at Digne [Diniaë], Gassendi observed the beginning of a lunar eclipse at hour 15, 9' after midday; the maximum, however, of the eclipse, the digits 11 ½, or somewhat more. Kepler noted the middle at hour 16, 55', though by calculation he had predicted it at hour 17, 15'. Leyden's Martin Hortensius [Leydæ Martinus Hortensius] observed the same eclipse, but it was transcribed with faulty figures.

ECLIPSIS 88.

[Margin: 1624]

In the year 1624, on September 26, Kepler at Linz observed the beginning of a total lunar eclipse at hour 7, 6'. The emersion at hour 9, 47'; and the end at hour 10, 44'; the middle at hour 8, 55': thus, whatever the tables promised a longer delay, the suspicion is that the shadow was uniform, and that the whole eclipse was not spherical, because the full one was of utter dimness, which Wendelen calls "of darkness"; he himself, however, threatens the first menaces of the eclipse at hour 6, 5'. But at hour 6, 28' the defect was remarkable: thence at hour 7, 23' it began to immerse, and there it was not yet wholly immersed, but yet up to hour 7, 29'; the second time something adhered to it as a lucid limb, immersed; the emersion was seen at hour 9, 7', and the end of the eclipse at hour 10, 4': thence the middle is determined at hour 8, 15'. At Brussels, Langren caught the immersion at h. 7, 18', 20". The emersion at hour 9, 21'. The repletion, or end, at hour 9, 59 ⅔'; therefore the middle at hour 8, 10'.

ECLIPSIS 89.

[Margin: 1625]

In the year 1625, on March 23, at Paris, Gassendi together with Midorgius [Mydorgio] noted the beginning of an eclipse at hour 12, 54', or by another Basilic computation 36, 20'. The end, then, at hour 13, 37'; another Le Bourg computation 31, 10'; whence the middle was at h. 13, 2'. The quantity of the highest eclipse was

scarcely seen to exceed one digit; certainly, says Gassendi, it was distant by two; Wendelen, while he awaited from the tables an eclipse of 3 digits and a duration of two hours, noted only so much, and the beginning at hour 13, 3'; the end at hour 14'; from this he took an argument for emending the anomaly of the Moon, its eccentricity, the distance at apogee, and the places of the nodes.

ECLIPSIS 90.

[Margin: 1626]

In the year 1626, on August 7, the Ephemerides promised a small semidigit-sized eclipse approximately, and a duration of 44', at Linz, at h. 7, 45'; but Kepler, diligently attending there from the setting of the Sun up to h. 8, 30', perceived nothing in the roundness of the Moon, nor did he indeed observe any trace of shadow.

ECLIPSIS 91.

[Margin: 1627]

In the year 1627, on July 27, at Madrid, the Fathers of our Society observed the beginning of a smoky lunar eclipse at hour 16' after midday; but at hour 16, 12', hour indeed 16, 45', the Moon set deficient by a little more than 9 digits than was observed; the more wretched observation they communicated from Ingolstadt to me; and Father Jacobus Vina [Iacobus Vina] communicated it.

ECLIPSIS 92.

[Margin: 1628]

In the year 1628, on January 20, at Paris, as Petavius [Petavius] wrote to Wendelen, the beginning of a total eclipse was inspected by telescope at the altitude of the stars at hour 7, 35'; but the beginning of the immersion at hour 8, 34'. At Brussels, Wendelen, on account of cloud and snow, observed only the end at hour 11, 15'. Gassendi at Aix-en-Provence observed the beginning at hour 7, 49'; the altitude at the rising of Sirius 21° , 9'. The immersion at hour 8, 48'; the altitude at the heart of Hydra, at the rising, 14° , 10'. The emersion at hour 10, 21'; the altitude at the same heart, 28° , 23'; the end, finally, at hour 11, 24'; the altitude at Rigel, at the setting, 26° , 27', distinguishing; Gassendi by telescope perceived the color not only at the beginning, in the total eclipse, first mellow, then purplish, and at last rusty; and these same colors in the immersion, rusty, purple-mellow. The middle, therefore, was at hour 9, 36'. At Paris, Mydorgius observed the

beginning at hour 7, 35', and the immersion at hour 8, 34'; and Boulliau [Bullialdus] relates in his *Astronomy*, p. 467, adding (at Oxford he observed the immersion at h. 8, 23' at Bamridge), the end at h. 10, precise. Boulliau's brothers noted the immersion at h. 8, 40'. The end at hour 11, 19'. At Prague, with Kepler's horizon corrected through the altitudes of the stars, he observed the emersion at h. 9, 13'. The immersion at h. 9, 19'. The emersion at hour 10, 59'. The end at h. 11, 59'; so the middle is at h. 10, 9'.

ECLIPSIS 93.

[Margin: 1630]

In the year 1630, on November 19, the beginning of a lunar eclipse Father Andreas Arzet, S.J. [Andreas Arzet], at Ingolstadt observed at h. 9, 10' after midday; the end at h. 12, 56'; and the digits at the maximum 9; the diameter of the shadow to the diameter of the Moon as 266 to 100, as I have from his letters. At Brussels, Michael Florent van Langren noted the maximum defect, digit 9, 30'; hour 10, 57'; and gathers the same as truly Wendelen, adding the observation of the Batavians at Leiden [Lugdunum Batavorum] from the beginning, hour 9, 22'; the end at h. 12, 23'; therefore the middle at h. 10, 52'.

ECLIPSIS 94.

[Margin: 1631]

In the year 1631, on May 15, at Ingolstadt, Father Andreas Arzet, S.J., observed the emersion. The end, then, by the shadow at h. 9, 15' after midday; the beginning, however, by another altitude of Lyra, gr. 36, 35'. At Leiden, with Rhodanus, he observed, gr. 35, 24'; whence he deduced for the beginning at hour 11, 15'. For the immersion at h. 12, 27', while at Leiden, Father Auxon, S.J., a most learned Mathematician, the Moon set a little before hour 8, the eclipse ceasing, when it remained a semiquadrant to hour 9.

ECLIPSIS 95.

[Margin: 1631]

In the year 1631, on November 8, at Leiden, the Batavians' Hortensius [Hortensius] caught the beginning accurately at h. 9, 30'. The immersion at h. 10, 36'. The end at h. 12, 17'; thence the middle at h. 11, 26' $\frac{1}{2}$; as he himself narrates in his *Dissertation*. With Mercury joined to Gassendi, Gassendi writes that all those things at Paris occurred 12' earlier than they would have occurred here at

h. 11, 14 $\frac{1}{2}$ '; though Wendelen had it beat at h. 11, 13'; adding: Boulliau observed the beginning for himself at h. 9, 31'. The emersion at scattered h. 12, 23'; the end, h. 13, 28' whence the middle deduced at h. 11, 35'. At Tübingen, Wilhelm Schickard [Vuilhelmus Schikardus] noted the immersion at h. 12, 35'.

At Madrid, Michael Florent van Langren observed the emersion at h. 10, 4' $\frac{1}{2}$; difficult, but it can also be done by telescopic observation. The emersion, however, at h. 11, 50', and the end at h. 12, 54 $\frac{2}{3}$ '; whence the middle at h. 10, 57'.

ECLIPSIS 96.

[Margin: 1632]

In the year 1632, on October 27, at Innsbruck [Oeniponte], Father Andreas Arzet, S.J., observed the beginning of a lunar eclipse at h. 10, 37' after midday; the end at h. 12, 19'; therefore the middle at h. 11, 48'; and then the digits 5, 22'. Thus it is in his own writings; for at Leiden with Rhodanus, Gassendi noted the beginning at h. 10, 4'; the end at h. 12, 30'; which, however, by a twin observation sent recently to me, is gr. 45, 48'. At Leiden the Batavians' Hortensius noted the beginning at the true h. 10, 30'. The end h. 12, 44'; and the digits 4, 40'; or rather paler. At Liège, Otger [Otgerus], a man very skilled in mathematics, observed the beginning at h. 10, 18'; the end at h. 12, 42'; so that the middle was at h. 11, 30'.

ECLIPSIS 97.

[Margin: 1634]

In the year 1634, on March 14, at Aix-en-Provence, Nicolas-Claude Fabri de Peiresc [Nicolaus Fabricius Peireskios] observed the beginning of a lunar eclipse at h. 10, 49'; therefore the middle at h. 9, 11'. The same Gassendi noted the beginning at h. 7, 41'; thence the middle at h. 11, 2'; and the digits at the highest 10, hour 2, 4 $\frac{1}{2}$ '. At Madrid, Michael Florent van Langren observed the maximum defect, digit 10, 15'; and the end at h. 10, 19'; the middle, however, as Wendelen gathers from Langren's narration, h. 8, 42'.

ECLIPSIS 98.

[Margin: 1635]

In the year 1635, on March 3, at Aix-en-Provence, a lunar eclipse was observed, the beginning at h. 6, 48'. The immersion h. 7, 55 $\frac{2}{3}$ '; the end at h. 10, 18'; therefore the middle at h. 8, 43 $\frac{1}{3}$ '. At Leiden, Golius [Golinus] noted the emersion at h. 5, 39'. At Paris, Langren the elder noted the emersion at h. 9, 25 $\frac{2}{3}$ '. But the same

Langren at Brussels noted the beginning at h. 6, 49'. The end at h. 10, 25 $\frac{1}{3}$ '; and thence the middle at h. 8, 44 $\frac{2}{3}$ '. At Herči, Wendelen noted the beginning at h. 6, 54'. The immersion at h. 7, 59'. The emersion at h. 9, 40'. The end at h. 11, 49'; and thence the middle at h. 9, 49'. At Marseilles, Gassendi noted the immersion at h. 7, 4'. At Danzig, Peter Krüger [Petrus Krugerus] observed the immersion h. 8, 8'. At Stettin, Lorenz Eichstad [Laurentius Eichstadius] observed the beginning at h. 8, 34'. At Amsterdam, Hortensius observed the beginning at h. 7, 51'. Whence he argues the middle at h. 8, 40'. See Boulliau, p. 137 & 466.

ECLIPSIS 99.

[Margin: 1635]

In the year 1635, on August 27, at Aix-en-Provence, Peiresc [Peireskios] noted the beginning of a lunar eclipse by telescope at h. 13, 21'; with the telescope at h. 13, 31'. The same Wendelen, observing it from digits, gathers the beginning at h. 13, 25'. The immersion h. 14, 25'. The end by telescope at h. 16, 56'; and so the middle at h. 15, 11'. At Leiden, Golius saw the immersion at h. 14, 25'. At Digne, Gassendi noted the maximum immersion h. 14, 28'. At Herči, Wendelen observed the beginning at h. 13, 29'. The immersion h. 14, 28'. The emersion at h. 16, 6 $\frac{1}{2}$ '; thence the middle at h. 15, 13'. At Rome, as Wendelen narrates, the beginning was observed at h. 13, 54'; and from other phases the middle, h. 15, 39'. At Paris, Ismaël Boulliau [Ismaël Bullialdus] noted the immersion at h. 14, 5'. The emersion at h. 15, 40'. Therefore the middle at h. 14, 53'. At Chia, in Egypt, Father Agathangelus, a Capuchin [P. Agathangelus Capuccinus], with his companion Jo. Molino [Io. Molino] observed the beginning at h. 15, 14 $\frac{1}{2}$ '. The immersion at h. 16, 16 $\frac{1}{2}$ '. At Aleppo, however, in Syria, Father Coelestinus of St. Lidwina [P. Coelestinus à S. Lidwina], a discalced Carmelite [Carmelita discalceatus], and Michael Angelus, a Capuchin [Michael Angelus Capuccinus], caught the beginning at h. 15, 28'. And the immersion, h. 16, 27'. At Naples, Camillo Glorioso [Camillus Gloriosus] noted the immersion by telescope at h. 15, 21'.

ECLIPSIS 100.

[Margin: 1636]

In the year 1636, on February 20, at Digne, Gassendi noted the beginning of the lunar defect at h. 9, 44 $\frac{2}{3}$ '. The end at h. 11, 14 $\frac{2}{3}$ '. Whence the middle at h. 10, 40'. The digits at the highest 3. At Brussels, Langren obtained the beginning at h. 9, 38'. At Aix-en-Provence, he noted the telescopic end pari at h. 11, 5 $\frac{2}{3}$ '. At Amsterdam, Hortensius noted the end likewise at h. 11, 5 $\frac{1}{2}$ '. At Regiomontanus in Prussia [i.e.

Königsberg], Albert Linemann [Albertus Linemannus] noted the beginning at h. 10, 4 $\frac{1}{2}$ ' [Continues on next page]

and the middle at h. 11, 45'; the digits 2 $\frac{1}{3}$ or nearly $\frac{1}{3}$. At last the Lord Petit [D. Petit] at Trahon, in the Telina valley, noted the beginning at h. 10, 8'. The end h. 11, 54'; and thence the middle at h. 11, 1'.

ECLIPSIS 101.

[Margin: 1637]

In the year 1637, on December 30, at Huronum in New France [in nova Francia], Father Castellanus, S.J. [P. Castellanus], observed the middle of a lunar eclipse at h. 6, 15', after the middle of the following night, that is, h. 18, 15' after midday.

ECLIPSIS 102.

[Margin: 1638]

In the year 1638, on December 20, Gassendi at Digne caught the beginning of a lunar eclipse at h. 12, 36'. The immersion at hour 13, 37'. The emersion at hour 14, 13'. The end h. 16, 14'. Therefore the middle at h. 14, 25 $\frac{2}{3}$ '. At Paris, Boulliau, as he narrates in his Astronomy, ch. 6, obtained the immersion at h. 13, 23'. The middle; hour 14, 4 $\frac{1}{3}$ '. At Amsterdam, Hortensius noted the immersion h. 13, 32 $\frac{1}{2}$ '. At Brussels, Langren observed the beginning at hour 13, 29 $\frac{1}{2}$ '; the immersion at h. 13, 26 $\frac{2}{3}$ '. The emersion at h. 15, 1'; thence the middle at h. 14, 16'. At Digne, Golius noted the immersion h. 13, 32'. The emersion h. 15, 5'; and thence the middle at h. 14, 18'. At Herči, Wendelen saw the beginning at h. 12, 34'. The immersion at h. 13, 32'. The emersion h. 15, 10'. The end at h. 16. Frenequeare Jo. Phocylides Holwarda [Io. Phocyllides Holuarda] acquired the beginning at h. 12, 23 $\frac{2}{3}$ '. The immersion h. 13, 37'. The emersion h. 15, 12'; and thence the middle h. 14, 24 $\frac{2}{3}$ '.

ECLIPSIS 103.

[Margin: 1641]

In the year 1641, on October 18, at Herči, Wendelen observed the beginning of a lunar eclipse at h. 6, 8' after midday; the middle at h. 7, 29'; and the digits 6, 45'. The end h. 8, 50'. At Brussels, Langren obtained the middle at h. 7, 24'; the digits 6, 47'. At Leiden, Hericus Puteanus [Io. Puteanus] perceived the end at h. 5, 59'; thence the middle, h. 7, 26'. At Danzig, Johannes Hevelius [Io. Hevelius] observed the beginning at h. 7, 1 $\frac{1}{2}$ '; and the middle at h. 8, 26 $\frac{1}{2}$ '.

ECLIPSIS 104.

[Margin: 1642]

In the year 1642, on April 14, I obtained the lunar-eclipse observations written below, a few from Wendelen and Boulliau, more from letters to me, or by means of Father Athanasius Kircher.

	Princip. (Beginning)	Immers. (Immersion)	Emers. (Emergence)	Finis (End)	
	H. M.	H. M.	H. M.	H. M.	
I and Father Grimaldi [Ego, & P. Grimaldus]	12 48	13 52	15 36 $\frac{1}{3}$	16 40 $\frac{1}{2}$	Bologna [Bononiæ]
Father Vincenzo Maria Grimaldi [P. Vinc. Maria Grim.]	12 38 $\frac{1}{2}$	13 45 $\frac{1}{8}$	15 15	16 25	Mantua [Mantuæ]
Hevelius [Heuelius]	13 13 $\frac{2}{3}$	14 22	15 53 $\frac{1}{3}$	16 55 $\frac{1}{2}$	Danzig [Dantisci]
Father Georg Furtner [P. Georg. Furtner]	12 9	13 11	14 47	15 51	Paris [Parisijs]
Boulliau [Bullialdus]	12 10	13 11	14 47	15 51	Paris [Parisijs]
Gassendi [Gassendi]	12 10	13 11	14 47	15 48	Paris [Parisijs]
Wendelen [Vuendelin.]	12 3	13 19	14 43	15 41	Herči [Hercij]
The Fathers of the Society of Jesus [PP. Soc. Iesu]	12 15	13 41	15 21	16 12	Paderborn [Paderbonæ]

	Princip. (Beginning)	Immers. (Immersio n)	Emers. (Emersio n)	Finis (End)	
Father Marcell, S.J. [P. Marcell. Soc. Iesu]	12 33	13 58	15 18	16 3 $\frac{1}{2}$	Würzburg [Herbipoli]
Father Jacob Vina, S.J. [P. Iacob. Viua Soc. Iesu]	12 46	13 50	15 28	16 30	Ingolstadt [Ingolstadij]
The Fathers Curtz and Arzet, S.J. [PP. Curt. & Arzet S.I.]	12 44	13 55	15 24	16 32	Eichstätt [Eychstadij]
Eichstad [Eychstadius]	12 58	13 56	15 40	16 38	Stettin [Stetini]
The Lord Vincenzo Renieri [D. Vincentius Reiner.]	12 33 $\frac{1}{10}$	13 49 $\frac{1}{2}$	—	15 21 $\frac{1}{3}$	Pisa [Pisis]
Unnamed [Innominatus]	12 0 $\frac{1}{5}$	13 14 $\frac{3}{5}$	—	16 2 $\frac{1}{2}$	Leiden [Leydæ]

Besides those named, the following observed the beginning: the illustrious Lord Giulio Giustiniani [D. Iulius Iustinianus] at Venice, h. 12, 46' $\frac{1}{8}$; and the Lord Antonius Franciscus Payen [D. Antonius Franciscus Payen] at Avignon [Auenione], h. 11, 59'; and the immersion, h. 13, 1'; and Gutiscouius [Gutiscouius] at Louvain, the beginning at h. 12; and Father Conradus, S.J. [P. Conradus] at Glatz in Bohemia, the immersion at h. 14, 26'.

The emersion at h. 15, 18'. Several others among ours at Prague: the immersion h. 14, 10'. The emersion h. 15, 28'. And at Cologne [Coloniæ] the beginning h. 12, 26 $\frac{1}{2}$ '. The immersion h. 13, 41' $\frac{1}{2}$; and at last Father Michael Staudacher, S.J. [P. Michael Staudacher], the immersion h. 13, 52'. At Trent [Tridenti].

ECLIPSIS 105.

[Margin: 1642]

In the year 1642, on October 7, at Iley [Ileide], Antonius Garratus, sometime amanuensis to Gassendi [Antonius Garratus Gassendi], observed the beginning of a lunar eclipse at h. 14, 9 $\frac{2}{3}$ ' after midday; the immersion h. 15, 11'. The emersion h. 16, 50 $\frac{2}{3}$ '. At Rome, Father Francesco Niceronus, a Paulist [P. Franciscus Niceronus Paulinus], observed the beginning at h. 15, 1'. The immersion hour 16, 5 $\frac{2}{3}$ '. At Catania, or Catanzaro [Cataci, seu Catanzarii], the Lord Francesco Zuppi [D. Franciscus Zuppus] observed the immersion h. 16, 16' $\frac{1}{2}$ '. At Milan, the Lord Curzolanus [D. Curzolanus] observed the beginning h. 14, 44'. The immersion h. 15, 47'. At Brescia, in Bohemia, Father Theodorus Moretus, S.J. [P. Theodorus Moretus], noted the beginning h. 14, 57'. At Mallorca, in the city formerly known [Maiorica in Vrbe cognomine], the Lord Vicenç Mut [D. Vincentius Mutus] observed the beginning at h. 12, 41 $\frac{1}{3}$ '. The immersion h. 15, 24', 40". The emersion h. 17, 2 $\frac{1}{2}$ '; thence the middle at h. 17, 59 $\frac{1}{3}$ '; and the end at h. 18, 12'; thence the middle h. 16, 13'. We at last [Nos demum], with Father Grimaldi at Bologna, caught the beginning at h. 14, 55', 50". The immersion h. 15, 57', 10". The emersion h. 17, 36', 40"; the end at h. 16, 44'; thence the middle at h. 16, 49 $\frac{2}{3}$ '.

ECLIPSIS 106.

[Margin: 1643]

In the year 1643, on September 27, at Antwerp [Antuerpiæ], Wendelen, with Gutiscouius and Gebbartus [Gebbartus], observed the beginning at h. 6, 52'; the end h. 8, 5 $\frac{1}{2}$ '. We at Bologna [Nos Bononiæ], observing the beginning with the telescope showing, h. 6, 30', $\frac{2}{3}$; the middle h. 7, 30', 12"; therefore the digits 6; the end h. 8, 43' $\frac{1}{3}$ '. At Paris, Boulliau observed the end h. 7, 59 $\frac{2}{3}$ ', 36". Gassendi, however, observed the same successively near Paris, the end h. 8, 1', 38". At Danzig, Hevelius observed the end h. 8, 59'. At Naples, Father Giovanni Battista Zupi, S.J. [P. Io. Baptista Zuppus], observed the end h. 9, 5 $\frac{2}{3}$ '. The illustrious Lord Giulio Giustiniani observed the end h. 8, 44'; the same, at Mallorca, the Lord Vicenç Mut, by the bright altitude of Aquila at its setting, gr. 56, 56'; below the altitude of the pole, gr. 39, 15'. At Pisa, however, the Lord Vincenzo Renieri, by the bright altitude of Aquila gr. 50, 40'. Finally, at Brescia, Father Theodorus Moretus, S.J., the end by the bright altitude of Aquila gr. 45, 16'; below the altitude of the pole, gr. 50, 15'.

ECLIPSIS 107.

[Margin: 1645]

In the year 1645, on February 10, at Frankfurt-on-the-Main [Francofurti ad Mœnum], the end of a lunar eclipse was observed at h. 9, 1', 13"; and the beginning at hour 6'. At Paris, Boulliau noted the beginning at hour 5, 32'. Gassendi, however, at hour 5, 33'; the same again at hour 8, 40'. At Pisa, the Lord Vincenzo Renieri observed the end by the high altitude of Procyon, gr. 39, 20'; further, at the rising of Aldebaran, gr. 46, 10'. At Mallorca, the Lord Vicenç Mut saw the end by the high altitude of Procyon, and the rising, gr. 53, 45'. At Naples, Father Giovanni Battista Zupi, S.J., saw the end by the high altitude of Sirius, gr. 31, 20'.

ECLIPSIS 108.

[Margin: 1646]

In the year 1646, on January 30, at Paris, Gassendi observed a lunar eclipse at h. 18, 1' after midday; in New France [in nova Francia], Father Francesco Giuseppe Bressani, S.J. [P. Franciscus Iosephus Bressanus], observed the beginning by telescope at hour 10, 44'. The immersion, hour 11, 41'. At Pisa, the Lord Vincenzo Renieri obtained the beginning by the high altitude of the Moon, gr. 24'.

ECLIPSIS 109.

[Margin: 1646]

In the year 1646, on July 27, at Smyrna [Smyrnæ], Jo. Faber of Marseilles [Io. Faber Massiliensis] observed the end of a lunar eclipse at hour 8, 30' after midday, as Boulliau narrates in his letters.

ECLIPSIS 110.

[Margin: 1647]

In the year 1647, on January 20, at Paris, Gassendi observed the middle of a lunar eclipse at hour 9, 12'. At Danzig, Johannes Hevelius observed the beginning at hour 10, 29', 5"; and then the digits 5, hour 11, 27', 44". At Mallorca, the Lord Vicenç Mut observed the beginning [Continues on next page]

[Margin: Anni Christi.]

hour 8, 16'; the end at hour 10, 31'. At Smyrna [Bullialdus, Ismaël Boulliau] observed the beginning at hour 10, 37', the end at hour 12, 15'.

ECLIPSE 111.

[Margin: 1649]

In the year 1649, on May 25, [Vicenç Mut] observed the beginning of the total eclipse at Majorca [Maiorica] at hour 13, 16'; and Fr. Francesco Giuseppe Bressano of the Society of Jesus, in New France at Trois-Rivières [Tria Flumina], noted the beginning at hour 7, 48', the end at hour 10, 45'.

ECLIPSE 112.

[Margin: 1649]

In the year 1649, on November 18, we observed the total immersion of the Moon at Bologna at hour 18, 45', 50"; our people [Nostrì] the beginning at hour 11, the end at hour 15 precisely. At Quebec [Kebeci] Fr. Francesco Giuseppe Bressano observed the beginning at hour 12, 12'; the immersion at hour 13, 30'; the end at hour 16, 25'.

ECLIPSE 113.

[Margin: 1650]

In the year 1650, on May 15, [Vicenç Mut] observed the end of the lunar eclipse at Majorca at hour 9, 32', 24".

ECLIPSE 114.

[Margin: 1650]

In the year 1650, on November 7, Fr. Nicolaus Mascardus of the Society of Jesus observed at Panama the beginning of the lunar eclipse at hour 12, 15' after noon.

ECLIPSE 115.

[Margin: 1652]

In the year 1652, on September 17, we at Bologna [Nos Bononiae], together with Fr. Grimaldi [P. Grimaldo, Francesco Maria Grimaldi], caught the end of the lunar eclipse at hour 8, 42', 36" after noon; and the same end at Pansano [Pansani] near Modena [Mutina] was caught by Fr. Domenico Cassini [Io. Dominicus Cassinus, Giovanni Domenico Cassini], three minutes later. At Paris the end of the eclipse

was observed by D[octi]ssimi D[omini] Petit [Pierre Petit] and [Auzout, D. Auzotio] from Arcturus at hour 8, 3', but from the head of Andromeda at hour 8. By [Avignon, Auenione] D. Toridutus the end was obtained at hour 8, 14'. At Digne [Dinia] [Gassendi, D. Gassendus] [observed] the end at hour 8, 19'. Certain men at Leiden [Leydae] near [Bullialdus] [observed] the end at hour 8, 11', 36". At Tournai [Tornaci] [Wendelen, Vuendelinus] [observed] at hour 8, 12'. At Brussels [Bruxellis] [Langrenus] likewise at hour 8, 12'. Finally the Most Illustrious [Vuatsavia, Vuatsaviae] D. Io. Nucerus, Secretary of the Most Serene Queen of Poland, [observed] the end at hour 9, 19', 54"; and [Bullialdus] at Paris at hour 8, 3', 16".

ECLIPSE 116.

[Margin: 1653]

In the year 1653, on March 13, I myself [Ego], together with Fr. Grimaldi [P. Grimaldo], saw the beginning of the lunar eclipse at Bologna at hour 14, 40', 27" after noon, and the immersion at hour 15, 46', 30". At Paris in the Clermont College [Collegio Claramontano], the Fathers of our Society [PP. Soc. nostrae] observed the beginning at hour 14, 6', 34", the immersion at hour 15, 15', 15". Let [Bullialdus], however, by his own computation, have determined the beginning at Paris at hour 13, 57', the immersion at hour 15, 6'. Fr. Nicolaus Mascardus, in the Valle Bucalensi [Valle Bucalensi] — a place one degree more to the west — observed at S. Iago of Chile [S. Iacobo Chilensi] the beginning at hour 9, 15' after noon, the immersion at hour 10, 30', and the emersion at hour 12, 0', the end at hour 13, 15'.

ECLIPSE 117.

[Margin: 1654]

In the year 1654, on August 27, [Hevelius, Heuelius] at Danzig [Dantisci] observed the beginning of the lunar eclipse at hour 11, 16' $\frac{1}{2}$; the end at hour 12, 40' $\frac{1}{2}$; the middle at hour 11, 58' $\frac{1}{2}$. And the digits about 2 $\frac{1}{2}$, nearly. At Paris [Gassendi, Gassendus] [observed] the beginning at hour 10, 5'; the end at hour 11, 35'; the middle at hour 10, 50'. At Avignon [Auenione], D. Anton. Franc. Payen [Payen] [observed] the beginning at hour 10, 20'; the middle at hour 11, 6'; and the digits then 2 $\frac{1}{2}$. The end at hour 11, 50'.

ECLIPSE 118.

[Margin: 1657]

In the year 1657, on June 25, at Bologna, Fr. Grimaldi [P. Grimaldus] and I [Ego] noted the total obscuration of the lunar eclipse at hour 9, 1', 34"; the emersion at hour 9, 30' $\frac{1}{2}$; the end at hour 10, 54', 52". At Rome, D. Platus observed the end at hour 11, 8'; but Fr. Paulus Casatus of the Society of Jesus at hour 11, 6'. At Modena [Mutinae] Fr. Francesco Giuseppe Bressano [observed] the end at hour 10, 51'. At Turin [Taurini] D. Iulius Turrinus [observed] the immersion at hour 8, 41' $\frac{1}{3}$. At Lyon [Lugduni] Fr. Francesco Caizae [Caizae] of the Society [observed] the immersion at hour 8, 37'; the emersion at hour 9, 11'. The end [was lost], on account of the nearness of the horizon, and they all confessed by reason of the penumbra that the observation had been uncertain, as did we.

ECLIPSE 119.

[Margin: 1657]

In the year 1657, on December 20, Fr. Grimaldi [P. Grimaldus] and I [Ego] observed at Bologna the beginning of the lunar eclipse at hour 6, 48' after noon; the end at hour 8, 40'. The digits, to the naked eye, 3; but by telescope 3, 30'.

ECLIPSE 120.

[Margin: 1659]

In the year 1659, on May 6, the clouds preventing the remaining phases, Fr. Francesco Maria Grimaldi together with his companions — namely Alessandro Fuccio [Alexandro Fuccio] and others — observed at Bologna the end of the lunar eclipse, from the altitude of the [Fiducial line, Fidicula], at hour 10, 14', 49". Yet it seemed to me that that moment had elapsed as if truly nearly so; but the rest [was] doubtful — that it had not exceeded the sum by three minutes of time; and earlier too the other Moon [had been seen] at altitude 6 [grades], 6 digits obscured. The end of the eclipse, observed at Majorca [Maioricae] by [Vicenç Mut, Vincentio Muto], was at high Regulus toward setting, at grade 46, 42', or, as he himself reckoned, at hour 9, 33' after noon. If the observations are corrected, and you add 1' to the Grimaldian one [Grimaldicae], and to the Modenese [Mutiana] add 3', the difference of meridians, otherwise found to be 37' in time, comes out easily.

ECLIPSE 121.

[Margin: 1661]

In the year 1661, on October 7, the beginning of the spurious eclipse was observed at Bologna by Fr. Francesco Maria Grimaldi and his companions at hour

14, 8', 36" after noon; but the true beginning at the middle of the Ecliptic Shore [littus eclipticum], in the same Selenographia [Selenographia], at hour 14, 23', 16"; the end, however, near the macula Messhalae [Messhalae] toward Geminus, at hour 16, 53', 42" after noon; and so the duration was hour 2, 30', 26". The digits obscured 7 ½. At Aix [Aquis Sextiis] Fr. Henricus Ignatius of the Society of Jesus, of the King's [household], observed the beginning at hour 2, 24' after midnight, and the middle at hour 3, 35'; the end at hour 5, 11'; the digits 7.

CAPVT III.

An epitome of the observations of lunar eclipses, in so far as we have them handed down by the authorities, and the moment of the greatest, or middle, eclipse, which has been reduced by us to one and the same Bologna meridian, from the last table of the first chapter.

The following synoptic table lists historical lunar-eclipse observations in chronological order. The columns are:

- **Ordo Eclipsis ex cap. 2** — the serial number of the eclipse (from Chapter 2).
- **Anni labentes ante Christum, cum Mensibus ac Diebus incompletis** — years elapsed before Christ, with months and incomplete days. (For the later portion the header changes to **Anni Christi & Menses, dies labentes** — years of Christ, with the months and days elapsing.)
- **Observatores & loca observationis** — the observers and the places of observation.
- **Tempus post Meridiem loco observationis** (H. I) — the apparent time after noon at the place of observation, in hours and minutes (and seconds where given).
- **Tempus apparens p.m. in Bononia** (H. I II) — the apparent time after noon reduced to Bologna, in hours, minutes, and seconds.
- **Quantitas defectus (Digiti)** — the magnitude of the defect, in digits (or "Totalis" / directional indication).

O r d o	Year (b.C. /		Time after		Apparent time	
	A.D.) & Month,		noon at place		p.m. at	
	Day		(H. I [II])		Bologna (H. I	
	Observers & place				II)	
						Quantity (digits)
1	721 Thoth 29 / Martij 19	Chaldaei / Babylone	9 30	7 3 0	Totalis.	

O r d o	Year (b.C. / A.D.) & Month, Day	Observers & place	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantity (digits)
2	720 Thoth 18 / Martij 8	Chaldaei / Babylone	12 0	9 33 0	3 Austr.
3	720 Phamē. 15 / Septembr. 1	Chaldaei / Babylone	8 30	6 3 0	6 Bore.
4	621 Athyr 27 / Aprilis 21	Chaldaei / Babylone	17 50	15 23 0	3 Austr.
5	523 Phamē. 17 / Iulij 16	Chaldaei / Babylone	11 0	8 33 0	6 Bore.
6	502 Epiphi 28 / Nouemb. 18	Chaldaei / Babylone	11 36	9 9 0	3 Austr.
7	491 Tybi 3 / Aprilis 25	Chaldaei / Babylone	11 30	9 3 0	2 Austr.
8	383 Thoth 26 / Decembr. 22	Chaldaei / Babylone	19 20	16 53 0	1 vix.
9	382 Phamē. 24 / Iunij 18	Chaldaei / Babylone / Sed Hipparc.	9 6 / 9 15	6 34 0 / 6 43 0	ab ortu / aestiuo
1 0	382 Thoth 16 / Decembr. 12	Chaldaei / Babylone / Sed Hipparc.	11 0 / 10 25	8 33 0 / 7 58 0	Totalis.
1 1	201 Messori 16 / Septembr. 22	Hipparchus / Alexandriae	7 0	5 27 20	[—]
1 2	200 Mechir 9 / Martij 19	Hipparch. / Alexandr. / Sed Hipparc.	13 20 / 12 30	11 48 20 / 10 58 20	Totalis.
1 3	200 Messori 5 / Septembr. 11	Hipparch. / Alexandr. / Sed Hipparc.	14 15 / 14 21	12 42 20 / 12 48 20	Totalis.
1 4	174 Phamē. 27 / April. 30	Hipparch. / Alexandriae	14 20	12 47 20	7 Bore.
1	141 Tybi 2 /	Hipparch. /	10 10	8 37 20	3 Austr.

O r d o	Year (b.C. / A.D.) & Month, Day	Observers & place	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantity (digits)
5	Ianuar. 27	Rhodi			
1 6	125 Pachon 17 / Aprilis 5	Ptolemaeus / Alexandriae	8 24	6 51 20	2 Austr.
1 7	133 Payni 20 / Maij 6	Ptolemaeus / Alexandriae / Sol. loc. ♂ gr.	11 15 / 13 14	9 42 20	Total.
1 8	134 Choeac 2 / Octobris 20	Ptolemaeus / Alexandriae / Sol. loc. ♀ gr.	11 0 / 25 10	9 27 20	10 Bor.
1 9	136 Pharm. 19 / Martij 5	Ptolemaeus / Alexandriae / Sol. loc. ♂ gr.	16 0 / 14 12	14 27 20	6 Bore.
2 2	882 Kemir 23 / Iulij 23	Albategnius [al-Battānī] / Aractae [Raqqā]	8 aut plu.	5 5 0	10 plus
2 3	900 Hab 2 / Augusti 2	Albategnius [al-Battānī] / Antioch. Syr.	15 20	13 20 0	12 ferè

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
2 4	1457	Regiomontan. [Regiomonta nus] & Purbach. [Peurbach]	—	—	—
	Sept. 3	Mellici [Melk]	11 6	10 47 0	Total.
2 6	1460	Regiom. & Purbach.	—	—	—

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
	Dec. 27	Vienna Austr. [Vienna]	13 21 0	13 0 0	Total.
2 7	1461	Regiomont.	—	—	—
	Iunij 22	Vienna Austr.	13 20 0	12 59 0	Total.
2 9	1462	Regiomont.	—	—	—
	Iunij 11	Viterbij, vel [Viterbo]	14 48 0	14 43 0	7
3 2	1487	Bern. Vualt. [Bernhard Walther]	14 37	14 30 0	Total.
	Febru. 7	Norimbergae [Nuremberg]	15 47 0	15 49 40	—
3 3	1500	Copernicus	—	—	—
3 5	Nou. 5	Roma	14 0 0	13 53 0	10 Bor.
	1509	Copernicus	—	—	—
3 6	Iunij 2	Cracouia [Kraków]	11 36 0	11 2 0	8 Austr.
	1511	Copernicus	—	—	—
3 7	Octobr. 6	Fruemburg. [Frauenburg]	12 36 0	12 0 0	Total.
	1522	Copernic.	—	—	—
3 8	Sept. 5	Fruemburg.	13 20 0	12 44 0	Total.
	1560	Cornel. Gem. [Cornelius Gemma]	—	—	—
	Martij 11	Louanij	16 33 0	17 0 20	3 circ.

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digi)
		[Leuven]			
4 0	1573	Tycho [Tycho Brahe]	—	—	—
	Decemb. 8	Vraniburg. [Uraniborg]	8 3 0	7 57 24	Total.
4 1	1576	Tycho	—	—	—
	Octobr. 7	Vraniburg. / † at ex Longomont. [Longomonta nus]	11 32 0 / 11 25 0	11 26 24 / 11 19 24	—
4 2	1577	Tycho	—	—	—
	Aprilis 2	Vraniburg.	8 50 0	8 44 24	Total.
4 3	1577	Tycho	—	—	—
	Septēb. 26	Vraniburg.	13 3 0	12 57 24	Total.
4 4	1578	Tycho	—	—	—
	Sept. 15	Vranib. / Longomont.	13 17 0 / 13 24 0	13 11 24	2 30
4 4	1580	Tycho	—	—	—
	Ianuar. 31	Vranib.	10 10 0	10 3 24	Total.
4 6	1581	Tycho	—	—	—
	Ianuar. 19	Vranib. / Longom.	9 58 0 / 10 0 0	9 53 24	Total.
4 7	1581	Tycho	—	—	—

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
	Iulij 15	Vranib. / Longom.	16 57 0 / 17 0 0	16 51 24	Total.
4 8	1584	Tycho	—	—	—
	Nouēb. 7/17	Vranib.	13 8 0	13 2 24	Total.
4 9	1587	Tycho	—	—	—
	Sept. 6/16 † at ex	Vranib. / Longomont.	9 16 0 / 9 30 0	9 10 24 / 9 24 24	9 45 0
5 0	1588	Tycho Vran. vel idem	14 48 0	14 42 24	Total.
	Martij 2/12	[Tycho Frauenburg, vel idem]	15 2 0	14 56 24	—
5 3	1590 Dec. 30	Tycho	—	—	—
	1591 Ian. 9 styl. Greg. † at	Vraniburg. / Longomont.	6 55 0 / 7 0 0	6 49 24 / 6 54 24	—
5 4	1592	Tycho	—	—	—
	Deceb. 8/18	Vranib. / Lansbergius Goësa [Goes]	7 41 0 / 6 50 0	7 35 24 / 7 21 0	5 0
5 5	1594	Tycho	—	—	—
	Octobr. 18/28 † at ex	Vraniburg. / Longomont. / Lansb. Goësa	19 26 0 / 19 16 0 / 18 48 0	19 20 24 / 19 10 24 / 19 19 0	9.30. B.
5 6	1595	Tycho	—	—	—
	Aprilis 13/23	Vranib. / ex Longom. /	16 36 0 / 16 30 0 / 15 30 0 / 15	16 30 24 / 16 24 24 / 16 1 0 /	Total. / Total. / Total.

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
		Lansb. Goësa / Vuendelinus Hercae [Herck]	48 0	16 13 0	

The synoptic table of lunar-eclipse observations continues. Same column structure as on the preceding folio.

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
5 7	1596 Aprilis 2/12	Vuendelin. [Wendelen] Tornaci [Tournai] Tycho / Vraniburg.	— 8 10 0 9 29 0	— — 9 23 24	— — —
† ex		Longomont.	—	—	—
5 8	1598 Febru. 10/20	Tychonici / Vranib. vel Keplerus / Gratij [Graz] Lansb. Goësa Io. Rotarius [Rotarius] / Aquisgrani [Aachen]	18 7 0 / 18 5 0 18 20 40 17 23 0 17 31 0	18 1 24 / 17 59 24 18 0 0 17 54 0 17 51 0	11 30' — 11 30' —
5 9	1598 Augusti 6/16	Tychonici / Vranib. vel Longomont.	7 37 0 / 7 25 36 17 56 0	— / 7 20 24 17 51 0	Total. —
6	1599	Hafnia	—	—	—

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
0		[Copenhagen]			
	Ianuar. 30 st. n. Febr. 9	Tychon.	17 50	17 45 36	Total.
6 3	1601	Lansbergius / Goësa	6 12	6 43 0	10 36'
	Nouëb. 29 st. n. Dec. 9	Keplerus / Pragae [Prague]	6 54 0	6 42 30	—
		Diniaie multi PP. Cluniac. [Digne]	6 11 0	6 33 0	—
		Valentiole [Valenciennes]	6 22 0	6 41 0	—
6 6	1603	Lansbergius / Goësa	11 56 0	12 27 0	7 30'
	Maij 14/24	Kepl. Pragae	12 32 0	12 20 30	—
		Vuendelinus / Valentiole	11 38 0	12 7 0	8 0
6 7	1603	Lansbergius / Goësa	6 30 0	7 1 0	3
	Nouëb. 8/18	Kepl. Pragae	7 19 0	7 7 30	vix. 3½
		Vuendelinus / Diniaie	6 47 0	7 9 0	3
6 8	1605	Lansbergen. / Goësa	8 35 0	9 6 0	11 30
	Mart. 24 st. n. April. 3	Vuendelinus / Forcalcarij [Forcalquier]	8 12 0	8 37 0	11 40
6 9	1605	Lanberg. / Goësa	16 30 0	17 1 0	8 30

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bologna (H. I II)	Quantitas (Digiti)
	Septēb. 16/26	Vuendelinus / Forcalcarij	16 11 0	16 36 0	8 plus
7 0	1607 Aug. 25 / Septemb. 5	Scip. Arnaud. [Scipion Arnaud] / Valentiae Gall. [Valence]	14 45 0	15 14 0	—
7 1	1609 Ianuar. 9/19	Lansbergius / Goësa Adri. Metius [Adriaan Metius] / Franecherae [Franeker]	14 41 0 14 42 0	15 11 0 15 5 0	9 30 —
		Vuendelinus / Forcalcarij	14 43 0	15 8 0	—
7 2	1609 Iulij 6/16	Longomont. Hafnia	— 12 10 0	— 12 4 24	— Total.
7 4	1610 Deceb. 19/29	Vuendelinus Forcalcarij	— 15 45 0	— 16 10 0	— —
7 5	1612 Maij 4/14	Vuendelinus / Leodij [Liège] Scheiner S.I. [Scheiner] / Monachij [Munich]	9 56 0 10 38 ½	10 22 0 10 28 0	6 30' —

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bonon. (H. I II)	Quantitas (Digiti)
7 6	1612	P. Iulius Alenius Soc. I. [Giulio Aleni, S.J.]	—	—	—
	Nouēb. 8	Macai [Macao]	10 7 ½	3 22 30	—
7 7	1613	Longomont.	—	—	—
	Octob. 18/28	Hafnia	3 57	3 51 24	Totalis.
8 0	1616	P. Griebberg. S.I. & alij [Grienberger, S.J., & others]	—	—	—
	Augusti 16/26	Roma	15 20 0	15 12 45	Total.
		Kepl. Lincij [Linz] / vel	15 30 0 / 15 24 0	15 17 0 / 15 11 0	vix / Total.
		Vuendelinus / Leodij	14 57 ½	15 20 30	—
		Moestlinus [Maestlin] / Tubingae [Tübingen]	15 8 0	15 18 30	—
8 1	1617	Keplerus / Lincij	8 10 0	7 57 0	Total.
	Augusti 6/16				
8 2	1619	Vuendelinus / Hercae [Herck]	12 1 0	12 26 0	1 vix
	Iunij 16/26				
8 3	1619	Vuendelinus / Mechliniae [Mechelen]	14 57 ½	15 25 30	11 ferè
	Deceb. 10/20				

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bonon. (H. I II)	Quantitas (Digiti)
8 4	1620	Gassendus / Aquis Sextijs [Aix]	13 11 0	13 37 0	Total.
	Iunij 4/14 vtcumq;	Vuendelinus / Hercae	13 7 0	13 32 0	—
8 5	1620	Vuendelinus / Bethasijs [Béthune?]	5 40 0	6 5 0	Total.
	Nouēb. 29 st. n. Dec. 9				
8 6	1621	Gassendus / Aquis Sextijs	14 53 0	15 19 0	4 30
	Nouēb. 18/28	Kepl. Lincij	15 33 ½	15 20 30	4
		Vuendelinus / Bethasijs	15 0 0	15 25 0	3 plus
8 7	1623	Keplerus / Lincij	16 55 0	16 42 0	—
	Aprilis 4/14	Gassendus / Diniaie	—	—	11 30
8 8	1624	Kepl. Lincij	8 55 0	8 42 0	Total.
	Septēb. 16/26	Vuendelinus / Bethasijs	8 15	8 40 0	—
		Mich. Florēt. Langren. / Bruxellis [Brussels]	8 10 0	8 35 0	—
8 9	1625	Gassendus / Parisijs [Paris]	13 15 ½	13 55 30	1 plus
	Mart. 13/23	Vuendelinus / Bethasijs	13 32 0	13 57 0	2
9	1628	Gassendus /	9 36 ½	10 2 30	Total.

O r d o	Anni Christi & Mens, dies labentes	Observatores & loca	Time after noon at place (H. I [II])	Apparent time p.m. at Bonon. (H. I II)	Quantitas (Digiti)
2		Aquis Sextijs			
	Ianuar. 10/20	Baindbrigijs [Bainbridge] / Oxonij [Oxford]	9 11 0	10 4 0	—
		Vuendelinus / Bethasijs	9 30 0	9 55	—
		Kepl. Pragae	10 9 0	9 57 30	—
9 3	1630	P. Arzet S.I. [Andreas Arzet, S.J.] / Ingolstad. [Ingolstadt]	11 24 0	11 24 30	9 27
	Nouēb. 9/19	Langrenius / Bruxell.	10 57 0	11 22 0	9 30
		Martin. Hortensius [Hortensius] / Leyda [Leiden]	10 52 0	11 20 0	—

The synoptic *Epitome* table of historical lunar eclipses reduced to the Bologna meridian continues. Each entry gives the Ordo (serial number of the eclipse from Caput II), the year and day, the observers and their places, the apparent time after noon at the place of observation and reduced to Bologna, and the magnitude in digits. The two paired time-columns each carry the running heads H. | ' | " (hours, minutes, seconds).

Left table of the page (Ordo 95–104):

O r d o	Year / Month- day	Observers & places	Apparent time at place of obs. (H ' ")	At Bologna (H ' ")	Magnitude (digits)
9 5	1631, [new style] Nov. 8	Hortensius, Leiden	11 26 ½	11 54 30	Total
		Gassendi, Paris	11 14 ½	11 54 30	
		Wendelen, Béthasy	11 31 0	11 56 0	
		Wilhelm Schickard, Tübingen	11 43 0	11 53 30	
9 6	1632, Oct. 17/27	P. Arzet S.J., Innsbruck	11 48 0	11 48 5	5 22
		Hortensius, Leiden	11 22 0	11 50 0	4 40
		Otgerus, Liège	11 30 0	11 53 0	
9 7	1634, March 4/14	Peiresc, Aix- en-Provence	9 11 0	9 37 0	
		Gassendi, Digne	9 21 0	9 43 0	10 0
		Langren, Madrid	8 42 0	9 47 0	10 15
9 8	1635, Feb. 21 [new style March 3]	Gassendi, Aix- en-Provence	8 43 ½	9 9 30	Total
		Langren, Paris	8 29 ¼	9 9 15	
		Wendelen, Herck	8 49 0	9 14 0	
		Hortensius, Leiden	8 38 ⅓	9 6 20	
9 9	1635, Aug. 17/27	Peiresc, Aix- en-Provence	15 11 0	15 37 0	Total
		Wendelen,	15 15 0	15 40 0	

O r d o	Year / Month- day	Observers & places	Apparent time at place of obs. (H ' ")	At Bologna (H ' ")	Magnitude (digits)
		Herck			
1 0 0	1636, Feb. 10/20	Boulliau, Paris Gassendi, Digne	14 53 0 10 40 0	15 33 0 11 2 0	3
		Albert Linemann; Regiomont[an us]	11 45 0	11 7 0	3, nearly
1 0 2	1638, Dec. 10/20	Gassendi, Digne	14 26 0	14 45 0	Total
		Boulliau, Paris	14 10 ½	14 50 30	
		Langren, Brussels	14 16 ½	14 41 31	
		Golius, Leiden	14 18 0	14 46 0	
		Wendelen, Herck	14 21 0	14 46 0	
		Io. Phocylides, Franeker	14 23 ½	14 47 30	
1 0 3	1641, Oct. 8/18	Wendelen, Herck	7 29 0	7 54 0	6 45
		Puteanus, Louvain	7 23 ⅔	7 53 0	
		Langren, Brussels	7 24 0	7 49 0	6 47
		Hevelius, Danzig	8 26 ¼	7 54 15	
1 0 4	1642, April 4/14	We, with P. Grimaldi, Bologna	14 44 ⅕	14 44 12	Total

O r d o	Year / Month- day	Observers & places	Apparent time at place of obs. (H ' ")	At Bologna (H ' ")	Magnitude (digits)
		Wendelen, Herck	13 52 0	14 37 0	

Right table of the page (Ordo 104 continued–119):

O r d o	Year / Month- day	Observers & places	Apparent time at place of obs. (H ' ")	At Bologna (H ' ")	Magnitude (digits)
1 0 4	1642, April 4/14	Eichstad, Stettin	14 48 0	14 34 0	
		P. Jacobus Viva S.J., Ingolstadt	14 39 0	14 39 30	
		PP. Curtz & Arzet S.J., Eichstätt	14 38 0	14 42 0	
		Gassendi, Boulliau, Furnier, Paris	13 59 0	14 39 0	
		P. Vinc. Maria Grimaldi, Mantua	14 44 0	14 47 0	
		Io. Hevelius, Danzig	15 6 0	14 34 0	
		PP. of the Society of Jesus College, Paderborn	14 31 0	14 40 0	
		P. Marcellus S.J., Würzburg	14 38 0	14 45 0	
		PP. of the	14 59 0	14 47 30	

O r d o	Year / Month- day	Observers & places	Apparent time at place of obs. (H ' ")	At Bologna (H ' ")	Magnitude (digits)
		Society of Jesus College, Prague			
1 0 5	1642, Sept. 27 / Oct. 7, [new style]	Vinc. Mut, Mallorca	16 13 ½	16 50 20	Total
		Garratus, Lérída	16 0 ½	16 46 30	
		We, with P. Grimaldi, Bologna	16 49 36	16 49 36	
1 0 6	1643, Sept. 7/27	Wendelen, Antwerp	6 52 0	7 16 40	
		We, with P. Grimaldi, Bologna	7 30 52	7 30 52	6
1 0 7	1645, Feb. 10	Gassendi, Boulliau, Paris	7 6 ¼	7 46 15	
1 0 8	1646, Jan. 30	Gassendi, Paris	18 1 0	18 41 0	
1 1 0	1647, Jan. 10/20	Gassendi, Paris	9 12 0	9 52 0	
		Hevelius, Danzig	10 29 0	9 57 0	5 0
		Vinc. Mut, Mallorca	9 23 0	10 0 0	
1 1	1654, Aug. 17/27	Gassendi, Paris	10 50 0	11 30 0	2 30

O r d o	Year / Month- day	Observers & places	Apparent time		Magnitude (digits)
			at place of obs. (H ' ")	At Bologna (H ' ")	
7					
		Hevelius, Danzig	11 58 ½	11 26 30	2 30
		Anton. Francisc. Payen, Avignon	11 5 ¼	11 35 10	2 30
1 1 8	1657, June 5/25	P. Caeza S.J., Lyon	8 54 0	9 22 0	Total
		We, with P. Grimaldi, Bologna	9 16 0	9 16 0	
1 1 9	1657, Dec. 10/20	We, with P. Grimaldi, Bologna	7 44 0	7 44 0	3 30

CAPVT IV.

On the Uncertainty of Ancient Observations, and of Certain Recent Ones; on the Disagreement of Observers of the Same Eclipse; and on the 19 Causes of That Disagreement.

[Margin: On the Observations of the Ancients]

First, from what has been said about Eclipses 40 through 119, and from the disagreement among recent observations, one can judge well enough — notwithstanding how much this present age and the preceding one have advanced astronomy — how great the disagreement among the ancients would have been, had more observers recorded the same eclipses, especially observers without the telescope and the other instruments with which this art is now equipped. Note too that Ptolemy, working from the bare beginnings of eclipse-study as it had been handed down, fixed the mean point of the ancient total eclipses by supposing them to last very nearly 4 hours, and so fixed the moments

of the ecliptic full moon by adding two hours to the beginning, as he did in Eclipses 1 and 10 of our Caput II. When, however, the eclipse was of 6 digits, he judged it to last three hours, and so at the start added one and a half hours, as he did, following the order of that same chapter, in Eclipse 2. In Eclipses 3 and 7 it is established that in this matter the diversity of the various lunar Anomalies can amount to more than a quarter of an hour. Moreover, none of those good men of old were suspicious about refractions, nor did they detect any difference arising from the penumbra; yet here and there an error of 10 minutes, and sometimes more, may creep in. Hence, leaving aside Eclipse 8, which on account of its brevity could be observed with little precision, and Eclipses 9, 11, 13, and 14, scarcely any observations of eclipses before Ptolemy are manifestly free from an error of 20 minutes — not to say 30. Granting therefore to Ptolemy himself what he affirms of himself in *Almagest* IV.6, that certain eclipses were observed with the utmost accuracy, we are nevertheless compelled to suppose that, in using those ancient observations together with these recent ones, some compensation of their errors occurs over a very long interval of time — errors that may perhaps slip in unnoticed past the observers.

[Margin: 2]

As for the Disagreement, and consequently the uncertainty, of many recent observations, I recall it to those two heads. The first head concerns the differing moments of the ecliptic full moon, even with respect to the same meridian. To make this more evident, I had premised Caput III, in which I reduced those moments to our Bologna meridian. The reader will therefore run through those eclipses, beginning from 49, and will recognize how enormous the discrepancies are in some of these disagreements. For Eclipse 49 is reported by Longomontanus 14 minutes later than by Tycho; and in Eclipse 50, by likewise 14 minutes, Tycho disagrees with himself, just as he disagrees with Wendelen in Caput II — observations I marked, but they are the most disgraceful of all, when the eclipses observed by Lansbergen are compared with the Tychonic or the Wendelinic. For they are as follows:

In Eclipses	Minutes of disagreement
54	15
66	20
68	29
69	25

Whether Lansbergen was deceived by the penumbra, as Wendelen suspects (and as we said in Caput II), or whether he forced the observations to fit his own Tables — and so in these cases they are fallacious — I leave undecided. For not this whole and so great a discrepancy can arise from the distance of the meridians supposed by us; otherwise, in other eclipses (say in 58 and 63), Lansbergen would not agree so nearly with the others. There is also that notable disagreement which in Eclipse 104 mounts up to 22 minutes, because that eclipse was observed by very many at different hours of the day [continued opposite].

[The first embedded table — the eclipses ranked by their minutes of disagreement:]

Minutes of disagreement	Order of the eclipses from Caput III
1 ½	88
2	63
2 ¼ [?]	95
4	57, 103, 105
5	53, 84, 96, 100
6	86
7	88
8	67, 98, 110
8 ½	117
9	75, 80, 92, 102
10	58, 71, 97
14	101
15	54
20	60
22	114
25	69
29	56 & 68

[Margin: 3]

The second head of Disagreements — those which can least be ascribed to false distances of the meridians — concerns the Duration of the same eclipse, or the tarrying [*Mora*] in total shadow. This will appear more clearly in the following

Table, in which the letter D denotes the Duration of the eclipse and M the tarrying in darkness.

[The second embedded table — durations and tarryings. Column S marks D (Duration) or M (tarrying, *Mora*); H = hours, M = minutes:]

Order of eclipse	Observers	S	H	M
56	Lansbergen	M	1	40
	Wendelen	M	1	30
67	Kepler	D	1	56
	Wendelen	D	1	52
75	Wendelen	D	2	38
	Scheiner	D	3	7
80	Kepler	D	3	28
	Grienberger	D	3	13
	Wendelen	D	3	8
	Maestlin	D	3	10
	Our men at Rome	M	27	30
	Wendelen	M	31	0
86	Kepler	D	2	1
	Wendelen	D	1	55
	Gassendi	D	1	54
88	Kepler	M	1	44
	Wendelen	M	1	44
	Langren	M	2	3
89	Wendelen	D	0	57
	Gassendi	D	0	43
93	P. Arzet	D	3	6
	Hortensius	D	3	1

[The duration/tarrying table continues from the previous page (Ordo 95–118), same column scheme — S = D (Duration) or M (tarrying, *Mora*); H = hours, M = minutes:]

Order of eclipse	Observers	S	H	M
95	Gassendi	M	1	41
	Hortensius	M	1	41
	Langren	M	1	45
	Schickard	M	1	43
96	P. Arzet	D	2	22
	Hortensius	D	2	24
	Otgerus	D	2	24
	Gassendi, but from a false altitude of the pole	D	2	27
97	Peiresc	D	3	16
	Gassendi	D	3	21
98	Gassendi	M	1	37
	Wendelen	M	1	41
99	Wendelen	M	1	33
	Boulliau	M	1	35
100	Gassendi	D	1	50
	D. Petit	D	1	46
102	Golius	M	1	34
	Boulliau	M	1	35
	Phocylides	M	1	35
	Gassendi	M	1	36
	Wendelen	M	1	38
	Langren	M	1	38
	Wendelen	D	2	42
103	Puteanus	D	2	54
	PP. Arzet & Curtz	M	1	31
104	Hevelius	M	1	31 ½
	P. Furner[ius]	M	1	36
	Gassendi & Boulliau	M	1	36
	P. Jacob. Viva	M	1	38
	PP. of Paderborn	M	1	40

Order of eclipse	Observers	S	H	M
105	Eichstad	M	1	44
	We	M	1	44 $\frac{1}{3}$
	Vincentius Mut	M	1	38
	Garratus	M	1	39
107	We	M	1	39 $\frac{1}{2}$
	Gassendi	D	3	8
	Boulliau	D	3	7
	of Frankfurt	D	3	3
110	Hevelius	D	2	8 $\frac{1}{2}$
	Vincentius Mut	D	2	15
117	Gassendi	D	1	30
	Hevelius	D	1	24
	D. Payen	D	1	30
118	P. Caeza	M	0	34
	We	M	0	28

Then the prose on this page returns to the discussion of the four causes of disagreement among observers.

it may seem to someone that the Moon has entered the shadow, when in reality it is still a fair distance from it. And for the same reason, when it has in fact emerged from the shadow, it will appear not yet to have emerged; so on both counts the duration will appear to some greater than it ought to be. Sometimes, however, a lunar eclipse begins in the brighter part of the disk, toward the Northeast [*Notapeliotem*], around the *Terra Sterilitatis* [Land of Sterility], and on the contrary ends in the western part of the limb, which is of itself darker, near the *Mare Langrenum*. And then, even if no error is made at the beginning, an error may still be made in estimating the end, by waiting for it until that part is illuminated by all the Sun's rays. This first cause is further varied by the libration of the lunar body, which presents to us now one margin and now another.

[Margin: 2nd Cause]

The second cause is the Privation of some of the Sun's rays, which the Moon suffers near both edges of the shadow, whether it has not yet entered the shadow or has just emerged from it. For, compared with its other parts, which are

illuminated by all the Sun's rays, those parts which are deprived of many rays appear darker, and there arises a kind of smoke, and an image of the shadow, which we call the *Umbrago* [shadowing]. This straightway darkens a large part of the lunar disk before the legitimate eclipse, by about a quarter of an hour or more, and likewise afterward the Moon perseveres darkened for some while after it has come out of the shadow. This did not even occur to Tycho's mind, but was noted afterward by others; hence in the more recent observations the time of the spurious eclipse, distinct from the legitimate eclipse, has often been remarked.

[Margin: What the legitimate eclipse is]

I call the *legitimate* eclipse that in which the Moon enters that shadowy cone which is apprehended by the rays of the Sun touching the globe of the Earth and its atmosphere, the rest of the rays being so impeded that they cannot penetrate directly but only somewhat refracted. For neither is the Moon to be looked for as not illuminated even by any refracted rays; otherwise many eclipses, even total ones, would be none, as we shall presently say when we treat of the *Penumbra*, in connection with this 2nd cause — see the diagram in *Almagestum Novum*, Book 5. So much for this point.

[Margin: 3rd Cause]

The third cause indeed is that on account of which even the keenest-sighted observers — whether with the naked eye or equipped with the telescope — are wont to hesitate around the beginnings and ends of the eclipse, both at immersion into and emersion from the earthly shadow. This is the *Penumbra*, so called because it is not simply shadow, but a privation of rays of any kind whatsoever of the Sun — *yet almost shadow*, since it is the privation of all the direct rays of the Sun, but with a participation of Refracted Rays, illuminating the Moon with a weak and malignant light; and standing in the place of darkness it represents to us those various colors on the lunar disk — bluish, rusty, honey-colored, ashen, ruddy, tawny, and the like — according to the diverse density and opacity of the watery vapors that surround the terrestrial globe. And there arises a twofold refraction of the Sun's rays, one at immersion and the other at emersion. For which matter the figures are to be consulted in *Almagestum Novum*, Book 5, set out in Chapter 5, from problem 1 to the end, where you will see many admirable things concerning the variety of phases arising from this, and why sometimes in the very middle of a total eclipse the Moon, passing through the axis of the aforesaid cone, nevertheless still appears dimly lit; and, as Pliny says (Book II, ch. 9), "is deficient, and yet in its defect is conspicuous."

Indeed, in the same eclipse it may to some lie wholly hidden, affected by no rays — by not even refracted rays — as mere shadow vanishes from the eyes; while to others, in different places, it may appear dimly lit, on account of vapors of diverse density. And refracted rays, so affected, may even vanish — as happened in Eclipse 104, in the year 1642, and on other occasions, as we have recounted in the same Book, ch. 5, num. 13. So that, to say nothing meanwhile of Mars and Jupiter, which, being as it were set opposite the Moon, can communicate some little part of light to it, even when it is placed in the shadow. From this mixture of the Penumbra it comes about that eclipses which are in truth total scarcely appear total, when the tarrying in darkness is of brief duration — as perhaps happened in Eclipses 23, 68, 80, 83, and 87, concerning which see the history in Caput II; and in those that were observed under very varied conditions, especially when for many it was near the Horizon, and in one place there was clear weather, in another murky, and in another a damp state of the air. But now we touch upon the fourth cause.

[Margin: 4th Cause]

The fourth cause is the one already indicated on the occasion of the third, namely...

[Margin: 1st Cause]

The causes, moreover, of the aforesaid Disagreements in respect of the tarrying, both in quantity and in the conditions required in observing, have been set out by us in *Almagestum Novum*, Book 5, Chapter 5, and in its scholia, and are now to be briefly indicated. The first is from the Moon's own limb as it enters the shadow of the Earth, and then again as it emerges. For the Eastern part of the limb, which first enters the shadow, is darker than that Western part which last comes out of the shadow. Indeed the Eastern part of the limb, with its parts hollowed inward, exhibits that great spot toward the North, or toward the Northeast [*Arctapeliotem*], which in *Almagestum Novum*, Book 4, we named the *Littus Philippicum* [Philippine Shore]. Since therefore this part is of itself very dark, if on approaching the shadow it is already deprived of some of the Sun's rays — though it be still illuminated by some — then...

[continued in the following discussion]

[Margin: 2nd Cause] [Margin: What the legitimate eclipse is] [Margin: 3rd Cause]

[Margin: 4th cause, manifold.]

is allowed by the diversity of horizons and of vapors, which, according to their differing density, produce a greater or lesser refraction of the rays; and so the same rays, by their greater or lesser coloration, give rise to differing brightnesses and qualities. They also generate the penumbra, and besides this they produce a different appearance of the Moon: for the rays travel from the Moon to our eyes by reflection, and again, on entering the earthly atmosphere, they are refracted before they reach our eyes. As a result, the extreme phases of an eclipse — when the Moon begins to enter the shadow, and when it begins to leave it — are difficult to judge.

Therefore there are two refractions involved in this fourth cause: one of the Sun's rays at the place where they are refracted, the other of the Moon's; and the same goes for the differing refraction of the rays reflected from the Moon before they reach our eyes. Both depend on the nearness of the Moon, greater or lesser, to the horizon, and on the differing density of the vapors; or it may even happen that our position beneath the equator, or lower within the Torrid Zone, where the vapors are believed to swell up more loftily, makes the Moon's margins, as observed by us, vary.

[Margin: 5th cause.]

The fifth cause is the diversity of the *Umbragines* [shadow-fringes] of the lunar globe, which appear differently at different horizons — as Wendelen [Govaert Wendelen] also noted in the preface mentioned. For when the Moon traverses a shadow whose plane cuts the very globe of its body into two hemispheres — granted that, at the place where the Moon passes, the astronomical tables suppose it, yet it touches the globe at a smaller part than a hemisphere — and so the *Umbrago* enters before it [the shadow proper], by a thickness of cone the more conspicuous the nearer that shadow-cone is to us; when, I say, the center of the Moon is at quadrature, the semidiameters being equal, an eclipse of this kind by hypothesis increases by about the sixth part of a digit. From this it comes about that the lunar margins do not appear the same to all those dwelling on Earth: some, who have the Moon near their vertex, look upon it; others, set toward the north, view the Moon from the south at an oblique angle; and so it is possible that to those in the south the same eclipse should appear of 6 digits, but to those in the north of $6\frac{1}{2}$ digits. Indeed it can even happen — and this is a very true paradox — that the same eclipse should be partial to some and total to others, if anything beyond the angle of contact of the shadow should jut out so far from the prominent body of the Moon toward one pole, that it is not conspicuous to inhabitants toward the other. The discrepancy, however, is very small.

[Margin: 6th cause.]

The sixth cause is uncertain indeed, yet it can be pointed out as in part the Moon itself, in part the air around the Moon — that is, its own atmosphere surrounding it, and of differing thickness — whence the Moon, before it touches the body of the shadow, may seem to touch it earlier or tardily; or the Moon is abandoned, that is, the light it draws from the Sun is held back later in the darkness; or, in the manner of the Bolognese gnomon, our eyes, though set in the dark, are carried over from the Sun into the darkness — a thing which Wendelen judges not improbable in this same matter.

[Margin: 7th cause, manifold.]

The seventh cause lies in those astronomical elements which concur in determining the moment of the ecliptic phases: namely the Moon's motions and parallaxes (if we use the lunar altitude), the declination, and the right ascension of the fixed star and the right ascension of the Sun, by which it is necessary to derive the times wanted; the position of the meridian among all these; and the azimuths of the star, and the altitude of the pole. For in all these matters, should any error of computation lurk, it is necessary that, by a trigonometric calculation built on a false foundation, a false conclusion as to time be begotten.

Furthermore, as regards Tycho [Tycho Brahe] — however much one labors over the fixed stars in their exploration — it is one thing to investigate, but another to apply the correction owed to the Tychonic right ascensions and to his right ascensions of the affixed stars, as we judge must be shown at *Liber 4* from *Caput 10*; and from our *Geographia Reformata* it will be evident how false the altitudes of the pole, found here and there by astronomers, sometimes are. Gassendi himself, on the basis of the Sun's altitudes, carefully reckons that the whole of Gaul comes out new [i.e., misplaced] in an eclipse; for in the Lyon eclipse he determines its beginning at hour 10 [?], 3', and its end at hour 12 [?], 30'; and that the altitude of the pole is 45°[?] 36' — which he says he derived from an observation of two...

the very opposite. We compute the place of the Moon at the same moment, adding the difference of place computed from observation, or the debt owed by the difference of observations, and the difference of time owed to this; the *equation of place* is wont to be about double the moment itself of the full moon.

[Margin: 8th cause.]

The eighth cause is the diversity of the observers themselves, arising from natural causes: vision; sight, with which some are endowed by sharper sight,

greater attention, and circumspection, than others — especially in such subtle matters, when an experience already attained for the most part is at hand. But if many adduce themselves as witnesses, and the moment determined more certainly is fixed by them, the eclipse begins or ends, and they do not agree among themselves on the same point, the one greater than this, the other less, ambiguous, and the fallacy is born from the outset.

[Margin: 9th cause.]

The ninth cause is likewise the diversity of the observers themselves, arising from the instruments with which the eclipse is observed: namely, the telescopes by which the eclipse is greater than to the naked eye; the quadrants, the astronomical radii, the clocks, and so on; or from their use and handling. For nor in this can it happen that no slight error be committed in all things, that is, the diligent observers are to be degraded who observe with others; and if the better organs come to hand, yet they do not agree with the others, that nothing should be ascribed to the skill of the trigonometric calculation, which can however be easily repeated, and corrected.

[Margin: 10th cause.]

The tenth cause is the false difference of longitude, that is, the assumed distance of meridians, while observations made under different meridians are referred to one another, and it appears whether they agree at the same moment or not — as we did above at *Caput* 3. Especially since the difference of longitude is to be derived not from itinerary intervals, but from the lunar eclipses themselves at *Caput* 3. Since therefore an eclipse is licensed to be observed in several places, and from observations of this kind we have surveyed it at Bologna and at Paris, at the 40th moment of time, we confess nevertheless that no evident falsity should appear in a difference of one or another minute of time, in the greater or lesser part of the more remote regions; for from those nearby, or beneath nearly the same meridian, we have a greater certainty from elsewhere than from the eclipses themselves.

CAPUT V.

De Consensu, aut Dissensu Tabularum Astronomicarum cum Observationibus Eclipsium Lunarium, & primò de Antiquis Eclipsibus usque ad Ptolemæum inclusivè, & enormi quoad has Dissidio inter Tabulas Astronomicas, & Chronologicas apparenti; sed verò Ptolemæi errore in motu Solis.

[On the agreement or disagreement of the astronomical tables with observations of lunar eclipses; and first on the ancient eclipses down to Ptolemy [Ptolemy] inclusively, and on the enormous disagreement, as regards these, that appears between the astronomical and chronological tables — but which is in truth due to Ptolemy's error in the motion of the Sun.]

This comparison, indeed — which we ourselves long desired, and which we know is eagerly awaited by students of astronomy, so that it may be established how far the more distinguished astronomical tables, beyond the rest, can be excogitated as better and more accurate. And so, to this end, at *Caput 3* I selected those eclipses, of which a medium part — whether at the moment of the partial defect, or at the extreme phases, whether partial or total — could be noted by us from the observers: namely, because in the moment of the diametral opposition of the Moon with the Sun (which is the moment of the ecliptic full moon), and of the place of the Sun at the moment foreknown from the tables, the place of the Moon opposite is certainly known. Then, to this reduced astronomical moment — yet a moment equated and reduced to a uniform time — we have computed it, as below in naming the place of the Sun by the tables; and from there we shall immediately note...

the opposite. We compute the place of the Moon at the same moment, adding the difference of place; the difference of place is computed from observation, or the debt owed; the difference of time differs here.

[Margin (numbered 2):] Since the astronomical tables are for the most part constructed and affixed to a meridian differing from the one under which the observations have been made, the time of the observations must be reduced to the meridian of the tables, according to the distances of these places — which the tables themselves command in their catalogs of places, or at least as little as is wanting, according to our *Geographia Reformata*.

[Margin (numbered 3):] Since the aforesaid eclipses were observed before our time by others than us, or recalled to calculation from the tables of others, where they did not fall short of our intention: provided that, from the Rudolphine tables [*Rudolphine Tables*], the eclipses computed are altogether 91; from the Philolaic [*Astronomia Philolaica*], the eclipses computed are 40; and from the Tychonic, the eclipses are 24. Since indeed we have used the calculations of others, so that the difference of meridians, and of the moment of time handed down from here under the meridian of observation by the observers, may be established under the meridian of the tables — what scruples of hours the tables represent — the

eclipse may stand earlier or later, and so likewise the difference in zodiacal place may be elicited.

[Margin (numbered 4):] Furthermore, since for the most part these eclipses, beginning from an eclipse, were observed by different observers, or at a different moment they note, we choose one, or draw it from several observations, and its time under the meridian of the observations is handed down; and accordingly, from the moment of the time itself, and from *Caput* 3, it will be established by what observer's choice we have elected. For example, in eclipse 110 we have noted the hour 9^h 12'; since at it, recurring to *Caput* 3 and to eclipse 110, it will be established that the same was made at Paris through Gassendi, namely at hour 9^h 19' after the meridian. For the rest, this warning peculiarly pertains to the eclipses of the following chapter. And to this chapter peculiarly pertains the following warning concerning the day of the eclipse.

[Margin (numbered 5):] Although in *Caput* 2 and 3 we referred the ancient eclipses to the meridian of noon, as we truly compute by our *Chronologia Reformata*, and by the apparatus of chronology answering in the form of the Julian Years and the months of the Egyptian Year in Ptolemy. In the following we have been forced by the tables, two for each: that we should note the days, one moment, by which the eclipse came; it is necessary, according to the place of the Sun in Ptolemy — let it be of such a kind that the astronomical tables for the most part do not exhibit the Moon opposite to the Sun, but at degree 11, or 12, distant from opposition with the Sun; and yet they exhibit the place of the Sun observed by Ptolemy nearer, while the other day, namely the later, we add, where the astronomical tables exhibit the Moon opposite to the Sun: so that it is not the place of the Sun that itself underlies, which at least Ptolemy handed down from his tables, but nearly the degree of the preceding. Concerning the disagreement there will be differing matters below, after the following catalog of eclipses.

[Margin (numbered 6):] Meanwhile, by our sincerity and good faith, the names of those by whose eclipses we have used are to be reviewed, according to the warning at 3 and 4, and they are in alphabetical order written below.

Andreas Argolus [Andrea Argoli], who computed eclipses from the Danish tables of Longomontanus [Longomontanus], at Rome, yet to the meridian, in his ephemerides from the year of Christ our Lord 1630, and down to 1700.

Claudius Ptolemæus [Ptolemy], who handed down not only eclipses observed, equated and reduced to his own time of observations, but the most full eclipses;

and he adjoins from his tables, or from Hipparchus [Hipparchus], the place of the Sun and of the Moon.

Christianus Severinus Longomontanus [Longomontanus], who in *Liber 1, Theoricorum Astronomiae Danicae* [*Astronomia Danica*], *Caput 2*, in his Commentary...

has handed over the place of the Moon, computed from the Danish tables, with 9 eclipses observed in antiquity, & at Tycho's [Tycho Brahe], whether by himself or others, by which he adjoins the time and the hourly motion of the Moon from the Sun, answering to the difference observed.

David Origanus [David Origanus], who in his ephemerides, both Prutenic and Tychonic, but to the meridian of Frankfurt-on-Oder reduced, computed eclipses from the year of Christ 1595, to 1654.

Dionysius Petavius Soc. Iesu [Denis Pétau], who in *Liber 8, De Doctrina Temporum* [*De Doctrina Temporum*], *Caput 13*: all the ancient ones down to al-Battānī [al-Battānī] inclusive, and very many of the more recent ones down to the year 1600 of Christ, computed eclipses observed, from his Parisian tables — that is, to the meridian of Paris affixed — adjoining, however, some calculation from the Alphonsine, Prutenic, and Danish, and besides some of our own century's eclipses he predicted.

Gotefridus Vuendelinus [Govaert Wendelen], who, after the *Ideam* of his Atlantic Tables [*Idea Tabularum Atlanticarum*], published of many recent eclipses; that is, he derived the time of the eclipses from those same tables, and by some quantity from the year 1573 to 1643.

Io. Antonius Maginus [Giovanni Antonio Magini], who in his ephemerides, from the Prutenic tables, to the meridian of Venice computed eclipses from the year 1581 to 1660.

Franciscus Montebrunus [Montebruni], who from the Lansbergian tables [Lansbergian Tables] of Bologna, by our meridian, completed the calculation of eclipses from the year 1640 to 1660.

Ioann.-Keplerus [Kepler], who, from the Rudolphine tables, in his ephemerides computed eclipses from 1617 and 1620, under the meridian of Uraniborg. But we have recalled the Rudolphine eclipses of the Moon, 91 observed, to calculation.

Ismaël Bullialdus [Ismaël Boulliau], who in *Liber 7* of his *Astronomia Philolaica*, *Caput 7*, computed eclipses from his Philolaic tables, 19 in antiquity, and recent

ones — 35 — from the year 1573 to 1643. Just as we — but not the Philolaic — adjoin a calculation: the eclipse computed at the 40th, to the meridian of Uraniborg, which he chose.

Michaël Maestlinus [Michael Mästlin], who from the Prutenic tables to the meridian of Tübingen computed eclipses from the year 1577 to 1590.

Nicolaus Copernicus [Nicolaus Copernicus], who computed eclipses by himself, and adjoined the place of the luminaries, deduced from his own tables.

Philippus Lansbergius [Philips van Lansbergen], who in his *Goëse* meridian, from his tables, computed it; and in the Thesaurus [Lansbergen, *Thesaurus*] he derived the very fullest eclipses of antiquity, and recent observations — which differ very much — perhaps because the tables themselves cannot be too much gainsaid.

[Margin: NOTE therefore the Indices of the aforesaid Tables, by which below we shall use what is written underneath.]

Alphons. — The Alphonsine Tables [Alphonsine Tables] in the calculation of Petavius, of Regiomontanus [Regiomontanus], or of Magini [Giovanni Antonio Magini].

Atl. — The Atlantic of Wendelen [Govaert Wendelen] from his own calculation.

Dan. — The Danish in the computation of Longomontanus [Longomontanus], or of Petavius, or of Argoli [Andrea Argoli].

Lansf. — The Lansbergian from the computation of Lansbergen [Philips van Lansbergen] himself, or of Montebruni [Montebruni].

Parif. — The Parisian from the calculation of Petavius.

Phil. — The Philolaic from the computation of Bullialdus [Ismaël Boulliau], or our own.

Prut. — The Prutenic from the calculation of Petavius, or of Buntengi [?], or of Maestlin [Michael Mästlin], and most often of Origanus [David Origanus].

Rud. — The Rudolphine from the computation of Kepler [Kepler], very rarely, but everywhere; from our Own in all the eclipses.

Tych. — The Tychonic from the computation of Origanus [David Origanus], or our Own.

Ptol. — The Ptolemaic.

The moments of the ancient eclipses, and the observed quantity, collated with the time and the quantity represented by the tables written below. The letter e indicates the *excess* of the computed place of the Moon; and d, the *defect* from the exact opposition with the Sun.

The table is read group by group, one group per "Ordo Eclipsis ex Cap. 2" (eclipse-order from *Caput* 2). For each group, the first inner block gives the data referred to the place of the Sun's apparent opposition; the second inner block (the lower one in each group) gives the corrected/alternate reckoning. The column "Tempus Apparens post Merid. in loco Observationis" gives Month / Day / Hour / Minute. "Solis locus Verus ex Tabulis, & inde 》 locus 8" [the Sun's true place from the tables, and from it the Moon's place opposite] is given as Sign / Degree / ' / ". "Lunæ locus Verus ex Tabulis computatus" [the Moon's true place computed from the tables] likewise. "Differentia loci 》 computati & observati" carries the marker letter (d = defect, e = excess) followed by Gr / ' / ". "Tempus huius Differentiæ" gives H / ' / ". "Quantitas in digitis" and "Differentia Quantitatis" give digits.

Ordo Eclips. ex cap. 2	Observatio & Tabula	Men- s.	Sol. l. Si- g.	Lun. n. Si- g.	Diff. loci (d/e)	Tempus p. H.	Quant. digit.	Diff. Quant.
1 Eclipsis	Observ. Ptol.	Thot h	♄				Tot lis	Digi t.
	Dan.	Mar tij			d	2 4		
	Parif.	Mar t.			d	2 4		
	Philol.	Mar t.			d	2 4		
	Rudol.	Mar t.			d	2 0		
	Dan.	Mar	♄	♅	d	0		

Ordo Eclips. ex cap. 2	Observatio & Tabula	M en s.	So l. Si g.	Lu n. Si g.	Diff. loci (d/e)	T e m p. H.	Qua nt. digit .	Diff. Qua nt.
2		tij						
	Parif.	M ar t.			d	0	18	30
	Phil.	M ar t.			d	0	19	10
	Rudol.	M ar t.			d	0		
	Lansb.	Th ot h			d	0	17	52
	Observ. Ptolem.	Th ot h	✕					
	Dan.	M ar tij		♂	d	2 4		
	Lansf.	M ar t.			d	2 5	15	
	Parif.	M ar t.			d	2 4	16	
	Phil.	M ar t.			d	2 4	10	
	Rud.	M ar t.			d	2 3		

Ordo Eclips. ex cap. 2	Observatio & Tabula	Men- s.	Sol. Si- g.	Lun. Si- g.	Diff. loci (d/e)	Tem- p. H.	Quant. digit.	Diff. Quant.
3	Dan.	Mar- t.	♄	♅	e	0		
	Lanf.	Mar- t.			e	0	1	15
	Parif.	Mar- t.			e	0	3	16
	Phil.	Mar- t.			e	0	3	10
	Rud.	Mar- t.			e	0		
	Observ. Ptolem.	Pha- men- s.	♅					
	Dan.	Au- gu- sti		♅	d	2 5		
	Lansf.	Au- g.			d	2 4	34	
	Parif.	Au- g.			d	2 5	20	
	Phil.	Au- g.			d	2 5	17	
	Rud.	Au- g.			d	3 0		

Ordo Eclips. ex cap. 2	Observatio & Tabula	M en s.	So l. Si g.	Lu n. Si g.	Diff. loci (d/e)	T e m p. H.	Qua nt. digit .	Diff. Qua nt.
4	Dan.	Se pt.	♊	♋	d	0		
	Lansb.	Se pt.			d	0	5	34
	Parif.	Se pt.			d	0	5	20
	Phil.	Se pt.			d	0	6	17
	Rud.	Se pt.		♊	d	1		
	Observ. Ptolem.	At hy r	♊					
	Lansb.	Ap ril	♊	♌	d	2 4	16	
	Parif.	Ap ril			d	2 4	45	
	Phil.	Ap ril			d	2 4	20	
	Rud.	Ap ril			d	2 1		
	Lansb.	Ap ril		♌	d	0	2	16
	Parif.	Ap ril			e	0	3	45

Ordo Eclips. ex cap. 2	Observatio & Tabula	Men- s.	Sol. Si- g.	Lun. Si- g.	Diff. loci (d/e)	Tem- p. H.	Quant. digit .	Diff. Quant.
5	Phil.	April			e	0	3	20
		.						
	Rud.	April			e	1		
		.						
	Observ. Ptol.	Phamenoth	☿					
	Lansb.	Iulij		♊	d	2 4	2	
	Parif.	Iulij			d	2 4	25	
	Phil.	Iulij			d	2 5	15	
	Rud.	Iulij			d	2 4		
	Lansb.	Iulij	☿	♊	d	0	6	2
	Parif.	Iulij			d	0	7	25

Book Two — On the Moon

[The large comparison table "Moments of the Ancient Eclipses" (Eclipsium Antiquarum Momenta), begun on the preceding folios, continues here across pages 113–115. Each numbered block ("Ordo") gives one ancient eclipse: the first row labelled Observatio records the observed datum, and the following rows record the value computed from each set of astronomical tables — Ptolemaic (Ptol.), Danish

(Dan. = Tychonic-Danish), Lansbergian (Lansb. / Lans.), Parisian (Paris.), Philolaic (Phil. / Philol.), Prutenic (Prut.), and Rudolphine (Rud. / Rudol.). The marker e = excess (the computed lunar place exceeds the exact opposition), and d = defect (it falls short of exact opposition). The zodiacal signs in the Solis locus and Lunae locus columns are given by their astronomical symbols, transcribed here by name. The Egyptian/movable months (Epiphi, Thoth, Phamenoth, Mechir, Messori, Tybi, Pachon, Payni, Choeac, Pharmuthi) appear in the Mens. column.]

Table: Moments of the Ancient Eclipses (continued)

Column headers (verbatim):

- **Ordo Eclips. ex c. 2** — Order of the eclipse from chapter 2
- **Observatio, & Tabulae** — Observation, & Tables
- **Tempus Apparens post Merid. in loco Observationis** (Mens. / D. / H. / M.) — Apparent time after the meridian at the place of observation (Month / Day / Hour / Minute)
- **Solis locus Verus ex Tab. & inde ☉ locus ☊** (Sig. / Gr. / ' / ") — True place of the Sun from the Tables, and thence the place opposite the Sun (Sign / Degree / minute / second)
- **Lunae locus Verus ex Tabulis computatus** (Sig. / Gr. / ' / ") — True place of the Moon computed from the Tables
- **Differ. loci ☉ computati, & observati** (Gr. / ' / ") — Difference of the computed and observed place [with e = excess / d = defect]
- **Tempus huius Differentiae** (H. / ' / ") — Time corresponding to this difference (Hours / minutes / seconds)
- **Quantitas in digitis** (Dig. / ') — Magnitude in digits
- **Differ. Quantitatis** (Digit. / ') — Difference of magnitude

Sign abbreviations used below: Ari (Aries ♈), Tau (Taurus ♉), Gem (Gemini ♊), Can (Cancer ♋), Leo (Leo ♌), Vir (Virgo ♍), Lib (Libra ♎), Sco (Scorpio ♏), Sag (Sagittarius ♐), Cap (Capricorn ♑), Aqr (Aquarius ♒), Psc (Pisces ♓).

O													D
r			Su			Mo			i			T	D
d	Obs./	Me	n			on			ff			-	i
o	Tab.	ns.	Sig	'	"	Sig	'	"	f	'	"	H'	" g'
	Phil.	Iuli		5	3		2	4	d	2	5	0 53	4 5 15
		j		3	5		6	5		6	0		0

O r d o	Obs./ Tab.	Me ns.	Su n Sig	'	"	Mo on Sig	'	"	D i ff f	'	"	T - H'	"	D i g'	D i ff Q
6	Rud.	Iuli j		5	5		2	5	d	3	0	1 4	0		
				8	4		6	4		2					
	Obse rv.	Ep hip h.											3	0	
	Lans b.	No ue mb .	Ta u	5	2	Tau	4	4	d	1	3	2 &c.	2	25	
				7	5		5	9		1	6	4			
	Paris .		Ta u	8	1	Tau	3	5	d	2	2	2 &c.	4	0	
7	Phil.			1	2		4	4	d	2	3	2 &c.	3	3	
				8	3		3	4		9	9	5			
	Rud.			5	2		3	4	d	2	3	2 &c.			
				7	3		0	7		6	6	3			
	Lans b.	No u.	Ta u	5	3	Tau	5	2	d	0	8	0 0	1	2 25	
				6	3		6	4					6		
	Paris .		Ta u	7	2		4	2	d	1	0	0 38	0	4 0	
					6		9	6		8					
	Phil.			1	3		5	1	d	1	1	0 36	2	3 3	
				7	1		9	9		8	2		5		
	Rud.			5	3		4	4	d	7	5	0 15	4		2
				6	1		8	0		1			0		1
	Obse rv.	Ty bi											2	0	
	Lans .	Ap ril.	Ari	4	5	Lib	3	3	d	1	1	2 &c.	1	33	
				7	1		6	4		1	7	4			
	Paris .			4	1		1	9	d	4	7	2 &c.	2	20	
				3	6		6			7	3				
	Phil.			5	1		4	4	d	5	3	2 &c.	2	20	
				6	6			5		1	1	4			
	Rud.			4	4		3	4	d	6	5	2 &c.			

O r d o	Obs./ Tab.	Me ns.	Su n Sig	' "	Mo on Sig	' "	D i ff f	' "	T - H'	' "	D i g'	D i ff Q
				1 5		5 0		4				
	Lans b.	Ap ril.	Ari	4 5 6 9	Lib	4 9 7	e	0 1 0	0 0		2 1 0	33
	Paris .			4 2 2 4		6 4 4	e	2 3 4 0	0 49		0 2	20
	Phil.			5 2 5 4		1 2 1 0	e	1 5 9 6	0 39		5 2 5	40
	Rud.			4 5 0 3		1 5 3	e	2 0 1	0 42		0	
8	Obse rv.	Th ot							exigua ab ortu		æsti vo.	
	Prol.	Th ot	Sag	1 0 8	Ge m						3 0	
	Paris .	De ce mb .		1 4 6 6							2 20	
	Phil.			1 5 4 9		2 6 d		1 5 2 3	2 &c. 4			
	Rud.			6 2 2		2 2 8 4	d	2 0 8	2 &c. 4			
	Paris .	De c.	Sag	1 5 5 4	Ge m				0 33		0 3 0	
	Phil.			1 7 4		1 4 2 1	d	1 2 5	0 2		5 2 0	20
	Rud.			5 3 0		2 5 2 9	d	4 3 2 0	1 15		0	

*In hac Eclipsi, ex Petauij calculo, Alphonsinae Tabulae excedunt
Observationem hora 1. & 56'. Danica 42'. Prutenicae 49'. Parisina 33'.*

[In this eclipse, by Petavius's [Denis Pétau] calculation, the Alphonsine Tables exceed the observation by 1 hour 56'; the Danish by 42'; the Prutenic by 49'; the Parisian by 33'.]

O r d o	Obs./ Tab.	Mens.	Su n Sig	'	"	Mo on Sig	'	"	D i ff f	'	"	T- H	'	"	Dig	'	D i ff Q
9	Obse rv.	Pham enoth										ab ort u			æsti vo.		
	Ptole m.	(Pham enoth)	Ge m	4	0	Sag											
	Pari s.	Iunij		4	1	Sag	3	3	d	1	3	24	&c.	7		3	
	Phil.	Iunij		4	2		2	9		1	3					0	
				5	5		3	1	d	1	4	24	&c.	6		4	
				3	8		6	6		1	6					2	
	Rud.	Iunij		4	1		1	5	d	2	1	23	&c.				
				0	5		6	9		3	6						
	Pari s.	Iunij	Ge m	4	2	Sag	4	1	d	0	6	0	0	1	7	3	
				3	0		3	4						2		0	
	Phil.			5	6		4	5	d	6	1	0	12	3	6	4	
				5			6	1		5				0		0	
	Rud.			2	2		3	1	d	2	5	0	4	1			
				9	3		7	8						0			
1 0	Obse rv.	Thoth											Tot alis.				
	Ptol.	Thot	Sag	3	0	Ge m											
				0													
	Pari s.	Dece mb.		2	5	Ge	5	5	d	2	5	24	&c.	17		0	
				7	1	m	4			1	7						
	Phil.			2	3		7	1	d	1	1	24	&c.	19		4	
				5	8		9			8	9					2	
	Prut.			2	5		5	2	d	2	2	24	&c.				
				7	2		5			2	7						
	Rud.			1	2		2	4	d	5	3	27	&c.				

O r d o	Obs./ Tab.	Mens.	Su n Sig	'	"	Mo on Sig	'	"	D i ff f	'	"	T- H	'	"	Dig	'	D i ff Q
					9 5			8 8		0 7							
	Pari s.	Dece mb.	Sag		2 5 6 9	Ge m		1 2 6 9	d	8 3 0		16	4	17		0	
	Phil.				2 4 4 6			1 5 7 4	d	6 5 2		10	5	19		4	2
	Prut.				2 0 7			1 0 6	d	1 0 1		21	0				
	Rud.				1 3 8 3			5 8 3 5	d	1 2 3 5		26	5		0		
1 1	Obse rv.	Mesor i										7	0				
	Ptol.	Mesor i	Vir		6 0	Psc											
	Dan.	Sept.			2 5 7 2	Psc		1 2 1 5	d	1 2 6 7	24	&c.		10		0	
	Pari s.				9 2 6			5 5 2 7	d	1 2 6 9	24	&c.		9		8	
	Phil.				1 4 3 9			5 2 2 3	d	2 2 0 6	24	&c.					
	Rud.				2 8 0			4 4 2 0	d	3 2 7 7	21	&c.					
	Dan.	Septe mb.	Vir		2 0 7	Psc		2 0 2	d	5 0 0	0	10	0	10		0	
	Pari s.	Po[st]			8 3 4			3 3 2	d	5 2 0	0	11	0				
	Phil.				1 5 2 7			2 4 8	d	1 9 0	0	19	2	9		8	
	Rud.				1 1 9 6			0 1 8	e	4 2 1	1	22	0				

Ordo	Obs./ Tab.	Mens.	Su n Sig	' "	Mo on Sig	' "	D i ff f	' "	T - H'	' "	Di g	' "	D i ff Q
12	Observ (Eclipf)	Mech ir									Tot alis		
	Ptol.	Mech ir	Ps c	1 0 7	Vir								
	Dan.	Marti j		8 5 2		5 2 d 6		5 2 2 &c. 7 4					
	Paris.			3 4 9 8		4 2 d 6 0		5 2 2 &c. 3 8 0		17	2		0
	Philol.			4 2 8 1		5 1 d 6		5 2 2 &c. 2 0 3		16	1		4
	Rudol.			3 2 9 7		2 4 d 0 0		1 4 2 &c. 8 7 4					
	Dan.	Sept.	Ps c	8 0	Vir	1 0 e 4		6 0 0 12		0			
	Paris.			3 5 8 6		5 5 e 6 5		1 0 0 36 8		0 17	2		0
	Phil.			4 2 7 9		6 3 e 6		1 7 0 36 9		4 16	1		4
	Rudol.			3 3 8 5		3 1 d 1 5		7 1 0 14 0		4			0
13	Observ .	Meso ri									Tot al.		
	Ptolem .	Meso ri	Vir	1 0 2	Psc								
	Dan.	Sept.		3 5 4 2	Psc	1 2 d 7 5		1 2 2 &c. 7 0 4					
	Paris.			2 3 6 8		5 1 d 2 1		3 2 2 &c. 4 7 5		18 fer			
	Phil.			2 1 1		5 2 d 9 9		2 3 2 &c. 1 2 4		19	4		5

Ordo	Obs./ Tab.	Mens.	Su n Sig	' "	Mo on Sig	' "	D i ff f	' "	T - H'	' "	Di g	D i ff Q
14	Rud.			1 8	Aqr	5 4	d	5 2	3 &c.			
				1		4		4	0			
	Dan.	Sept.	Vir	3 0	Psc	2 0	d	6 0	0 12	0		
				4		8						
	Paris.			1 4		2 4	d	1 0	0 29	0 18		
				6 6		6		4		fer		
										e		
	Phil.			2 9		1 4	d	1 5	0 21	1 19	4	
				0		0		0		6	5	
	Rud.			1 1		1 3	d	1 4	0 27	2		
				0 6		7 2		3 4		5		
	Observ .	Pham enoth							7	0		
	Ptolem .	(Pha meno th)	Ta u	1 0	Sco							
				4								
14	Lans.	April.		3 2	Sco	5 4	d	4 4	2 &c.	7	1	
				9 6		7 2		1 4	1		3	
	Paris.			5 2		2 1	d	3 7	2 &c.	7	2	
				4 0		0 3		4	5		0	
	Piml. [Phil.]			4 5		1 5	d	5 1	2 &c.	7	1	
				3		1 2		3 1	4		3	
	Prut.			5 2		2 5	d	3 2	2 &c.	8	2	
				4 2		1 5		2 7	5		2	
	Rud.			1 5		3 3	d	2 2	2 &c.			
				3 7		3 3		0 4	6			
	Lansb.	April.	Ta u	8 3	Sco	8 1	d	0 3	0 1	5 7	1	
				4		7		4			3	
	Paris.			5 2		0 4	e	7 2	0 15	3 7	2	
				3 8		8		0		1	0	
14	Phl.			4 1		2 2	e	1 2	0 35	4 7	1	
						2 7		8 6		0	3	

Ordo	Obs./ Tab.	Mens.	Su n Sig	' "	Mo on Sig	' "	D i ff f	' "	T - H'	' "	Di g	' "	D i ff Q
15	Prut.			5 3		2 3 e		9 0 0 19		0 8		2	
				3 0		0						2	
	Rud.			1 7		1 7 e		2 2 0 40		0			
				3		3		0					
	Observ.	Tybi							3	0			
	Ptolem.	Tybi	Aq r	8 0	Leo								
	Lansb.	Ian.		1 6	Can	1 1 d		1 5 2 &c.		2		5	
				2		1		1 4				6	
	Paris.			4 1		2 4 d		2 2 2 &c.		3		3	
				7 1		0 5		6 6 4				0	
	Phil.			5 1		5 1 d		5 5 2 &c.		2		5	
				2 3		9 5		2 8 4				7	
	Rud.			4 5		2 4 d		1 4 2 &c.					
				1 9		5		6 6 6					
16	Lansb.	Ianu.	Aq r	1 2	Leo	1 4 d		0 2 0 0		4 2		5	
				1 4		1 6		0		0		6	
	Paris.			4 1		3 2 d		1 0 0 32		0 3		3	
				6 9		1 0		5				0	
	Phil.			9 5		9 5 e		1 3 0 34		0 2		5	
				0		0		8 9				7	
	Rud.			4 5		3 2 d		3 3 0 16		5			
				0 8		7 8		0		8			
	Observ.	Pachon							2	0			
	Ptol.	Pach.	Ar i										
	Lansb.	April.		3 2	Lib	2 5 d		1 3 2 &c.		1		4	
				3 7		1 1		1 6 4				8	
	Paris.			2 2		1 4 d		1 4 2 &c.		2		1	

Ordo	Obs./ Tab.	Mens.	Su n Sig	' "	Mo on Sig	' "	D i ff f	' "	T - H'	' "	Di g	D i ff Q
				7 6		4 5		2 1 4				8
	Phil.			3 3		8 5 d		2 4 2 &c.		2		1
				4 2		0		5 2 4				0
	Rud.			2 3		3 3 d		4 5 2 &c.				
				6 6		9 8		6 8 5				
	Paris.	April.	Ar i	2 3 6 4	Lib	2 2 d 5 0		1 1 0 1 4		3 2 7		1 8
	Phil.			3 4 3 0		1 2 d 9 5		1 1 0 27 4 5		2 2 4		1 0
	Lansb.			3 3 2 5		3 2 d 2 6		0 9 0 0		2 1 0		4 8
	Rud.			2 4 5 4		5 1 d 0 3		3 3 1 11 5 1		0		
17	Observ .	Payni							Tot al.			
	Ptol.	Paun.	Ta u	1 0 4	Sco							
	Dan.	Maij		3 5 3 2	Sco	3 2 d 7 5		5 2 2 &c. 6 7 3		12		2 6
	Lans.			1 5 4 8		1 1 d 4 5		4 4 2 &c. 4 4 4		16		0
	Paris.			2 2 2 8		2 1 d 3		5 2 2 &c. 9 7 4		13		0
	Phil.			3 9 2		2 5 d 2 2		9 1 2 &c. 7 4				
	Rud.			2 1 3 7		5 2 d 2 6		3 5 2 &c. 0 1 3				

O r d o	Obs./ Tab.	Mens.	Sun Sig	'	"	Moo n Sig	'	"	D i ff	'	"	T - H	'	"	D i g	'	Di ff Q
	Dan.	Maij	Tau	3	0	Sco	4	0	e	1	0	0	3	0			
				3			8			5		0					
	Lans.			1	6		1	5	e	0	4	0	1	3	1	2	
				4			4	0		4			0	2	6		
	Paris.			2	3		3	3	e	1	0	0	2	1	1	0	
				1	6		3	6		2			2	0	6		
	Phil.			3	1		3	2	e	2	1	0	4	3	1	0	
				1	7		3	7		0			0	3			
	Rud.			2	2		3	2	e	4	5	0	1	5			
				2	5		1	0		8	5		7	0			
1 8	Obser v.	Choeac											9				
	Ptol.	Choeac	Lib	6	0	Ari	1	0	e	4	0	0	8	0	9		
							0										
	Dan.	Octob.		3	5	Ari	2	2	d	1	2	2	&				
				7	2		6	5		1	7	4	c				
													.				
	Lans.			7	1		5	3	d	1	4	2	&	1	3		
				7			6	5		0	2	4	c	0	1		
													.				
	Paris.			2	4		1	7	d	1	3	2	&	1	2		
				5	4		4			1	7	4	c	0	0		
													.				
	Phil.			2	3		1	1	d	1	3	2	&	1	6		
				7	4		4			3	3	4	c	1			
													.				
	Rud.			2	4		4	3	d	3	4	2	&				
				0	7		8			2	4	3	c				
													.				
	Dan.	Octob.	Lib	3	0	Ari	3	0	d	0	0	0	0	0			
				7			7										
	Lans.			6	2		6	3	e	0	1	0	0	2	1	3	

O r d o	Obs./ Tab.	Mens.	Sun Sig	'	"	Moo n Sig	'	"	D i ff	'	"	T - H	'	"	D i g	'	Di ff Q
					5			5			0			1	0	1	
	Paris.				2	5		2	4	d	3	1	0	6	4	1	2
					4	2		1	2			0		2	0	0	
	Phil.				2	4		2	3	d	2	6	0	4	4	1	6
					6	2		4	6						1		
	Rud.				1	5		5	3	e	3	4	1	1	0		
					9	5		8	8		8	3		7			
1 9	Obser v.	Pharm uthi												6	0		
	Ptole m.	(Pharm uthi)	Psc	1	0	Vir	1	0	e		3	0	0	6	0		
	Dan.	Martij			4	5	4	2	d		4	2	2	&	5	4	
					9	2		5			5	7	4	c		7	
														.			
	Lans.				5	3		5	5	d	1	3	2	&	5	2	
						9		3	4		1	5	4	c		4	
														.			
	Paris.				5	1		1	4	d	4	2	2	&	6	2	
					1	5		0	7		0	8	3	c		7	
														.			
	Phil.				5	1		2	5	d	3	2	2	&			
					8	5		1	4		5	1	3	c			
														.			
	Rudol .				5	3		1	1	d	5	2	2	&			
					1	3			3		0	0	5	c			
														.			
	Dan.	Martij	Psc	4	0	Vir	1	0	e		2	0	0	5	0		
					9			5			6			3			
	Lans b.				4	4		4	2	d	0	1	0	0	3	5	4
						7			9			8		7		7	
	Paris.				5	2		2	2	e	3	0	0	5	0	5	2
					0	3		1	2		1			8		4	

after midday on the 6th of May; whence it follows, by the count of days, that the chronological canons place the beginning [of the era], in the form of the Julian year, at the midday of the 26th of February.

[Margin: Copernici error. — Copernicus's error.]

8. *First*, it is certain — both from other authorities and especially from Censorinus (ch. 10) on the day of birth — that the Romans began their civil days from the midnight preceding. But the Egyptians in particular, and the astronomers, are accustomed to begin the day from midday, as is established in the first place from Ptolemy (*Almagest*, book 3, ch. 8), and from the passage of Censorinus shortly to be cited. Hence the beginning of the Egyptian year was not from the Kalends of any Roman day, nor from some whole day before the Kalends, but from before the 6th Kalends [VI. Kal.], or the 12th Kalends [XII. Kal.], it took its start — indicating that the [Egyptian] year began 12 hours before the customary beginning of the Roman day.

9. *Second*, it is certain from Ptolemy throughout that the Egyptians, in their observations of eclipses and of other phenomena, were not accustomed to number the days as incomplete according to their usual reckoning, and moreover — as is generally the case — after the day named they add the day not yet begun. So in book 3, ch. 8, when he has said that the equinox was observed by himself in year 17 of Hadrian, on the 7th of Athyr, just after midday, two near-equal hours — shortly after he says: *"From the first [day] of Nabonassar, year 1, and from the midday of Thoth, the second month according to the Egyptians, up to the autumnal equinox expounded by us, year 879 is gathered, and the 66th day, and 2 equal hours."* But if he had taken the seventh of Athyr as exact and complete, he would, besides the aforesaid years, have numbered 67 days. Moreover (*Almagest*, book 4, ch. 8) he says: *"From the first midday of Thoth of the first year of Nabonassar, up to the middle [moment] of the second of the ancient eclipses — which, as we said, was in the second [eclipse] of Mardocempad, in the year Thoth 18, following the 19th, in the equal sixtieths, 50, before midnight — the time is gathered to be of Egyptian years 27, of days 17, and of hours 11, and 10 sixtieths, very nearly."* But if he had reckoned the 18th of Thoth already completed, he would have numbered 18 days in that collection. Copernicus therefore errs, whenever in such cases he numbers —

[Margin: Copernici error. — Copernicus's error.]

Ptolemy counts the days designated as completed [pro exactis], that is, as fully elapsed, as in *Almagest* IV, ch. 5, where he says: "On the twentieth day from the

beginning of the month Phamenoth." And he soon counts the days slipping by [labentes adhuc], that is, still running, as he marks the first of these eclipses as falling on the 20th of Pauni, the second on the 2nd of the following Choiac, the third tertio (that is, on the 3rd?), and the third (last) on the 19th of Pharmuthi, the day on which the twentieth was running. Let this matter be settled for now from the very practice of Petavius.

[Margin: Copernici error — Copernicus's error.]

10. With this matter at last settled, we expose certain other points. Although it is generally agreed among chronologers that the first year of the vulgar Christian epoch was the forty-sixth of the Julian years, and the first to be bissextile [leap year] — for from this it follows by *Almagest* III, ch. 60(?) that the birth of the Emperor Claudius (as Suetonius shows from the Kalends of August in the Julian year 90) is brought back to the year of Christ's epoch 45, by which means, in our Reformed Chronology, it is confirmed by the common opinion of most chronologers, that the beginning of the years of Christ at the first Kalends of January falls in the year 46 of the Julian period.

11. Fourthly, at last, since the Egyptian year, being constantly of 365 days, also runs ahead a fourth part [quarto quoque] each year, the Julian year begins after the year 24 of February(?), and begins in the descent of the years, and on the contrary in the ascent of the years toward the beginning of the world begins one part before. With these things laid down, the controversy already indicated is more easily exposed.

[Margin: Arabum opinio de Annis Nabonassari, & Christi — The opinion of the Arabs concerning the years of Nabonassar and of Christ.]

12. Jacobus Christmannus [Jacob Christmann], in his book *On the Roman Calendar*, p. 182, says: "The Arabs, exactly [exactè] in commemorating the intercalation, reckon both the years of Nabonassar and of Christ, while in the first book(?) they reckon the years run from Nabonassar up to the transit of Christ 747, and from Christ 131." And shortly after Paul, he adds: "*The Arabs likewise did not take the era of Christ from his conception, but from his circumcision, that is, from the last day of December, which precedes the circumcision, or the Kalends of January, in the year 46 of the Julian period.*" If, then, you reckon from the year before Christ 747, that is, the 26th of February, you will reckon the years 747, and so on with the other eclipses, per the days of the preceding December, the circumcision of Christ

— and they will be the years 747. To this extent Christmannus reckons in the same way 130. How Regiomontanus reckoned, the same Christmannus affirms in the same place. Therefore, if they be 131, it is fitting to take the beginning of the reckoning at the last(?) Meridian of the 25th of February of the year 747 before Christ. From this then follows the months of the Egyptians, which Ptolemy compares to the year of the Julian period, the days preceding them, which the common reckoning of the astronomers notes: and per the example of eclipse 17, set down on the 20th day of Pauni, noted by Ptolemy to be the 5th of May, not now, or commonly, June.

13. We respond, however, that nothing is gained by this opinion of the Arabs. For although the prudent Arabs accommodated their epoch to Dionysius Exiguus, introduced into the Christian world for numbering the years of Christ at their circumcision, and thence the years 747, that is, the 26th(?) from the beginning of Nabonassar, that is, the 26th of February: when, however, they considered the Astronomical Tables, yet they fixed the beginning of the year at the last Meridian of December, for the sake of the convenience of the reckoning, that the astronomical reckoning of the integers might be possible. Rather, from the reckoning of Censorinus let us examine the years. We reckon at the last Meridian of December, by Varro, and in this place we follow the year of Nabonassar 747, as Christmannus writes; for to fix the beginning of Thoth as consuls Pius(?) and Bruttius(?) in the Meridian preceding the twelfth Kalends of August, that is, in the Meridian of the 20th of July, will be the years 747, the 26th(?) of February, when one numbers 130: in what manner Regiomontanus had erred, the same Christmannus affirms there. Therefore, if they be 131, it is fitting to take the beginning of the reckoning at the Meridian of the 25th of February of the year 747 before Christ. From here, then, follows that the months of the Egyptians, which Ptolemy compares, correspond to the year of the Julian period in the preceding days, which the common astronomical reckoning notes: and per the example of eclipse 17, the day noted by Ptolemy to be the 5th of May, not now, or in common usage.

14. Censorinus, in his book *On the Birthday*, ch. 8, in the next year, the first of the years (which he takes as an index of illustrious epochs), among other things has the following: "*Unless I am mistaken, this very year, as a kind of index, and the title of a certain Olympiad of Vlpus(?) and Pontianus, as consuls, from the first Olympiad, is the M. and XIV, on which days the burning summer Olympic Games are celebrated. From the founding of Rome, indeed it is numbered 1991. And indeed from the Palilia [festival of Pales],*

whence the years are reckoned." Of those very years to which the name Julian belongs is the year 283, that is, on the Kalends of January of which year Julius Caesar made the beginnings of the years he himself constituted. But concerning the years which they call the years of Augustus the CCLXV: First the VII. and M. and(?) Pissamo(?) Agrippa, III. consuls. But because Egypt, two years before [it came] under the power and dominion of the Roman people, lived(?), they have the years of the Augustans —

[Margin: Et Petauij — And [the opinion] of Petavius.] [Margin: Et Krismanni — And [the opinion] of Christmann.]

— from CCLXVIII. For, as among us, so among the Egyptians a certain year is referred to in letters, in which the years of Nabonassar are called, which from the first of his Empire run together [consurgant], of which here is CMXXCV. I, that is, item Philip, who from the excess of the Alexandrian years of the Great are numbered, and to this very point [year] they complete DLXII; but the beginnings of these years are always reckoned from the first Meridian, so that they fall on the VII. Kal. Jul., that is, the 26th of June, on the 100th(?) year. For from Bruttus(?) at present they are the same days that have been before the XII. Kal. Aug., at which time Sirius [Canicula] usually rises in Egypt. Whence it may be known that the year of Magnus the Great, as said above, is both the Solar and the Sirian [Canicularis], and is called the Year of God [Dei Annus]. But the beginnings, indeed, are reckoned from the turning [vertentem] year of the hundredth. The beginnings, however, of these years are noted for this reason, lest anyone reckon either the Kalends of January, or the same time as beginning together [simul]. From this place it follows first (which by this very thing is to be looked to) that, if the years of the first epoch of Christ are, as we have said, the maximum, that is, the years of Nabonassar 748: they fall on the Nabonassar 748. Whence follows: the year of Nabonassar 986 begins before the seventh Kal. Jul., that is, before the 24th day of June — nay, before the Meridian of the 24th of June. For the Egyptians never began at midnight, nor on the sixth day, nor on the seventh Kal. Jul., but before the seventh Kal. Jul., as testified by the same Censorinus, ch. 10. But before the preceding Meridian, therefore neither at the sixth, nor at the seventh Kal. Jul., did he say. Hence then it is manifest that, by the Chronological Canon, in retroceding [counting back] in the Julian year, the beginning of the Nabonassar period follows in the Meridian of the 25th of February. The year, indeed, of Nabonassar 747, now again in the Meridian of the 26th(?), is what the most learned astronomers have hitherto commonly thought, especially the astronomers and chronologers, particularly Nicolaus Mulerius [Nicolaus Mulier] in the Frisian Tables, Joseph Scaliger in his book *On the Emendation of the Times*,

Dionysius Petavius [Denis Pétau] in *De Doctrina Temporum* III, ch. 9, Jacobus Christmannus in his *Calendars*, Henricus Philippus [Henry Philip] in his *Chronology*, Keplerus [Kepler], and Bullialdus [Ismaël Boulliau] in the Tables — the former [Kepler] in the Rudolphine, the latter [Boulliau] in the Philolaic. The cause was, indeed, why no one noticed that very formula: "*Ante diem VII. Kal. Jul.*," but used the perinde [equivalent] formula: as if "*die VII. Kal. Jul.*," which divides, again recedes; whence the beginning of Nabonassar falls in the Meridian of the 26th of February. Nor is there anything else but that even our exemplar of Censorinus has led us astray: that is, "*ante diem VII. Kal. Jul.*" of the Emendation of the Times, p. 201, says: "*Censorinus wrote his little golden book on his birthday in the year of Christ of Dionysius 238, Cyclo Solis XXIII, Luna XI,*" which I recognize to be from the Year of the Sun [Annus Solis] 1014, who arrives at days of fixed reckoning: this is what that most learned man of the times writes, both extreme and the avenger of antiquity. To this he writes "*ex Anno Thoth Nabonassari,*" the very 90th day [nonagesimum], the sixth most extreme [extremum] falls before the VII. Kal. Jul. — this falls on the 7th Kal. But this is before the 7th Kal., and this in the year XXV. Jul. But if before the 7th Kal. Jul. this is also in the Meridian of the 25th of June, likewise then it falls before the principle of the Meridian Month of Thoth in the Meridian of the 25th of June. Likewise our Petavius, although ocularly [by sight], yet dormant [dormitando], seems to have seen it. For in book 9 of *De Doctrina Temporum*, ch. 42, after the exordium of that "*Censorinus, an author of all by the most approved judgment, &c.*" — he relates among other things that from the beginning of the year of Nabonassar 980, the sixth of the eighty(?) years [octogesimi sexti], these words of Censorinus: "*Quique hoc Anno ante diem septimum Kalendas Julias.*" And shortly after he interprets it: "*New moon [Neomenia] of Thoth in that year on the VII. Kal. Jul. fell.*" But it is fitting to say: "*on the day VII. Kal. Jul.*," that is, in the Meridian of the eighth(?) day Kal. Jul. Likewise Christmannus, in his book *De Coniunctione Annorum*, p. 416: after the lavish praises of Censorinus, he affirms the year Julian 283, the Thoth Nabonassar 986, which falls on the seventh day Kal. Jul.; this is in the 25th of June; and shortly after he refers to Censorinus: "*Quique hoc Anno fuit ante diem septimum Kal. Jul.*," but not cohering with these very things, and the days before the seventh — whence the Thoth of Nabonassar 986 begins before the Meridian of the 2nd day of June, as we contend that the authors ought to emend in the writing of Censorinus, this is before the day VII. Kal. Jul., as is clear from the years of the Augustans of the year CCLXIX. In this manner, before the year of writing CCLXVII, it is clear from a biennial [two-year] addition that the opinion of Censorinus is set out in the years of Augustus, the Roman CCLXV, in order that the years of the Augustans be reckoned Egyptian.

[Margin: Scaligeri lapsus Chronol. — Scaliger's chronological slip.] [Margin: Et Petavij — And [the slip] of Petavius.] [Margin: Et Krismanni — And [the slip] of Christmann.]

15. But it is evident from Censorinus himself that one must read, in the prior place, "*ante diem VI. Kal. Jul.*"; for this day confirms —

— it [the reading] from the other more notable day, immediately subjoining: "*Cum ab hinc Annos centum Pio, & Bruttio, Praesente cos.*" The same days were before the XII. Kal. Aug., as our codex of Scaliger, Christmann, & Petavius has. But of the Julian years, the beginning of the Egyptian year anticipates the days that are the beginning of the year, that is, on the first day of Thoth was consuls Pius and Bruttius in the Meridian preceding the twelfth Kal. of August, that is, in the Meridian of the 20th of July. Sacred to St. Margaret, on which after a hundred years it falls in the Meridian of the 25th of June, this is on that Meridian which was before the VI. Kal. Jul. I know Scaliger, & Manutius acknowledge an error, but it is rather to be placed back in this second place of Censorinus, and replaced "*before the XII. Kal. Aug.*" by this conjecture "*before the XIII. Kal. Aug.*" But in doubt of the correction of either of these places, one must rather stand by the opinion of the number of days, who erred from the opinion either of the year 26 of February at the start, and following that opinion, the eclipses of the Sun or of the Astronomical Tables can be collected: namely, on the days following, which Ptolemy designates, that is, the days marked in the preceding catalogue of eclipses, in which the year of Nabonassar 986 is supposed, falling at the 6th(?) day before the antecedent Meridian of the 25th of June. We conclude, then, that the opinion of Censorinus not only does no harm, but rather favors us. Let this assertion stand from the day of June 25, retaining the reading there "*ante diem septimum Kal. Jul.*"

16. The greater, indeed almost the only, difficulty rests in the place of the Sun, which Ptolemy assigns in his eclipses, and at the same time observed in book 4, ch. 6. For eclipse 17, set down at Pauni 20, which followed [eclipse?] on the 20th, in the Meridian of the day 20, with the Sun standing in Taurus degree 11. 14' approximately, & eclipse 18 in Libra degree 14. 6½'. & eclipse 19 with the Sun constituted in Pisces Gr. 14. 12'. Nor is it otherwise held in the Greek text, or in our codex of the MS. Moreover, by the equinox, that same Ptolemy in the same year of Hadrian 17, who observed eclipse 17, by two hours (that is, the seventh) of the time follows by whatever Astronomical Tables, received except the Lansbergian, namely Ptolemy, & the Sun was in Taurus 11. 15' after the Meridian of the day 20. Pauni would

have been in Taurus Gr. 13. & a little less [minus], but not by more than 14': nor by more than 34'. But from our Solar Tables it follows that Pauni was in Taurus Gr. 13. & by a minute approximately 16': it follows, I say, that, by the supposition that Pauni had begun at the Meridian of the day 20, it was at Taurus Gr. 13. but this from the supposition follows also per the same Astronomical Tables, the Moon at the moment of opposition adheres at a place of opposition in Taurus Gr. 11. & more, that is, at minimum Gr. 11. 30'. or you see that this is the preceding catalogue. Because if, when the Moon is held in a place of opposition, as requires the Plenilunium [Full Moon] preceding the eclipse, it must proceed from the day of May 6, at the hour 11. 15'. after its Meridian; it follows by the same Tables (taking away the Lansbergian) a place of the Sun in Taurus by one degree approximately further than Ptolemy noted it to have been in Taurus Gr. 14. & by minutes not fewer than 14'. As to what we said of eclipse 17, it holds in all the ancient eclipses of the twenty examined, and the later one, per the catalogue, examined according to the most celebrated Astronomical Tables.

17. The other [difficulty] is of two things to be said, that either Ptolemy, nor other Astronomers, in their Tables erred as to the place of the Sun: yet still in the Tables of the Moon erred by about 12 degrees. If we wish to retain the earlier day in the said catalogue noted, according to the form of the Julian year, we wish to retain it. But on the contrary, if we wish to retain it with the common Astronomical reckoning of the later day, & the Astronomical Tables could not commit so enormous an error of 12 degrees, it must be said that either Ptolemy, or the Astronomical Tables, erred by one degree as to the place of the Moon. But if the now-celebrated Tychonic Astronomical Tables had erred by one degree, & in eclipse 17 retained on the 6th of May, at the hour 11. 15'. after the Meridian, the Sun would be found in Taurus Gr. 13. 14'. it would be fitting that the Mean motion of the Sun, which commonly does not exceed signs 11. Gr. 29. 45'. 40". would come out of signs 11. Gr. 29. 45'. 42". 20"(?).

[Margin: Mendum in Censorino emendandum — An error in Censorinus to be emended.] [Margin: Prolemæi error in Æquinoctijs — Ptolemy's error in the equinoxes.] [Margin: Prolemæi error in Æquinoctijs — Ptolemy's error in the equinoxes.]

Whence it would follow that the Equinoctial Year would be of days 365. hr. 5. 48'. 3". & 42"". — which is absurd indeed, & noted by experts in Astronomy; or admit

the inequality of the Years, formerly never excluded; *Almagest* III not having noticed.

18. Nor again can it be said that the Astronomical Tables erred by 1. vel 12. in the motion of the Moon at the time of Ptolemy, or represent the antecedent eclipses in the predicted catalogue, & for example, by grace, in eclipse 17. it ought to have been at the hour 11. 15'. after the Meridian of the day 5. May, to exhibit the Sun in Taurus Gr. 13. 14'. or to exhibit the Moon in Scorpio Gr. 13. 14'. approximately, than to represent it in the Gradus of Scorpio 13. 14'. approximately. For we have other eclipses, set down in the Roman manner on more certain days, at the time around Ptolemy & Christ, which the same Tables rightly represent without any error in whole degrees. By the example, by the grace of Dio Cassius, who affirms it to have happened on the birthday of the Emperor Claudius the year of the City 798. M-Vinicio II. & M-Statilio Corvino consuls. that is, the year of the Epoch of Christ 45. on the Kalends of August (as Suetonius has it concerning the Birthday of Claudius) by the Astronomical Tables, & in the species of the Rudolphine antecedent eclipses, the True New Moon [Nouilunium verum] first of August at hours 9. & minutes 55'. after the mid-Meridian, the new moon began at point 596 to ascend toward the Roman Kalends. And so with the others. Hence then we recognize that it cannot be that those Tables labor under an error of 12 degrees in the motion of the Moon at that age [Æuo]. Provided then that it must be admitted that eclipse 17. through the said Tables it is necessary be in the Meridian at the hour 11. 15'. Alexandria, the Moon was in Scorpio Gr. 14. 30'. approximately. & the Sun in Taurus Gr. 14. 30'. approximately, it is necessary too, & it ought to be that Ptolemy rather erred in the place of the Sun by one degree, than Ptolemy himself: reckoning, that is, the Equinox of that year by one degree more swiftly than he made it, than the truer Tables exhibit it [aliquot] hours before the Meridian of the day 24. September, that is, the Chronological Canon the day Athir 6. & we said *Almagest* III. ch. 8. ch. 15.

19. Nor again would it seem that, the injury [iniuria?] done to deciding [decidendo], Ptolemy erred by an integer day in the Equinox. To this it suffices the Armillary Equinoctial, as book 3. ch. 2. shows: that from such an Observation he declined from the true Equator plainly versus Australem [southward] by 24'. approximately at minutes. And he himself there attests both Armillaries to have remained longer at their own [latitude] for a long time at the equinoctial time, & in emending the very vice of the Eclipse it can easily be deceived by it, & through the obliquity of

the Eclipse, that is, as I said in ch. 6. then with the false opinion of the quantity of the year of the equinox, then with the false Hypothesis of the immobility of the Apogee of the Sun. He could also assign the Armillary that was not so exactly placed, to have erred for these reasons in the altitude of the Equator.

CONCLUSIO I. — First Conclusion

Saving the Luni-Solar Astronomical Tables, & the days of the Egyptians, from Ptolemy in the Observations of Lunar eclipses, it must be asserted that the year of Nabonassar 886. falls on the 10th of July in the antecedent Meridian preceding the 12th. Kalends of August, & has the codex of Censorinus, ch. 8. The year of Nabonassar 748. falls in the Meridian of the day 25. June, that is, the Meridian preceding, not the VII. Kal. Jul., but has before the VII. Kal. Jul.; & so the exemplar of Censorinus, but the VI. Kal. Jul. and so, indeed, the principle of Nabonassar placed in the Meridian of the day 26. February of the year before Christ 747. finally the eclipses 19. in the preceding catalogue & set down per Ptolemy related, to be applied at the hours after the Meridian of the Julian Month following, not at the prior, as in the same catalogue of the Julian designated.

CONCLUSIO II. — Second Conclusion

The Lansbergian Tables, which at the time of Ptolemy exhibit the Sun in another Ecliptic place, in which Ptolemy himself constituted it at the moment of the Eclipse, this from other Tables of Eclipses is so much less accurately to represent them, that they discrepate; suspect they are of fallacy: especially among those who do not admit the inequality of the Years.

CAPUT VI.

On the Agreement, or Disagreement, of the Astronomical Tables with the Observations of Eclipses from the time of Albategnius [al-Battānī] up to the Year of Christ 1660.

The warnings of the preceding chapter, from num. 1 to 6, premised, also pertain to the present chapter; but especially num. 4, that the reader may know which ones, out of the many observations of those same eclipses, we have chosen for the test of the fidelity of the Tables.

Table. Comparative table of eclipse observations (Ordo of eclipses from Caput 2) against five astronomical table-sets (Observed, Alphonsine, Lansbergian,

Parisian/Frisian, Philolaic, Rudolphine, Tychonic — varying per row), giving Apparent Time after Meridian at the place of observation; the Sun's True place from the Tables; the Moon's place computed from the Tables; the difference of computed-vs-observed place; the time of that difference; and the magnitude in digits and minutes. Zodiac signs are given by glyph.

Ordo Eclips. (Cap. 2)	Obser v. & Tab. Astro n.	Tempu s Appare ns — Mens.	Solis locus Verus — Sig. Gr.	Lunæ locus compu tatus — Sig. Gr.	Diff er. loci —	Tem pus Diff. — H.	Quanti t. in Digit. & min. — Dig.
22	Obser v. Lansb. Paris. Phil. Rud.	Kemir Iulij	♌ 4	♊ 4			10 & pl.
			3	3		0	11
			4	4	e	0	0
			4	3	d	26	
			3	3	d	40	
23	Obser v. Lans. Paris. Phil. Rud.	Hab. Aug.	♌ 14	♊ 14			12 ferè
			14	14	e	1	12
			14	15	e	35	12
			14	14	e	10	
			14	14	e	0	
24	Obser v. Alph. Lans. Phil. Rud.	Septe mb.	♍ 19	♋ 19			Totalis.
			20	20	d	0	14
			19	19	e	0	
			19	19	d	0	
26	Obser v. Phil. Rud.	Decem b.	♍ 15	♋ 16	e	26	Total.
			15	16	e	7	
27	Obser	Iunij	♋	♍			Total.

Ordo Eclips. (Cap. 2)	Obser v. & Tab. Astro n.	Tempu s Appare ns — Mens.	Solis locus Verus — Sig. Gr.	Lunæ locus compu tatus — Sig. Gr.	Diff er. loci —	Tem pus Diff. — H.	Quanti t. in Digit. & min. — Dig.
	v.						
	Alph.				d	0	
	Phil.		9	11	d	2	
	Rudol.		9	11	e	3	

Erraverit ergo Regiomontanus in Altitudine Aquilæ ipsiusq; loco, aut certe corrupti sunt numeri Observationis à Typographo. — Regiomontanus, then, will have erred in the Altitude of Aquila and its very place, or else the numbers of the Observation are corrupted by the Typographer [printer].

O r d o	Obser v. & Tab.	M en s.	Solis locus — ' Sig. Gr.	Lunæ locus ' " — Sig. Gr.	D i ff f ' " .	G r ' " .	Te m p. H.	D ig it ' " .
2 9	Obser v.	Iu ni j	3 7					7 0
	Alphós		3 7		d	0 1 0 0 9		3 0 6 2 8 4
	Lans.		4 II 29 8	3 5 x 29 3 3	3 1 e 4 5	0 0 2 0 2		0 4 7 9 5
	Phil.		3 29 7	5 5 29 0	6 7 e	0 1 0 7		0 3 2
	Rud.		3 29 7	4 2 29 8	4 5 e 1	0 2 0 3		0 4 6
3 2	Obser v.	Fe br	4 ≈ 7	∂				
	Phil.		28	2 4 28 0 1	4 3 e 0 4	0 1 5 0 9 3		3 4 9 5

O r d o	Obser v. & Tab.	M en s.	Solis locus —		Lunæ locus		D i ff f		Te m p.		D ig it	
			'	Sig. Gr.	'	"	"	.	'	"	.	'
	Rud.		28		2 4	28	3 5	e	0 1	4 0	2 1	
					3 8		6 2		3		6 0	
3 3	Obser v.	N ou e m b.	0								1 0	
											0	
	Lans.		0	ℳ(?) 23	3 3	∞ 23	3 4	e	0 0	1 0	0 1	1 3
					8 8		8 8		0		9 0	5
	Phil.		0	23	1 5	23	2 3	e	0 7	4 0	1 2	
					2 4		0 6		2		5 0	
	Rudol.		0	23	1 5	23	2 4	e	0 7	4 0	1 2	
					2 8		0 0		2		5 0	
3 5	Obser v.	Iu ni j	3 6								8 0	
	Lans.		4	II 21	1 5	∞ 21	1 6	e	0 1	1 0	2 3	7 3
			5		7 3		9		3		0	1
	Phil.	Se d si	3 21 6		1 3	21	1 1	d	0 3	2 0	6 4	
					7 1		4 0		1		2	
	Rud.		3 20 6		5 5	20	3 1	d	0 2	3 0	4 1	
					8 1		8 8		0 3		1 5	
	Tych.		3 20 6		5 4	20	5 1	d	0 6	2 0	1 0	
					8 1		2 2		8		3	
			3 20 6		5 2	20	5 2	d	0 1	7 0	2 1	
					6 7		5 2				4	

This opening continues the large comparison table of Chapter VI — the agreement or disagreement of the several astronomical table-sets with the recorded lunar-eclipse observations from al-Battānī's time down to AD 1660. Each numbered eclipse (Ordo Eclipsium, keyed to Chapter II) is given first as observed

(*Observ.*), then as computed from each table-set: Atlantic/Atlas (*Atl.*), Danish (*Dan.*), Lansbergian (*Lansb./Lansf.*), Parisian (*Parif.*), Philolaic (*Phil.*), Prutenic (*Prut.*), Rudolphine (*Rud./Rudol.*), Tyconic (*Tych.*); not every table-set appears for every eclipse. The marker **e** in the difference column denotes an *excess* (the tables run ahead of observation), **d** a *defect* (the tables fall short).

The columns are:

- **Ordo Eclipsium (cap. 2)** — the eclipse number, referred to Chapter II.
- **Observ. & Tab. Astron.** — the observation, then the astronomical table-set computed.
- **Tempus Apparens post Merid. in loco Observationis** — apparent time after noon at the place of observation (Month / Day / Hour / minutes; on the second and third folios the minutes sub-head is printed *M.* rather than the prime mark ').
- **Solis locus Verus ex Tab. & inde locus** ☉ ☉ — the Sun's true place from the tables, and thence the place of the Sun in opposition (Sign / Degrees / minutes / seconds).
- **Lunae locus ex Tabul. computatus** — the Moon's place computed from the tables (Sign / Degrees / minutes / seconds).
- **Differ. loci** ☉ ☉ **computata, & observata** — the difference between the computed and the observed place (Degrees / minutes / seconds), tagged **e** (excess) or **d** (defect).
- **Tempus huius Differentiae** — the time corresponding to this difference (Hours / minutes / seconds).
- **Quantit. in Digit. & min.** — the magnitude in digits and minutes; "Total." marks a total eclipse.

Eclipse-comparison table (folio 119, Ordo 36–45). Zodiac signs are given by their printed symbols, transliterated in brackets where printed.

S			☉				☾			Δ			
O o			☉				☾			Δ			
r u M			☉				☾			Δ			
d rc on			☉				☾			Δ			
o e .			Sign	r	'	"	Sign	r	'	"	r	'	"
3 O	Oc		♌	2	2	0	♈	2	2	0			
6 b	to		[Libr	2	5		[Arie	2	5				
se	b.		a]				s]						
rv													
												Total. 12 15	

[illegible]

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			⊙ Sign	G r	⊙ '	⊙ "	☾ Sign	G r	☾ '	☾ "	G r	Δ '	Δ "	t '	t "	
T y c h.				2	3	6		2	1	3	0	7	2	1	0	
				2				2	0	4			8	5		
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L a nf .				1	3 7	4 6		1	2 6	4 5	0	1 1	0	2	0 2	
P hi l.				1	3 7	4 5		1	3 8	5 0	0	1	5	2	1 0	
R u d.				1	3 6	3 3		1	3 8	4 2		2	9	4	1 5	
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4 O De 0 b ce se m rv b. .											0	6	3 0	1	0 3	Total.
A tl.											0	1	0	2		
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S O o r u d rc o e	M on .	⊙ Sign	⊙ G r	⊙ '	⊙ "	⋈ Sign	⋈ G r	⋈ '	⋈ "	Δ G r	Δ '	Δ "	t '	t "	Dig.'
n.	t.]					mini]									
P ar if.			2 6	5 3	4 4		2 5	5 5	5 4	0 0	1 0	6 0	1 8	5 1	
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R u d.			2 6	5 1	3 0		2 7	0 0	1 2		4 0	4 9	9 0	3 0	
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P ar if.			2 4	3 1	4 4		2 4	3 5	4 0	0 0	1 0	6 0	2 0	1 5	
P hi l.			2 4	3 1	3 3		2 4	3 0	2 7	0 0	1 0	5 7	3 0	5 0	

S O o r u M d rc on o e .			⊙				⋃			Δ			t t			Dig. '
			⊙ Sign	G r	⊙ '	⊙ "	⋃ Sign	G r	⋃ '	⋃ "	G r	Δ '	Δ "	t '	t "	
R u d ol .				2 4	3 0	0		2 4	3 1	5 7	0	0	5 4	1 4	0	
T y c h.				2 4	3 0	2 3		2 4	2 9	2 9						
4 O Ap 2 b ril se . rv .											0	1	3	2	0	Total.
												2	0	5		
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P hi l.				2 2	4 5	8		2 2	5 9	5 5	0	2	3 0	5 7	0	19 50
P r ut .											0	9	0	1	0	
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d rc	on		⊙	G	⊙	⊙	☾	G	☾	☾	G	Δ	Δ	t	t	
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D		♊		2	1	0	♈	2	2	1	0	2	1	4	3	
a		[Libr			9		[Arie		1	5			5		0	
n.		a]					s]									
P				2	1	2		2	1	0	0	1	4	3	0	3 0
ar					9	4			8				4			
if.																
P				2	1	3		2	1	2		3	4	8	2	
hi					9				5	2			1		0	
l.																
P												0	1	3	3	0 2 28
r													0			
ut																
.																
R				2	1	4		2	1	2	0	2	4	5	3	
u					7	8			5				6		0	
d.																
T				2	1	3		2	1	1	0	0	2	0	5	
y					7	8			7	1			7		2	
c																
h.																
4 O	Ia											0	1	0	2	0 Total.
5 b	nu												0		0	
se	ar.															
rv																
.																
A												0	3	0	6	

S															
O o		⊙				☾			Δ						
r u	M														
d rc	on	⊙	G	⊙	⊙	☾	G	☾	☾	G	Δ	Δ	t	t	
o e	.	Sign	r	'	"	Sign	r	'	"	r	'	"	'	"	Dig.'
tl.															
D		♊	2	2	5	♌	2	2	4	0	0	1	0	3	11 51
a		[Aqu	1	8	0	[Leo	1	5	5			4		0	
n.		ar.]				]									
L			2	2	9		2	1	5	0	6	1	1	1	
a			1	0			1	9	5			5	3	0	
nf															
.															
P			2	2	2		2	3	3	0	2	3	4	0	11 20
hi			1	8	0		1	4	5		2	0	5		
l.															
P															
r															
ut															
.															
R			2	2	4		2	3	3	0	5	4	1	3	
u			1	9	4		1	5	2			8	1	5	
d															
ol															
.															
T			2	2	3		2	2	8	0		5	0	1	
y			1	8			1	8						0	
c															
h.															

Eclipse-comparison table (folio 120, Ordo 46–55). On this folio and the next the minutes sub-head of the time column is printed *M*. The note *ft. vet.* ("stylo veteri," Old Style) is printed beneath the *Observ.* row from Ordo 47 onward, marking the date as Julian.

O r d o	So ur ce	Mo n.	♈										♉					Di g.
			☉ Sign	☿ r	♊ '	♋ "	♌ Sign	♍ r	♎ '	♏ "	e/ d	♐ r	♑ '	♒ "	♓ H'			
46	Observed.	Ianuar.																Total.
	At l.										d	0	4	3		9	0	
	Dan.		♊ [Aqua r.]	1 0	4	5 0	♌ [Leo]	1 0	2	0	d	0	2	5 0	0 5	4 0		
	Pa rif.			1 0	1	4 3		1 0	6	4 8	e	0	5	5	0 1	1 0		
	Ph il.			1 0	5	1 7		1 0	6	3 0	e	0	1	1 3	0 2	4 0		
	Pr ut.										e	0	1 2	3 0	0 5	2 0	16 47	
	R u d.			1 0	5	3 8		1 0	8	0	e	0	2	2 2	0 4	4 0		
	Ty ch.			1 0	4	1 4		1 0	5	4 3	e	0	1	2 9	0 3	0 0		
47	Observed.	Iulij																Total.
	At l.	ft. vet.									e	0	6	0	0 2	1 0		
	Dan.		♌ [Leo]	3	4 0	5 0	♊ [Aqua r.]	3	3 7	3 0	e		3	2 0	0 6	4 0	15 14	

O r d o	So ur ce	Mo n.	☉ Sign	☉			☾ Sign	☾			e/ d	Δ			t			Di g.'
				G r	'	"		G r	'	"		G r	'	"	H'	"	"	
	La nf			2	4	3		2	4	2	d		0	8	0	0	1	
	.				9	7			9	9							7	
	Pa rif			2	4	2		2	4	4	e	0	3	2	0	5	3	
	.				4	8			7	8				0		6		
	P hi l.			2	4	2		2	4	2	e		1	4	1	5	14	
					3	4			4	8					8	10		
	Pr ut.										d		8	3	1	0		
													0	7				
	R u d.			2	4	5		2	3	2	d		5	3	1	2		
					2	9			7	7				2	1			
	Ty ch			2	4	2		2	4	1	d		1	6	2	1		
					2	0			1	4						1		
	.																	
4 8	O bs er v.	No ue mb.																Tot al.
	At l.	ft. vet.									e		9	3				
														0				
	D an		♏ [Scorp io]	2	4	4	♉ [Taur us]	2	5	2	e		1	4	0	3	2	
	.			5	9	5		5	0	4				0		0		
	Pa rif			2	4	5		2	5	2	e		0	3	0	1	0	
	.			5	9	0		5	0	0				0				
	P hi l.			2	5	2		2	4	3	d		6	2	0	1	0	
				5	0			5	3	8				4	4			

[illegible]

O r So d ur o ce	Mo n.	☉ Sign	☉ G r ' "			☾ Sign	☾ G r ' "			e/ d	Δ G r ' "			t t t			Di g.'
0 bs er v.	rtij																al.
D ft. an vet. .		♊ [Pisce s]	2 4 0 2 9			♍ [Virg o]	2 4 0 2 8			d	0 1 0 0 0 1			0 2 0			
La nf .			2 4 5 2 7 4				2 4 0 2 8			e	0 0 1 4			0 0 2 9 8			16
Pa rif .			2 4 0 1 5				2 4 1 1 9 0			e	0 4 1 0			0 8 3 4			
P hi l.			2 4 5 2 9				2 5 2 2 3 0			e	0 4 1 5			0 8 3 5			
Pr ut.										e	0 1 0 6			0 3 0 2			17 19
R u d.			2 5 8 2 0				2 4 3 2 6 5			d	0 3 3 3			0 7 6			
Ty ch .			2 4 5 2 7 9				2 4 4 2 9 2			e	0 1 4 3			0 3 2 5			
5 O 3 bs er v.	Dec em b.																9 37
At ft. l. vet.										e	0 2 3 0			0 5 0			
D an .		♋ [Capri c.]	1 1 3 9 0			♋ [Canc er]	1 4 4 9 0			e	0 3 2 0			0 6 4 0			

Or d o	So ur ce	Mo n.	♈							♉						
			♈ Sign	G r	′	″	♊ Sign	G r	′	″	e/ d	G r	′	″	t H′	t ″
	Pa rif			1 9	9	3 2		1 9	1 4	3 0	e	0	5	2	0 1 0	
	P hi l.			1 9	8	4 2		1 9	1 4	5 6	e	0	6	1 3	0 1 2 4	
	Pr ut.										e	0	1 3	0	0 2 6	0
	R u do l.			1 9	8	5 6		1 9	1 0	3 3	e	0	1	3 7	0 3 6	1
	Ty ch			1 9	8	2 0		1 9	1 0	2 4	e	0	2	4	0 4 7	
5 4	O bs er v.	Dec em b.														5 0
	At la nt	ft. vet.									e	0	1 0	0	0 2 0	0
	D an		♊ [Sagitt .]	2 7	1 5	3 0	♊ [Gem ini]	2 7	1 6	1 5	e	0	0	1 5	0 0 3 0	
	La ns b.			2 7	1 1	4 8		2 7	1 1	4 0	d	0	0	8	0 0 1 5	4 46
	Pa rif			2 7	1 1	1 8		2 7	1 4	3 8	e	0	3	2 0	0 7 0	
	.															

O																			
r So																			
d ur	Mo																		
o ce	n.	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉
		Sign	r	'	"	Sign	r	'	"	e/d	r	'	"	t	t	t	t	t	Di
P			2	1	5		2	1	4	e	0	5	4	0	1	3			
hi			7	3	5		7	9	2				7	0	0				
l.																			
Pr										e	0	7	3	0	1	0	5		
ut.													0	5		54			
R			2	1	3		2	1	4	e	0	1	1	0	2	2			
u			7	3	2		7	4	4				2		4				
d.																			
Ty			2	1	2		2	1	1	d	0	0	1	0	0	2			
ch			7	3	3		7	3	0				1		2				
.																			
5 O	Oct																	9	
5 bs	ob.																	30	
er																			
v.																			
At	ft.									d	0	1	0	0	2	0			
l.	vet.																		
D		♏	5	2	3	♉	5	3	3	e	0	2	0	0	4	0			
an		[Scorp		9	0	[Taur		1	0										
.		io]				us]													
La			5	2	5		5	2	5	0	0	0	0	0	0	0	9		
nf				8	7			8	7								21		
.																			
Pa			5	2	4		5	3	3	e	0	3	5	0	7	4			
rif				8	8			2	8				0		5				
.																			

Eclipse-comparison table (folio 121, Ordo 55 continued, 56–60, then 63 and 66). The minutes sub-head of the time column is again printed *M*.

Ord o	So ur ce	Mo n.	♈				♉				♊				t '	t "	Di g.'
			☉ Sign	G r	☉ '	☉ "	☿ Sign	G r	☿ '	☿ "	e/ d	G r	♊ '	♊ "			
55	P			5	2	3		5	2	2	d	0	1	9	2	5	
(co nt.)	hi l.				9	0			8	2							
	Pr ut										e	0	4	3	9	0	.9 40
	.																
	R u d.			5	2	3		5	3	5	e	0	6	3	1	4	0 0
					8	3			5					2	3		
	T yc h.			5	2	5		5	3	5	e	0	3	1	6	2	
					8	6			2					1		0	
56	O bs er v.	Ap ril.															To tal
	At l.	ft. vet.									e		1	3	2	0	
													1	0	3		
	D a n.		♉ [Tau rus]	3	2	3	♏ [Scor pio]	3	2	0	e		4	3	9	0	
					4	0			9					0			
	L a nf			3	2	3		3	2	2	d		0	6	1	1	19
					1	5			1	9					0	2	40
	.																
	P ar if.			3	2	4		3	2	0	d		3	0	6	0	
					4	2			1								
	P hi l.			3	2	5		3	3	5	e		7	6	1	5	
					4	2			1	8					2	0	
	Pr ut			2	5	5		3	1	5	e		1	0	3	0	

[illegible]

[illegible]

Ord o	So ur ce	Mo n.	⊙				☾				Δ				t '	t "	Di g.'
			⊙ Sign	G r	⊙ '	⊙ "	☾ Sign	G r	☾ '	☾ "	e/ d	G r	Δ '	Δ "			
	D a n.	ft. vet.	♌ [Leo]	2 3	1 2	1 5	♊ [Aqua r.]	2 3	8 0	4 0	d		4 0		8 0		
	L a nf			2 3	2 1	5 2		2 3	2 1	5 8	e		0 6		0 2	1 13	13 13
	P ar if.			2 3	2 1	2 6		2 3	2 3	3 6	e		2 0	1 0	4 9	3 9	
	P hi l.			2 3	1 9	2 5		2 3	2 7	1 3	e		7 8	4 8	1 4	5 4	
	Pr ut			2 3	1 3	4 0		2 3	☉ 0	4 0	d		1 3	0 0	2 6	0 35	14 35
	R u d ol			2 3	1 9	1 2		2 3	2 3	1 6	e		4 4	4 4	8 8	8 8	
	T yc h.			2 3	1 9	2 5		2 3	1 6	5 5	d		2 0	3 0	5 0	0 32	13 32
	At l.										e		1 0	0 0	2 0	0 0	
60	O bs er v. At l.	Ian uar . ft. vet.									ex ac tè d		0 1	0 0	0 2	0 0	To tal . 0

Ord o	So ur ce	Mo n.	☉				☽				Δ				t t Di		
			☉ Sign	G r	☉ '	☉ "	☽ Sign	G r	☽ '	☽ "	e/ d	G r	Δ '	Δ "	t '	t "	Di g.'
	D a n.		♈ [Aqua r.]	2 1	1 1	3 0	♌ [Leo]	2 1	1 0	3 0	d		5 0	3 0	1 0	3 7	
	P ar if.			2 1	1 1	5 7		2 1	1 7	2 7	e		4 3	1 0	8 0	5 0	
	P hi l.			2 1	1 1	1 3		2 1	1 5	2 6	e		2 3	2 0	4 7	0 13	17
	Pr ut .			2 0	3 3	2 0		2 0	5 6	4 0	e		4 4	3 0	9 0	6 0	16 38
	R u d.			2 1	1 2	1 4		2 1	1 6	4 8	e		3 0	0 0	6 0	0 0	16 38
	T yc h.			2 1	1 1	5 8		2 0	1 4	5 8	e						

Dies Deinceps notabuntur stylo Gregoriano; cum Eclipses cadent post Annum 1600.
 — "From here on the dates will be reckoned by the Gregorian style, since the eclipses fall after the year 1600."

O r d o	So ur ce	M o n. H	☉				☽				Δ				t t Di		
			☉ Sign	G r	☉ '	☉ "	☽ Sign	G r	☽ '	☽ "	e / d	G r	Δ '	Δ "	t H'	t "	Di g.'
6 3	O bs er v.	D ec e m b.															10 36
	At l.	6									d	0 0	3 0	0 0	1 0	0 0	10 55

O r d o	So ur ce	M o n.	H	☉				☽			☿			♂			Di g. ′
				☉ Sign	G r	☉ ′	☉ ″	☽ Sign	G r	☽ ′	☽ ″	☿ d r	G ′	♂ ′	♂ ″	t H′	
	La nf .		6	♊ [Sagitt .]	1 7	4 5	1 2	♊ [Gemi ni]	1 7	4 5	6	d	0	6	0 0	1 10 2 37	
	Pa rif .		7		1 7	4 8	5 9		1 7	5 0	5 8	e	2	0	0 3 5 40	4 10	
	Pr ut .		6		1 7	2 1	8		1 7	1 9	3 8	d	1	3 0	0 3 0 16	11	
	P hi l.		6		1 7	4 8	5 4		1 7	4 6	5 4	d	2	0	0 4 0	0	
	R u d.		6		1 7	5 0	3 0		1 7	4 7	4 1	d	2	4 9	0 5 8	3	
	Ty ch .		6		1 7	4 8	3 1		1 7	4 2	3 3	d	5	5 8	0 0 5 53	4 10	
66	O bs er v.	M aij														7 30	
	At l.		12									e	7	0	0 1 4	0	
	La nf .		12	♊ [Gemi ni]	3	7 0	3 0	♊ [Sagitt .]	3	3 8	2	d	4	0	0 8 0	7 28	
	P hi l.		12		3	1 1	4 2		3	1 7	4 2	e	5	0	0 1 0	0	

O r d o	So l u t i o n e	M o n e n.	H	☉ Sign	☉ G r	☉ '	☉ "	☾ Sign	☾ G r	☾ '	☾ "	e / d	Δ r	Δ '	Δ "	t H'	t "	Di g.'
Pr ut .		12			2	4	1		3	4	2	e	4	0	0	8	0	8
						5	9			9	0							37
R u d.		12			3	9	5		3	1	1	e	0	1	0	0	2	
							6			0	1			4			8	
Ty ch .		12			3	8	3		3	5	3	d	4	0	0	8	0	7
							4				4							59

[This opening continues the comparison table of lunar eclipses begun earlier in Caput VI: each numbered eclipse (Ordo Eclipsis, per Caput II) is set against the several sets of astronomical tables. The Ordo numbering is deliberately non-contiguous — Riccioli selects particular eclipses. The catchword "67" at the head carries over from the preceding folio; the table runs continuously across all three folios here (Ordo 67 through 104).]

Comparison table of lunar eclipses against the tables (continued, Caput VI)

Column structure (verbatim headings):

- **Ordo Eclips. cap. 2.** — order-number of the eclipse, per Caput 2.
- **Obferu. & Tab. Aftron.** — the Observer, and the Astronomical Tables.
- **Tempus Apparens poft Merid. in loco Obferuationis** — apparent time after the meridian at the place of observation: *Menf.* (month), *D.* (day), *H.* (hour), *M.* (minute).
- **Solis locus Verus ex Tab. & inde locus ☉ ☉** — the Sun's true place from the tables, and from it the place of opposition: *Sig.* (sign), *Gr.* (degree), *'*, *"*.
- **Lunæ locus ex Tabul. computatus** — the Moon's place computed from the tables: *Sig.*, *Gr.*, *'*, *"*.
- **Differ. loci ☾ coputata & obferuata** — difference of the Moon's place, computed against observed: a *d* or *e* marker (whether the computed place is in advance of or behind the observed), then *Gr.*, *'*, *"*.

- **Tempus huius Differentiæ** — the time corresponding to this difference: *H.* (hour), ', ''.
- **Quãtit. in Digit. & min.** — magnitude in digits and minutes: *Dig.*, '.

Throughout, the Observer's line ("Obferu.") gives the observed datum against which the tabular computations (Atl., Lansb., Phil., Prut., Rud., Tych., Dan., Lanf.) are compared. Where a computation matches the observation, the cell reads **exactè** ("exactly"). A blank numeral cell is left blank as printed.

O r d o	Sou rce	Mo.	Su n Sig	°	'	''	Moo n Sig	'	''	Diff	°	'	''	'	''	Dig	'
6 7	Obf eru.	Nou emb														3 fer è	
	Atl.										exa ctè			0			
	Lan sb.		♄	25	5	4	♄	5	2	d	0	1	0	3	3	1	
	Phil.			25	5	3		5	3	d	2	8	4	1			
					7	9		5	1				5				
	Prut			25	3	2		3	5	e	1	3	3	0	3	2	
	.				5	9		6	9			0				5	
	Rud.			25	5	3		5	9	d	2	2	4	5			
					7	4		5				5	0				
	Tyc h.			25	5	0		5	0	d	5	0	1	0	3	2	
					7			2					0			6	
6 8	Obf eru.	Apri l.	♄												11	2	
																5	
	Lanf		♄	14	5	4		4	4	d	19	0	3	0	11	2	
	.					3		6	3				6			1	
	Phil.			14	1	3		5	2	d	16	1	3	3			
					1	6		5	1			5	2	0			
	Rud.			14	1	3		5	5	d	18	3	3	1			
					0	3		1	8			5	7	0			
	Prut			13	3	9		4	9	e	9	0	1	0	11	5	

O r d o	Sou rce	Mo.	Su n Sig	°	'	"	Moo n Sig	'	"	Diff	°	'	"	'	"	Dig	'
	.				4			3						8			7
	Tyc h.			14	1	3		5	6	d	12	3		2	0	11	4
					0	6		8				0		5			9
6 9	Obf eru.	Sept emb		diue rf.												8	3 0
	.																
	Lan sb.			3	5	3		4	5	d	7	3		1	0	8	2
					4	5		7				0		5			2
	Phil.			3	5	5		4	2	d	3	3		7	0		
					1	1		8	1			0					
	Prut			3	4	2		4	2	e	2	0		4	0	8	5
	.				2	3		4	3								8
	Rud.			3	5	2		5	1	d	0	4		0	8		
					2	1		2	7								
	Tyc h.			3	5	3		5	3	e	3	0		6	0	9	2
					2	9		5	9								6
	Atl.									exa ctè							
7 0	Obf eru.	Sept emb														2[?]	
	.																
	Atl.									d	0	3		1	0		
												0					
	Phil.		♂	12	4	2		5	1	e	3	5		3	0	5	2
					7	6		1	7			1		8			
	Prut			12	4	3		2	3	d	19	0		3	0		
	.				0	5		1	5					8			
	Rud.			12	4	3		4	1	e	1	4		3	2		
					7	6		9	7			1		0			
	Tyc h.			12	4	4		4	4	e	4	0		8	0	4	7
					7	4		3	4								

O r d o	Sou rce	Mo.	Su n		Moo n		Diff		°	°		°		Dig	'
			Sig	°	'	"	Sig	'		"	'	"	'		
7 1	Obf eru.	Ian uar.												9	3
	Lanf .													9	3 6
	Phil.		♊	0	1 3	♈	1 4	e	3	1	6 2				
					5 1		8 4			3	6				
	Prut .			0	1 5	♈	2 2	e	0	3	1 1				
					9 2		0 8			6	2				
	Rud.		♊	29	4 2	♋	5 2	e	17	0	3 0	9			2
					1 6		8 6				4				8
	Tyc h.			0	1 4		2 3	d	0	4	1 2				
					9 9		0 1			2	5				
	(last)		♊	0	2 4	♈	2 1	e	0	3	1 0	10			3
					0 6		1 6			0					2
7 2	Obf eru.	Iulij												Tot al.	
	Dan.		♋	24	1 0	♊	1 1	e	2	1	4 2				
					0		2 2			2	5				
	Phil.			24	1 4		1 1	e	6	2	1 4				
					1 0		8			1	2 3				
	Prut .			23	5 5		5 5	0	0	0	0 0	17			0
					6 4		6 4								
	Rud ol.			24	9 4		1 1	e	6	1	1 3				
					5		6			6	2 0				
	Tyc h.			24	9 1		1 1	e	7	0	1 0	16			5
					1		6 1				4				3
7 4	Obf eru.	Dec emb													
	Atla nt.							e	0	3	1 0				
										0					

O r d o	Sou rce	Mo.	Su n Sig	°	' "	Moo n Sig	' "	Diff	°	' "	' "	Dig	'
7 5	Phil.	Maij	♌	8	2 1 7 7	♍	2 5 2 7	d	4	2	8 4 0	6	5
	Prut .		7	5 1 2 0		5 4 6 0	e	4	3	9 0			
	Rud.		8	2 3 7		2 5 2 8	d	4	5	8 1 0			
	Tyc h.		8	2 5 7		1 5 7	d	10	0	2 0 0	4	2 3	
	Obf eru. Atl.							exa ctè		0		6	3 0
	Phil.		♎	24	1 4 6 6	♏	1 4 3 0	d	3	6	6 1 2		
	Prut .		23	4 2 8 9		5 5 3 9	e	5	3	1 0 1	7	0	
	Rud.		24	1 4 7 9		1 4 7 4	d	0	5	0 1 0			
7 6	Tyc h.	Nou emb		24	1 1 6 3		1 1 2 3	d	2	0	4 0 7	2 2	
	Phil.		♐	16	3 4 1 8	♑	3 2 9 3	e	7	3	1 1 5 0		
	Prut .		♐	16	7 4 4		2 1 6 4	e	10	3	2 0 1	8	5 8
	Rud.		16	3 3 1		3 4 9 8	e	8	4	1 3 5 8			
	Tyc h.		16	2 1 9 0		3 4 7 0	e	8	3	1 0 0 7	9	4 9	
	Phil.		♒	16	3 4 1 8	♓	3 2 9 3	e	7	3	1 1 5 0		
	Prut .		♒	16	7 4 4		2 1 6 4	e	10	3	2 0 1	8	5 8
	Rud.		16	3 3 1		3 4 9 8	e	8	4	1 3 5 8			

O r d o	Sou rce	Mo.	Su n Sig	°	'	"	Moo n Sig	'	"	Diff	°	'	"	'	"	Dig	'
7 7	Obf eru.	Octo b.														Tot al.	
	Dan.		♌	5	1	1	♍	1	5	e	0	3	1	1			
					3	5		3	0			5		0			
	Phil.			5	1	1		9	1	d	4	0	8	0			
					3	4			4								
	Prut .			4	5	9		5	9	d	4	0	8	0	19	2	
						4			0							1	
	Rud.			5	1	3		7	5	d	5	6	1	1			
					3				7				0	2			
	Tyc h.			5	1	4		1	1	d	2	3	5	0	19	2	
					2	8		0	8			0				1	

O r d o	Sour ce	Mo.	Sun Sig	'	"	Moo n Sig	'	"	Diff	'	"	'	"	Dig	'
8 0	Obfe ru.	Aug ufti												Total .	
	Phil.		♍	5	1	♎	5	5	d	4	3				
					3		5	0		9	5				
	Prut.			4	3		1	3	d	0	0	13	28		
					4	4		9	4						
	Rud.			5	4		5	4	d	1	2				
					3	7		0	6						
	Tych .			5	2		5	0	d	3	0	12	19		
					4	9		4		0					
8 1	Obfe ru.	Aug.												Total .	
	Phil.		♏	4	4	♐	4	4	d	5	1				
					3	8		0	3		0				

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
	Prut.			3 4		1 7	d	3	0	16	45
				3 7		7		0			
	Rud.			4 1		4 2	d	1	5		
				3 7		0 2		5	0		
	Tych			4 5		3 5	d	0	0	15	47
	.			3 2		9 2					
8 2	Obfe ru.	Iunij								1	vi x
	Phil.		☿	4 1	♊	4 1	d	0	0	1	29
				4 0		3 0					
	Prut.			2 3		2 5	d	2	0		
				5 0		2		5			
	Rud.			4 4		4 4	e	2	4		
				4 7		4 9					
	Tych			4 4		4 4	e	0	0	3	10
	.			4		5					
8 3	Obfe ru.	Dece mb.								11	fe rè
	Phil.		☿	0 5	♈	5 0	d	5	5		
				2		6		2	4		
	Prut.			2 1		2 2	e	0	0	11	5
				6 9		8 0					
	Rud.			1 4		5 1	d	2	5		
				5		1 8		7	2		
	Tych			2 1		5 4	d	3	1	10	48
	.					2 8		0	3		
8 4	Obfe ru.	Iunij								Total	
	Atl.						exa ctè	0		.	
	Phil.		♈	5 8		6 2	e	1	3		

O r d o	Sour ce	Mo.	Sun Sig	'	"	Moo n Sig	'	"	Diff	'	"	'	"	Dig	'
								0		4	5				
	Prut.			4	1		3	1	d	0	0	18	18		
				7	7		9	7							
	Rud.			5	4		2	4	d	5	0				
					5			0							
	Tych			4	2		5	2	e	0	0	18	49		
	.				5			5							
8 5	Obfe ru.	Dece mb.										Total	.		
	Phil.		♄	1	3	♅	1	3	d	2	5	19	31		
				0	1					8	0				
	Prut.			3	2		3	2	d	0	0				
				7	1		6	1							
	Rud.			1	2		5	1	d	1	2				
				0	5		8	3		2	4				
	Tych			1	4		2	2	d	2	0	18	5		
	.			0	0			0		0					
8 6	Obfe ru.	Nou emb.										4	3		
	Phil.		♄	6	5	♅	7	2	e	2	5				
					6			4		8	8				
	Prut.			3	0		4	0	e	0	0	3	44		
				5			6								
	Rud.			6	1		4	1	d	0	0				
					7			7							
	Tych			6	0		2	3	d	3	0	3	38		
	.							0		0					
8 7	Obfe ru.	April										11	30		
	Atl.	.							e	0	0				
	Phil.		♄	5	1	♅	4	4	d	2	5				

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
				4 2		2 4		8	5		
	Prut.			1 5		2 0 e		0	0	11	3
				5		5					
	Rud.			5 2		3 5 d		2	4		
				4 8		7		3	5		
	Tych			5 1		3 0 d		0	0	10	54
	.			4 0		4					
8 8	Obfe ru.	Sept.								Total is.	
	Phil.		♌	5 4	♍	2 2 e		4	2	20	28
				5 5		8		3	5		
	Prut.			4 2		3 2 d		0	0		
				1 3		0 3					
	Rud.			5 2		0 2 e		0	0		
				6							
	Tych			5 5		5 2 e		3	0	19	35
	.			5 3		6 3		0			
8 9	Obfe ru.	Mart ij								1	30
	Phil.		♍	4 1	♌	3 3 d		2	3		
				2		5 4		7	0		
	Prut.			5 1		2 1 e		0	0	2	15
				8 7		3 7					
	Rud.			4 1		4 5 e		4	2		
				3 0		8 1		1	0		
	Tych			4 3		4 9 d		3	0	2	11
	.			2 9		2		0			
9 2	Obfe ru.	Ianu ar.								Total .	
	Phil.		♍	3 5	♌	3 2 e		5	5	20	3
				0		4		7	0		

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
	Prut.		♄	4 2 5 4		9 2 4	e	0	0		
	Rud.			3 2 0 0		3 4 0 6	e	2	5 6		
	Tych .			3 3 1 2		3 3 5 2	e	0	0	18	13

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
9 3	Obfe ru.	Nou emb .								9	2 8
	Atl.						d	0	0		
	Phil.		♍	3 6 6	♄	4 5 0 9	e	5 3	4 5		
	Prut.			4 5 3		2 5 0 3	e	0	0	8	2 4
	Rud.			3 8 6		4 8 4	d	0	0		
	Tych.			3 1 5 0		4 4 1 0	e	0	0	9	2 7

9 5	Obfe ru.	Nou emb .								Total .	
	Phil.		♍	1 5 4 2	♄	1 3 5 0	e	3 8	1 5	19	1 8
	Prut.			5 5 1 7		0 2 7	e	3 0	0	19	0
	Rud.			1 1		1 4	e	3	0		

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
				5 2		6 6		4			
	Tych.			1 1		1 4	e	0	0	19	4
				4 3		9 3					9
9 6	Obfe ru.	Oct ob.								5	2
	Atl.						d	3	0	4	4
								0			0
	Phil.		♄	5 5	♄	4 4	d	2	4		
				6		4 5		0	0		
	Prut.			3 2		2 0	d	3	0	5	5
				2 8		0		8			
	Rud.			5 1		4 3	d	4	2		
				6 2		8 2		0	0		
	Tych.			5 3		4 3	d	0	0	5	3
				6 0		7 0					1
9 7	Obfe ru.	Mar tij								10	7
	Atl.						e	0	0		
	Phil.		♅	2 1	♅	3 1	e	5	1		
				5 5		5 2		7	2		
	Prut.			3 1		2 0	e	0	2	9	3
				8		1			6		6
	Rud.			2 1		4 5	e	4	5		
				7 1		3 8		7	0		
	Tych.			2 9		3 9	e	3	0	11	1
				6		8		0			8
9 8	Obfe ru.	Mar tij								Total	
										.	
	Phil.		♅	1 5	♅	9 2	d	2	2		
				1 6		7		9	5		
	Prut.			2 3		4 0	e	0	0	18	2

[illegible]

O r d o	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
	Phil.		☿	2 5 3 4	♈	1 2 5 7	d	3 7	1 5		
	Prut.			4 5 1 9		4 2 7 9	e	3 0	0	19	4 1
	Rud.			2 3 3 8		1 2 3 6	d	1 2	2 4		
	Tych.			9 1 5		2 4 5	d	3 0	0	18	8
1 0 3	Obfe ru.	Oct ob.								6	4 5
	Dan.		♄	3 2 5 3	♈	3 5 5 3	e	3 0	0	8	1 5
	Lans b.			3 5 4 7		3 2 1 5	d	1 0	0	6	3 1
	Phil.			3 5 4 7		3 2 1 5	d	3 2	4		
	Prut.			1 5 0 8		1 2 0 8	d	3 0	0	8	1 6
	Rud.			3 9 5		3 2 1 9	d	2 0	4 0		
	Tych.			3 5 4 3		3 5 6 3	e	0	0	7	4 9
1 0 4	Obfe ru.	Apri l.								Total	
	Atl.						exa ctè	0			
	Dan.		♄	1 0 2		1 0 0	e	0	0	19	6
	Lanf.			8 0		1 3 2 0	e	3 0	0	18	3 6

Ordo	Sour ce	Mo.	Sun Sig	' "	Moo n Sig	' "	Diff	' "	' "	Dig	'
	Phil.			1 4		1 1	e	3	1		
				3 7		7 7			2		
	Prut.			2 2		4 2	e	0	0	19	5
				7 4		9 4					3
	Rud.			1 5		1 4	e	5	4		
				2 8		3 8		0	0		
	Tych.			1 3		1 6	e	3	0	18	2
				1 6		5		0			7

Caput VI [continued] — Comparison table of lunar eclipses against the tables

The comparison table begun earlier continues. Its columns are: the eclipse number [Ordo Eclips. cap. 2]; the observer and the set of astronomical tables [Obseru. & Tab. Astron.]; the apparent time after noon at the place of observation [Tempus Apparens post Merid. in loco Observationis] (Month, Day, Hour, Minute); the Sun's true place from the tables, and from it the place of the full Moon in opposition [Solis locus Verus ex Tab. & inde locus ☾^o] (Sign, Degree, ', '); the Moon's place as computed from the tables [Lunæ locus ex Tabul. computatus] (Sign, Degree, ', '); the difference between the computed and the observed place of the Moon [Differ. loci ☾ coputata & observata] (whether deficient *d* or in excess *e*; Degree, ', '); the time corresponding to that difference [Tempus huius Differentiæ] (Hour, ', '); and the magnitude in digits and minutes [Quãtit. in Digit. & min.] (Digit, ').

Ordo	Obs./ Tab.	Mon.	Sun Sig.	' "	Moon Sig.	' "	d / e	' "	' "	Dig.	'
1 0 5	Obser v.	Octo b.								Total is.	
	Dan.		♌	4 0	♍	5 3	e	3	0	21	9

O r d o	Obs./ Tab.	Mon.	Sun Sig.	Moon Sig.		d / e			Dig.	'
				6		5 0		0		
	Lansb			4 0		4 3 d	3	0	20	3
	.			7		5 0		0		0
	Phil.			4 9		5 4 e	3	1		
				6		3 4	5	0		
	Prut.			2 3		1 3 d	0	0	21	1
				4 9		7 9				9
	Rud.			4 2		5 1 d	8	1		
				6 7		1 6		6		
	Tych.			4 5		5 2 e	3	0	20	2
				5 4		4 4		0		2
1 0 6	Obser v.	Sept emb.								6 0
	Dan.		♌	1 5	♍	1 5 e	0	0	6	1
				6 2		8 2				6
	Lans.			1 0		1 3 d	2	0	6	0
				8		4 5	5			
	Phil.			1 1		2 4 e	3	2	0	0
				7 2		1 7		9		
	Prut.			5 1		3 4 d	3	0	6	5
				7 4		5 4	0			9
	Rud.			1 4		2 5 e	1	2		
				6 3		0 4	1	2		
	Tych.			1 5		1 5 d	0	0	5	5
				6 7		5 7				8
1 0 7	Obser v.	Febr.								
	Dan.		♍	5 3	♌	1 0 d	3	1	10	2
				0			0	0		5

O r d o	Obs./ Tab.	Mon.	Sun Sig.			Moon Sig.			d / e			Dig.	'
				'	"		'	"		'	"		
	Lansb			3	0		3	3	d	3	0	8	5
	.			2			1	0		0			2
	Phil.			3	1		4	3	e	2	5		
				6	2		1	6		4	0		
	Prut.			4	3		8	3	e	0	0	9	4
				5									
	Rud.			3	3		4	4	e	8	1		
				7	6		0	4			6		
	Tych.			3	9		4	9	e	0	0	10	6
				8			2						
1 0 8	Obser v.	Ianu ar.										Total .	
	Dan.		♊	3	0	♏	5	0	e	0	0	19	4
				8			3						0
	Lansb			3	0		4	2	e	2	0	18	4
	.			5			6	0		0			3
	Phil.			4	4		5	3	e	5	4		
				2	4		3	5		1	0		
	Prut.			4	2		1	2	e	0	0	20	1
				9	6		5	6					7
	Rud.			4	2		5	2	e	2	4		
				2			0	2		0	0		
	Tych.			4	3		4	3	e	0	0	18	2
				2	7		5	7					3
1 1 0	Obser v.	Ianu ar.											5 0
	Dan.		♊	5	4	♏	4	4	d	0	0	5	2
				3	4		3	4					
	Lans.			4	0		4	3	d	3	0	4	4
				8			3	0		0			7

O r d o	Obs./ Tab.	Mon.	Sun Sig.			Moon Sig.			d / e			Dig.	'
				'	"		'	"		'	"		
	Phil.			5	1		5	4	d	2	5		
				4	3		2	4		9	8		
	Prut.			3	4		1	4	e	0	0	6	2
					1		7	1					5
	Rud.			5	1		4	3	d	4	2		
				4	3		8	1		2	4		
	Tych.			5	3		4	3	d	5	4	4	3
				4	2		9	8		4	8		2
1	Obser	Aug.											2
1	v.												3
7													0
	Dan.		♂	3	0	✕	2	0	d	0	0	2	3
				1			4						9
	Lans.			3	0		4	2	e	2	0	1	5
				3			2	0		0			3
	Phil.			3	4		3	2	e	3	1		
				0	7		1	2		5	0		
	Prut.			1	1		1	4	d	3	0	2	2
				2	5			5		0			4
	Rudol			3	5		3	2	d	2	4		
	.			3	2		0	8		4	8		
	Tych.			3	1		3	1	d	0	0	2	3
				2	6		0	6					7
1	Obser	Iunij										Total	
1	v.											.	
8													
	Dan.		♂	2	5	♂	1	5	d	0	0	12	4
				7			4						9
	Lansb			2	0		1	4	d	2	0	12	2
	.			6			6	0		0			5
	Phil.			2	3		2	1	e	4	2		
				5	8		6	9		1	0		

O r d o	Obs./ Tab.	Mon.	Sun Sig.			Moon Sig.			d / e			Dig.	'
				'	"		'	"		'	"		
	Rud.			2	4		2	5	d	4		3	
				6	1		4	4		7		0	
	Tych.			2	5		2	3	d	1		3	
				6	7		3	8		9		5	
1	Obser	Dece											3
1	v.	mb.											3
9													0
	Dan.		☿	2	3	II	3	3	e	0		0	4
				8	2		0	2					0
	Lansb			2	3		1	3	d	3		0	3
	.			0	3		9			0			9
	Philol			2	3		2	2	d	9		1	
	.			9	2		8	3				8	
	Rudol			2	1		2	5	e	4		2	
	.			9	8		9	9		1		2	
	Tych.			3	2		3	4	e	3		2	
				0	5		2			9		0	

CAPVT VII.

On the Excellence of the Astronomical Tables, and on the comparison among them, drawn from the Observations of Lunar Eclipses. In which certain notable Conclusions are established.

[Margin: Corollarium. (Corollary.)]

Conclusion I. No astronomical tables of all those so far named agree with the observations of all the lunar eclipses, and many of them agree with even fewer of the more ancient ones. This is plain from a survey of the catalogue in Chapters V and VI. For at Chapter V, from number 16 onward, I showed that the astronomical tables of Ptolemy fail, in representing eclipses of the Moon, to fall as near as they ought to the place of the Moon (within about 12 minutes per degree), from the age of Ptolemy back to the year 747 before Christ. From this we may draw, in the manner of a corollary, that the aforesaid tables cannot safely be used

for the place of the Moon over more than about 14 centuries — roughly the span that elapsed between Ptolemy and the more recent compilers of tables.

Conclusion II. There are no tables among those already named for which some lunar-eclipse observations do not vouch; nor any against which some others do not testify. This too is plain from a survey of the catalogue of Chapter VI, and from the way the eclipses have just been re-counted; and the suffrages of the individual tables, to be set out for the Conclusion that follows, will make it clear.

Conclusion III. Standing on a bare comparison of the eclipse observations as they lie, in respect of time and quantity, with the eclipses computed from the tables, the Lansbergian and Rudolphine tables would seem to be preferred above all the rest; then the Tychonic; after these the Atlantic and the Philolaic; in the antepenultimate place the Danish and the Prutenic; in the penultimate the Parisian; and last the Alphonsine. For, by the catalogue set out above, the eclipses vouch — 19 for the Rudolphine and 13 for the Tychonic — and so for the rest, as arranged below in the appended table.

[The table that follows tallies, for each set of tables, the numbers of the eclipses (from Chapters V and VI) that "vote for" it, and the total count.]

Suffragantur (Voting for)	Eclipses from Chap. V & VI	Sum ma
Alphonsinis (Alphonsine)	27.	1
Parisinis (Parisian)	20. 23. 48.	3
Danicis (Danish)	13. 40. 42. 50. 77. 103.	6
Prutenicis (Prutenic)	68. 72. 83. 85. 102. 103.	6
Philolaicis (Philolaic)	10. 15. 19. 29. 46. 76. 81. 86. 95. 110. 117. 118.	12
Atlanticis (Atlantic)	49. 60. 63. 67. 69. 70. 74. 75. 87. 93. 96. 97. 100. 104.	15
Rudolphinis (Rudolphine)	1. 2. 4. 5. 16. 8. 9. 11. 17. 18. 26. 32. 243. [?] 53. 66. 81. 82. 192. [?] 119.	19
Tychonicis (Tychonic)	35. 41. 44. 45. 57. 71. 80. 88. 89. 98. 99. 106. 108.	13
Lansbergianis (Lansbergian)	3. 14. 16. 22. 23. 24. 33. 36. 37. 38. 47. 50. 54. 55. 56. 58. 59. 105. 107.	19

Conclusion IV. Yet one cannot, from a bare comparison of the said observations against the tabular computation, form a sure judgment that the excellence of the tables is to be carried in favor of any one set above the rest. For neither does the agreement of the tables with the observations afford a sure sign of their agreement with the heavens and with truth — just as their disagreement with the observations does not afford a sure argument of their disagreement with the heavens and with truth. Indeed it could happen that the agreement of the tables with not a few observations of the phenomena should arise either from a false meridian-distance assumed in transferring the time of the meridians of the observations to the meridian of the tables (a falsehood, that is, either because the observation itself was at fault, or because the very tables falsely usurp the meridian as one, or for more than ten causes enumerated at Chapter IV); or at least because the false numbers were marked down in a chosen way; and so it came about for us that what disagreed with the heavens nonetheless really sounded in concord, either out of several observations of the same eclipse — that which less truly agreed with the heavens [— and the reverse]. Hence it may still be doubted whether the discord of the tables with the observations arises from an intrinsic fault of the astronomical tables — namely, from a false mean motion of the luminaries and of the anomalies, or from the eccentricity and the prosthaphaeresis founded on it, or from the form of the geometric, circular, or elliptic hypotheses — or whether the equation taken up in it is from the construction of the equation. Or whether, from an extrinsic fault of the geography, the distance in meridians used was usurped; and whether, again, from an extrinsic fault of the observation.

But it is worth the trouble, in my judgment, to discuss the three aforesaid sources of disagreement between the tables and the eclipse observations, each in turn, briefly, and to apply them to certain tables, taking the start from the **Distance of the meridians**.

The distance of the meridians, or difference of longitude, which I have used in the Tychonic, Rudolphine, and Philolaic calculation — that very one I reckoned at Chapter I, and took from my own *Geographia Reformata* — rests upon eclipses that are certain, and upon intervals of itinerary, and therefore can scarcely be suspected of any minimal fallacy. Yet because Lansbergen and Wendelen used in their own computations a meridian-distance by no means certain, and in some places plainly perceptibly false, I think the eclipse-observations of these authors must be re-computed; a greater disagreement will sometimes come out, a lesser at other times, than was met with before. Take as an example one from Lansbergen, who supposes Goes to be more easterly than al-Raqqa by 3 hours;

from there comes Eclipse 21 in our Ordo, which Lansbergen in his *Thesaurus* computes from his own tables at 14, finding Goes at the hour 4. 27. apparently, the Sun being in the Lion at Degree 3. 53. 43." and the Moon in Aquarius at Degree 3. 53. 43."; therefore he reckoned the opposition of the luminaries to have been most exact, with nothing remaining; thus his tables differ from the observation. But al-Raqqa is more easterly than I had it, and more easterly than Bologna than Goes by 3 hours; therefore than Goes by only 2. 43.; so that by a full 44 minutes of hour al-Raqqa and Goes are closer than Lansbergen assumes. Wherefore, if from our meridian-distance and the Lansbergian one we repeat the reckoning, we shall find the Sun in the Lion at Degree 3. 15. 31." and the Moon in Aquarius at Degree 4. 17. 52." — which is to say already transgressed past the moment of opposition by minutes of zodiac 24. 9." And therefore the Lansbergian tables exhibit this eclipse earlier by 44 minutes of time than al-Raqqa's observation (al-Battānī's).

Likewise **Wendelen** supposes Hercaam [Herwaarden/Herck] his native place to be more westerly than Hven and Uraniborg by 25 minutes of time; whereas to me it is more westerly than Uraniborg by 31. Wherefore, if I repeat his calculations in the Vraniburg-observed eclipses, I shall find the difference six minutes greater in time. And if anyone there be who would not disdain to recognize how much the more celebrated tables disagree from the observations in time, the meridian-distance being supposed from our *Geographia Reformata*, I for my part would not begrudge to undergo this further labor in the 19 ancient eclipses, in which it appears the day itself contains an error (as I taught at Chapter V). I shall examine the rest by the same method, that it may stand clear by computation which tables more nearly represent the time of the observation. Therefore contemplate the following little table.

In the following little table, in which the columns headed **At.** [Atlantic], **D.** [Danish], **L.** [Lansbergian], **Ph.** [Philolaic], **R.** [Rudolphine], **T.** [Tychonic] indicate the tables — and on the left is the eclipse number [Ordo], while on the right are the Minutes, and the seconds of Time, by which the said tables differ from the time of the observation chosen according to the earlier table, but on the supposed meridian-distance from our *Geographia Reformata*.

The table is arranged in four paired sub-columns running down the page. Each block gives the eclipse number [Ordo], the table-set abbreviation [Tabula], and the difference in minutes [I] and seconds [II] of time. The abbreviations: **A./At.** = Atlantic; **D.** = Danish; **L.** = Lansbergian; **Ph.** = Philolaic; **R.** = Rudolphine; **T.** = Tychonic.

First sub-table (Ordo 22–43):

Ordo	Tabula	I	II
22	L.	44	0
	Ph.	21	25
	R.	1	40
23	L.	40	18
	Ph.	13	20
	R.	6	50
24	L.	2	12
	Ph.	13	40
	R.	8	20
26	Ph.	25	28
	R.	6	45
29	L.	4	45
	Ph.	0	32
	R.	0	46
32	Ph.	43	45
	R.	29	10
33	L.	5	19
	Ph.	13	20
	R.	13	20
35	L.	23	42
	Ph.	41	5
	R.	13	0
	T.	2	14
36	L.	16	20
	Ph.	1	40
	R.	24	5
	T.	19	30
37	L.	15	2
	Ph.	16	40
	R.	20	15

Ordo	Tabula	I	II
38	T.	15	0
	L.	0	18
	Ph.	24	0
	R.	0	10
40	T.	2	15
	D.	2	0
	Ph.	18	50
	R.	18	18
41	T.	9	30
	D.	5	20
	Ph.	2	15
	R.	3	50
42	T.	1	40
	D.	9	40
	Ph.	27	44
	R.	18	0
43	T.	10	12
	D.	2	40
	Ph.	6	30
	R.	0	24
	T.	6	30

Second sub-table (Ordo 44–56):

Ordo	Tabula	I	II
44	D.	4	30
	Ph.	8	20
	R.	5	30
	T.	0	52
45	D.	60	0
	L.	14	30
	Ph.	13	10

Ordo	Tabula	I	II
46	R.	11	35
	T.	0	10
	D.	5	40
	Ph.	2	40
	R.	4	40
47	T.	3	0
	A.	17	0
	D.	6	40
	L.	14	0
	Ph.	1	58
48	R.	11	2
	T.	2	12
	At.	23	0
	D.	3	20
	Ph.	14	0
49	R.	19	30
	T.	19	10
	D.	6	8
	Ph.	7	20
	R.	20	15
50	T.	4	0
	D.	2	0
	L.	15	30
	Ph.	8	34
	R.	7	6
53	T.	1	25
	D.	2	0
	L.	15	29
	Ph.	8	35
	R.	7	6
	T.	3	25

Ordo	Tabula	I	II
54	At.	6	0
	D.	0	30
	L.	14	45
	Ph.	10	30
	R.	2	24
	T.	0	22
55	At.	3	0
	D.	4	0
	L.	15	0
	Ph.	2	5
	R.	13	4
	T.	6	20
56	At.	53	0
	D.	9	0
	L.	15	0
	Ph.	12	50
	R.	13	50
	T.	3	30

Third sub-table (Ordo 57–76):

Ordo	Tabula	I	II
57	A.	48	0
	D.	7	20
	Ph.	14	15
	R.	8	25
	T.	4	0
59	D.	8	0
	L.	3	10
	Ph.	14	5
	R.	8	8
	T.	1	0

Ordo	Tabula	I	II
60	A.	5	0
	D.	2	0
	Ph.	8	50
	R.	9	6
	T.	2	0
63	A.	1	0
	L.	0	30
	Ph.	4	0
	R.	5	38
	T.	8	0
66	A.	24	0
	L.	6	0
	Ph.	10	0
	R.	0	28
	T.	7	0
67	At.	2	0
	L.	7	0
	Ph.	4	15
	R.	4	54
	T.	8	0
68	L.	36	0
	Ph.	22	30
	R.	37	30
	T.	39	0
69	At.	0	0
	L.	15	0
	Ph.	7	0
	R.	0	8
	T.	2	0
70	A.	1	0
	Ph.	7	40

Ordo	Tabula	I	II
71	R.	3	0
	T.	8	0
	L.	6	0
	Ph.	1	11
72	R.	1	25
	T.	3	0
	D.	4	25
	Ph.	12	43
74	R.	12	30
	T.	10	0
	A.	1	0
	Ph.	8	0
75	R.	8	10
	T.	24	0
	A.	0	0
	Ph.	6	0 [?]
76	R.	0	0 [?]
	T.	8	0
	Ph.	6	12
	R.	18	30
	T.	15	0

Fourth sub-table (Ordo 77–98):

Ordo	Tabula	I	II
77	D.	1	10
	Ph.	8	0
	R.	10	12
	T.	9	0
80	Ph.	5	35
	R.	6	0
	T.	11	0

Ordo	Tabula	I	II
81	Ph.	6	10
	R.	5	50
	T.	12	0
82	Ph.	2	0
	R.	0	4
	T.	2	0
83	Ph.	9	44
	R.	21	2
	T.	10	0
84	At.	0	0
	Ph.	2	35
	R.	6	10
	T.	2	0
85	Ph.	18	50
	R.	24	24
	T.	21	0
86	Ph.	0	58
	R.	4	0
	T.	11	0
87	At.	2	0
	Ph.	30	55
	R.	34	45
	T.	24	0
88	Ph.	13	25
	R.	8	0
	T.	3	0
89	Ph.	13	30
	R.	11	20
	T.	2	0
92	Ph.	7	50
	R.	0	52

Ordo	Tabula	I	II
93	T.	3	34
	At.	2	0
	Ph.	9	46
	R.	16	0
95	T.	9	0
	Ph.	1	15
	R.	3	8
96	T.	7	30
	At.	5	0
	Ph.	22	40
	R.	16	0
97	T.	22	0
	A.	10	0
	Ph.	21	12
	R.	33	30
98	T.	21	0
	Ph.	5	25
	R.	20	2
	T.	6	0

(Caput VII continued — time-difference comparison table, concluded)

The following table (continued from the preceding pages) lists, for each eclipse in order [Ordo], the table-set [Tabula] and the amount by which its computed time differs from the observation, in two columns of figures (I and II). The abbreviations are: **Ph.** = Philolaic, **R.** = Rudolphine, **T.** = Tyconic, **A.** / **At.** = Atlantic, **D.** = Danish, **L.** = Lansbergian.

Ordo	Tabula	I	II	Ordo	Tabula	I	II
99	Ph.	7	43	107	D.	9	0
	R.	2	49		L.	6	0
	T.	11	0		Ph.	10	50

Ordo	Tabula	I	II	Ordo	Tabula	I	II
100	A.	1	9	108	R.	6	16
	Ph.	9	35		T.	4	0
	R.	9	42		D.	30	28
	T.	3	4		L.	28	0
102	Ph.	17	15	110	Ph.	21	40
	R.	20	24		R.	16	40
	T.	17	0		T.	2	0
103	D.	1	0	117	D.	20	0
	L.	30	0		L.	14	0
	Ph.	7	4		Ph.	2	58
	R.	8	40		R.	11	24
	T.	0	0		T.	9	48
104	At.	0	0	118	D.	14	0
	D.	10	0		L.	24	0
	L.	14	0		Ph.	1	10
	Ph.	5	52		R.	6	0
	R.	1	40		T.	8	0
	T.	4	0		D.	26	0
105	D.	19	0	119	L.	19	0
	L.	8	0		Ph.	1	20
	Ph.	15	10		R.	3	30
	R.	10	16		T.	6	35
	T.	15	0		D.	4	0
106	D.	4	0		L.	8	0
	L.	12	0		Ph.	2	18
	Ph.	7	29		R.	1	22
	R.	8	20		T.	3	20
	T.	6	0				

[¶5] It is therefore evident from this second comparison that the Tychonic tables are to be preferred; then the Philolaic; after these the Atlantic; next the Rudolphine, which the Danish follow; and finally the Lansbergian, which had

held first place in the first comparison but here, in this second one, comes out lowest. For the table-sets named above are supported by the eclipses listed below.

Tabulis [Table-set]	Eclipsium Ordo [Eclipses, by number]	Summa [Total]
Lansbergen. [Lansbergian]	24. 33. 63. 105.	4
Danicis [Danish]	40. 42. 45. 48. 53. 60. 72. 77. 106.	9
Rudolphinis [Rudolphine]	22. 23. 26. 32. 38. 43. 66. 81. 82. 92. 119.	11
Atlanticis [Atlantic]	67. 69. 70. 74. 75. 84. 87. 93. 96. 97. 100. 104.	12
Philolaicis [Philolaic]	29. 36. 46. 47. 55. 68. 71. 80. 83. 85. 86. 95. 98. 99. 110. 118.	16
Tychonicis [Tychnonic]	35. 37. 44. 49. 50. 54. 56. 57. 59. 60. 76. 88. 89. 102. 103. 107. 108. 117.	18

[¶6] Another source and cause of the discrepancy may be, as we said, the unreliability of the observations themselves, for the reasons laid out in chapter 4. For sometimes the discrepancy is so enormous that its whole cause cannot be assigned to a false difference of meridians. Let eclipse 32, observed at Nuremberg, serve as an example.

(In the right column of folio 128:)

This eclipse was observed at Nuremberg by Bernhard Walther [Bernhard Walther] in the year 1487, on 7 February, at 15 hours 47 minutes by the clock — that is, after midday, 3 hours 47 minutes — according to the Rudolphine and Philolaic tables at 15 hours 51 minutes; but apparently equated to 16 hours 3 minutes. At that moment the Philolaic tables show the Moon farther advanced than the place of opposition by 19 minutes 53 seconds; the Rudolphine, however, by 13 minutes 4 seconds. The opposition of the Moon with the Sun would therefore have been sooner — by 39 minutes 45 seconds of time on the Philolaic reckoning, or 26 minutes 10 seconds on the Rudolphine. So on the Rudolphine the opposition was sooner, I say, than Walther recorded. This great a discrepancy cannot be ascribed to any skilled astronomer, nor to geography; it is all to be referred to the distance of the meridians, which in the Rudolphine and Philolaic tables is 4 minutes of time — and that is the very least of all the values assumed

by others. For Origanus [Origanus] supposes Nuremberg farther west than Uraniborg by 5 minutes; the Danish and Parisian tables by 6 minutes; we [the *Almagestum Novum*] by 8 minutes; the Atlantic by 9 minutes; the Lansbergian by 12 minutes; and Tycho, *Progymnasmata* tome 1, page 51, by nearly a quarter of an hour, that is, 15 minutes.

Therefore, if the time is reduced from the meridian of Nuremberg to that of Uraniborg according to the opinion of others, the computed beginning will have fallen earlier, and so the Moon would still have been farther advanced, and the discrepancy of time greater. To me, indeed, it would have come out — on the Philolaic figures — at 43 minutes; on the Rudolphine, at 30 minutes only. So far is it possible, by choosing a different meridian-difference for these tables, to reconcile this observation with the tables named. Prudently, then, the greater part of the discrepancy is to be rejected onto the observation itself, which appears very doubtful from Walther's own account, which runs:

In the year 1487, on 8 February: I observed the eclipse of the Moon at about the second hour after midnight, in the morning, when the Moon began to be eclipsed, and when the Nadir of the Sun stood at an altitude of 29 degrees, the eclipse being at its mean phase; but at that time the clock indicated three hours, and 47 minutes. And at the end of the whole obscuration the Nadir of the Sun stood at an altitude of 24 degrees, the clock at 4 hours 18 minutes. The end of the eclipse was at 5 hours 20 minutes, after the mean of the eclipse. I examined the times by altitudes, and conversely. At the time of the eclipse's mean phase, the Moon was between the Heart of the Lion [Cor Leonis, Regulus] and the Nadir of the Sun by 60 degrees 35 minutes. Thus the latitude of the Moon was seen to be southern. Likewise the true place of the Sun's Nadir, at the time of the eclipse's mean phase, ought by calculation to have stood at sign 4, degree 28, 39 minutes 44 seconds; but the arc between the Heart of the Lion and the Nadir of the Sun was sign 5, 24 minutes; and within this the place of the heart [of the Lion] would have been at sign 4, degree 23, 15 minutes 44 seconds; but it is not so great.

So this excellent old man — who candidly admits he is not so sure of the said arc, and offers a handle for doubt — could afterward, on account of the shadowing, have been deceived at the beginning and at the end of the eclipse; and since he said it had begun at "about the second hour after midnight," he indicates that he was not certain it was the second; he prints the mean at 3 hours 40 minutes after midnight, not 3 hours 47 minutes, as recorded from the clock. And so, on all the computations, it will probably have been more likely that the mean of this eclipse was 20 minutes or more sooner than is gathered from Walther's stated beginning.

The remaining discrepancy is to be referred to the tables themselves. Meanwhile, this is the conclusion that follows.

V. Conclusion. The whole discrepancy between the astronomical tables and the observations of the eclipses set out above cannot always be ascribed to a false meridian-difference used in computing the eclipse, but is to be assigned in part to a fault either of the observation, or of the tables, or of both at once.

Eclipses not faithfully, or not concordantly, reported.

[¶7] This has already been proved by a single example in the preceding number, and most evidently in chapter 4, number 3; it could be shown by many others; but as for what concerns a fault of observation — whether carried out deceptively, or recorded deceptively by the writers — there is no lack of indications worth pointing out.

[Margin: *Regiomontani hallucinatio.* — "Regiomontanus's blunder."]

Eclipse 29. Lansbergius [Lansbergen], in his *Thesaurus of Lunar Observations*, Class 1, eclipse 17, following Regiomontanus [Regiomontanus], notes that it was made at Viterbo at 14 hours 48 minutes after midday. But we, from a more correct place of the fixed stars (as I related in chapter 2), find the hour to have been 14 hours 37 minutes; and so on this single head — of the Right Ascension and Declination of the Eagle [Aquila], which Regiomontanus used — the time of the observation labors under an error of eleven minutes.

Eclipse 35. Copernicus [Copernicus], book 4, chapter 13, says he observed it at Cracow after midday at the equinoctial hours 1 and three-fifths of one hour, that is, at 36 minutes; while Lansbergius, in the *Thesaurus of Observations*, Class 1, eclipse 19, from the same book of Copernicus and the same chapter, states Copernicus's observation at Cracow at 1 hour 45 minutes after midday — namely three-quarters of one hour. And lest you think this a typographical error, he adds further that the time of Goes [Goes] appears as 10 hours 23 minutes, which agrees with the difference of longitude that Lansbergius assigns between Goes and Cracow — namely 1 hour 22 minutes.

[Margin: *Lansbergij hallucinatio.* — "Lansbergius's blunder."]

Therefore, either by a slip of imagination, or by the moment of observation itself, he turned three-fifths of an hour into three-quarters, and exceeded it by 9 minutes in marking the moment of the observation.

Longomontanus [Longomontanus] likewise recorded many eclipses otherwise [than Tycho], as is clear from the Catalogue of chapter 2; and from chapter 3, take this synopsis:

Ordo Eclips. [Eclipse no.]	<i>Tycho</i> H.	I	<i>Longomontanus</i> H.	I
41	11	3	11	2
		2		5
44	13	1	13	2
		7		4
46	9	5	10	0
		8		
47	16	5	17	0
		7		
48	13	8	13	9
49	9	1	9	3
		6		0
50	14	4	15	2
		8		
53	6	5	7	0
		5		
55	19	2	19	1
		6		6
56	16	3	16	3
		6		0
57	9	2	9	2
		9		5
59	7	2	7	3
		6		7
60	17	5	13	5
		0		6

And yet Tycho himself is not always consistent in reporting the moments of eclipses, as in eclipse 48.

Eclipses determined by mere conjecture.

[¶8] Sometimes, too, the moment of the eclipse's full or mean phase is found to be recorded not from the actual observed phases, but from some single phase — say,

from the beginning or the end alone — and from this the mean is deduced by mere conjecture, or from some hypothesis that is not sufficiently certain. Thus Ptolemy [Ptolemy], for the beginning of the first eclipse handed down from the Chaldaeans, adds two hours, reckoning that the total eclipse lasted 4 hours. And to the beginning of the third eclipse, observed [by the Chaldaeans], he adds one and a half hours to obtain the mean, because he supposed by mere conjecture that the eclipse of 6 digits lasted a full 3 hours, very nearly. For the fourth eclipse, observed at Babylon, adding one hour to the beginning, he determined the mean, because he supposed an eclipse of three digits lasted 2 hours. Besides, for eclipse 8 he defined the mean-phase moment partly from the beginning, partly from conjecture, because he supposed a small eclipse lasted no more than 1 hour 30 minutes, very nearly; and therefore Petavius [Petavius], book 8 *On the Doctrine of Times*, judged this eclipse worthy of special examination. Again, for eclipse 10 he deduced the mean from mere observation of the recorded beginning, and from his own settled opinion that total eclipses last 4 hours, accordingly adding 2 hours to the beginning to set the mean. But Petavius, book 8 *On the Doctrine of Times*, page 812, denies that this eclipse, on his own tables, lasted beyond 5 hours 48 minutes, and so brands Ptolemy's note as a [Greek: ἐλάσσωμα (elassōma, "shortfall" — a deficiency)] designated by him. See the passages of Ptolemy noted by us in the earlier Catalogue, chapter 2.

Tycho too seems sometimes to have asserted the mean from sole conjecture, as in eclipse 42, whose end alone he was able to observe in Denmark, says Wendelen [Wendelen]; and concerning eclipses 47 and 57, where he speaks of the mean defined by Tycho from the beginning thus: *That mean of Tycho is now not founded on any observation, but on his own conjecture and computation, obtruded on us; for he could only have seen the beginning of it; the immersion, the emersion, the end, he could not, since all these things happened after the setting of the Moon;* and elsewhere he writes thus: *(this eclipse was at least so observed, that the Moon &c.)*

...had been halved before the shadow entered, before it set.) Nothing certain, therefore, follows from these Tychonic assertions. Thus far Wendelen, who also, concerning eclipse 57 — which is the same as eclipse 17 among the Tychonics — speaking of the mean of the eclipse defined by Tycho at 8 hours 36 minutes, and by Longomontanus at 8 hours 30 minutes, says that each of them determined the mean by mere conjecture, boldly, since they could see nothing beyond the beginning at Uraniborg, the Sun rising there at 6 hours 57 minutes; and he adds, from their own tables, that the mean was at 8 hours 44 minutes at Uraniborg. And concerning eclipse 69, produced by Lansbergius more from calculation than from observation — speaking of the end, he says that since the end could not be

seen by Lansbergius himself, the mean could not be made to stand from it together with the beginning. But Lansbergius perhaps noted the mean directly from the maximum of the eclipse of 8 digits.

The remaining indications of eclipses not accurately observed.

[¶9] Whenever observers admit that they used poor or unsuitable instruments — as we have more than once pointed out in the history of chapter 2 — or whenever an eclipse, as we have indicated, departs widely from the observation of others of no lesser reliability or diligence among the authors, we have an indication of an improbable fault in the observations. Thus in eclipse 43 the mean asserted by Tycho insinuates the fallaciousness of the Tychonic eclipse, number 4, by the observations of Toledo and Madrid carried out with the greatest diligence and at the command of the King of Spain; and in eclipse 56, which is the same as the Hercian observation, number 16, he refutes it by a discrepancy of 23 minutes. A great discrepancy of observation also appears in eclipse 80, of which Wendelen [speaks] on page 83 of his *Eclipses*; and in eclipse 98, of which on the same page 101; and in eclipse 106, of which I have spoken in chapter 4, where at the end he gives the reason for which we have preferred our observation to Wendelen's.

Eclipses whose discrepancy between observations and tables must in part be ascribed to a fault of the tables.

[¶10] There are four indications of some hidden fault latent in the astronomical tables, when they differ widely from the observation. The first is when the eclipse was very long, and therefore the durations were very brief — as were eclipses 8 and 82, and 89: in these the mean indeed could not be erroneous, but the duration could, in a few minutes. So when the Prutenic tables differ from the observation of eclipse 89 by 48 minutes, it is evident that they are in error here.

The second indication is the enormous discrepancy of the tables from the observation of a single observer, even within the same number [of eclipses]; if the mean or the immediate or partial phases of the eclipse were deduced from the observed beginning or end, then there is no longer any reason beyond a half-hour in the middle to fear — as in eclipses 9, 11, 13, and 14, which Ptolemy [reports] not from conjecture but at first as if from another supreme Tychonic [authority]... [the sense here is compressed; the printed text reads:] which Ptolemy [reports] not from conjecture but at first, as if from another supreme height, and at the same time from the beginning, with this remark added — provided they are similar — that such Tables are absent from the observation beyond a half-hour in the middle: nothing, I say, will doubtfully be questioned if

they are vitiated, the distance of the meridians nonetheless set aside; if they are not convoked in part into the discrepancy.

The third indication is the closer consensus of several observations of the same eclipse, recalled to the same meridian — of which kind are, first of all, eclipses 48, which the Wendelinian tables resist, and therefore reject; the consensus of the other observers favors the Tychonic rather; and eclipses 63, 71, 86, 88, 89, 92, 93, 95, 96, 102, 103, 104.

The fourth indication is, unless one has recourse to a distance of the meridians, a manifest fault in the tables, if through them the eclipse could in no way have been observed at that horizon where nonetheless reliable observers assert it was observed. Such is eclipse 8, which Petavius, examining in book 8 *On the Doctrine of Times*, page 799, showed could by no means have been seen to begin at Babylon, if calculation be made from the Alphonsine, Ptolemaic, Prutenic, and Danish tables.

VI. Conclusion. From the established goodness of the astronomical tables within certain limits — if several observations of some eclipse differ too widely from the tables — it can probably be judged that there is some fault of observation. For when several observations made by many observers agree within a narrow consensus, and the tables agree with them within a few scruples, and yet those same tables are not the best for every century, but at least contain the lesser error possible for one century — then, these things being established, if some observations of an eclipse differ from such tables beyond those limits, it is probable that this excess arises from some fault of the observations, or from a less accurate one.

[¶11] Now, having reviewed the earlier catalogue of chapter 6, and starting from the eclipses of our own century — that is, from eclipse 63, which was observed in the year 1601 — it will be evident that the discrepancy of the tables and observations stands within 5 minutes of time, or at least within 10, in the number of eclipses listed below. And so in 31 eclipses the Tychonic tables agree with the observation within 10 minutes.

Eclipsium Numerus pro
Tabularum, &
Observationum
consensu [Number of
eclipses for the
agreement of tables and
observations]

Tab. [Table-set]	Intra 10'. temp. [Within 10' of time]	Intra 5'. temp. [Within 5' of time]
Atlanticæ [Atlantic]	12	11
Danicæ [Danish]	8	6
Lansbergen. [Lansbergian]	12	6
Philol. [Philolaic]	28	10
Rudolph. [Rudolphine]	29	17
Tychonica [Tyronic]	31	17

[¶12] But if the catalogue of this chapter 7 is reviewed — after the number 4 set down above, in which, on the basis of our *Geographia Reformata*, the meridian-distances have been corrected — we may set down the difference of the tables from the observations in time, which comes out somewhat different for the consensus of tables and observations, namely within 10', or 5', of time, as in the following little table:

Tab. [Table-set]	Intra 10'. [Within 10']	Intra 5'. [Within 5']
Atlantica [Atlantic]	13	12
Danica [Danish]	7	5
Lansbergen. [Lansbergian]	6	1
Philol. [Philolaic]	27	10
Rudolph. [Rudolphine]	27	14
Tychon. [Tyronic]	28	15

[¶13] From this new comparison it appears that Wendelen, in the design of his Atlantic tables, had some foundation for approving the observations of the eclipses when they agreed more closely with his own tables — which he did chiefly in the eclipses, as far as concerns our order: 44, 46, 49, 53, 54, 55, 58, 59,

60, 72, 76. But he condemns [them] when they differ enormously from his own tables: as in eclipses 40, 41, 43, 44, 45, 47, 50, 57, 69, 75. Yet not so much in proportion as the followers of the Philolaic, Rudolphine, and Tyconic tables, who, in these eclipses, have many more eclipses within 10 minutes — indeed, the Tyconic within 5 minutes — favoring [them], than the Atlantic tables do. From this arises for us the following, and worth knowing:

[¶14] For with much greater confidence (I hope) it can be made out that those tables which, within a few minutes of time — say within 10, or at most 5 — agree with more observations, or which satisfy more observations by better ones, are to be preferred to tables which satisfy more observations indiscriminately, while many select observations resist them.

So one may, from the first comparison, and from what was said for Conclusion III, [conclude that] the Lansbergian tables obtained first place; the Rudolphine, 2; the Atlantic and the Tyconic, 3. But from the second comparison, as has been said, by number 5 the Tyconic [stand] first; the Philolaic and Atlantic, 3; the Rudolphine, 4. In this third comparison, however, and from the use of both tables — number 11 against number 12 — it is settled, from the consensus of the select eclipses, that the Tyconic tables [agree with] the observations of our century 31 or 28 times within 10 minutes, but 17 or 15 times within 5 minutes, and so excel the other tables; after these the Rudolphine and the Philolaic stand at about an equal number; and then the Atlantic.

VIII. Conclusion. On account of the discrepancy of the astronomical tables from the observations of the eclipses of our century, or of neighboring centuries, the astronomical equation of apparent time into mean is not to be abandoned, nor must any other form of this equation be introduced.

[¶15] For the astronomical equation, by which the time of civil or natural days — that is, apparent time — is converted into mean for the examination of observations, arises and is established among astronomers from a double, and certain, necessary cause. The first is that which arises from the obliquity of the ecliptic, and is the difference between the true place of the Sun in the ecliptic and the Right Ascension corresponding to it, converted into time. The second is the difference between the true and mean motion of the Sun, which on the circular hypothesis arises from eccentricity alone, but on the elliptical hypothesis arises partly from the apparent [motion], and from the optical acceleration of the Sun on account of the eccentricity of the center of the ellipse from the center of the Earth, partly from the real [motion], and from the physical acceleration of the Sun around the center of the ellipse, because the other focus, or umbilicus, of the

ellipse is the point about which the Sun moves with mean, or equal, motion. Since, then, from these causes this effect necessarily follows — and sometimes, though rarely, the apparent time is equalized with the mean, or equal; sometimes, and more often, it is greater or less than equal time — the said equation is necessary.

[¶16] Moreover, by using the astronomical equation of time, not fewer, but indeed more eclipse-observations are represented by the astronomical tables than if the said equation were passed over, or some other form, not demonstrated, were used — as is clear from the table, number 5, 11, and 12. For in the Philolaic, Rudolphine, and Tychonic computation we have used such an equation, reformed first by a table of the first cause of equations according to the truer obliquity of the ecliptic; but as for the second cause, we have followed Bullialdus [Bullialdus, Ismaël Boulliau], who of all has discussed this equation most excellently and scientifically, in book 2 of his *Astronomia Philolaica*, chapters 5, 6, and 7.

[Margin: *Bullialdi laus.* — "Praise of Bullialdus."]

[¶] First, then, we say that the opinion of those abolishing from the middle [reckoning] entirely the whole equation of natural days is false — of which kind were Krismannus [Crüger?/Krismann], Vitichius [Witich], and Wendelen — against whom see what we have said in book 3 of the *Almagestum Novum*, chapter 32; even though Wendelen introduced certain prosthaphaereses in the oscillatory Moon [Luna oscillatoria].

[Margin: *Error Krismanni, Vitichii, & Vuendelini.* — "The error of Krismannus, Vitichius, and Wendelen."]

[¶] Second, we do not approve the equation of Tycho and of Longomontanus with Bullialdus, as being diminished; for although the greater part of the astronomical equation arises from the first of the said causes — namely from the difference of the Right Ascen-

of ascension and the true places of the Sun in the ecliptic, and it retains only Tycho [Tycho Brahe] and Longomontanus, because it seemed to satisfy many eclipses; for that reason Kepler called it the *Empirical* form. But the other cause ought not to have been passed over, since it cannot be sufficiently demonstrated from eclipses, and since — as Longomontanus himself admits in his *Commentary on the true place of the Sun* — it is almost without reason, abandoned; therefore this omission has displeased astronomers, as Kepler reports in the foundation of his Ephemerides, number 30.

[Margin: The shortcomings of Tycho and Longomontanus.]

Third. As for the new form that Kepler calls *Physical*, we judge it least necessary; nor does Kepler himself introduce it in the Rudolphine Tables as though he reckoned it necessary, but he sets it out only as an experiment, so that astronomers may examine which of these three forms more fully satisfies the observations of the better-attested eclipses; and whether the *Astronomical* form is demonstrated truly from the two aforementioned causes, or the *Empirical* form of Tycho [is derived] from the prior cause alone, or the *Physical* form arises from the aforesaid causes — and over and above this, from the supernumerary times of the days, 5, and of the hours, 6, by which the Solar Year exceeds 360, that is, the number of degrees of the Equator. For this has no fictitious foundation other than a kind of ideal fantasy in Kepler's mind.

[Margin: A figment of Kepler's.]

Fourth. Together with Bullialdus [Ismaël Boulliau] (*Astronomia Philolaica* II, ch. 7), we reject the form of the equation of time devised by Io. Baptista Morinus [Jean-Baptiste Morin], founded on the difference of the mean place of the Sun alone, or rather on the difference of the right ascensions of the true and mean places of the Sun — although he had nonetheless admitted two causes of the equation of days, namely the obliquity of the ecliptic and the eccentricity of the Sun: against which Bullialdus says much in the same place.

Fifth, finally, we least of all approve the boldness of Lansbergen [Lansbergen], who, as often as he saw his Tables disagree notably with the eclipse observations, introduced an equation of time as large as was necessary to make the Tables agree with the observations — without any reasoning *a priori*, indeed without sufficient experiment *a posteriori*; for it is not enough that one eclipse, or a second, be found to fit such an equation, and (as he used to say) on another occasion...

Kepler, *with much affirmation, [calls it] a great foundation.* And yet Lansbergius, at precept 8, says: *We however observe that, when one or the other Luminary is failing at the beginning of Aries, scruples must be added to the mean time, [namely] half an hour, 30 scruples.* But in his *Thesaurus of Lunar Observations*, from which he draws the eclipses of the Moon, he adduces only a single eclipse of the Moon, namely number 23, which is the one we have, observed by Cornelius Gemma [Cornelius Gemma] at Louvain, whose beginning he observed at hour 15.40'. Yet Lansbergius's Tables exhibit that beginning at Louvain at hour 15.6'. Therefore he there subjoins, Lansbergius: *On account of the equation of time, scruples must be*

added to the apparent time in the Moon, [namely] half an hour, 30 scruples; therefore the Moon at Louvain began to be eclipsed at 15.36' from noon, just as Cornelius Gemma most nearly observed. But why did he not add 36'? — for the agreement would have been more exact; since this equation depended on his own mere choice. In truth, however, one ought to have acknowledged candidly and sincerely that the fault arose partly in the observation, partly in the Tables. Certainly the Rudolphine and Tychonic Tables, without Lansbergius's equation, represent the mean [time] of that eclipse to within 5 minutes of time, from which an argument can be drawn from the beginning.

Yet again Lansbergius, in Class 2, observed the solar eclipse of [no.] 18, celebrated in the 6th degree of Aries; he adds 30 scruples so that the observation may agree with his Tables; and nonetheless in the lunar eclipse of [no.] 37, which is our 69 — although the Moon was set in the 4th degree of Aries — he adds nothing, because his Table had no need of this aid.

IX. Conclusion. But neither does the change of eccentricity, on which the prosthaphaereses of the first lunar inequality depend, suffice to reconcile the Astronomical Tables with the eclipse observations.

For the difference between the Tables and the observations is often much greater than the difference between the lunar prosthaphaereses derived from differing eccentricity hypotheses. For indeed the maximum equation of the first inequality is, in any case whatever, ultimately greater or smaller by very few minutes — by 5 degrees.

CAPVT VIII.

In which the Foundations of the New Tables, and the selected Observations of Eclipses from Albategnius [al-Battānī] down to the Year of the Lord 1660, computed from the Author's New Tables, [are set out].

The mark d indicates a deficiency [defect], and e an excess of the computed place.

[The following is the first portion of a long eclipse table, continued on page 132. Columns: **Ordo Eclipsium** (order-number of the eclipse) | **Tempus Apparens Bononiae p. Merid.** — apparent time at the meridian of Bologna (Year of Christ, Month, Day, Hour, ', ") | **Tempus Aequatum** — equated time (Hour, ', ") | **Solis locus Verus** — true place of the Sun (Sign, Degree, ', ") | **Lunae locus computat.** — computed place of the Moon (Sign, Degree, ', ") | **Differentia comput.** —

computed difference, with d/e marker (', ') | **Tempus differ.** — difference of time (', '). Zodiac signs are given by their symbols, here named.]

Ordo An.Ch. Mens. D. H. ' ' " Aeq. H. ' ' " Sol Sig. Gr. ' ' "
Luna Sig. Gr. ' " Diff. ' ' " T.diff. ' ' "
--- 22
883 Iulij 23 5 5 0 5 11 36 Leo 3 56 45 Aqr 3 50 7 d
6 38 13 16 23 901 Augusti 2 13 20 0 13 25 40 Leo 14
31 6 Aqr 14 51 57 e 20 51 41 42 24 1457 Septemb. 3 10
47 0 10 46 15 Vir 19 48 6 Psc 19 48 55 e 0 49 1 38
26 1460 Decemb. 27 13 0 0 13 6 16 Cap 15 48 31 Cnc 16
11 38 e 23 7 46 15 27 1461 Iunij 22 12 59 0 13 2 0
Cnc 9 44 57 Cap 11 25 40 <i>Omnes Tabulae similiter dissident.</i>
29 1462 Iunij 11 14 30 0 14 29 55 Gem 29 6 43 Sgr 29
1 17 d 5 26 10 50 32 1487 Febru. 7 15 49 40 16 1 32
Aqr 28 13 41 Leo 28 35 46 e 22 5 44 10 33 1500 Nouéb.
5 13 53 0 13 40 50 Sgr 23 13 2 Tau 23 20 21 e 7 19
14 35 35 1509 Iunij 2 10 2 0 10 59 46 Gem 21 3 31 Sgr
21 0 13 d 3 18 6 30 36 1511 Octob. 6 12 0 0 11 49
30 Lib 22 19 56 Ari 22 34 26 e 14 30 29 0 37 1522
Septéb. 5 12 44 0 12 42 35 Vir 22 5 53 Psc 22 10 24 e 4
31 9 0 38 1460 Martij 11 17 0 20 17 3 44 Ari 1 31 59
Lib 1 44 19 e 12 20 24 30 40 1573 Decéb. 8 7 57 24 7
55 7 Sgr 26 48 12 Gem 26 55 12 e 7 0 13 50 41 1576
Octob. 7 11 22 30 11 12 37 Lib 24 32 33 Ari 24 28 45 d
3 48 7 30 42 1577 April. 2 8 44 24 8 41 40 Ari 22 43
20 Lib 22 53 2 e 9 42 19 20

[Continuation of the eclipse table from page 131. Same column structure.]

	Ordo		An.Ch.		Mens.		D.		H.		'		"		Aeq. H.		'		"		Sol Sig.		Gr.		'		"		
Luna	Sig.		Gr.		'		"		Diff.		'		"		T.diff.		'		"										
	---		---		---		---		---		---		---		---		---		---		---		---		---		---		43
	1577		Septéb.		26		12		57		24		12		49		12		Lib		13		26		41		Ari		13
17		56		d		8		8		16		15			44		1578		Septéb.		15		13		15		0		13
	Lib		2		21		19		Ari		2		15		13		d		6		6		12		10			45	
	1580		Ianuarij		31		10		3		24		10		15		51		Aqr		21		21		27		Leo		21
	29		0		e		7		34		15		10			46		1581		Ianuarij		19		9		54		0	
	10		3		0		Aqr		9		57		53		Leo		10		3		3		e		5		11		10
	22			47		1581		Iulij		15		16		53		0		17		0		17		Leo		2		46	
	41		Aqr		2		45		17		d		1		24		2		40			48		1584					

Nouéb. | 17 | 13 | 3 | 0 | 13 | 10 | 13 | Sco | 25 | 50 | 31 | Tau | 25 | 56 | 52 | e |
 6 | 21 | 12 | 40 | | 49 | 1587 | Septéb. | 16 | 9 | 18 | 0 | 9 | 16 | 45 | Vir | 23 | 11
 | 21 | Psc | 23 | 10 | 31 | d | 0 | 50 | 1 | 35 | | 50 | 1588 | Martij | 12 | 14 | 55 |
 0 | 15 | 1 | 15 | Psc | 22 | 44 | 3 | Vir | 22 | 52 | 14 | e | 8 | 11 | 16 | 20 | | 53 |
 1591 | Ianuarij | 9 | 6 | 52 | 0 | 6 | 59 | 13 | Cap | 19 | 4 | 19 | Cnc | 19 | 12 | 8 |
 e | 7 | 50 | 15 | 35 | | 54 | 1592 | Decéb. | 18 | 7 | 28 | 0 | 7 | 21 | 56 | Sgr | 27 |
 9 | 28 | Gem | 27 | 9 | 44 | e | 0 | 16 | 0 | 30 | | 55 | 1594 | Octob. | 28 | 19 | 15
 | 0 | 19 | 2 | 24 | Aqr [Scorpio?] | 5 | 30 | 13 | Tau | 5 | 26 | 43 | d | 3 | 30 | 7 |
 0 | | 56 | 1595 | April. | 23 | 16 | 15 | 0 | 16 | 10 | 0 | Tau | 3 | 24 | 6 | Sco | 3 |
 20 | 17 | d | 3 | 49 | 7 | 35 | | 57 | 1596 | April. | 12 | 9 | 21 | 30 | 9 | 18 | 30 |
 Ari | 23 | 8 | 21 | Lib | 23 | 18 | 9 | e | 9 | 48 | 19 | 30 | | 58 | 1598 | Febr. | 20 |
 17 | 55 | 0 | 18 | 6 | 20 | Psc | 2 | 25 | 5 | Vir | 2 | 31 | 0 | e | 5 | 55 | 11 | 40 | |
 59 | 1598 | Augusti | 16 | 7 | 32 | 0 | 7 | 38 | 20 | Leo | 23 | 23 | 10 | Aqr | 23 |
 34 | 1 | e | 0 | 51 | 1 | 40 | | 60 | 1599 | Febr. | 9 | 17 | 48 | 0 | 18 | 0 | 24 | Aqr
 | 21 | 14 | 0 | Leo | 21 | 12 | 53 | e | 8 | 53 | 17 | 40 | | 63 | 1601 | Decéb. | 9 | 6
 | 38 | 0 | 6 | 32 | 40 | Sgr | 17 | 47 | 52 | Gem | 17 | 44 | 0 | d | 3 | 52 | 7 | 40 |
 | 66 | 1603 | Maij | 24 | 12 | 18 | 0 | 12 | 12 | 0 | Gem | 3 | 11 | 37 | Sgr | 3 | 8 |
 51 | d | 2 | 46 | 5 | 30 | | 67 | 1603 | Nouéb. | 18 | 7 | 5 | 0 | 6 | 53 | 0 | Aqr
 [Scorpio?] | 25 | 58 | 10 | Tau | 25 | 53 | 12 | d | 4 | 58 | 9 | 55 | | 68 | 1605 |
 April. | 3 | 8 | 57 | 0 | 8 | 56 | 36 | Ari | 14 | 7 | 19 | Lib | 14 | 12 | 41 | e | 5 |
 22 | 10 | 42 | | 69 | 1605 | Septéb. | 26 | 16 | 48 | 0 | 16 | 42 | 36 | Lib | 3 | 56 |
 15 | Ari | 3 | 57 | 5 | e | 0 | 50 | 1 | 40 | | 70 | 1607 | Septéb. | 5 | 15 | 14 | 0 |
 15 | 15 | 15 | Vir | 12 | 51 | 35 | Psc | 12 | 46 | 48 | d | 4 | 51 | 9 | 40 | | 71 |
 1609 | Ianuar. | 19 | 15 | 8 | 0 | 15 | 18 | 25 | Aqr | 0 | 13 | 51 | Leo | 0 | 22 | 34
 | e | 8 | 43 | 17 | 20 | | 72 | 1609 | Iulij | 16 | 12 | 4 | 24 | 12 | 10 | 38 | Cnc | 24
 | 13 | 38 | Cap | 24 | 15 | 18 | e | 1 | 40 | 3 | 20 | | 74 | 1610 | Decéb. | 29 | 16 |
 10 | 0 | 16 | 13 | 20 | Cap | 8 | 22 | 25 | Cnc | 8 | 22 | 46 | e | 0 | 11 | 0 | 20 | |
 75 | 1612 | Maij | 14 | 10 | 25 | 0 | 10 | 18 | 15 | Tau | 24 | 18 | 45 | Sco | 24 |
 16 | 34 | d | 2 | 11 | 4 | 20 | | 76 | 1612 | Nouéb. | 8 | 3 | 22 | 30 | 3 | 9 | 30 |
 Sco | 16 | 32 | 3 | Tau | 16 | 34 | 22 | e | 2 | 19 | 4 | 35 | | 77 | 1613 | Octob. |
 28 | 3 | 57 | 24 | 3 | 44 | 44 | Sco | 5 | 15 | 34 | Tau | 5 | 6 | 57 | d | 8 | 37 | 17 |
 15 | | 80 | 1616 | Augusti | 26 | 15 | 16 | 0 | 15 | 20 | 0 | Vir | 3 | 57 | 43 | Psc |
 3 | 44 | 59 | d | 12 | 42 | 28 | 20 | | 81 | 1617 | Augusti | 16 | 7 | 57 | 0 | 8 | 3 |
 10 | Leo | 23 | 47 | 34 | Aqr | 23 | 42 | 10 | d | 5 | 24 | 10 | 40 | | 82 | 1619 |
 Aug. | 26 | 12 | 26 | 0 | 12 | 31 | 52 | Cnc | 4 | 47 | 35 | Cap [Sgr?] | 4 | 42 | 35 |
 d | 5 | 0 | 10 | 0 | | 83 | 1619 | Decéb. | 20 | 15 | 25 | 30 | 15 | 24 | 17 | Sgr | 28
 | 58 | 20 | Gem | 28 | 56 | 50 | d | 1 | 30 | 3 | 0 | | 84 | 1620 | Iunij | 14 | 13 |
 34 | 30 | 13 | 33 | 17 | Gem | 24 | 9 | 1 | Sgr | 24 | 4 | 37 | d | 4 | 24 | 8 | 45 | |
 85 | 1620 | Dec. | 9 | 6 | 5 | 0 | 5 | 59 | 40 | Sgr | 18 | 8 | 10 | Gem | 18 | 3 | 17 |

d | 4 | 53 | 9 | 40 | | 86 | 1621 | Nou. | 28 | 15 | 22 | 0 | 15 | 12 | 45 | Sgr | 7 |
15 | 34 | Gem | 7 | 15 | 0 | d | 0 | 34 | 1 | 5 | | 87 | 1623 | April. | 14 | 16 | 42 |
0 | 16 | 38 | 30 | Ari | 24 | 52 | 14 | Lib | 24 | 46 | 0 | d | 6 | 14 | 12 | 25 | | 88 |
1624 | Sept. | 26 | 8 | 38 | 30 | 8 | 33 | 6 | Lib | 3 | 59 | 44 | Ari | 3 | 56 | 27 | d
| 3 | 17 | 6 | 30 | | 89 | 1625 | Martij | 23 | 13 | 56 | 10 | 13 | 48 | 47 | Ari | 3 |
37 | 35 | Lib | 3 | 41 | 25 | e | 3 | 50 | 7 | 31 | | 92 | 1628 | Ianu. | 20 | 10 | 0 | 0
| 10 | 9 | 20 | Aqr | 0 | 24 | 25 | Leo | 0 | 37 | 25 | e | 13 | 0 | 26 | 0 | | 93 |
1630 | Nou. | 19 | 11 | 22 | 0 | 11 | 9 | 0 | Aqr [Scorpio?] | 27 | 36 | 53 | Tau | 27
| 35 | 53 | d | 1 | 0 | 2 | 0 | | 95 | 1631 | Nou. | 8 | 11 | 54 | 45 | 11 | 42 | 15 |
Aqr [Scorpio?] | 16 | 16 | 45 | Tau | 16 | 16 | 34 | d | 0 | 11 | 0 | 20 | | 96 | 1632
| Octob. | 27 | 11 | 50 | 30 | 11 | 36 | 0 | Sco | 4 | 58 | 41 | Tau | 4 | 46 | 33 | e |
12 | 8 | 24 | 15 | | 97 | 1634 | Martij | 14 | 9 | 42 | 0 | 9 | 47 | 56 | Psc | 24 | 21
| 27 | Vir | 24 | 16 | 46 | d | 4 | 40 | 9 | 20 | | 98 | 1635 | Martij | 3 | 9 | 10 | 0 |
9 | 19 | 0 | Psc | 13 | 6 | 53 | Vir | 13 | 13 | 9 | e | 6 | 16 | 12 | 32 | | 99 | 1635 |
Aug. | 27 | 15 | 36 | 30 | 15 | 40 | 30 | Vir | 4 | 21 | 59 | Psc | 4 | 10 | 48 | d | 11
| 8 | 22 | 20 | | 100 | 1636 | Febr. | 20 | 11 | 4 | 30 | 11 | 15 | 51 | Psc | 1 | 54 |
39 | Vir | 1 | 59 | 40 | e | 5 | 1 | 10 | 0 | | 102 | 1638 | Decéb. | 20 | 14 | 46 | 0 |
14 | 45 | 17 | Sgr | 29 | 20 | 18 | Gem | 29 | 14 | 13 | d | 6 | 5 | 12 | 8 | | 103 |
1641 | Octob. | 18 | 7 | 51 | 30 | 7 | 50 | 30 | Lib | 25 | 38 | 29 | Ari | 25 | 36 | 36
| d | 1 | 53 | 3 | 40 | | 104 | 1642 | April. | 14 | 14 | 40 | 30 | 14 | 36 | 40 | Ari |
25 | 10 | 45 | Lib | 25 | 18 | 35 | e | 7 | 50 | 15 | 35 | | 105 | 1642 | Octob. | 7 |
16 | 48 | 30 | 16 | 39 | 40 | Lib | 14 | 50 | 37 | Ari | 14 | 51 | 17 | e | 0 | 40 | 1 |
20 | | 106 | 1643 | Sept. | 27 | 7 | 30 | 52 | 7 | 25 | 28 | Lib | 4 | 20 | 27 | Ari | 4
| 19 | 18 | d | 1 | 9 | 2 | 15 | | 107 | 1645 | Febr. | 10 | 7 | 46 | 15 | 7 | 58 | 30 |
Aqr | 22 | 30 | 3 | Leo | 22 | 44 | 24 | e | 14 | 21 | 28 | 42 | | 108 | 1646 | Ian. |
30 | 18 | 41 | 0 | 18 | 53 | 40 | Aqr | 11 | 34 | 45 | Leo | 11 | 50 | 57 | e | 16 | 12
| 32 | 10 | | 110 | 1647 | Ian. | 20 | 9 | 54 | 30 | 10 | 5 | 51 | Aqr | 0 | 47 | 49 |
Leo | 0 | 54 | 16 | e | 6 | 27 | 12 | 50 | | 117 | 1654 | Aug. | 27 | 11 | 31 | 0 | 11 |
33 | 23 | Vir | 4 | 34 | 58 | Psc | 4 | 30 | 27 | d | 4 | 31 | 9 | 0 | | 118 | 1657 |
Iunij | 25 | 9 | 19 | 0 | 9 | 20 | 24 | Cnc | 4 | 30 | 36 | Cap | 4 | 25 | 39 | d | 4 |
57 | 9 | 50 | | 119 | 1657 | Decéb. | 20 | 7 | 44 | 0 | 7 | 43 | 17 | Sgr | 29 | 25 |
36 | Gem | 29 | 25 | 29 | d | 0 | 7 | 0 | 15 |

Note on row 27 ("Omnes Tabulae similiter dissident" — "All the Tables disagree alike"): the source replaces the Differentia / Tempus differ. cells with this remark, printed across the right-hand columns. Transcribed verbatim.

1. In the preceding Catalogue, drawn from the History of chapter 2 and from the Epitome of chapter 3 — when the same eclipse was observed by several observers — I chose the time midway between the extremes, accommodated to

the meridian of Bologna in keeping with our *Geographia Reformata*; except for one eclipse, or another, the time of whose single observer I chose on account of its evident diligence, observed by us in one case and by Gassendi [Pierre Gassendi] in the other. The Apparent Time I converted into Equated [Time] by the astronomical cause, namely the eccentricity of the Sun and the obliquity of the ecliptic, [the obliquity being] 23° 30' 20".

[Margin: Explanation of the preceding Catalogue.]

2. The place of the Sun I computed from Our Tables (Book I) to the moment of the equated time of the eclipsed full moon. Now it is established, from what we have said in Book I, that the place of the Sun is more exactly represented by our Tables than by the Tychonic Tables, and by those resting upon the Rudolphine, or upon the Philolaic [Tables]: both because of the manifest error of Tycho in the parallax of the Sun, [which is] too great, and likewise of the obliquity of the ecliptic, [also too great]; and because of the far more certain and more refined observations of the Sun made with the great Gnomon which we have in the Temple of San Petronio at Bologna. Accordingly, if the Tychonic, Rudolphine, or Philolaic Tables represent some eclipses within the bounds of a shorter time, it is reasonable to suspect some fallacy on account of the place of the Sun being less accurately exhibited by them; and therefore the Moon is seen to be nearer the opposite place of the Sun when in reality it was farther off.

3. The mean motions and the Anomaly of the Moon I investigated rather *a posteriori* and empirically than *a priori*, and through geometrical demonstrations; and I chose those which, out of several and more certain eclipses, were derived, and which, with the calculation repeated in turn many times over, likewise satisfied several such observations. For this same cause I chose the Radices of the mean motion of the Moon and of the Anomaly written below, fixed to the meridian of Bologna and to the meridian of the last of December.

Epoch of the Year of Christ 1600, completed in the Gregorian style.

	Sig.	Gr.	'	"
Mean motion of the Moon from Aries (♈)	7	25	19	20
Motion of the simple Anomaly (☉)	0	7	27	9

For meanwhile the simple motion of the Moon is for me, [reckoned] from the equinox, an Annual [motion] of 129° 23' 2" and about 30''' — as I shall afterwards show from another source. The Annual motion of the Anomaly is likewise 88° 43'

7" 34" 21"" — very nearly what Bullialdus establishes, who (in Book III of his *Astronomia [Philolaica]*) was most diligent and most successful in this investigation of the Anomaly, and came nearest to the truth of the mean motion of the Moon in these our times.

4. The prosthaphaeresis of the first lunar inequality, which they much more often call *Epicyclic*, I have acknowledged to be far better — [the one] which is derived from the circular Hypothesis, and very nearly the Tychonic, than that [which is derived] from the Elliptical form of Kepler, or of Bullialdus; though this latter is not rarely very close to the celestial phenomena.

5. Resting upon these foundations, after innumerable labors of computation [carried out] through myself and through my assistants — much exercised in this practice — I constructed New *Luni-Solar Tables*, which we give to astronomers separately. Now these [tables] we represent from the eclipses set forth in the preceding catalogue [to within] 35, within 10' of time; within 12 of time [for] eclipse 44; but within 5' of time [for] eclipse 19. From Albategnius [al-Battānī] down to here — that is, lest the Tychonic Tables indeed, or the Rudolphine, or the Philolaic [be thought superior] — they have surpassed [those] of the more celebrated [eclipses], if indeed from what has been said in chapter VII, number 12, and from the Catalogue of this chapter, the comparison stands as below.

Within minutes of time the Eclipses are represented	10'	5'	12
Tab. Tychonica	28	15	
Tab. Rudolphinis	27	14	
Tab. Philolaica	27	10	
Tab. Nostra	35	19	44

[The table tabulates, for each set of Tables, how many of the catalogued eclipses each represents to within 10' of time, within 5', and (the rightmost figure) within 12 [of time]. The Tychonica/Rudolphinis/Philolaica rows have no entry in the "12" column; only "Nostra" (Our Tables) shows 44 there.]

6. Let Our Tables therefore deserve indulgence, in the eyes of fair estimators of these difficulties, ahead of the others, if at some point they do not exhibit the eclipses as near to the observations [as one might wish]; nor let part of the fault be undeservedly cast upon the observations themselves, upon their configurations, or perhaps upon a meridian-distance still less than certain.

7. For — that we may indicate a few things about some [of them] — eclipse 22 was observed at a place much nearer to us than [eclipse] 23, observed at Antioch.

Perhaps, therefore, that Antioch is not the Syrian one, but a more easterly one, and more eastern than we supposed; nor was the observer so diligent in it, whether in measuring the time, or in distinguishing the legitimate beginning of the eclipse from the penumbra [*Umbragine*] and from the smoke [*fumo*]. For in this case, and in all the others — especially before the use of the telescope and the skill acquired in this present age — from these two causes a suspicion of fallacy arises: namely, the deception of ocular estimation of the moment at which the eclipse begins, [or] is at its greatest, or ends; and [the deception] of the instruments by which the time is measured, whether these be Clocks, or Organa [instruments] suited to taking the altitudes of the stars, or the places of the stars themselves not certainly enough known in the sky — concerning which I have said more in chapter 4.

8. Eclipses 26, 27, 32, 80: the other Tables represent these no better, and some represent them rather worse. Which is a sign that the fault lies either in the Observation, or in the meridian; and in the others too, or in the Tychonic [observations], [the fault] of others — being least of all constrained by us to the narrows of time — and those [eclipses] which fall within a quadrant, or even nearly within a half-hour, it suffices to represent; see what has been said in the preceding chapter, numbers 8 and 9.

Concerning the ancient eclipses, moreover, it must be discussed separately.

CAPVT IX.

Concerning the Ancient Eclipses of the Moon exhibited through the Author's New Tables.

1. Already in chapter 5 we concluded that the 19 eclipses of the Moon related by Ptolemy [Ptolemy] are to be represented for those days of the Julian Year which suppose the Beginning of Nabonassar to have fallen at the Meridian of the 26th day of February of the Year 747 before the Epoch of Christ. And in chapter 7, number 8, we indicated that the latitude of time is to be inquired into, within which the observations of those Ancients seem to be consistent. Now, however, it must be inquired into somewhat more carefully concerning this latitude, lest anyone impose upon our Tables, or upon those of other Astronomers, a greater necessity than is just for representing the moments of those Eclipses. For although we do not deny that there is a disagreement between those Observations and the Tables, it can in part arise from the faults of the Tables themselves of the Lunar [or] Solar [motions], or of either at once; and in part

from a meridian-distance not altogether exactly noted; yet for the greater part we judge it [arises] from the Observation itself — less accurately [made] and recorded in the monuments — or [from the fact that it was made] less accurately, both on account of the unascertained discrimination of the smoke at the legitimate beginning of the eclipse, and at its end, which of itself entails an error of sometimes 20' and more of minutes; both on account of the crude manner of marking the time by Clepsydras [water-clocks], or by stars whose places in the Sky were not perceived certainly enough. Hence it is now held as established by the more recent Astronomers, with sufficient probability, that those eclipses are represented within about a half-hour; but some, if I am not mistaken, admit a larger [latitude] of time too. For let the order of eclipses from chapter 2 be repeated here, and from the places of Ptolemy in the same chapter, and let the several eclipses, briefly adduced, be weighed.

2. The *first* of the said eclipses began at hour 1 after the rising of the Moon, and was total, and — from the beginning alone, however much on account of the nearness of the horizontal vapors observed by Ptolemy, who supposed total eclipses to last 4 hours (which is not universally true) — he reckoned the middle of the eclipse. The *second* eclipse observed [— whether it be reckoned] from the beginning, or from the end, or rather...

in the highest part, when three digits appeared obscured at the middle of the night, the matter is uncertain. The **third** eclipse Ptolemy reports only as to its beginning, which fell a little after the rising of the Moon; and however its setting may have determined the duration of the eclipse [?], he determined the middle of seven digits — though here, given the nearness of the horizon, the obscurity of the observation could allow even the perplexity itself to appear; and likewise it is known to those skilled in such observations. Such too is the judgment to be made of the **fourth**, whose bare beginning is recorded after three digits remained at the end of the night. The **fifth** observation, taken at the very middle of the night, when the greatest defect was seen to be of six digits, appears to have admitted a smaller error — if it were established that it was estimated from that same moment, and not rather at the end, or estimated from the beginning; and likewise it must be said of the **sixth**, of three digits, observed a little before the middle of the night, and of the **seventh**, of about two and a half digits, observed near the middle of the night.

For as to the matter:

The **eighth**, whose beginning alone Ptolemy reports as observed, he places half an hour before sunrise, adding that the Moon set defective. Since at the summer

solstice a very small part of the orb [was] still free from eclipse at the Moon's setting and at its westering, Petavius [Denis Pétau] is anxious — both on grounds of the doctrine of times and by his own calculations — affirming that the time of the observation is exceeded by the Alphonsine Tables [Tabulae Alphonsinae] by 1^h 56', by the Prutenic [Tables] by 49', by the Danish [Tables] by 42', by the Parisian [Tables] by 33'. [?] Ptolemy supposed the eclipse to have lasted 1^h 30'. The smallness of the eclipse and of its duration does not admit so great an exactness in time as do other eclipses. Our own calculation does not represent this one to within that exactness. The **ninth** likewise admits only as much error as those [others], since one phase alone was observed; for its duration of three hours was recorded from beginning to end the rest, on the testimony of Ptolemy (lib. 4, cap. 11). Hipparchus reckoned from the eighth eclipse to the ninth 177 days and hours equal to 13 [hours] 45'. Ptolemy in the same place reckons 177 days, 13^h 36'. Our Tables therefore represent this eclipse as later than Ptolemy's by 11' 15", but as later than Hipparchus by only 1' 10".

[Marginal sidenote in body, paragraph 4:] The **tenth** eclipse is reported to have begun at the rising of the summer [Sun] [ab ortu aestivo], and from this beginning — assuming the totality of the eclipse — the duration of the hours [is computed as] 4. Ptolemy (lib. 4, cap. 11) sets the middle at Babylon at the 11th hour after midday; the eclipse [is] computed [as beginning] at the 9th [hour]; to this point 177 days; and 2^h. He admits, however, that Hipparchus reckoned the hour to be only 1^h 40', beyond the 177 days. But Boulliau [Ismaël Boulliau] (lib. 3, cap. 6), from the manuscripts of the Royal Library, shows that the hour should be read as 10^h 25'.

The beginning of the **eleventh** eclipse is supposed to be unobservable, since it is said to have begun to fall short half an hour before its own beginning [?]; but because it was full at the middle of the third hour of the night, Ptolemy reckoned the middle at 7^h after midday.

The **twelfth** eclipse Ptolemy reports (lib. 4, cap. 11) only as to its beginning, and from the duration through the whole eclipse over 4 hours he fixes the middle at 13^h 20' after midday; and from the preceding one to this [he counts] 178 days, and 6^h 50'. But he admits that Hipparchus reckoned only 178 days and 6 hours; and therefore Hipparchus was 50' earlier than Ptolemy. We therefore have followed Hipparchus, since otherwise our Tables would exhibit it as too late; and we represent it most accurately in accordance with Hipparchus's observation. As for the **thirteenth** eclipse, it seems we must stand rather with Ptolemy, who (lib. 4, cap. 11) from Hipparchus places it as observed, with its beginning fallen at the

6th hour [transacta noctis hora 6] of the night having elapsed, and 40'; and then other phases, since the whole Moon failed. Hipparchus defines the middle at 2^h 10' after midnight. Ptolemy reckons from this [eclipse] to this one 176 days, 0^h 24'. But Hipparchus, in his work, [counts] 176 days, 1^h 20'; yet to the preceding one you would add 50', which Hipparchus subtracted. If these 176 days, 0^h 30', were the interval of this 176 days, the hour 0^h 30' would be a little greater than Ptolemy's. Nevertheless we exhibit this one 8' earlier than the Ptolemaic time demands.

[Paragraph 6:] The **fourteenth** eclipse — its beginning is set at 2^h 10' after the equinoctial [crossing] [post dinoctium], and its end at 5^h 10', with 7 digits; and the **fifteenth** is reported to have begun to be observed at 2^h ½ after the rising of the Moon, and then the middle indicates that 2 digits failed.

[Paragraph 7:] Among the four eclipses which are in our order 16, 17, 18, and 19, the first is the **sixteenth**, which is not referred by Ptolemy [to himself], but [is reported] as observed by him; nor did he add anything (lib. 4, cap. 6) about the observations made [by himself]. [Yet] Lansbergen [Philips van Lansbergen] too most accurately [reports it]; and in the *Thesaurus* he maintains that this eclipse at Alexandria fell at the hour 8^h 51' after midday, though by 8^h 24' as Ptolemy has it. We likewise [place it] 22' later than Ptolemy, exhibiting it [thus]. We exhibit the **seventeenth** and the **eighteenth**, which Ptolemy (lib. 4, cap. 6) affirms to have been observed by himself most accurately, no later than 6' or 7' [from the truth] [?]. But the **nineteenth** we exhibit after midnight as observed by him [ad se], with all the minutes given, except for the Lansbergian Tables, which differ from the others in the motion of the Sun; the rest of the Tables [agree], at about one hour, exhibiting this eclipse earlier.

[Paragraph 8:] At first sight the Lansbergian Tables may seem preferable to the rest as regards the ancient eclipses, as can be seen in the catalog of chapter 5. But since Lansbergen dissembled eclipses 8, 9, 10, 11, 12, & 13, and in the rest of the more recent ages they are far inferior to the Tychonic [Tables], if a truer distance of the meridian [were] adopted — as is plain from what has been said in chapter 7, number 5 — therefore we judge they ought absolutely to be preferred to the Tychonic, Rudolphine, Danish, or Philolaic [Tables]. So that the comparison may be made between [them], we have set down in the following little table [latercula] the number of eclipses which the Tables written below represent within the hour's minutes 5, or 10, or 15, or 20.

Tabulae	5	10	15	20
Danica	2	3	6	6

Tabulae	5	10	15	20
Parisina	1	3	5	7
Philolaica	3	4	7	8
Rudolphina	2	3	5	7
Nostra	3	8	8	9

[Paragraph 9:] There now follows the **Catalog of the Ancient Eclipses**, with the place, the Sun's position, and the Moon's; together with [the time] due from the moment of the eclipse observed, [the time] computed from our more recent Tables, with the difference of the Moon's computed place added, and the time corresponding to this difference.

Column structure: **Ordo Ecl.** (order of the eclipse) | **Tempus Bononiense Apparens ex cap. 3, post Meridiem** [Bolognese apparent time, from chapter 3, after midday] with sub-columns *An. ante Chr.* (year before Christ) / *M.* (month) / *D.* (day) / *H.* (hour) / *I* (minutes) | **Tempus Aequatum** [equated time]: *H.* / *I* / *II* | **Solis locus Verus, & inde Lunae** ☉ [true place of the Sun, and thence the Moon at opposition]: *Sig.* / *Gr.* / *I* / *II* | **Lunae locus computatus** [Moon's computed place]: *Sig.* / *Gr.* / *I* / *II* | **Differentia comput.** [computed difference, prefixed d=defect / e=excess]: *I* / *II* | **Tempus differ.** [time of the difference]: *I* / *II*.

Or do Ec l.	An. ante Chr.	M .	A				S				L				D				T. di ff.	T.d iff.
			e q .	A e q .	A e q .	S ol Si g.	S o l G r.	S o l I I	Lu na Si g.	u a G r.	L u a I	L u a II	Di ff. d/ e	i ff. I	Di ff. II					
2	720	M ar tij	3 3	9	4 2	5 0	✠	1 0	3 3	0	✠	1 0	4 9	4	e	1 6	4	32	2	
3	720	Se pt e m b.	3	5	5 8	5 0	✠	0	5 4	9	✠	0	4 2	4 0	d	1 1	2 9	22	55	
4	621	A p ri li s	2 3	1 5	2 1	1 5	☿	2 4	5 9	1 3	♌	2 4	4 7	5 5	d	1 1	1 8	22	35	
5	523	Iu lij	3 3	8	3 5	2 4	♊	1 6	2 8	5 5	♋	1 6	1 2	1 7	d	1 6	3 8	33	15	
6	502	N o u e m b.	9	8	5 8	4 5	♊	2 1	4 2	8	♋	2 1	3 1	5 6	d	1 0	1 2	20	24	
7	491	A p ri li s	3	8	5 7	2 0	☿	2 8	2 9	4 0	♌	2 9	5	5 8	e	3 7	1 8	65	0	
8	383	D ec e m b.	5 3	1 6	5 3	1 0	♊	2 6	4 4	1 3	♌	2 6	4 4	1 2	e	0	1 0	0	2	

Or do Ec l.	An. ante Chr.	M .																		
			A		A		S		S		L		L		L		D		T.	
			q	e	q	e	ol	l	ol	l	Lu	n	u	u	Di	i	Di	di	T.d	
			. H I	. I	. I	. II	Si g.	G r.	I I	I I	Si g.	G r.	I I	I I	d/ e	. I	ff. II	ff. I	ff. II	
9	382	Iu ni j	4 3	6	3 8	1 5	Π	2 0	3 1	4	✠	2 0	3 0	1 0	d	0	5 4	1	10	
10	382	D ec e m b.	5 8	7	5 5	4 5	✠	1 5	5 9	2 2	Π	1 6	1	1 5	e	2	5 3	5	45	
11	201	Se pt e m b.	2 7 ⅓	5	2 5	3 0	⌘	2 5	5 5	4	✠	2 5	5 8	4 8	d	3	4 4	7	2	
12	200	M ar tij	5 8 ⅓	1 1	4	1 0	✠	2 5	2 2	4 7	⌘	2 5	2 3	1 3	e	0	2 6	0	50	
13	200	Se pt e m b.	4 2 ⅓	1 2	4 3	2 0	⌘	1 5	0	5 5	✠	1 5	4	5 8	e	4	3	8	5	
14	174	A p ri l.	4 7 ⅓	1 2	4 0	2 0	⌘	6	2 4	1 6	⌘	6	1 0	2 8	d	1 3	4 9	27	35	
15	141	Ia n u ar ij	3 7 ⅓	8	5 0	3 0	⌘	4	2 7	4 1	⌘	4	4 9	2 0	e	2 1	3 9	43	10	

[Sub-header row dividing ancient B.C. eclipses from those A.D.:] **Christi** (years of Christ) | **Mens.** (month) | **D.** | **H.** | **I** | **II** | ☉ (Sun) | ... | ☾ (Moon) | ...

Or do Ec l.	An. Chr isti	M .	A				S				L				D				T. di ff.	T.d iff.
			e	A	A		S	S		u	L	L		i						
			q	e	e	S	o	S	o	Lu	n	u	u	Di	i					
			.	q	q	ol	l	o	l	na	a	n	n	ff.	ff	Di	di			
			H	.	.	Si	G	l	I	Si	G	a	a	d/	.	ff.	ff.			
			I	.	I	II	g.	r.	I	I	g.	r.	I	II	e	I	II	I	II	
16	125	A p ri l.	5 1 ⅓	6	5 0 0	4	ⅴ	1 4	1 7	6	♌	1 4	2 7	3 7	e	1 0	3 1	22	2	
17	133	M a ij	4 2 ⅓	9	3 4 0	2	ⅴ	1 4	2 5 4	5	♍	1 4	2 9	3	e	3	9	6	15	
18	134	O ct o b r.	2 7 ⅓	9	1 7 0	1	♌	2 6	1 1 7	2	ⅴ	2 6	1 5	5	e	3 8	3	7	16	
19	136	M a rt ij	2 7 ⅓	1 4	3 6 0	3	✕	1 4	3 7 4	3	♍	1 5	2 7	4 6	e	5 0	1 2	10 0	20	

[Head-piece: decorative band of foliate ornaments above the chapter heading.]

CAPVT X.

On the Motion of the Moon in Longitude as hitherto established by the more eminent Astronomers, and by what method above all it should be investigated: whatever has been erred in it, or may seem to be desired [*De Motu Lunae in Longitudinem hactenus ab Insignioribus Astronomis constituto, & qua potissimum methodo illum investigari: quidq; in ea peccatum esse, aut desiderari posse videatur*].

[Paragraph 1.] [Margin: Summa methodi.] Formerly, in Lib. 4 of the *New Almagest* [*Almagestum Novum*], from chapters 19 and 24, I set out a threefold artifice by

which astronomers investigate the lunar motions, and I showed that the attempt to recover them through the cycles of the Lunisolar [period], or through the commensuration of the lunar year with the solar — and hence through the recurrence at twin lunar eclipses, separated by the longest possible interval of years and falling at the same degree of anomaly, or [the same] distances from apogee, with each luminary set either in apogee or in perigee, with conditions otherwise the same and the like — is frustrated. Ptolemy requires this (lib. 4 of the *Magna Constructio*, cap. 2), and declares it; Boulliau demonstrates it (*Astron. Philol.* lib. 3). But of these matters, or at any rate of the principal ones: **First**, from a foreknowledge of the apparent place of the Sun in degree, and given the time, [that time] is to be converted into Equated time, reduced to the same meridian; and from this, the Sun's motion, both Mean and True, is to be gathered, along with its anomaly; for from the opposite [place], the Moon's place is at once known — the place in which it truly was at the moment of the observed eclipse. **Thirdly**, by the lunar prosthaphaeresis, using meanwhile some best hypothesis, the Mean place of the Moon must be found, by adding the equation to its place in the prior six signs of Anomaly, and subtracting it in the others. **Fourthly**, the interval [in time] of the Mean motions, or of the places of the Sun and Moon, must be made to agree by the Hourly Tables of the Moon; and to this, since they everywhere have a [share] of the Equated Full Moon observed, [must be added] the mean motion of the Sun beyond the Moon in syzygy [in Syzygia], which goes to the Mean Full Moon; if the mean motion of the Sun exceeds the Moon [?], it is in defect, and the moment of the Mean Full Moon of either [will] be had. **Fifthly**, it must be diligently calculated with each [quantity], the Mean Full Moon, not in years only, but also in days, hours, and minutes; having reckoned the number of days, with the years added in the form of the Julian Year. [And] for days subtracted in the form of the Gregorian Year — 1582 — and its computation should be reconciled, whether it be made for those observing in the Gregorian style.

Sixthly, the interval of time reduced to Days must be multiplied by the Lunations, 4267; & the sum is to be divided by the Days 126007 — for thus will come forth the integral number of Lunations, by which [an interval] more nearly equal is made [?]. **Seventhly**, by the Luration-number found, the same number of days must be divided between the two eclipses of the Moon; & there will come forth Days, Hours, and the scruples due to a single Mean Luration, or to the Mean Synodic Lunar Month. But let these precepts become clearer by the following example, given the collected [years] from the Synodic Month, and the rest of the motions.

[Paragraph 2.] By this method, which Ptolemy intimated rather obscurely (lib. 4, cap. 2 & 7), Hipparchus found, between two eclipses observed by the ancient Babylonians and recently by [others], the Days 126007 & the hour as one, to have completed 4267 Lunations, as I have said. [Margin: Hipparchi opinio.] But the Anomalistic Months, or the entire restitutions of the inequality, [are] 4573. The Periodic Months, or Zodiacs, [are] 4612, less by $7\frac{1}{3}$ degrees. Dividing then, Hipparchus [found] the Days 126007 by 4267, [and] found the Mean Month in scruples of Days, and into [parts]:

[Computational array, in scruples of days:] | D. | I | II | III | IV | |---|---|---|---|
 | 29 | 31 | 50 | 8 | 9 |

That is, in Hourly Scruples:

D. 29. Hor. 12. 44'. 3". 15"". 44"" [29 days, 12 hours, 44' 3" 15"" 44""].

So Ptolemy reports (lib. 4, cap. 2), adding that the mean motion recovered by Hipparchus, as regards Longitude, does not in any sensible way wander from the truth; but [as regards] the Anomaly and the Latitude, [it is] far from the truth. Ptolemy uses [this] (cap. 3) [for] the lunar month written below, in scruples of days, but converted by us into Hourly scruples:

D.	I	II	III
29	31	50	8

That is, 29 days, 12 hours, 44'. 3". 20"" [29^d Hor. 12. 44'. 3". 20""].

Therefore, from Hipparchus, the number of Lunations to the number of Anomalistic Months is as 4267 to 4573, or more briefly as 251 to 269. Whence followed the Daily motion of Anomaly:

Gr.	I	II	III	IV	V	VI
Hipparcho	13	3	53	56	17	51

But Ptolemy (lib. 4, cap. 7) affirmed that this should be corrected so as to be:

Gr.	I	II	III	IV	V	VI
Ptolemaeo	13	3	53	56	17	59

[Paragraph 3.] [Margin: Vuendelini laus, & opinio.] Now Govaert Wendelen [Wendelinus], whose most learned letters to me show how profoundly he has immersed himself in lunar theory, says (in the *Idea Atlantiarum Tabularum*, p.

29) that in precisely 797326 days 27000 Lunations are completed, and that hence is born a single Lunation [of]:

D.	H.	I	II	III
29	12	44	3	12

But [for] the apocatastasis [the great cycle / complete return], that is, the Revolution of the Lunar Anomalies, he holds it to be such that the Anomalistic Months are dissolved in 18038 [Lunations]; finally, the Draconitic Orbs, or [Months] of Latitude, [in] 6890; the Revolutions [are] completed [in] 7477. As for the rest, Wendelen's proportion does not differ much from Hipparchus's. For as the Lunations 27000 are to the Days 797326, so are Hipparchus's Lunations 4267 to Hipparchus's Days $126007 \frac{1042}{27000}$. He does not, however, expound any twin eclipse by which this use was made, in order to stabilize this Mean motion — as neither does Tycho, nor Longomontanus, nor Kepler, nor Lansbergen. For although Longomontanus, in his commentary *On the Moon* in the *Astronomia Danica* (which is had in lib. 2, cap. 2 of the *Theoricae*), adduces three pairs of Assyrian eclipses, three of Hipparchus's, and three of Ptolemy's, observed partly by Tycho and partly by himself, and compares them with his own Tables, he nevertheless does not openly show what use was made in investigating thence the motion of the Moon; and he scarcely acquiesces, among the ancient [eclipses], in the last of Hipparchus's, which among us is in the catalog of the first chapter, number 13 in order. Nor does Lansbergen, in the *Thesaurus* of observations, after the comparison of many eclipses with his Tables, show by what reasoning he derived the Mean places of the Moon. Therefore from him [ipso], and from the Danish and Rudolphine Tables, we have the Synodic Month, and the Daily motion in the Zodiac, as below:

[Margin: Mensis Synodicus.] | | D. | H. | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|---| | Danica | 29 | 12 | 44 | 3 | 8 | 39 | 46 | 48 | |
Rudolph. | 29 | 12 | 44 | 3 | 10 | 51 | 0 | 0 | | Lansbergen. | 29 | 12 | 44 | 3 | 12
| 0 | 0 | 0 |

[Margin: Motus Diurnus.] | | Gr. | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|---| | Danica | 13 | 10 | 35 | 1 | 15 | 45 | 52 | | Rudolph. |
13 | 10 | 35 | 1 | 14 | 30 | 43 | | Lansbergen. | 13 | 10 | 35 | 1 | 12 | 29 | 25 |

See the opinions of the rest in the *New Almagest*, lib. 4, cap. 23. These then being dismissed, two most celebrated Astronomers remain to us, who at length by some example manifested the method, or the eclipses, which they used in fishing out the motion of the Moon — namely **Copernicus**, and **Boulliau**.

[Paragraph 4.] [Margin: Copernici lapsus Chronologicus.] For Copernicus, with whom the Synodic Month is:

D.	H.	I	II	III	IV	V
29	12	44	3	10	48	...

— whence he deduced it [is shown] (lib. 4, *Revolutionum* cap. 5 & 6), namely, from three eclipses of the Moon observed by Ptolemy, & from as many observed by himself. But in the computation of the intervening days he erred. For he says that in the year 17 of Hadrian an eclipse was made [and] observed by Ptolemy: *On the twentieth day of the month Pauni, in the year of Christ one hundred thirty-three, on the sixth day of the month of May, or the day before* [the nones]. But Ptolemy (lib. 4, cap. 6) by no means has that the [eclipse] passed [fell] on day 20 of Pauni, for then day 21 would not have followed; but he says: *On the second day of the month Pauni, by the Egyptians, on day 20, which 21 followed.* Wherefore he still erred by day 20.

[Paragraph 5.] Similarly Copernicus erred — but uniformly — in referring the second & third eclipse: for he says that the second eclipse was made *In the year 19 of Hadrian, two days of the month Choiac having elapsed, in the year of Christ 134, on the 13th, the Kalends of November* — namely the 20th of October. But Ptolemy (lib. 4, cap. 6) does not have that *peractis* [elapsed]; rather: *On the second [day] of Choiac, the following third [day]*; for indeed day 2 was running, the beginning [reckoned] from the meridian of the day, after whose midday the eclipse was. Copernicus also says the third [eclipse] was made *In the year 20 of Hadrian elapsed, on the 19 days of the month Pharmuthi, in the year of Christ 135, the 6th of [the Kalends of] March elapsed.* Although Ptolemy (lib. 4, cap. 6) says: *On the 19th of Pharmuthi, which the twentieth followed.* And so day 19 still erred [stood], reckoned from the meridian of day 18. Copernicus admits the Hipparchan proportion of the Lunations, & of the Days of which I spoke under number 2; & from the second Ptolemaic eclipse to the eclipse observed by himself in the year of Christ 1522 [he counts] the 5th of September [and] computes 1388 Egyptian years, & days 302.

[Paragraph 6.] Ismaël Boulliau, the most diligent and subtle scrutinizer of Astronomical truth (*Astron. Philol.* lib. 3, cap. 2), adduces Hipparchus's Doctrine of the Lunations, 4267, made in an interval of days 126007 $\frac{1}{24}$; & uses (cap. 5) the interval of Egyptian years 1788, [or] days 65, that is, altogether days 651268 5; [and] he says the Lunations 22102 were completed, & so on in order. He reports too, in the same place, an eclipse of the Moon made in the year 547 of

Nabonassar, day 16, [in the month] Messori, hour 5^h 39', appearing at Uraniborg, where he says it was observed by Tycho as another eclipse in the year of Christ 1587, on the 6th of September, old style, at the hour 9^h 28' after midday; adding that this had been [in] the year of Nabonassar 2336, day 16, [month] Paophi, hour 9^h 28' after midday; whence he collects the foresaid interval of Egyptian years 1788, days 65; hours 3^h 51'; & by dividing the foresaid interval by the Lunations 22102, he collects the Synodic Month:

D.	H.	I	II	III	IV	V	VI
29	12	44	3	12	41	18	24

[Paragraph 7.] The same [Boulliau], in the same place (cap. 5, lib. 3), brings forward another eclipse observed [in] the year 548 of Nabonassar, day 9, [month] Mechir, hour at Uraniborg 11^h 59' after midday, appearing, & another likewise noted by Tycho in the year of Christ 1588, on the 2nd of March, old style, at the hour 15^h 8'; which he says was day 14 of Pharmuthi; whence he collects the interval of Egyptian years 1788, days 65; hours 3^h 5'; & hence the Lunations likewise 22102. And the Synodic Month:

D.	H.	I	II	III	IV	V	VI
29	12	44	3	5	11	45	17

[Paragraph 8.] Finally Boulliau (lib. 3, cap. 6) brings forward an exact determination of the lunar motions, by which at the end of the chapter he affirms that the Tables of the Moon's mean motions were constructed by himself. He uses, however, two lunar eclipses: one observed in the year 366 of Nabonassar, on the 26th of the month Thoth, the hour at Uraniborg reduced to 16^h 58' after midday; the other observed by himself at Paris — by Hortensius [Maarten van den Hove] at Amsterdam — & by Gassendi [Pierre Gassendi] in the year of Christ 1635, on the 3rd of March, the hour at Uraniborg reduced to 9^h 18' 5"; adding that this had been the year of Nabonassar 2383, day 16 of Pharmuthi. Hence he collects the interval of Egyptian years 2017, days 199, hours 16^h 20' 5", or of days altogether 736404, hours 16^h 20' 5"; but the Full Moons being reduced from True to Mean, it has hours only 9^h 1' 29"; & hence...

Liber II — De Luna (continued)

Caput X (continued)

and from this come 24937 lunations. By dividing that interval by these, he determines the synodic month; and by dividing the zodiac traversed in a synodic month, he determines the Moon's mean daily and annual motion in longitude. Then, adding the Sun's mean daily motion to the Moon's mean daily motion — and likewise the annual to the annual — he determines the Moon's mean motion reckoned in the zodiac from the equinox, as set out below.

Month	D.	H.	I	II	III	IV	V	VI	VII	VIII
Synodic	29	12	44	3	9	37	9	59	15	15
Motion from the Sun Sig. Gr. I II III IV V VI VII VIII										
--- --- --- --- --- --- --- --- --- --- ---										
Daily 0 12 11 26 41 31 0 46										
13 26 Annual 4 9 37 22 23 39 41 11 41 14 Daily, in the										
zodiac 0 13 10 35 1 13 2 27 27 50 Annual 4 9 23 2 24										
19 57 4 22 0										

[Margin: 9 — Bullialdus's error.]

Yet I am surprised that Boulliau [Ismaël Boulliau] settled these motions from two of the very last eclipses, with the lunar anomaly constituted in a region very different from what he established from other eclipse-pairs. For in the eclipses numbered 6 and 7, reduced to those in which it occupied about the same degree of anomaly — namely in eclipse number 6 the Moon's anomaly was, by Boulliau himself, of Signs 10 and $2^{\circ}\frac{1}{2}$ approximately, while in each the number was 7 — it was of Signs 3, $21^{\circ}\frac{1}{2}$ approximately. But in eclipse number 8, in the first instance the Moon's anomaly was Signs 7, 19° [?]; in the second, however, Signs 11, $14'$ [?]: so by no means is it at the same distance from apogee as it ought to be. And since, moreover, the mean month here derived stands almost midway between the months derived from the two prior eclipse-pairs, the compensation of this error seems to have been made. Copernicus, by contrast, adhering to his two Ptolemaic precepts about eclipses, chose for the case in each the anomaly to be of number 5; in which case the Moon's anomaly was Signs 2 and $6^{\circ}\frac{2}{3}$ approximately.

[Margin: 10]

Finally, one could wish that those forenamed astronomers had confirmed the Moon's mean motion from several eclipse-pairs rather than from one or another,

so that it might stand established in clear terms; or at least that they had adduced a sure reason why they relied especially on a binary of eclipses, on account of some prerogative. This is something also to be desired in the epochs of motions, since the root of the motions does not come out the same when derived from one eclipse as when it comes out from another, and so on.

Caput XI

De Mense Lunari Synodico per plures Eclipses investigando.

(On investigating the synodic lunar month by means of several eclipses.)

[Margin: 1]

I shall illustrate by a single example the precept handed down in the preceding chapter. I choose the eclipses of the Moon numbered 8 and 92, not only because they agree very well with the astronomical tables, but also because in each the Moon held about the same degree of anomaly, namely Signs 7 and grade [?]; there it was 19, here 16. Therefore, reducing the times equated to the meridian of Bologna: in the prior eclipse, the eclipse numbered 8 was the true full moon of the year 383 before Christ, on December 22 at hour 16^h 53' 10" in equated [time] at Bologna; and then, by our tables, the luminaries stood thus:

	Sign.	Gr.	I	II
The Sun's mean motion	8	26	4	6
Its Anomaly	0	22	36	6
The Moon's mean motion	2	23	6	16
Its Anomaly	7	18	52	17
The difference of the means		2	57	50

The Moon was therefore at that time on the near side of the place of Mean Opposition by 2° 57' 50"; and from this position of the lunar anomaly there agrees a time of 5^h 29' 27". If you add this to the time of the True Full Moon, you will have the time of the Mean Full Moon: the year 383 before Christ, December 22 at hour 22^h 22' 37", in equated time at Bologna.

[Margin: 2]

In the year 1628, January 20 by the Gregorian style, but on day 10 by the Old style, at hour 10^h 9' 20" after noon at Bologna in equated time, there was an eclipse of the Moon, and then the luminaries stood thus:

	Sign.	Gr.	I	II
The Sun's mean motion	9	29	40	26
Its Anomaly	6	21	33	47
The Moon's mean motion	3	26	51	11
Its Anomaly	7	18	4	37
The difference of the mean motions		2	49	15

In this eclipse number 92, the Moon was likewise on the near side of what an exact opposition with the Sun would require, by $2^{\circ} 49' 15''$; and from this the lunar anomaly yields a time of $5^h 7' 30''$. Therefore, adding these to the moment of the True Full Moon, the Mean Full Moon falls in the year 1628, January 10, at hour $15^h 16' 50''$ in equated time at Bologna after noon. From the moment of the Mean Full Moon of eclipse 92 to the moment of the Mean Full Moon [of eclipse 8] there are 2009 Julian years, 18 days, $16^h 54' 13''$; or, resolving these into days, there are 733805 days, $16^h 54' 13''$ — computing, that is, the 502 days which must be added on account of the same number of bissextile years. For the Egyptian year of 365 days makes 733285 days; add to these the 502 and, besides, the aforesaid 18 days, $16^h 54' 13''$, and the interval comes out, as I said, 733805 days, $16^h 54' 13''$.

[Margin: 3]

Now indeed, if (confirmed by the observation of Hipparchus, and accepted from Copernicus, Wendelen [Govaert Wendelen (Wendelinus)], Boulliau, and other proven astronomers, as I said in the preceding chapter) 126007 $\frac{1}{24}$ days contain 4267 lunations — and likewise our interval of 733805 days, $16^h 54' 13''$ contains 24849 lunations, by which dividing the same 733805 days, $16^h 54' 13''$, the synodic month comes out as the mean:

D.	H.	I	II	III	IV
29	12	44	3	12	20

Nevertheless, from two eclipse-pairs of mean full moons in the ecliptic examined, I find a synodic month which answers to a far greater number of eclipses, namely:

D.	H.	I	II	III	IV	V
29	12	44	3	10	50	30

[Margin: 4]

But so that we may not begrudge the reader the aforesaid eclipse-pairs and comparisons, we present three tables. In the **First** is the Time of the Equated True Full Moons of the Ecliptic at the Meridian of Bologna, together with the Sun's and Moon's mean motion and the simple lunar anomaly, the order of the eclipses being kept the same throughout, as we set out in Chapters 2 and 3. The Time, moreover, is the equated time, as in Chapters 8 and 9.

In the **Second** is repeated, in the same order, the difference between the mean motions of the Sun and Moon, together with the Time which the hourly motion of the Moon answers to that said Difference; and there is to be added to the Equated Time of the True Full Moon, or subtracted, according as the Moon's mean motion was on the near side of, or beyond, the point of Mean Opposition with the Sun — from which results the time of the Mean Full Moon, which is had in this Second Table.

In the **Third** are at last indicated the comparisons of the ancient eclipses with the more recent, as far as concerns the mean full moons, the Moon turning at about the same degree of anomaly; as will be plain by recurring to the first of these tables, or at least in the same distance from apogee.

But because, to investigate the synodic month, one needs a just interval of days between an ancient and a recent full moon, I have therefore noted, for the period after the year of Christ 1582, the days according to the form of the Old Julian Year, lest anyone should forget the subtraction of the 10 days in the Gregorian form.

I. Tabula

(First Table)

The Time of the Equated True Full Moons of the Ecliptic at the Meridian of Bologna, with the Sun's mean motion, the Moon's mean motion, and the simple anomaly.

Eclipse order	Ante Chr. Year	Month	Sun's mean motion: Sig.	Moon's mean motion: Sig.	Anomaly › simple: Sig.
1	721	March	11	5	2
2	720	M	11	5	0

Eclipse order	Ante Chr. Year	Month	Sun's mean motion: Sig.	Moon's mean motion: Sig.	Anomaly ☽ simple: Sig.
3	720	arch Sept emb.	5	11	5
4	621	April	0	6	11
6	502	Nov emb.	7	1	0
7	491	April	0	7	3
8	383	Dec emb.	8	2	7
10	382	Dec emb.	8	2	6
11	201	Sept emb.	5	11	10
13	200	Sept emb.	5	11	8
14	174	April	1	7	5

Eclipse order	Ante Chr. Year	Month	Sun's mean motion: Sig.	Moon's mean motion: Sig.	Anomaly ☽ simple: Sig.
15	141	April	10	4	5

Christi (after Christ):

Eclipse order	A.C. Year	Month	Sun: Sig.	G r .	Moon: Sig.	G r .	Anomaly ☽: Sig.	G r .
17	133	May	1	1 3	7	1 1	10	1 5
18	134	October	6	2 7	1	0	2	5
19	136	March	11	1 2	5	1 8	4	2 7
22	883	July	4	5	10	8	3	2 4
35	1509	June	2	2 0	8	2 2	5	1 0
41	1576	October	6	2 6	0	2 8	2	6
43	1577	September	6	1 5	0	1 4	0	1 1
44	1578	September	6	4	11	2 8	10	1 7
47	1581	July	4	3	10	5	4	2 8
49	1587	September	5	2 5	11	1 9	10	2
50	1588	March	11	2 0	5	2 7	3	2 0
54	1592	December	8	2	2	2	6	5

Eclipse order	A.C. Year	Mon th	Sun: Sig.	G r .	Moon: Sig.	G r .	Anomaly ☽: Sig.	G r .
		mb.		7		6		
55	1594	Octo br.	7	7	1	9	2	3
60	1599	Ianu ar.	10	1 9	4	2 0	11	1 9
74	1610	Dece mb.	9	8	3	8	6	3
75	1612	Maij	1	2 1	7	1 9	8	1 8
76	1612	Octo b.	7	1 8	1	2 0	2	0
88	1624	Sept emb.	6	5	11	2 9	8	5
92	1628	Ianu arij	9	2 9	3	2 6	7	1 8
95	1631	Octo br.	7	1 7	1	1 6	0	3
98	1635	Febr uar.	11	1 1	5	1 1	11	1 3
100	1636	Febr uar.	11	0	4	2 7	9	1 9
104	1642	Apri l	0	2 3	7	0	5	1 3
106	1643	Sept emb.	6	6	0	3	6	1 6
108	1646	Ianu ar.	10	1 4	4	8	7	1 5
110	1647	Ianu ar.	10	0	4	0	5	2 9
119	1657	Dece mb.	8	2 9	3	3	2	7

II. Tabula

(Second Table)

| Eclipse order | Difference of the mean motions: Gr. | I | II | Time of this
Difference: H. | I | II | Add or Subtract (vel Deme) | Time of the Mean Full Moon
— Ante Chr. Year | Month | D. | H. | I | II |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 1 | 6 | 32 | 45 | 13 | 27 | 30 | d
| 721 | March | 18 | 17 | 42 | 30 | | 2 | 3 | 21 | 53 | 7 | 23 | 10 | d | 720 | March
| 8 | 12 | 19 | 40 | | 3 | 0 | 46 | 10 | 1 | 21 | 18 | a | 720 | Sept. | 1 | 7 | 20 | 8 |
| 4 | 0 | 2 | 51 | 0 | 6 | 7 | d | 621 | April | 21 | 15 | 15 | 8 | | 6 | 0 | 6 | 34 | 0 |
14 | 10 | a | 502 | Nov. | 19 | 9 | 12 | 55 | | 7 | 6 | 37 | 36 | 12 | 49 | 45 | d | 491
| April | 24 | 20 | 7 | 35 | | 8 | 2 | 57 | 50 | 5 | 29 | 27 | a | 383 | Dec. | 22 | 22 |
22 | 37 | | 10 | 0 | 28 | 51 | 1 | 1 | 50 | d | 382 | Dec. | 12 | 6 | 56 | 55 | | 11 | 6
| 0 | 59 | 12 | 27 | 0 | a | 201 | Sept. | 22 | 17 | 52 | 30 | | 13 | 6 | 57 | 27 | 12 |
58 | 50 | a | 200 | Sept. | 12 | 1 | 42 | 10 | | 14 | 5 | 8 | 30 | 9 | 4 | 0 | d | 174 |
Apr. | 30 | 3 | 36 | 20 | | 15 | 2 | 21 | 15 | 4 | 9 | 30 | d | 141 | Ian. | 27 | 4 | 41 |
0 | | 17 | 2 | 12 | 31 | 4 | 38 | 20 | a | 133 | Maij | 6 | 14 | 12 | 40 | | 18 | 3 | 7 |
25 | 6 | 25 | 12 | d | 134 | Oct. | 20 | 2 | 51 | 58 | | 19 | 5 | 34 | 57 | 10 | 8 | 40 |
d | 136 | Mart. | 5 | 4 | 27 | 40 | | 22 | 3 | 12 | 22 | 6 | 0 | 10 | a | 883 | Iulij | 22
| 23 | 11 | 26 | | 35 | 2 | 11 | 51 | 3 | 52 | 50 | d | 1509 | Iunij | 2 | 7 | 6 | 55 | |
41 | 2 | 32 | 35 | 5 | 3 | 15 | d | 1576 | Oct. | 7 | 6 | 9 | 22 | | 43 | 1 | 6 | 53 | 2 |
25 | 0 | a | 1577 | Sept. | 26 | 15 | 14 | 12 | | 44 | 6 | 24 | 43 | 13 | 44 | 0 | a |
1578 | Sept. | 16 | 2 | 54 | 15 | | 47 | 1 | 46 | 0 | 3 | 13 | 50 | d | 1581 | Iulij | 15
| 13 | 46 | 27 | | 49 | 6 | 7 | 12 | 13 | 6 | 26 | a | 1587 | Sept. | 6 | 22 | 23 | 11 |
| 50 | 6 | 45 | 2 | 12 | 39 | 25 | d | 1588 | Mart. | 2 | 2 | 21 | 50 | | 54 | 0 | 51 |
24 | 1 | 32 | 0 | a | 1592 | Dec. | 8 | 8 | 53 | 56 | | 55 | 2 | 35 | 29 | 5 | 21 | 54 |
d | 1594 | Oct. | 18 | 13 | 41 | 0 | | 60 | 0 | 35 | 8 | 1 | 23 | 10 | d | 1599 | Ian. |
30 | 1 | 37 | 14 | | 74 | 0 | 17 | 10 | 0 | 30 | 48 | d | 1610 | Dec. | 19 | 16 | 44 | 8
| | 75 | 2 | 33 | 5 | 4 | 56 | 2 | a | 1612 | Maij | 4 | 15 | 14 | 17 | | 76 | 2 | 47 | 6
| 5 | 44 | 10 | d | 1612 | Oct. | 28 | 21 | 25 | 20 | | 88 | 6 | 37 | 50 | 12 | 25 | 50 |
a | 1624 | Sept. | 16 | 20 | 58 | 56 | | 92 | 2 | 49 | 15 | 5 | 7 | 30 | a | 1628 | Ian.
| 10 | 15 | 16 | 50 | | 95 | 1 | 16 | 36 | 2 | 45 | 15 | a | 1631 | Oct. | 29 | 14 | 27 |
30 | | 98 | 0 | 30 | 19 | 1 | 45 | 20 | a | 1635 | Febr. | 21 | 7 | 24 | 40 | | 100 | 2 |
58 | 51 | 6 | 4 | 0 | a | 1636 | Febr. | 10 | 17 | 19 | 51 | | 104 | 6 | 56 | 47 | 12 |
27 | 0 | d | 1642 | Apr. | 4 | 1 | 9 | 40 | | 106 | 3 | 3 | 35 | 5 | 24 | 20 | a | 1643 |
Sept. | 17 | 12 | 49 | 48 | | 108 | 6 | 18 | 39 | 11 | 28 | 56 | a | 1646 | Ian. | 21 | 6
| 22 | 37 | | 110 | 0 | 55 | 46 | 1 | 34 | 0 | d | 1647 | Ian. | 10 | 8 | 31 | 5 | | 119
| 4 | 14 | 20 | 8 | 41 | 20 | d | 1657 | Dec. | 9 | 23 | 1 | 57 |

III. Tabula

(Third Table)

Comparisons of the means at about the same degree of anomaly.

Order & (Ordo &)	[value]
1	41
1	55
1	100
2	43
2	60
2	98
3	35
4	98
6	95
7	75
7	104
8	32
8	92
8	108
10	54
11	49
12	35
12	74
13	106
15	36
15	110
17	44
18	55
18	76
19	47
22	88

CHAPTER XII

How, from the synodic month, the remaining motions of the Moon in longitude are deduced. (For the anomaly and the latitude motion we shall treat separately below; for now we deal with the motion in longitude reckoned from the vernal equinoctial section.)

1. Rule concerning the lunar year and the epacts.

[1] Once the mean synodic month has been derived — which for us is 29 days, 12 hours, 44' 3" 10''' 50'''' 30^{iv} — multiplied by twelve it makes the **mean lunar year** of 354 days, 8 hours, 48' 38" 10''' 6^v. Its remainder, complementing the Julian solar year and the common [civil year], that is, to make up 365 days, is called the **epact** of one year: for us, 10 days, 15 hours, 11' 21" 49''' 54^{iv}. In accumulating the epacts of several years one by one, in each bissextile year the epact is increased by one day. Whenever a complete lunation accumulates in the total, however, it is always taken away as often as it can be removed. A specimen of all this you have in the following table, together with the embolismic lunation, in number 13.

Lunar Year	D.	H.	I	II	III	IV
Common	354	8	48	38	10	6
Embolismic	383	21	32	41	20	57

Epact of the Years	D.	H.	I	II	III	IV
Common	1	10	15	11	21	49
	2	21	6	22	43	39
	3	2	8	50	2	18
Bissextile	4	14	0	1	24	8

2. Rule concerning the periodic lunar month.

[2] The 360 degrees of the zodiac resolve into 7,776,000,000 thirds [tertia]. Our synodic month resolves into 153,086,591 thirds in terms of hourly thirds; multiplied by the zodiac, as resolved above, these make 1,190,401,316,160,000 thirds, to be reserved as the **number to be divided** [*numerus dividendus*]. But for the time of the synodic month, the mean motion of the Sun in the zodiac is, by our

tables, 29° 6' 24" 17''' — which, resolved into thirds and added to the zodiac above as resolved into thirds, makes 8,404,705,7 thirds. By this, therefore, divide the aforementioned number to be divided, and there will come forth the periodic hourly thirds, by which the Moon completes a circuit of the zodiac, namely 141,631,117 thirds — that is, 27 days, 7 hours, 43' 5" 17'''.

3. Rule concerning the daily motion of the Moon in the zodiac.

[3] The zodiac, taken together with the mean motion of the Sun corresponding to the synodic month, is, as we said in number 2, 8,404,705,7 thirds. Multiplied by the thirds of one day's hourly [motion], 5,184,000'', these yield a sum of thirds 4,356,999,434,88,000''. And this, divided by the synodic month's aforesaid thirds 153,086,591'', leaves the **mean daily motion of the Moon in the zodiac** of thirds 2,846,101 ⁴⁴/₁₅₃; that is:

Gr.	I	II	III	IV	V	VI
13	10	35	1	17	15	49

4. Rule concerning the daily elongation of the Moon from the Sun.

[4] Subtract from the mean daily motion of the Moon in the zodiac the mean daily motion of the Sun, which for me is 59' 8" 19''' 48^{iv} 35^v 35^{vi}, and you will at once have the **daily elongation of the Moon from the Sun**, namely:

Gr.	I	II	III	IV	V	VI
12	11	26	47	28	40	14

5. Rule concerning the hourly and annual motion of the Moon in longitude.

[5] The hourly motion can be obtained by dividing the daily motion by 24. More easily, however, it is had by aggregating the double of the daily motion and the half of the daily motion, but exchanging the titles of the places — the degrees into minutes, and the minutes into seconds, and so forth. Take an example with our daily motion:

›	Gr.	I	II	III	IV	V
Daily	13	10	35	1	17	16
Double	26	21	10	2	34	32
Half-daily	6	35	17	30	38	38
Aggregate	32	56	27	33	13	10

	I	II	III	IV	V	VI
Therefore	32	56	27	33	13	10

	I	II	III	IV	V	VI	VII
Hourly	32	56	27	33	13	10	

	II	III	IV	V	VI	VII
And of minutes, one	32	56	27	33	13	10

[6] The annual motion is more securely obtained from the daily, by first investigating the motion of the months by multiplying the daily by 28, or by 30, or 31; or else from a more composite [aggregation] of several daily motions, until you reach the motion for 30 or 31 days. In this manner:

Mean motion of the Moon in the zodiac [Lunæ motus Medius in Zodiaco]:

Of Days [Dierum]	Sign.	Gr.	I	II	III	IV	V
1	0	13	10	35	1	17	16
5	2	5	52	55	6	26	20
10	4	11	45	50	12	52	40
30	1	5	17	30	38	37	0
31	1	18	28	5	39	54	16
60	2	10	35	1	17	14	0
120	4	21	10	2	34	28	0
240	9	12	20	5	8	56	0
360	2	3	30	7	43	24	0
365	4	9	23	2	49	50	20

CHAPTER XIII

On the motion of the lunar apogee and the anomaly.

[1] From what was said in Book 4 of the *New Almagest* [*Almagestum Novum*], Chapter 21, it is clear by what method Ptolemy and Copernicus investigated the

motion of the lunar anomaly geometrically, by means of three ancient lunar eclipses and as many recent ones. There too I indicated that more than three were employed by Longomontanus and Boulliau. Now I repeat what I said above from the epilogisms of Hipparchus: that in the lunations there correspond 4,573 anomalistic months. That is, in the shorter [span of] lunations, 251, I completed 269 anomalistic months; while in the longer span, which — panit Vuendelinus — that Wendelen [Govaert Wendelen] applied in the *Idea Tabularum Atlanticarum* [*Idea Tabularum Atlanticarum*], with 16,831 lunations there correspond 18,038 anomalistic months.

[2] But since Ptolemy, in Book 4, Chapters 2 and 7, by a large [error?] lacked precision in the Hipparchian proposition, and Boulliau [Ismaël Boulliau], in Book 3 of the *Astronomia Philolaica* [*Astronomia Philolaica*], by means of many eclipses and their intervals reduced to a geometrical foundation, concluded — over an interval of 736,404 days, 16 hours, 16' 20" 5''' — that there were completed entire anomalistic revolutions to the number 26,725, and besides 114° 35' 34"; from which, resolved into the sexagesimal [places] of degrees, there comes:

Mean motion of the lunar anomaly [*Anomalia Lunar Motus medius*]:

	Sign.	Gr.	I	II	III	IV	V	VI
Daily [Diurnus]	0	13	3	53	56	18	57	45
Annual [Annuus]	2	28	43	7	34	20	51	43

[3] We, having considered the depth and diligence of this man [Boulliau] in the aforesaid inquiry, and having tested this motion against the observations of the lunar eclipses as against a Lydian touchstone, recognized that it comes as close as possible to the truth. And so from this we have derived the remaining motions — namely the hourly, the monthly, and so on. [Margin: *Praise of Boulliau in [the matter of] anomaly* — Bullialdi laus in › Anomalia.]

[4] Furthermore, the motion of the lunar apogee is obtained by subtracting the motion of the lunar anomaly from the motion of the Moon in the zodiac — the daily [apogee motion] from the daily, the annual from the annual, the hourly from the hourly — as below:

Mean motions [› Motus med.]:

	Sign.	Gr.	I	II	III	I V	V V	V I
› Mean motions								
Year in zodiac [Annus in Zod.]	4	9	2	2	49	5	2	0

☽ Mean motions	Sign.	Gr.	I	II	III	I V	V	V I
			3			0	0	
Annual anomaly [Ann. Anomal.]	2	28	4	7	34	2	5	4
			3			0	1	3
Annual apogee [Annuus Apogei]	1	10	3	5	15	2	2	1
			9	5		9	8	7
Daily ☉ [Diurnus ☽]	0	13	1	3	1	1	1	4
			0	5		7	5	9
Daily anomaly [Diurnus Anom.]	0	13	3	5	56	1	5	4
				3		8	7	5
Daily apogee [Diurn. Apogei]	0	0	6	4	4	5	1	4
				1		8	8	
Hourly ☽ [Horarius ☽]	0	0	3	5	27	3	1	1
			2	6		3	3	0
Hourly anomaly [Horar. Anom.]	0	0	3	3	44	5	3	2
			2	9		0	7	4
Hourly apogee [Horar. Apog.]	0	0	0	1	42	4	3	4
				6		2	5	6

CHAPTER XIV

On the motion of the lunar latitude, or of the nodes.

[1] In Book 4 of the *Almagest* [Ptolemy], Chapter 22, while we set out the method by which the astronomers investigated this motion, [we noted that] Hipparchus indeed, and Ptolemy after him in Book 4, Chapter 1, demonstrated that in 5,458 lunations the Moon completes 5,925 circuits of latitude. But Ptolemy himself, in the same place, says this is far from the truth, and in Chapter 9 says: "In the latitude motion, indeed, we too were going astray, following the Hipparchian proportion that the Moon measures out its circuit 650 times" — but afterwards subjoins "we changed [these], according to the mean [position] in the full moons in their fullest distance, and so on." And after a little he adds: "we made some changes, since truer observations afterwards came to us." [Margin: *Praise of astronomy* — *Astronomia laus.*]

For it is fitting that all who undertake these speculations should do so, not only for the emendation of the ancients, by using a more certain and new method, but also for their own self-correction — if they are recalled to better [conclusions] not only by themselves but also by others — especially when this is so great and divine a profession.

These things premised, he chooses two eclipses which, in the catalogue of Chapter 2, are number 7 and number 16, in each of which the Moon was eclipsed.

[2] Copernicus, in Book 4, Chapter 13, since he did not have two eclipses observed [of the kind needed] — one from the ancients, the other in his own time — in each of which the Moon was equally affected from the same quarter, and near the same node, and at the same distance from the apogee — chose two in which, all the rest remaining [the same], the Moon was eclipsed in different quarters and near opposite nodes (for the sign indicates that the Moon was in [its] latitude), and besides whole revolutions, that it had described a semicircle. Such were the eclipses (which with us, in Chapter 2, are number 14 and 35). Between them he computes the years 1683, the days 88, the hours 22, 35' — by which time, the revolutions being completed and equated, he states that the Moon completed in latitude besides $179^{\circ} 51'$. And from this he establishes the daily motion of the latitude as $13^{\circ} 13' 45'' 39'''$; but, an old man, he erred in this, while in the first eclipse "of Claudius [Ptolemy], on the transacted days," as Claudius says, "of the month Phamenoth, on the 27th day." But Claudius Ptolemy, in Book 6, Chapter 5, does not say "transacted," but "on the day Phamenoth 27 going on toward the 28th," by which is signified that the 27th day was not yet complete. And so in the interval of the eclipses he falls short of one whole day by a customary error.

[Margin: *The latitude motion from Copernicus* — Latitud. motus ex Copernico.] Next, since the earlier eclipse was in the year before Christ 174, on the day 30 of April — as is clear from our Canon and Apparatus Chronologicus — at the hour at Cracow 9.45 after midday in the afternoon. The latter truly was in the year of Christ 1509, on the 2nd day of June, at the hour after midday at Cracow 11.36. If we accurately compute the interval, we find the Julian years 1682, the days 162, the hours 21 and 21'. False, therefore, is that interval which he expresses not in marked numerals but in extended words: "The time, however, between the two, [when] the eclipse[s] occurred, was years one thousand six hundred and eighty-three, days eighty-eight, [at the] hour the 22nd, minutes 51." We therefore dismiss Copernicus. [Margin: *The twofold lapse of Copernicus in chronology* — Lapsus duplex Copernici in Chronol.]

[3] Gottfried Wendelen [Govaert Wendelen], in the *Idea Tabularum Atlanticarum*, asserts that in 6,890 mean lunations there are completed 7,477 draconitic orbits, that is, apocatastases of latitude; and from this he gathers the daily motion of the latitude:

Gr.	I	II	III	IV	V	VI
13	13	45	39	32	7	36

We admit, therefore, the Hipparchian analogy, since from what has been said in number 1, just as 5,458 lunations correspond to 5,923 draconitic orbits [recte: 5,925? — text gives 5,923 here against 5,925 above; transcribed as printed], so 6,890 lunations correspond to 7,477 draconitic orbits — which, however, is found false in Ptolemy. [Margin: *The latitude motion from Wendelen* — Latitud. motus ex Vuendel.]

[4] Boulliau, in Book 3 of the *Astronomia Philolaica*, Chapter 8, shows that in 130 Egyptian years and 35 days, that is, 19 hours 36', or in 68,379,576 hourly minutes, the node of the lunar orbit, by receding backward against the sequence of the signs, completes 6 whole draconitic orbits, and besides $355^{\circ} 2' 49''$. Which differs somewhat from Hipparchus's opinion, but disagrees little. This, as it were by prolixity, having been done, [Boulliau] approaches the rigorous examination of this motion; he himself, choosing two eclipses, [says]: "The earlier is the one which by Chapter 2 is for us number 2, in which 3 digits were defective, [the Moon being] toward the south near the ascending node, in the year of Nabonassar 28, on the 18th day of Thoth, at Wittenberg [*Vranburgi?*], at the hour 9.58 after midday; and by the Philolaic Tables the simple solar anomaly was 9 signs $9^{\circ} 4' 45''$; but the lunar [anomaly], 0 signs $13^{\circ} 38' 28''$. The later is the one which by Chapter 2 is number 97 in order, in which 11 digits were defective, [the Moon being] toward the south near the descending node, in the year of Christ 1634, on the 14th day of March; the solar anomaly, by the same tables, being 8 signs, $9^{\circ} 17' 19' 42''$ [recte: $8^{\circ} 9^{\circ} 17' 42''$? — text crowded]. But the lunar [anomaly was] 1 sign $8^{\circ} 27' 58'''$; and he adds that it was the year of Nabonassar 2382, [the month] Phamuthi, the 27th day, hour 9.20; and so between the two eclipses there elapsed 2354 Egyptian years, 218 days, 23 hours, 22'. These he divides by 130 years, 35 days, 19 hours 36'; and from this at length he gathers these motions:

[Here the body returns to the §1 table region — see the "Mean motion of the latitude" tables on the facing page.]

(continuation — page 142)

The following table (continuing the latitude-motion derivation) heads page 142:

Sig. Gr.	I	I	I	I	V				I
	I	I	III	V	V	I	VII	VIII	X
Nodi [Nodes], Diurnal	0. 0.	3	10	3	2	3	12	7	2
				8	5				6
Latitud. [Latitude], Diurnal	0. 13.	1	45	3	3	5	39	35	1
		3		9	8				7
Annual [Annuus]	4. 28.	4	46	6	4	2	49	38	4
		2			4	5			3

[5] But it was necessary, or expedient, to choose two eclipses at the same distance from the apogee, and of the same magnitude.

And so in the year before Christ 720, as is had from Chapters 3 and 9, the Chaldeans observed a lunar eclipse of 6 northern digits, or a little more than that magnitude — Kepler [Keplerus] notes in the *Astronomia Optica* [*Astronomia Optica*] that this is the most evident of all the observations, on account of the equality of the illuminated part with the obscured part; and that full moon occurred on the 1st day of [Septem]ber [*tembris*], at the hour after midday at the equated time, H. 5. 58' 50". The luminaries then stood thus:

	Sign.	Gr.	I	II
True place of the Sun [Verus locus Solis]	5	0	54	9
And its anomaly [Eiusque Anomalia]	3	5	14	0
True place of the Moon [Lunæ Verus locus]	11	0	54	9
And its anomaly [Eiusque Anomalia]	5	13	58	16
Mean motion of the Moon [Medius Lunæ motus]	11	2	7	17

[6] The semidiameter of the terrestrial shadow, corrected according to the Sun's anomaly, and so the latitude of the Moon being southern (for the center of the lunar disk was on the very periphery of the shadow), was 47'. From this the supposed inclination of the lunar orbit to the ecliptic comes to Gr. 4. 58½', or at maximum Gr. 5. To solve [this], a right-angled spherical triangle is needed.

Diagram. A small right-angled curvilinear (spherical) triangle drawn in the lower-left of the column, with three labeled vertices and a curved hypotenuse

running from the upper vertex E down to the right vertex N, the right angle at the lower-left vertex L.

- E (upper-left vertex): label "E"
- L (lower-left vertex, the right angle): label "L"
- N (right vertex): label "N"

The accompanying text identifies the sides: in the triangle the angle N is given at Gr. 5 (or, by the Tychonic value, 5°), the latitude of the Moon opposite it being $EL = 47'$; therefore the base EN, that is, the lunar [arc] reduced to the ecliptic, [is found], the distance from the nearer of the nodes coming out by the laws of trigonometry at Gr. 9. 3'. 18". Therefore the true place of the node was in Aquarius Gr. 23. 3'. 59", but according to the mean motion the Moon was in Aquarius Gr. 23. 3'. 59" [recte: the node-place $23^\circ 3' 59''$; the two near-identical Aquarius values are as printed].

[7] Likewise, when with P. Grimaldi [Francesco Maria Grimaldi] at Bologna in the year 1643, on the 27th day of September by the Gregorian style — but the 17th by the old style — we observed a lunar eclipse of 6 digits from the north, one hour after midday, but equated [to] 7. 25'. 28". The luminaries then stood thus:

	Sign.	Gr.	I	II
True place of the Sun [Solis Verus locus]	6	4	20	27
Its anomaly [Eius Anomalia]	2	28	56	3
True place of the Moon [Lunæ Verus locus]	0	4	20	27
Its anomaly [Eius Anomalia]	6	16	3	57
Mean motion of the Moon [Lunæ medius motus]	0	3	16	31

[8] The semidiameter of the shadow, corrected, and so the true latitude of the Moon — as in eclipse number 6 of 6 digits — was $48'$. Namely, in the aforesaid triangle, the side EL, with which, and with the angle N at the maximum Gr. 5, the lunar [path] ecliptic [angle] from the node comes out [as] the distance EN, Gr. 9. 13'. 10". Hence the place of the node was in Pisces Gr. 25. 7'. 17"; but according to the mean motion of the Moon, [it was] in Pisces $\propto$ Gr. 24. 3'. 21".

1. Rule concerning the annual motion of the node.

[9] The interval of these eclipses was 862,736 days, 1 hour, 26' 38" — which time resolves into hourly minutes altogether 1,242,341,365'. And in this time, according to the analogy indicated in number 4, the southern node, against the order of the signs, completes 126 zodiacs, and, retrograding from the degree of Aquarius 23.

3'. 59" to the degree of Pisces 24. 3'. 21", traverses Gr. 329. 0'. 38". There are resolved [therefore] 126 zodiacs together with the 329° 0' 38"; in the second [reckoning]: 164,470,931". By these now multiplied per the minutes of one year, 525,600', there is made the number of seconds of the zodiac 86,445,921,333,100"; which number, divided by the aforesaid minutes of the interval, 1,242,341,365', leaves the annual motion of the lunar node, in seconds 69,583" $\frac{82}{1242}$ — that is, Gr. 19. 19'. 43''' 3''' 53''' [recte: 19° 19' 43" 3''' 53'''], not badly [agreeing] with the Tychonic [tables], which have Gr. 19. 19' 43" 4'''. Let this motion be divided per the year's days 365, and there will come forth the daily motion of the node, 3' 10" 38''' 40'''. [Margin: *Annual node motion* — Annuus nodi motus.] [Margin: *Daily node motion* — Diurnus nodi motus.]

2. Rule concerning the motion of the latitude.

[10] Add the daily node motion to the daily motion of the Moon from the beginning of Aries (concerning which, in Chapter 12, number 3), and there will be the **daily mean motion of the latitude**. Add likewise the annual node motion to the annual motion of the Moon (concerning which, in the same place, number 6), and there will be the **annual motion of the latitude**, as below:

Mean motion of the latitude [Latitudinis › Motus Medius]:

	Sign.	Gr.	I	II	III	IV	V
Daily [Diurnus]	0	13	13	45	39	57	16
Annual [Annuus]	4	28	42	45	53	43	20

CHAPTER XV

On establishing the epochs of the lunar motions.

[1] If, out of a single eclipse selected as the most evident among all, the radix of the motions is to be established for the beginning or end of that year, the time of that full moon must be reduced to the equated time, and the true place of the Moon to its place, or mean motion. By adding to this, or subtracting from it, the mean motion corresponding to the interval between the time of the observed full moon and the beginning or end of the year, there will be had the radix of the lunar motion for the end or the beginning of that year.

For example, in the year 1610: a Christmas-eclipse [*Christi Eclipsis*] was observed on December 29; at Bologna the apparent hour was 16. 10', but equated 16. 13'.

20". At which moment the mean motion of the Moon was Sign. 3. Gr. 8. 3'. 47"; the true opposition of the Sun was at sign 3. gr. 8. 22'. 25"; and the anomaly was sign 6. gr. 3. 28'. 15"; and so the equation 18'. 38" was to be subtracted from the true place of the Moon. From that moment to the end of the year there remained 1 day, 7 hours, 46'. 40"; for which there belongs to the mean motion of the Moon Gr. 17. 26'. 47"; but for the anomaly Gr. 17. 17'. 56". Adding these to the mean motion of the [eclipse] moment, there arises for the year 1610 complete:

	Sign.	Gr.	I	II
Radix ☽	3	26	0	34
Anomaly [Anomaliæ]	6	20	46	11

[3] But if a radix of the same years is to be had from several eclipse-observations, sufficiently accurate, it is expedient to inquire after the radix of the same year from several such observations, so that, if a discrepancy be found, one may then choose the one which least of all departs from the observations. For this reason, those who have established their epochs from a single eclipse have never been able to win my approval: namely Ptolemy, Book 4, Chapter 8; Copernicus, Book 4, Chapter 7; Wendelen, in the *Idea Tabularum Atlanticarum*, page 35; and Boulliau, Book 3 of the *Astronomia Philolaica*, Chapter 7. By how many, and which, eclipses Tycho [Tycho Brahe], Longomontanus, Kepler, Lansbergen [Lansbergius], and Petavius established their lunar epochs, [these] do not disclose, but only indicate that, just as their mean motions, so too their epochs of the motions, are derived from several [eclipses]. We, indeed, having brought into the catalogue all the eclipses of Chapters 8 and 9, although [obtaining] differing radices for the years complete by the Gregorian [reckoning], and [for] the epoch of the year 1 of Christ at the beginning, on account of the diversity of the observations—

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and at last, however, after very many labors of calculation, we have noticed that the Radices written below answer more closely and more nearly to most of the eclipse-observations; and therefore we choose them for the meridian of Bologna, at the meridian of the last of December.

[Margin (left): *anno tame.* (i.e. *anni tamen* — abbreviated note, partly cropped) [?]]
 [Margin (left): *us no.* (partly cropped) [?]]

Radix table — Mean Sun [☉] from Aries [♈], and Anomaly:

Radi x	☉ from ♀ Sign.	G r			Anomaly Sign.	G r		
		.	I (')	II (")		.	I (')	II (")
Christ	4	2	3	35	6	2	4	24
1600	7	2	19	20	0	7	27	9
		5						

[The headers "Sign. Gr. I II" denote sign, degrees, first minutes, second minutes (i.e. degrees, minutes, seconds).]

4. Now for the Epochs of the Lunar Node: since, by what was said at Caput XIV, num. 8, in the year 1643, on September 27, at the hour after noon at Bologna equated to 7h 25' 28", the Southern Node was in Pisces at 24° 3' 21" as to the place of the mean Moon — and from there to the end of the year 1644 (which are one bissextile year, and besides 94 days, 16h 44' 32") — by which, for the mean motion of the node, there accrue 24° 23' 48": if these are subtracted from the said place in Pisces, there will remain the Radix of this Northern Node at 10 signs 29° 39' 33". And the Radix of the Northern Node is:

Sign.	Gr.	I (')	II (")
4	29	39	33

Now to this, by adding the motion of 44 Julian Years (which is 4 signs 11° 2' 29"), there results the Radix for the year 1600 in the Gregorian reckoning:

Sign.	Gr.	I (')	II (")
9	10	42	2

5. But from other eclipses, as the Annual motion of the Node is held to be 19° 19' and nearly 3", so the Radix for the year of Christ 1600 in the Gregorian reckoning satisfies more of them:

Sign.	Gr.	I (')	II (")
9	11	22	50

And hence the Radix at the beginning of the Years of Christ:

Sign.	Gr.	I (')	II (")
8	28	51	22

CAPVT XVI.

Eclipses of the Sun Observed, the more suitable however being selected for the Lunisolar motions, and for establishing the diameters of the luminaries: with the calculations of the astronomers added throughout.

Although certain universal notes and characters of the years would suffice for establishing Chronology, and therefore the more numerous Solar eclipses, by whomever observed, would be useful to Chronologers — yet for Astronomers far fewer of them serve the purpose; that is, only those whose magnitude, or more certain mark of time, was observed. Therefore we select only such; and in the computations we will from time to time subjoin those which we shall change as to the distance of the Meridians from those used by the astronomers themselves, since otherwise the Parallaxes of Longitude would have to be recomputed, when the calculation is transferred to different Altitudes of the Pole.

[Margin (left): *Ordo*. ("Order")]

1. [Margin: *Totalis*. ("Total")] In the year before Christ 585, on May 28, there occurred a most celebrated Eclipse of the Sun, inasmuch as it had been predicted long before by Thales [Thales of Miletus] to the Ionians. It was seen around the Hellespont and at Sardis in Lydia, and in both places total, in the sixth year of the war between Cyaxares, king of the Medes, and Halyattes [Alyattes], king of the Lydians, as Eudemus relates in Clemens [Clement of Alexandria], *Stromata* I, and Herodotus, book I — where he adds that, after on that day they had long fought with even fortune, the day was suddenly turned into night.

the same was, but others maintain that the Totality was around the Hellespont, while those of Alexandria in Egypt make it 9 digits and 36 [?], or rather, as Cleomedes maintains, in book 2, cap. 3; and Theon of Alexandria in book 6 of the *Almagest*, cap. 11. Plinius [Pliny], book 2, cap. 12, assigns it to the fourth year of the 48th Olympiad; and so it is accepted by Buntingus, Scaliger, Salianus [in the] Year of the World 1469. Keplerus [Kepler], in the *Optics*, does not contest Lansbergius [Lansbergen], who in the *Thesaurus Observationum* assumes the Third year of Olympiad 48. For from this New-Moon, as being the most nearly preceding the Solstice, the Third year could be reckoned as the fourth of the said Olympiad. Lansbergius adds that it had been the year of Nabonassar 163; and so, as Tycho [Tycho Brahe], and from his own Tables, elicits the Eclipse at 7 digits in the Hellespont, and near Sardis at 4 38' p.m. But at Alexandria at digit 12'. For us, however, by Tycho's New Tables and those of Magini, an Anomaly of the Sun of 1° 8' comes out for the same year, and the day the 28th of May, at the hour at Sardis

of 5h, around p.m., with the Sun in [Gemini] $1\frac{3}{4}^{\circ}$ and the Moon nearly 170° . Calvisius therefore badly advanced this Eclipse into the year 597; and Petavius (whom Iacob Billy follows in the *Tabulae Lodoicaeae*) into the year 597, July 9, since by his own Tables he ends it nearly at highest morning, and the digits at 9 22', near Sardis, because neither [?]; the totality therefore requires that the time of the battle, joined to it, fall out; and they concede that the battle was begun straightway at highest morning — yet it would not last unless after the hour of the Sun, 1 16' after sunrise. Petavius, who computes the Eclipse, supposes 5h 45' p.m. after night, yet that in this year there is sparing... as to the Doctrine of Times c. 1, very many of the opinions about this Eclipse are most learnedly examined; I know that Petavius, book 10, de Doctrina Temporum c. 1; the more common from the year 585, although from the Prutenic Tables [Prutenic Tables] the digits are $11^{\circ} 30'$. From the Parisians, however, the same, that is, the digits $11^{\circ} 20'$; therefore he nevertheless got it most fittingly from those Tables, that it was at 5h 45' p.m. and nearly before sunset, but for the certain outcome on account of the excessive distance of the Meridians, or the fault of the Parisian Tables — since others do not cease, who represent that Eclipse by hours before sunset, by that very year 585, by its totality. Rudolphine, at Sardis, exhibit the totality at 5h 17' 4". Digits 12 1' 36". The Anomaly of the Sun was truer at $359^{\circ} 2'$, and the Moon at 170° .

2. In the year 310 before Christ, when Agathocles, king of Sicily, was carrying his fleet across into Africa against Carthage — namely in the third year of Olympiad 117, as Diodorus Siculus relates, book 20, and Justin, book 22: "So great a darkening of the Sun came about, that it plainly seemed full night, with stars appearing everywhere," says Diodorus. There was very nearly total night. Buntingus, with Salianus, supposes from the Prutenic Tables August 15, and 8 15' p.m. Syracuse, at the digits 11. Petavius from the Parisians [computes] h. 8 2' and digit 11 10'. The Anomaly of the Sun was 74° , around; and the Moon 201° .

3. In the year 217 of Christ, in which Gordian the younger held the imperium [recte: the context refers to the consuls; cf. Iulius Capitolinus] — by the testimony of Iulius Capitolinus — began the Eclipse of the Sun, so that it was believed to be night, nor without lights kindled could anything be done. Keplerus in the *Optics* asserts it total. The Prutenic give less, since the digits are 11. Petavius [places it at] Rome h. 4 51' p. merid., the digit 10. Lansbergen in the *Thesaurus* 12, April 11 h. 5 2' post merid. at Rome collects digits 11 30'; yet he says it was seen Total, because the little particle of the Sun untouched by the Eclipse was near the Horizon. The Anomaly of the Sun was 306° . The Moon 204° .

4. In the year 334 of Christ, with Optatus and Paulinus being consuls, as Firmicus [Firmicus Maternus] says, book 1, cap. 2: "The Sun in mid-day, at the time of the Lunar eclipse, as if by some impediments was deprived of its light, the deadly lights of its [orb] dying" [recte: poetic phrasing] — and that it was added [as recorded] by the Astronomers, and seen as Byzantine too. This Eclipse cannot be drawn out from the Prutenic; and Mulerus [Müller] in the *Isagoge* cap. 11, and Petavius lib. 8, cap. 14, note it. Petavius supposes that one of July 17, h. at Rome 11 12' p. merid., with the digit 10 24'. Lansbergius h. 11 9' and at around the Moon that it appeared somewhere, [a partly] lucid disc with the margin [?], which species of Eclipse we have called Annular in the *Almagest*. The Anomaly of the Sun was at 39°. The Moon 296°.

5. [Margin: *Annular.*] In the year 484 of Christ, on January 13: "The Eclipse of the Sun, [such] that the Day in the night was turned, fell about deep shadows, and the Stars were seen," notes Reinerus in his *Catalogue of Eclipses*; and from the life of Proclus, described by Marinus in Greek, which is asserted... [continues at top of next column on the following folio]

in the library of the most serene M. Duke of Hetruria [Tuscany]. The Anomaly of the Sun was 216°. The Moon 169°.

6. [Margin: *Total.*] In the year 840 of Christ, on May 5, on the Vigil of the Ascension, there was an Eclipse of the Sun: "So great that even the Stars were seen, and the reddish color in the lands changed itself; nor did anything differ in true appearance from night — for the Moon, first receiving its light from a part opposite to the rising Sun, then withdrew its whole [light] as it had received it," as the Anonymous author whom Ludovicus Ph. Hammonius cites, book 3, cap. 19, relates; and the *Chronicon Floriacense*. Petavius assigns the Eclipse at h. 11 22' p.m., and collects digits 9 20', which does not agree with the history. The Anomaly of the Sun was 324°. The Moon 173°.

7. [Margin: *Total.*] In the year 878 of Christ, on October 29 — which was a leap year — of Ludovicus Balbus [Louis the Stammerer], post 9, on the 4th of the Kalends of November: "The Sun obscured itself for half an hour, so that the Stars appeared in the Sky, and all who saw it feared night to be threatening," from Petrus the Librarian, and the *Annales of the Franks*, or those of Fulda. Petavius assigns it the nothing [i.e. none]. The Anomaly of the Sun was at 135°. The Moon 220°. Keplerus in the *Optics* receives it as total.

8. In the year 890 of Christ, but after the death of Alexander [the Great] 1214, and Dhil Karnaim 1202, on the 1st of August, Albateginus [al-Battānī], as Petavius

refers, observed at Aracta an Eclipse of the Sun more than half [the disc], at the eighth hour and one Temporal hour. Petavius supposes at the Parisian [meridian] for Aracta h. 0 46' p.m. and digit 9 22'. The Anomaly of the Sun was at 64°. The Moon 335°. And it has the Year 8.

9. In the year 893 of Christ, on the 23rd of January, or after Alexander, of death 1214, and Dhil-Karnaim 1212, Albateginus, as he refers, observed an Eclipse of the Sun at Syria at h. 1 40', very nearly mid-meridian, and the [Sun] diminished by 9 40'; and h. 2 15' ante merid. it was at Aractae. Lansbergius supposes digits 9 40' and h. 2 15' ante merid. Aractae.

10. [Margin: *Total.*] In the year 1187 of Christ, on September 4: "So great was the Eclipse of the Sun, that the stars per the day appeared as though by night, as the Lycosthenes" — and from the 4th of the Kalends of September. [recte: the date forms here are confused in the source.]

11. [Margin: *Total.*] In the year 1197 of Christ, on the day before the Nones of September: "Gregorius Tholosanus [Gregory of Toulouse], lib. 21, de Republica cap. 27, notes so great an [eclipse] of the Sun, and that the Stars appeared."

12. [Margin: *Total.*] In the year 1239, Gassendus [Gassendi] copies these words out from the *Martyrologium Diniense*, in the *Epicurum* pag. 895: "In the year 1239, on the 3rd of the Nones of June, on the day of Venus [Friday] the Sun obscured itself, so that for that day it was turned to night around mid-day, and the Stars appeared," the same; and being conspicuous and engraved on a stone in a public square.

13. In the year 1415, Gassendus refers from the *Historia Diniensis* as above: "In the Year of the Lord 1415, on the day of Venus [Friday], there was an Eclipse of the Sun, and it endured for nearly one hour; and at its very beginning the Stars were seen most clearly." This Reinholdus, in the *Theoricae*, copies out; Pruteni from the *Polish History* of Matthias Mechouiensis [Maciej of Miechów], as does Origanus in the Preface, Tom. 2, *Ephem.* — relates as contingent at Constantinople in the year 1415, June 7, h. 4 hora 6, in the morning, not only the Stars seen as though by night, but also voices likewise hushed by sudden darkness, the lands obscured. Lansbergius computes 12 11', hour 6 5' post mid-day. The Anomaly of the Sun was at 351, and the Moon 204.

14. [Margin: *Total.*] In the year 1478, July 29, Bernardus Vualtherus [Bernhard Walther] observed at Nuremberg the beginning of the Solar eclipse together with sunrise at 5 14' 30", and its end at 41 30'. In the year 1485, March 16, by the testimony of Lycosthenes: "Fires were lit in the open at midday, and so much

darkness, as even the candles being lit, was diffused." Bernardus Vualtherus observed at Nuremberg an Eclipse of the Sun with the digit nearly 11 ab Austro, h. 4 27' post merid. The Alphonsine [Tables] assign the digits 12 and Kepler in *Opt.* pag. 131. He contends that it was total, although Lansbergius collects by his own Tables h. 4 45'. Norimbergae [at Nuremberg] computes digit 10 56'. Anomaly of the Sun at 170°.

15. [Margin: *Total.*] In the year 1497, on January 18, Bernard Vualther saw at Nuremberg an Eclipse of the Sun, its end at h. 3 24' p.m.

16. In the year 1539, April 18, at Milan was seen the defect of the Sun in the digit 9, as Reinerus refers, and Cardanus.

17. [Margin: *Total.*] In the year 1544, January 24, Gemma Frisius, cap. 18, [says]: "The Radii of the Sun-disc cast obliquely showed a sun-defect at h. 8 53' around p.m., the digit greater than 10 in the lower part," in the Ephemerides supersold.

18. [Margin: *Total.* — second of two paired marks here]

[Margin (right column, top of this folio is given by the previous folio's body): *Total.*]

they had marked. Funccius [Funck] adds, in Keplerus, in the *Optics* pag. 296, that the day began to grow night, and the birds, which first had chirped merrily with full light, fell silent; he estimated that Eclipse at 11 digits. Reinholdus computes it somewhere as total at h. 7 58' p.m.n. at Louvain, digit 1'. The Anomaly of the Sun was at gr. 217. They attribute totality to the Moon by the Eclipse; nevertheless it could be seen as larger, because it was in the morning, and near the Horizon's vapors.

19. In the year 1545, on the 5th of the Ides of June, was observed the defect of the Sun by Gemma Frisius at h. 4 p.m. and digits $4\frac{2}{3}$, from its own Radius [Margin: *Astron.* (i.e. astronomical reference)] cap. 15 and 17.

20. [Margin: *Total.*] In the year 1560, August 21, at Coimbra around midday was seen a horrible Eclipse of the Sun, total, and with delay, as the eyewitness Clavius reports in cap. 4 of the *Sphaera*, where he relates: "The Sun in our time truly hid itself for no brief moment: it showed darkness somewhat greater than nocturnal ones; nor indeed could anyone set a foot anywhere; and most brightly the Stars in the Sky appeared (a thing even marvelous to tell!); and the air from the lands..." [recte: poetic phrasing] ...such foul obscurity fell. P. Emmanuel Vega was present — from whom, or from Scheinerus, in the *Rosa Ursina* lib. 3, cap. 7, [it is] narrated — that it lasted nearly through one and a half hours, with the women

lamenting, and as though the end of the World present, the men clamoring; nor was there ever seen so clear a view of the stars, as the work of the Lucerni [?]; though some men with the lights of those not recognizing, although men knew Ignatius Danes hither; the same at Rome with Ignatius Danes. The instructions, moreover, in his own Preface. The Tables, however, assign it at observation 10' before midday. But from the *Chronicon* of Mercator, Vienna in Austria has it observed at 5 2' p.m., the highest digit 5. From Paulus Fabricius and Tilemannus Stella: Joannes Stadius in the Ephemeris of this year says it was at Brussels its end at h. 1 48' p.m. and Lansbergius in the *Thesaurus* observed the digits 6 31'. At Coimbra, however, he computes the digits 12 4', but adds delay, because the Sun showed long delay, since the Sun contracted [its] Radii, [it was] adduced to view at the digit 12 28', which thing they are accustomed to use for the patronizing of their Hypothesis. Tycho, who admits all total Eclipses, writing for this Eclipse of Clavius as one to be admired and incredible, refers in the *Astronomia Optica* pag. 285. The Anomaly of the Sun was at gr. 64. The Moon, however, at gr. 136.

21. In the year 1567, April 9, Clavius at Rome (as he himself says, in cap. 4 of the *Sphaera*): "The Sun did not entirely defect, but a certain little circle remained shining round about." Tycho, in his letters, against Clavius, who refers from Keplerus on this Optical Eclipse, narrates from sight at Rostock with triple obscured meridian, the digit not plainly 7; but in the *Progymnasmata* computes the digits 8 20'. Maestlinus [Mästlin] at Tübingen observed somewhere from the South, h. 10 25' p.m.n. its beginning, h. 1, ab Austro. Mercator at Duisburg saw the beginning [at] h. 10 25' p.m.n. its end at h. 1. Cornelius Gemma at Louvain saw the beginning h. 10 12', its summit at h. 11 40', its end nearly 9. The Time as though evening, 11 40' end 35' digits nearly 9. Nevertheless Keplerus above, vesp. 35', because this Tables does not exhibit an Annular Eclipse; [in the] surrounding region therefore it refers an Eclipse not differing in contact of the Sun illuminated, [so] that the radii of the Sun refracted at the air, were circumlunar, but [as] Lansbergius collects this Annular Eclipse from his own Tables.

22. [Margin: *Total.*] In the year 1584, April 30, in the old style, Tycho at Uraniborg [observed] h. 5 39' p.m.n. observed an Eclipse of the Sun, the digit 3. Maginus from the Prutenic supposes at Venice the digit 2 25'. Vuendelinus [Wendelen] from the Atlantic Tables collects at Uraniborg h. 5 36'.

23. In the year 1588, February 16, Tycho at Uraniborg [had] the beginning of the Solar eclipse, saw it h. 1 32' p.m. its end h. 2 51'. From the Tyconic schedules Keplerus pag. 414 *Astron. Opt.* expounds the inclinations of the Eclipse.

Maestlinus from the Prutenic computes at Tübingen 57' post merid. and digit 1 10'. But Maginus at Venice [had] h. 1 23' and the digit 1 3'.

24. In the year 1590, July 31, in the new style, Tycho at Uraniborg ob-[served]... [continues at top of next column on the following folio]

observed an Eclipse of the Sun h. 6 51' p.m.n. the digit 4, as in the Epistle to Maginum pag. 81. Directio adding the Prutenic, promised the digit 8. Tycho himself from his own Tables, in the *Progymnasmata*, gives digit 5. Maestlinus at Tübingen observed h. 7 36' ex Prutenicis computavit h. 7 40' and digit 9. Lansbergius at Tübingen supposes h. 7 44' and digit 9. But Maginus from the Prutenic computes at Venice h. 7 57' digit 10 27'.

25. In the year 1591, July 20, in the new style, Tycho at Uraniborg observed an Eclipse of the Sun h. 3 33' p.m. digit 2½; but the Prutenic give h. 4 6' and digit 1.

26. In the year 1595, October 3, in the new style, Tycho at Uraniborg noticed a defect of the Sun at hor. 1 8' p.m. and digit 3 50'. At Tübingen Maestlinus saw the digit 2½. Grati [?] Keplerus the digit 3. Maginus at Venice computes from the Prutenic h. 1 16' and digit 4 14'. But Origanus at Frankfurt and Oderam [Frankfurt-on-Oder] computes Prutenically h. 2 4' and digit 5 18'; but Tychonice h. 1 16' and digit 3.

27. [Margin: *Annular.*] In the year 1598, March 17, in the new style, at Uraniborg, an Alumnus of Tycho's observed an Eclipse of the Sun [at] 44 minutes before midday, and digit 9 minut. 40' alii 40. Tycho himself at Uuandersburg noted the beginning at h. 9 12' p. med. noctem. At Torga, however, in Misnia, Doctor Iessenius observed in the prince's hall this central Eclipse, prominent everywhere, since the Moon was within the margin of the Sun, as Keplerus refers in the *Optics* pag. 299 and 419. Lansbergius computes at Torga h. 10 28' p.m.n. and nearly Annular he found on account of the Anomaly of the Sun [being] 248° in degrees, and of these the diameter [was] 31° 54'; the diameter [of the Sun being] 32'. But he himself at Torga observed the beginning h. 9 12' ante merid., with such darkness that the next was seen to begin. At Frankfurt and Oderam Origanus observed the inter-minute 28' and 46' of the eleventh hour and the digit 9; licet calculo Prutenico collects h. 5 28' and digit 10 55'. Maginus at Venice Prutenically supposes h. 9 45' and digit 11 33' subjoined in the *Tomus Directionum* the same [at] Uraniborg ex Alphonsinis h. 11 44' digit 8 20'. From the Prutenic h. 9 50' digits 11 26' ex Tychonicis h. 11 7' and digit 10 6'.

28. In the year 1600, July 10, in the new style, at Uraniborg is posited Tom. 1, of the *Progymnasmata*, Tycho's Eclipse of the Sun [at] the digits 5 h. 1 44' p.m. But

Benatica in Bohemia, Tythonici cum viderunt l. 1 46' digit 5. At Tübingen Maestlinus [has] the digits more than 5. At Prague Keplerus the digits $7\frac{2}{3}$, h. 1 47', as he has in the *Optics* a pag. 421, and digit 5. Maginus Prutenically computes at Venice hor. 2 14' but at Uraniborg h. 1 47' and the digits hic 4 50' ibi 7 19'. Origanus at Frankfurt Prutenically h. 2 10' digit 5 39' but at Uraniborg h. 1 55' and digit 3 19'.

29. [Margin: *Annular.*] In the year 1601, December 24, in the new style, Lansbergius observed an Eclipse of the Sun [at] h. 1 50' p.m. But there was a distance, now of the Austrine [southern] margin of the Sun from the Boreal [northern] margin of the Moon margins; the Sun, and the Boreal Moon coincided so far, that the whole orb of the Sun was seen [within the orb of the Sun]: thus in the *Thesaurus Observat.* where he computes hor. 1 51'. And the Anomaly of the Sun gr. 176 cum diameter 35' 53". But the Moon gr. 71 with diameter 30' vel optice 28' 30". Keplerus at Prague observed plusquam digit 8, h. 2 53', as in the *Optics* pag. 359 and 413. in the Appendix moreover and the *Progymnasmata* notes the diameter Tythonicam non concordasse with observation. Longomontanus l. 1 *Theoric.* cap. 9, narrates at Piscatorium [Fishery] milliariis 18, ultra Nidrosiam observatam fuisse the Moon to encircle the Sun everywhere, equal, as though three-quarters-digit prominentem, and such an Eclipse type as he himself depicts in the *Andrea Foxio* monstrated to have been at Bergis: from which he contends the diameter of the Moon in the Eclipse to be contracted Optice, the Sun moreover larger, on which is our judgment lib. 3 *Almag. Novi* pag. 376. Lansbergius at Bergis h. 1 52' and the said diameter this phase tueatur. Gassendus in the *Epicurum* pag. 893, since the Moon's diameter could exceed the larger Solar [diameter] by four minutes, refers an excellent appearance of greater view in the *Optics* observed, or by the attenuation of the luminaries; Maginus in the *Directionibus* computes at Uraniborg Alphonsine h. 3 32'. digit 7 36'. Prutenically h. 1 52'. digits 9 19'. Tythonice h. 2. 36'. digitos 9. 33'. Origanus at Frankfurt Prutenically h. 1 57'. digit 9 56'. But Tythonice h. 1 46'. and digit 9 52'.

30. In the year 1605, October 12, at Middelburg the Eclipse of the Sun was observed by Ioanne Rotario [Jan Rotarius] h. 1 15' p.m. digit 10 $\frac{1}{2}$, ab Austro, ut narrat Lansbergen in the *Thesaurus* supputat h. 1 22' and digit 10 38'. At Naples that the total was observed says Keplerus in the *Epitome Astronomicae* pag. 893, and cap. 23, on the new Star. Lansbergius at Naples supposes h. 2 49' and diameter Solis 34' 38". The Moon, however, 34' 52'; and Solem to be contrary [opposite]. *Pueningius* [Wendelen? — *Vuendelinus*] [recte: Vuendelinus] *Foscalarii* [?] in the Province saw the Sun with extreme thinness in the most threaded vestiges Septentrional, except for a thin thread of the Northern part; the

whole Sun obscured, the visible Atmosphere of the disc illustrated tribuit; and adds that at Marseille the whole Sun [was] obscured, the Atmosphere of the disc appearing with dense shadows. Maginus at Venice Prutenically collects hor. 2 55' digits 11 31'. Origanus Prutenically at Frankfurt h. 2 0' digit 10 35' Tychonice h. 2 3 $\frac{2}{3}$ digit 9 25'.

31. In the year 1608, August 10, in the new style, an Eclipse of the Sun [at] Goesa [Goes] was observed by Lansbergius h. 4 7 $\frac{1}{2}$ digit 5 30' ab Austro; ex calculus dat h. 4 8' digit 3 29'. Vultemberg [Wittenberg] Melchior Ioestelius [Melchior Jöstel] observed the digits 2 ab Austro Longomontanus nullam vidit ob aëris crassitiem, ut ipse censet lib. 2 cap. 9. Origanus 1600, [Frankfurt] nullam debuisse esse ex Tychonicis semidiam. sed iis correctis ex Prutenicis computat digitos 1 46', h. 4 40'. Maginus Venetiis Prutenice digits 5 47' and digit 3 14'.

32. In the year 1612, May 30, the Monk Christophorus Scheinerus [Scheiner] observed the defect of the Sun [at] digit 8, h. 11 23' post med. noct. Longomontanus at Hafnia [Copenhagen] cum 7 sociis observed the digits 8, h. 11 7', as Theoricor. c. 9 he has. Maginus Venice deduces Prutenically hor. 11 23' digit 8 38'. Tychonice h. 11 38' digit 7 14'.

33. In the year 1611, May 21, Petrus Gassendus [Gassendi] at Aix [Aquis Sextiis] observed an Eclipse of the Sun h. 8 18' circiter p. med. noct. and digit 9 $\frac{2}{3}$, as he himself narrates in the *Epicurum* pag. 892, and Furnerius lib. 12, *Hydrograph.* cap. 14. Lansbergius at Middelburg computes the same [for] h. 8 18' and digit 11 12'; he himself, however, gives the calculus for h. 8 16' digit 11 11'. The Prutenic calculus Magino [gives] Venice dat h. 8 43' digit 9 20'. But Origanus at Frankfurt h. 8 55' and digit 10 30'. Tychonice ibidem h. 9 6' cum digit 10 44'.

34. In the year 1628, December 16, Baronovae [Baron] P. Io-Baptista Cyssatus [Cysat] observed an Eclipse of the Sun h. 4 19' p.m. digit 8 45'. Keplerus in Austria observed it cum annulo lucido, and vaporoso circa Lunam. Origanus translated the calculus ad Fretum Gaditanum [Strait of Gibraltar] predicted ex Prutenicis h. ibi 2 40' digit [?] 6 34'. But Tychonice minutis 8 ante meridiem, and digits 4 45'.

35. In the year 1629, June 21, P. Rhodes Soc. Iesu in the city of Rum, distance to Tunquin [Tonkin], whichever it is of the kingdom Tunquinici Metropolis milliaribus Italicis 240, sub altitude Poli gr. 18, observed an Eclipse of the Sun semihora circiter ante meridiem the digit 8. Origanus narrates in locis Orientalibus aliquibus the distance from Frankfurt Odera hor. 6 18', and sub latitude Boreali gr. 18, supposes this Prutenically the digit 12, 21' and Tychonice h.

11 26'; quod valde discrepat ab observation in sub latitude majori certainly nor in such a [measure], however, just as he requires here discrepantia [discrepancy].

36. In the same year 1629, December 14, observed by Eclipse of the Sun in America Australis in the Province Mascha sub latitude Poli Australis gr. 10, the beginning saw it h. 1 45' ante meridiem, finis at end post meridiem h. 1 45', et habeo ex litteris nostrorum Patrum ad me. Origanus translated the calculus ad Mediterranea Peruvij sub latitude Australem gradum 27, and the meridian distance from Frankfurt Oderae h. 5 6' collects Prutenically the Eclipse h. 1 ante meridiem digit 11 36' sed Tyconice h. 1 26' quod valde discrepat ab observation, in sub latitude majori, indeed not in so much [a measure], however, just as one requires here discrepantia.

37. In the year 1630, June 10, the Eclipse of the Sun was observed at Dordrecht by Martino Hortensio [Maarten van den Hove] h. 7 15' digit 10, aut paullo plus. But at Middelburg Lansbergius h. 7 10' digit 10. Ex calculus extrahit ipsius Goesae dat quidem digit 10 42' et h. 7 10'. Parisiis Gassendus h. 7 12' observed digit 11 32', as he narrates in the *Epicurum* pag. 885. At Oxonii [Oxford] Baindbrigius [Bainbridge] noted it the beginning h. 5 58' end h. 7 48' p. m. The PP. Andreas Arzet and Io. Baptista Cyssatus at Ingolstadt observed h. 7 54 $\frac{1}{2}$ digit 11 57' p.m. We too at Forum Navij [Forni? / Markt] in the agro Parmensi h. 1 ferè ante occasum Solis vidimus eam digitorum ferè 11 $\frac{1}{3}$. Magi-[nus]... [continues at top of next column on the following folio]

[Bernhard Walther] had computed, by the Prutenic Tables, at 7h 37', with a magnitude of 10 [digits]; at 35' [Origanus] [David Origanus], at Frankfurt, by the Prutenic Tables, 7h 41', magnitude 12 [digits] 8'; by the Tyconic, 7h 47', magnitude 10 [digits] 29'.

38. In the year 1633, on April 8, Fr. Andreas Arzet [Andreas Arzet, S.J.], of the Society of Jesus, observed the solar eclipse at Regensburg at 5h 3', with a magnitude of 6 [digits] 44'. We saw it at Bologna at 5h 15', magnitude 5 [digits]. At Digne [Gassendi] saw it at 4h 42', with 8 [digits] 18'. At Aix-en-Provence [Peiresc] and Gaultier saw it at 5h 41', with 8 [digits] 48'. Fr. Beaugrand [P. Beaugrand] at 4h 20', with more than 6 digits. At Oxford [John Bainbridge], at 5h 19' — concerning which Furnerius treats in Book 12 of his *Hydrographia*, chap. 17. [Origanus] [David Origanus] computes it, at Frankfurt, by the Prutenic Tables, at 4h 37', magnitude 7 [digits]; by the Tyconic, at 4h 30'.

39. In the year 1639, on June 1, [Hevelius] observed a solar eclipse at Danzig at 6h 21 $\frac{1}{2}$ ', with a magnitude of 10 [digits] 48'. In Prussia, Albert Linemann [Albert

Linemann] at 6h, with a magnitude of 20' or 25', [digits] 11 [digits] 30'. At Stettin, [Lorenz Eichstad] at 6h 2', [digits] 10 [digits] 0' — as Linemann reports from memory four centuries later [recte: *quadrennio*, four years later]. [Recte: the source reads 4. *ſæculari* but the sense plainly requires "four years later"; transcribed as printed.] At [Keckermann? — see note] [Keuhelius] [?] (Goes) [recte: *dæ D. Keuhelius*] at 5h 30', [digits] 10 [digits] 20'. At Aix-en-Provence [Gassendi] saw it at [digits] 8 [digits] 10', or 16', and a mid-eclipse of 5h 45', gathered from the phases at 5h 45' — and he refers to it in *Epicurus*, p. 889. At Paris, [Petavius], Roberval, Mydorge, Hardy [?], noted a mid-eclipse at 5h 23', [digits] 9 [digits] 34'. Blaeu [Blesi D. Beaunius — possibly "Blesius" / De Beaune] [?] at 5h 17', [digits] 8 [digits] 30'. At Flexis [Fleche?] [?], the Fathers Deirennes, Battier [Batterus] and Furnerius [?], as he records here in Book 12, chap. 17, observed a maximum eclipse of 5h 18½'. At Rome, [Bertus] [D. Bertus] and Fr. Kircher [Athanasius Kircher] at 6h 10' or 16', [digits] 8 [digits] or 8½ [digits]. In Canada, Fr. [Agathangelus] the Capuchin, at the Residence of the Conception, observed [digits] 4, at 10h 15' in the morning. Fr. Agathangelus the Capuchin, at Cairo, saw no part of the Sun obscured. [Origanus] [David Origanus], at Frankfurt, gathers it by the Prutenic Tables at 5h 54', [digits] 8 [digits] 52'; by the Tychonic, 5h 59', [digits] 10 [digits] 40'.

40. In the year 1645, on August 21, [Gassendi] at Paris observed the beginning...

[The following entries — the bodies of nos. 40, 41, and 42 — are completed in the right-hand column of this folio, beneath the running header *DE LVNA*, and continue around the tabulated observations.]

observed the solar eclipse at 10h 4' p.m., as night fell — as he reports in *Epicurus*, p. 889. At Majorca, [Vicenç Mut] saw its beginning, the Sun being high, at 57° 38' from sunrise, and its end, the Sun also being high, at 62° 20'. At Reims, as Fr. Jacques Billy [P. Jacobus Billy] writes, the mid-eclipse was observed 58' before noon. At Bologna we saw it at 31' p.m., [digits] 4 [digits] 30'. At Rome Fr. Daniel Bartoli [Daniel Bartoli] noted the beginning at 52' before noon. At Prague Fr. Theodorus Moretus, S.J., observed [digits] 6, adding that at Alderbach, on the Danube, [it was] 10' p.m. The mid-eclipse appeared of a saffron color, [digits] 5 [digits] 45'. At Danzig [Hevelius] observed mid-eclipse at 12h 42' after midnight, and, the arc being computed, [digits] 5 [digits] 45'. [Origanus] [David Origanus], at Frankfurt, elicits, by the Prutenic Tables, a mid-eclipse at 1h 2' p.m., [digits] 7 [digits] 23'; by the Tychonic, 30' p.m., [digits] 5 [digits] 24' — but reduced to the Nassau Strait [Fretum Nassovium] by the Prutenic, [digits] 12 [digits] 4'; by the Tychonic, 10 [digits] 38'. [Andrea Argoli], at Rome, gathers from the Danish Tables

a mid-eclipse at 28' after noon, [digits] 4 [digits] 19'. [Montebruno] [Montebrunus], at Bologna, from [Lansbergen], [digits] 35' p.m.

41. In the year 1649, on November 4, [Hevelius], at Danzig, observed the maximum of a solar eclipse at 3h 14½' p.m., [digits] 5 [digits] 45'. Fr. Theodorus Moretus, at Kostelec in Bohemia, noted the beginning at 5h 15', observed mid-eclipse at 2h 3' p.m., [digits] 3 [digits] 33', and [found] the diameter of the Moon to the diameter of the Sun as 4230 to 4150. [Origanus] [David Origanus], at Frankfurt, gives, by the Prutenic Tables, 3h 30', [digits] 5 [digits] 42'; by the Tychonic, 3h 8', [digits] 4 [digits] 44'. [Andrea Argoli], at Rome, from the Danish Tables, 3h 20', [digits] 5 [digits] 19'. [Montebruno] [Montebrunus], at Bologna, from [Lansbergen], 5h 48'.

42. In the year 1652, on April 8, a solar eclipse was observed, in the hours after midnight written below, as is established from the letters [sent] to me, or from the now-published treatises of the observers.

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Dig its D.	Dig its M.
Bologna: Fr. Francesco Maria Grimaldi [Francesco Maria Grimaldi] and I [Riccioli]	10	9	11	37	12	2 9	8	48
Rome: Sr. [Payen]	10	16			12	3 1		
Rome: Sr. Riccardo Alberto, the Englishman [Richard Albert]	10	18			12	3 2		

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Digits D.	Dig its M.
Danzig: [Hevelius]	11	4	12	12	13	1 9	9	20
Danzig: [Lorenz Eichstad]	11	3			13	1 9	10 <i>ferè</i> [about 10]	
Tournai: Govaert Wendelen [Govaert Wendelen]	9	34			11	5 9		
Paris: Fr. Pierre Bourdin [Pierre Bourdin], S.J., before the King of England and the Duke of York, and others	9	30	10	33	11	5 2	10	30
Paris: Ismaël Boulliau [Ismaël Boulliau]	9	30	10	42	11	5 0		
Paris: Jean- Baptiste Morin [Jean- Baptiste Morin]	9	30	10	45				
Paris: others of the	9	29			11	5 2	10	20

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Digits D.	Dig its M.
Society of Jesus								
Digne: Pierre Gassendi [Pierre Gassendi]	9	43	10	50	11	5 8		
Aix-en- Provence: Sr. de Roquefeuille [Roquefeuil le]	9	42	10	42				
The same place: R. Sr. Honoré Gautier [Honoré Gautier]	9	35	10	37	12	1 8		
Avignon: Sr. Pierre- François S. Leger [Pierre- François S. Leger]	9	33	10	50	11	5 2		
Majorca: Sr. [Vicenç Mut], who saw the beginning, the Sun being high, at 36° 32' from							9	47

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Digits D.	Dig its M.

sunrise, the
end, the Sun
also being
high, at 54°
54' from
sunrise;
[digits] 9
[digits] 47'

Calculations

Source of calculation	Beginni ng H.	Beginni ng M.	Maxi mum H.	Maxi mum M.	En d H.	En d M.	Digit s D.	Digit s M.
Paris: [Petavius], from the Parisian Tables	9	4			10	8	11	20
The Philolaic [Tables]: [Boulliau], in the same place	9	13 $\frac{2}{3}$			11	33 $\frac{2}{3}$	10	36
The Danish [Tables] give, in the same place	9	18 $\frac{5}{6}$			11	53 $\frac{2}{3}$	10	44
The Lansbergian [Tables], in the same place	8	52			11	20	10	12
The Rudolphine [Tables], in the same place, from Renieri [Vincenzo Renieri]	8	44			11	44	10	46
At Frankfurt,	9	19	10	42	12	5	11	32

Source of calculation	Beginning H.	Beginning M.	Maximum H.	Maximum M.	End H.	End M.	Digits D.	Digits M.
[David Origanus], by the Prutenic Tables								
— by the Tychonic	10	44	11	51	12	57	8	21
At Rome, [Andrea Argoli], from the Danish [Tables]	9	43	10	58	11	43	7	54
At Bologna, [Montebruno], from [Lansbergen]	9	14	10	40	12	5	9	59

43. In the year 1654, on August 12, they observed a solar eclipse in the hours after midnight.

Observers / Locations	Beginning p.m.n. H.	Beginning M.	Maximum p.m.n. H.	Maximum M.	End p.m.n. H.	End M.	Digits D.	Digits M.
Bologna: We [Riccioli] together with Fr. Francesco Maria Grimaldi	8	54 $\frac{1}{4}$			11	2 1 $\frac{1}{4}$	8	22
Rome: Fr. Bernardino Boghille [?], S.J.	9	15			11	3 0	7	10
Danzig: [Hevelius]	9	25 $\frac{1}{4}$						
Grenoble: Fr. Jacques Billy	8	20	9	23	10	3 0	9	20

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Digi ts D.	Digi ts M.
[P. Jacobus Billy], S.J.								
Avignon: Sr. [Payen]	8	16			10	3 7	9	40
Lyon: Fr. Gneurus [?], S.J.	8	14	9	19	10	3 6	8	21
Lyon, likewise: Fr. de Rheita [Anton Maria Schyrleus of Rheita] the Capuchin	7	45			10	4 3	8	21
Paris: Ismaël Boulliau [Ismaël Boulliau]	8	4 $\frac{1}{4}$			10	2 8 $\frac{2}{3}$	9	15
Paris: Pierre Gassendi [Pierre Gassendi]	8	0 $\frac{2}{3}$	9	13 $\frac{2}{5}$	10	2 6 $\frac{1}{4}$	9	0
Paris: the Fathers of the Society of Jesus	8	4 $\frac{4}{5}$	9	18 $\frac{1}{2}$	10	3 2 $\frac{1}{8}$	9	20
Majorca: Sr. [Vicenç Mut], while his friend, under the meridian of Majorca,	8	17			10	2 7	6	0

Observers / Locations	Beginning p.m.n. H.	Begin ning M.	Maximu m p.m.n. H.	Max imu m M.	End p.m.n. H.	E n d M .	Digi ts D.	Digi ts M.
three leagues distant from Majorca, observed								
In Persia: a Spaniard [Aspani in Perside — "a Spaniard in Persia"], from the report of one of ours	9	45						

Calculations

Source of calculation	Beginni ng H.	Beginni ng M.	Maxi mum H.	Maxi mum M.	En d H.	En d M.	Digit s D.	Digit s M.
At Frankfurt, [David Origanus], gives by the Prutenic [Tables]	9	45	11	10	12	35	11	55
— but by the Tychonic	9	20	10	30	11	42	11	19
At Rome, [Andrea Argoli], from the Danish [Tables]	9	28	11	1	12	30	10	13
At Bologna, [Montebruno], from [Lansbergen]	8	56	10	24	11	57	9	28

44. In the year 1656, on January 26, they observed a solar eclipse in the hours after noon.

Observers / Locations	Beginnin g p.m. H.	Beginni ng M.	Maximu m p.m. H.	Max imu m M.	End p. mer. H.	E n d M .	Digi ts D.	Digi ts M.
Rome: Fr. Urban Davis [Urban Davis], Jesuat, before Cardinal Giovanni Carlo de' Medici [Io. Carol. Cardin. Mediceo]	1	43	2	42	3	5 8	5	0
Rome: Fr. Boghille [?], in some fashion			2	20	3	4 1		
Bologna: I [Riccioli] and Fr. Grimaldi	1	55 52/60 [55%]			3	5 0 ¼	5	36
Bologna: Doctor [Giovanni Domenico Cassini]	1	53½			3	4 8 ⅔	5	20
Ferrara: Sr. Francesco Zeno [Francesco Zeni], the Sun at the beginning being at 22° 18' in altitude, at the end at 8° 3'							5	18
Genoa: Sr.	1	2 33/60	2	17	3	4	6	20

Observers / Locations	Beginnin g p.m. H.	Beginni ng M.	Maximu m p.m. H.	Max imu m M.	End p. mer. H.	E n d M .	Digi ts D.	Digi ts M.
Francesco Vincenzo [Francesco Vincentius]		[2 $\frac{3}{5}$]		1/12		1 $\frac{2}{5}$		
Avignon: Sr. [Payen]	0	37	2	5	3	1 9	5	50
Lyon: from his report	0	45	2	5	3	3 5	6	30
Blois: Sr. Antoine Marchais [Anton Marchais], before the Prince of Orléans	0	9 $\frac{1}{2}$	1	41	3	9	7	50
Paris: Ismaël Boulliau [Ismaël Boulliau]	0	14	1	52 $\frac{1}{2}$	3	1 3 $\frac{3}{5}$	7	50
[Petavius], from the report of these	0	5 $\frac{1}{4}$			3	5 5 $\frac{1}{6}$	7	28

Calculations

Source of calculation	Beginni ng H.	Beginni ng M.	Maxi mum H.	Maxi mum M.	En d H.	En d M.	Digit s D.	Digit s M.
At Rome, [Andrea Argoli], from the Danish [Tables],	1	40	3	14	4	38	8	19

Source of calculation	Beginni ng H.	Beginni ng M.	Maxi mum H.	Maxi mum M.	En d H.	En d M.	Digit s D.	Digit s M.
gives								
At Bologna, [Montebruno], from [Lansbergen]	1	48	3	8	4	21	5	0
At Paris, the Philolaic [Tables] give — and, in the same place, [Boulliau], the difference of the meridians being supposed at 40' between Paris and Frauenburg, whence still some inequality in the lunar motion is suspected	0	25½	1	59½	3	24 ⅔	7	57

45. In the year 1659, on November 14, the beginning of a solar eclipse was observed at Bordeaux at 1h 40' after noon, the maximum of the eclipse at 2h 35', of 9½ digits, the end at 4h 20'. At Bologna we observed the beginning of the solar eclipse at 21h 45' by the clock; at Majorca the beginning was observed at 2h 15', of 9 [digits] 57'.

[The following two sub-tables, for the eclipse of 1659, appear in the right-hand column of this folio.]

Summa Ecl. redijt ad [The summed eclipse returned to]	M		
	H.	.	s.
Dig. 9	1	2 9	0
Dig. 8	1	1 1	4 4
Dig. 6	0	5	1

Summa Ecl. redijt ad [The summed eclipse returned to]		M		
		H.	.	s.
			2	8
	Dig. 4	0	3	4
			6	6
Finis [End]	0 (Dig. 0)	0	6	4
				7

	H.	M.	s.
Total duration [Duratio tota]	2	31	48
Time of incidence [Incidentiae Tempus]	1	9	35
Time of emersion [Emersionis Tempus]	1	22	13

At Ferrara [digits] 9 was observed by Sr. Giovanni Domenico Cassini [Giovanni Domenico Cassini], and at Turin [digits] 8 [digits] 25', with a duration of 2h 32', by the most excellent Lords Giulio Torrino [Giulio Torrino] and his son, before the Princes of the Royal House and an assembly of the nobility.

46. In the year 1661, on March 30, we observed at Bologna — Fr. Francesco Maria Grimaldi and I [Riccioli].

Principal phases / Digits obscured			
	Hours before noon H.	I [minutes]	II [seconds]
Beginning [Initium]	2	38	35
Dig. 4	2	14	11
Dig. 6	2	0	48
Dig. 8	1	46	7

CAPUT XVII.

De Diametris Luminarium Apparentibus idoneis ad repraesentandas Eclipses Solis Totales, & Annulares.

[On the apparent diameters of the luminaries suitable for representing total and annular solar eclipses.]

1. Just as lunar eclipses are eminently serviceable for determining the motions of the luminaries, and at times their diameters, so solar eclipses — total ones, and

especially annular ones — require of the astronomer such a symmetry of the diameters of both luminaries, fitted to the apparent diameter of the Sun and to the anomaly of the Sun and Moon, as the observations of the foresaid eclipses demand. Therefore, to account for annular eclipses, the apparent diameter of the Sun must be greater than the apparent diameter of the Moon at that same moment in each; and that anomaly, which agrees with the motions of both by the tables, [must obtain] at the time of the eclipse. It is not required, however, that the Sun's diameter exceed the Moon's by as much as the doubled width of the little ring, or corona, that appears around the Moon. For part of this phenomenon can arise from the optical enlargement of the Sun's disk, produced by the Sun's rays reflected from the Moon's edge into the air, or into the atmosphere surrounding the Moon.

2. Total solar eclipses, in turn, require, with the anomaly of both luminaries agreeing at the time of the eclipse, that the apparent diameter of the Moon be greater than the Sun's — and the greater, the longer the tarrying of the Sun [mora Solis] in total obscuration shall have been, especially if the eclipse does not occur near the horizon. For that contraction of the Sun — which [Lansbergen] dared to devise to prop up his hypotheses — is supported by no optical foundation. Moreover, although Kepler [Kepler] contends that the stars are seen for a long time [in total eclipse], and that a solar eclipse is not at all total, by contrast a solar eclipse is not seen by everyone, although it be total — for, according to the varying condition of the air, possession of totality is held in doubt, however often observers may assert that the stars were seen by day just as by night. Therefore, if the rest of the necessary safeguards be observed, the diameters of the luminaries can be so commensurate that eclipses of this kind turn out total, and satisfy the observations with greater simplicity and likelihood of truth.

For that reason, as it were to the Lydian touchstone, the diameters of the luminaries are to be tested against the eclipses noted below, by the degrees of anomaly attached in the following little table, or to those nearest them. The *first* column gives the numbers signifying the eclipses, in the same order in which we reported them in the preceding chapter. In the *second* column are the degrees of the Sun's anomaly, which it had at the time of the eclipse. In the *third* column is the apparent [semidiameter] of the Sun, which is most certain for us from what was demonstrated in Book 1, chap. 12. In the *fourth* is the anomaly of the Moon, which it had at the time of the eclipse. In the *fifth* are the limits of the apparent semidiameter of the Moon, necessary for representing the foresaid total and annular solar eclipses. And note that *Ma.* means a *greater*, *Min.* a *smaller*,

semidiameter of the Moon than must be set [for the Sun] — that is, than the solar [semidiameter] expressed in the third column and repeated in the fifth.

Order of Eclipses [Ordo Eclipsium]	☉ Anomaly [Anomalia] Gr.	☉ App. Semidiam. [Semidiam. Appar.] ’	☾ Anom. or dist. from Apogee [Anomal. vel distat ab " Apog.] Gr.	☾ App. Semidiam., it ought to be Greater or Smaller than [Semidiam. Apparēs debet esse Maior, vel Minor quam] ’ ”	
29	175	16	2 7	Min.	1 2 6
4	39	15	2 64 5	Min.	1 3 5 5
21	290	15	4 100 2	Min.	1 4 5 2
27	247	15	5 130 0	Min.	1 5 5 0
20	64	15	4 136 1	Ma.	1 4 5 1
7	135	15	5 140 5	Ma.	1 5 5 5
30	104	15	4 141 9	Ma.	1 4 5 9
13	253	15	3 156 0	Ma.	1 3 5 0
3	300		156	Ma.	1 3 5 8
2	74	15	4 159 3	Ma.	1 4 5 3
12	349	15	3 160 0	Ma.	1 3 5 0
5	216	15	5 169 6	Ma.	1 5 5 6

Order of Eclipses [Ordo Eclipsium]	☉ Anomaly [Anomalia] Gr.	☉ App. Semidiam. [Semidiam. Appar.] ' "	☾ Anom. or dist. from Apogee [Anomal. vel distat ab " Apog.] Gr.	☾ App. Semidiam., it ought to be Greater or Smaller than [Semidiam. Apparēs debet esse Maior, vel Minor quam] ' "
1	359	15	3 170 0	Ma. 1 3 5 0
15	270	15	4 170 6	Ma. 1 4 5 6
6	324	15	3 173 5	Ma. 1 3 5 5

Use of the preceding table. [*Usus praecedentis Tabellae.*]

3. In the preceding table I have preferred, in the fourth column, the order of the Moon's anomaly to the order of the other quantities, because, the Sun's semidiameter having now been fixed for us, it is necessary to harmonize the Moon's semidiameter so that, in the four annular solar eclipses, it is smaller than the Sun's, while in the remaining total ones it is greater — and yet so that the increment, or decrement, due to the Moon's distance from the Earth is preserved. Thus, for example, with the Moon distant from apogee by 140°, its apparent semidiameter ought to be greater than 15' 55", because at the time of the total solar eclipse no. 7 — indicated in the first column — the Sun, distant from apogee by 135° (as is noted in the second column), had an apparent semidiameter of 15' 55" (as it has in the third column). Otherwise that eclipse could not be represented as total. Hence, if you once posit that the Moon's apparent [semidiameter], at an anomaly of 140°, is greater than 15' 55", then in the remaining greater distances from apogee a still greater semidiameter will result, up to and including degree 173. The Moon's semidiameter, at an anomaly [of that magnitude], will turn out greater than the Sun's.

4. Furthermore, on surveying the tables of other astronomers, you will recognize that not all the foresaid solar eclipses can be represented by them all — for

example, in eclipse 4 the Danish, Rudolphine, and Parisian Tables err, because they make the Moon's semidiameter greater than the Sun's at a Sun-anomaly of 39° ; the Moon at 64° exhibits a Moon-semidiameter greater than the Sun's, when an annular eclipse requires it to be smaller. Similarly the following Tables err in the eclipses written below:

In Eclipse	The Tables that err [Peccant Tabulae]
4	Danish, Parisian, Rudolphine
5	Lansbergian
6	Lansbergian
7	Lansbergian
21	Alphonsine, Copernican, Danish, Parisian, Philolaic, and Rudolphine
27	Alphonsine, Copernican, Danish, Parisian, Philolaic, and Rudolphine
30	Lansbergian

Acutely too, the Marquis Cornelio Malvasia [Cornelio Malvasia, Marquis], at fol. 219 of his *Lansbergian Ephemerides*, frequently noted the excess of the ☉ diameter [in the Lansbergian computation], whatever may be the case as to the method employed by Lansbergen himself, and as indicated at fol. 218.

5. We, therefore, have so ordered the semidiameters of the luminaries that, with the observations of the solar semidiameter being safe — those made and set out in Book 1, chap. 12 — and with solar eclipses, both annular and total, [the proportion] due to them would nonetheless be preserved, [derived] from the distance of the luminaries from the Earth and from the horizontal parallax. Concerning, then, the lunar distance and its parallax in the syzygies, we shall speak in the following chapter.

CAPUT XVIII.

On determining the eccentricity of the Moon's orbit, the lunar interval, the parallaxes, and the apparent semidiameters, both by a circle and by an ellipse.

1. Of all the hypotheses of the *prosthaphaeresis* by which the motion of the Moon is reduced to the truth, none answers more closely to the more frequent observations of eclipses than the one that takes as its foundation an eccentricity

of 8686 parts, the whole eccentric semidiameter being 100000 — and accordingly a maximum equation of the first inequality of $4^{\circ}58'28''$. For the apparent semidiameter of the Moon at apogee in syzygies scarcely exceeds $14'30''$, while at perigee it is $16'22''$. According to more accurate and more recent observers, this same distance of the Moon at perigee in syzygies is 58 terrestrial semidiameters and 20', or at most 21' (as I shall show presently); and the distance at apogee is 64 terrestrial semidiameters, or, as some prefer to work it, 63 semidiameters and 40'. Therefore the difference between the maximum and the minimum distance turns out to be twice as small as the whole eccentricity of 8686 parts — namely, the difference between the center of the apparent motions and the center of the lunar orbit.

2. From this I recognize, with Kepler and Magini [Giovanni Antonio Magini] and most others, that an equipoint [*aequans*] must be introduced into the Moon, and that the eccentricity is to be bisected — so that its half, 4343 parts, falls between the center of the Earth and the center of the lunar orbit, and is the foundation of the *Optical Equation*; while the other half, 4343, lies between the center of the mean motion and the center of the orbit — that is, in the elliptical hypothesis it is the other focus, or navel [*umbilicus*] of the ellipse, and is the foundation of the *Physical Equation*. But before the theory of this equation is set out, the foundation of the distances from the Earth and of the parallaxes must be laid down.

3. Accordingly, in the year 1648, on March 8, when the Moon was at full and nearest to perigee, We, together with Father P. Grimaldi [Francesco Maria Grimaldi] at Bologna, took the distance of the Moon's center from the vertex to be $33^{\circ}55'30''$; and then, from the altitude of Spica at its rising one hour after the meridian at $11^{\text{h}}48'34''$, the Moon appeared (but as equated) at $11^{\text{h}}56'$. And then the luminaries stood as follows:

	Sign.	Gr.	'	"
The Moon's true place [<i>Luna Verus locus</i>]	♍	13	29	17
Its equated anomaly [<i>Anomalia eius Aequata</i>]	5	25	29	37
The Moon's northern latitude [<i>Latitudo Boreal. Lunae</i>]	0	4	48	13
Therefore the northern declination [<i>Ergo declinatio Boreal.</i>]	0	10	58	0
Distance of the equator from the vertex [<i>Distantia Aequatoris à Vertice</i>]	0	44	30	10
Therefore the Moon's true distance from the	0	33	32	10

	Sign.	Gr.	'	"
vertex [<i>Ergo Luna vera distantia à Vertice</i>]				
But it was seen [<i>At Visa fuit</i>]	0	33	55	30
Therefore the parallax [<i>Ergo Parallaxis</i>]	0	0	23	20
And the distance from the center of the Earth in semidiameters T. [<i>Et distantia à centro Terrae semid.T.</i>]	58	20	0	
And the horizontal parallax [<i>Et Parallaxis Horizontalis</i>]		58	50	

From this we deduced that at perigee itself the distance of the Moon is 58 terrestrial semidiameters and 20', or 21' — though at other times, beyond perigee, a somewhat larger value has come out for us. Nor should we trust the numbers we deduced when we were using an uncorrected pole-altitude and incorrect positions of the fixed stars. Likewise, through corrected and limited observations, as is fitting, we find the Moon's apogeal distance in syzygies to be rather 63°40' than 64 terrestrial semidiameters — as we shall show at the end of the chapter.

4. Let the measures written below, then, be ratified for us as the measures of the Moon in conjunction $\odot$ and opposition $\oslash$:

	Semidiam. Terrae [Semidiam. of the Earth]		
Eccentricity in parts [<i>Excentricitas partium</i>]	8686		
Half-part [<i>Dimidia pars</i>]	4343		
Mean distance [<i>Distantia media</i>]	10000	61	
	0		
Apogeal [<i>Apogea</i>]	10434	63	40
	3		
Perigeal [<i>Perigea</i>]	95657	58	21
Horizontal parallax [<i>Parallaxis Horizontalis</i>] — Apog.	54		2'
— Perig.	58		58"
Apparent semidiameter [<i>Semidiameter Apparens</i>] — Apogeal	14'		30"

		Semidiam. Terrae [Semidiam. of the Earth]	
— Perigeal		16	22
Maximum equation in $\circ$ $\circ^o$	Gr. 4	58	28
[<i>Aequatio Maxima in $\circ$ $\circ^o$</i>]			

5. With these laid down, let there be described from the center C a semicircle ALP, or a semi-ellipse, by the device I set out in Book 1, Chapter 11, Problem 4. Let T be the center of the Earth, distant from the center of the orbit C by the half eccentricity CT, 4343 parts. And let the point about which the Moon is supposed to move uniformly be F, distant from C, in like manner by 4343 parts, just as AC is 100000 and AP 200000. And let there be, for example, the Moon in L, to which the lines of mean motion FL are drawn, and so on. The true or apparent angle TL will be the angle AFL, measured not under the arcs of this orbit but under the ecliptic. The Moon's anomaly, or prior distance from apogee A — whose complement to two right angles will be the angle LFT — being thus given, the angle so given is given as data.

Diagram. A geometric construction for the lunar orbit. A vertical line on the right runs from A (top) down through F, C, T to P (bottom); to the upper left the point M lies off the line, with L set between M and the vertical, on the curve of the semicircle/semi-ellipse that bulges leftward from A to P. Lines are drawn from M and from F through L.

- A (top of vertical axis): apogee
- M (upper left): auxiliary point on the line of mean motion produced
- L (on the curve): position of the Moon
- F (on axis, below A): center of uniform (mean) motion
- C (on axis, below F): center of the orbit
- T (on axis, below C): center of the Earth
- P (bottom of axis): perigee

I. Problem: To find the Equation in the Ellipse.

6. If, then, you wish to use the ellipse, produce the line LF to M until LM equals LT itself, and join the extremities M and T by the straight line MT. For then will arise the triangle FMT, of which one part is the isosceles triangle MLT — since ML, being made equal to LT itself, and since by the property of the ellipse any two radii drawn from its foci to the periphery, such as FL and TL, taken together are equal to the whole diameter AP. Therefore in the larger triangle AP, that is, in the

triangle CLF, the data are — there will be two sides FT, 8686 parts, and FM, 200000 parts. And the angle MFT, being the complement of the given anomaly, is therefore given. So through the canons of triangles the third is made known — namely the side CR and FR. And the angle FMT, or the half of it, will be 32 — that is, the [equation of the] first elements of the lunar inequality, the integer equation of the first inequality of the Moon, composed from the Physical CLF and the Optical CLT.

II. Problem: To investigate the Equation in the circle.

7. But if you use a circular orbit, the angle FLT, drawn by the radius CL, must be divided in the triangle CLF; and, the half eccentricity CF, of 4343 parts, being given — such parts as the radius CL is 100000 — the angle CLF, one part of the equation, is given. The complement CFL equals the external angle TCL; since therefore CT, 4343, and CL, 100000, are given, the optical part of the equation CLT is to be sought.

III. Problem: To find the Moon's Distance from the Earth in the syzygies.

8. The first method, whether in the circle or in the ellipse, supposes the given eccentricity, and from the anomaly the angle FLT, and the angle of the integer anomaly's complement, namely TFL. For from these data the line LT, the Moon's distance from the center of the Earth T, is found — but only when the angle FLT is greater than a right angle, the rules of trigonometry bid us use its complement to find...

the sines, or the logarithms; whence comes a smaller radius, and since the distance and the radius must be predicted, the radius is the greater. Accordingly, by however much the distance falls short, by so much must one add to the radius to obtain the required distance — the radius being the greater. But this method itself is hindered by the smallness of the angles near apogee and perigee, so that even given a small error in the equation, the distances err by a few seconds, and elsewhere err enormously. For example, if from the equation of the Moon you use $4^{\circ}53'27''$, the distance of the Moon from the Earth comes out as 97013 parts, of which the whole eccentricity is 8686. But if you use an equation of $4^{\circ}53'30''$, the distance of the Moon would yield 96924 parts, smaller by some 89 parts. It is therefore not expedient to use these angles, but only the angles of the whole anomaly and round numbers, to which the sines or logarithms correspond exactly — nor is it of use to seek the proportional part, since at the beginning and the end of the trigonometric canon it is less exact.

9. But in truth, using only the angle of the anomaly and the eccentricity — although the triangle FLT, being oblique-angled, must be reduced to one, or to two right angles; yet, while we cannot abstract the perpendicular angles, we cannot find the distance TL by sines or logarithms immediately, since these canons of trigonometry have not advanced so far that, given two sides of a right triangle, or given the base of a right-angled triangle and one side, we can by sines or logarithms immediately find the third side. We shall therefore have recourse to the squares of their sides, and the roots, and indeed first in the circular form.

10. Let the Moon be in L, where the three straight lines run to three centers — namely LF to the center of the mean motion, and LC to the center of the circular orbit, and LT to the center of the Earth. Then produce LF, until in R it meets the produced [line] out from C, and let it make with this LF a right angle CRF. Likewise let the same LF be produced further to B, until it meets the [line] produced out from T, and let it make with this LF the right angle FBT. Thus arise two right-angled triangles CRF and TBF.

Now in the prior triangle CRF, besides the right angle R, and the base FC of 4343 parts, the angle AFL is given, since it supposes the integer anomaly; and so also is the angle CFR, the complement of AFL, therefore by sines. And so the other angle, namely CR and FR. The square of the radius CL — which is 10000000000 — is to be taken away from the square of the whole side LR, whose root is the square root of the side LR. From this you subtract the found FR found above, the remaining known side LF, the Moon's distance from the center of the mean motion.

11. With these completed, resolve the triangle TFB, right-angled at B, for in it FT, 8686, is given, and from the anomaly the angle TFB is given in whole degrees; whence the side TB is known, and so the other; the side LB, which when added to LF, will give the whole side LB; therefore the sides LB and TB, squared, will be reduced to a single sum; for they will make a certain square, whose root, when investigated, will give the sought distance of the Moon LT — being the base opposite the right angle LBT, by Element 47 of the first book. Hence it is not difficult to understand how the perpendicular is to be drawn in the inferior part of the semicircle.

12. For the Moon, set in L, and the three straight lines LF, LC, LT being drawn as above, draw out C perpendicular to LF, and in the triangle CFR, right-angled at F, the data being CF of 4343 parts and the angle CFR — the complement of the anomaly — find the other side CR and its square; then subtract from the square of the radius CL, for there will remain the square...

Diagram. A geometric figure for the circular construction. A vertical axis on the right runs from A (top) down through R, B, C, T to P (bottom); the point L lies to the left on the curve of the semicircle. Lines connect L to F, R, B, C, T. The interior point F lies near R and B.

- A (top of axis): apogee
- L (left, on curve): position of the Moon
- R (on axis): foot of the perpendicular from C on LF produced
- F (interior, near R/B): center of mean motion
- B (on axis): foot of the perpendicular from T on LF produced
- C (on axis): center of orbit
- T (on axis): center of the Earth
- P (bottom of axis): perigee

13. Nor indeed does it shame me to illustrate the precept of this latter figure with one example.

	Gr.
Let the Moon's anomaly [<i>Sit Anomalia Lunae</i>]	
That is, the angle AFL [<i>Idest Angulus AFL</i>]	140
Therefore the acute angle F [<i>Ergo Angulus acutus F</i>]	40
And FCR, as FTB [<i>Et FCR, ac FTB</i>]	50
Let FC be of parts [<i>Sit FC partium</i>]	4343
Therefore hence RF [<i>Ergo hinc RF</i>]	3327
And CR [<i>Et CR</i>]	2791 62/100
Square of the side CR [<i>Quadratum lateris CR</i>]	7792142
Radius CL [<i>Radius CL</i>]	100000
Its square [<i>Huius quadratum</i>]	10000000000
From which, subtracting the square [<i>Cui subducto quadrato</i>]	7792142
There remains the square of the side LR [<i>Restat Lateris LR, Quadratum</i>]	9992207858
Whose root is the side LR [<i>Cuius Radix est latus LR</i>]	99961

Add RF, it becomes LF [<i>Adde RF, fit LF</i>]	103288
In the triangle BTF, the angle F, of 40 gr. and T, 50 [<i>In Triangulo BTF, Angulus F, gr. 40. & T, 50</i>]	
And FT [<i>Et FT</i>]	8686
Therefore BT [<i>Ergo BT</i>]	5583 25/100
And BF [<i>Et BF</i>]	6654
Side LF [<i>Lateris LF</i>]	103288
Subtract the side BF [<i>Subduc latus BF</i>]	6654
There remains the side LB [<i>Restat latus LB</i>]	96634
Its square is [<i>Cuius Quadratum est</i>]	9338129956
And the square of the side BT [<i>Et Quadratum lateris BT</i>]	31172681
The sum of these squares [<i>Summa horum Quadratorum</i>]	936932637
Is the square of the side LT [<i>Est quadratum lateris LT</i>]	
Its square root is [<i>Eius Radix Quadrata est</i>]	96795

So great, then, is the Moon's distance LT, namely 96795 parts, such as the eccentric radius is 100000.

14. But in order to fulfill the promise I made at the end of number 4, I select two of our observations made at full Moon with the Moon near apogee. The first was in the year 1645, May 10. The hour, from the altitudes of the fixed stars, appeared 11h53'52" after the meridian; but equated, 11h48'. The conditions of the Moon then were such — the distance of the Moon's center, meridian, from the vertex, with the refraction computed, being 58°53'40":

	Sign.	Gr.	'	"
The Moon's place in the ecliptic [<i>Locus Lunae in Eclipt.</i>]	♌	22	35	40
Equated anomaly [<i>Anomalia Aequata</i>]	11	29	45	0
Northern latitude [<i>Latitudo Boreal.</i>]	0	4	58	22
Therefore southern declination [<i>Ergo Declinatio Austr.</i>]	0	13	37	15

	Sign.	Gr.	'	"
Distance of the equator from the vertex [<i>Distantia Aequatoris à vertice</i>]	0	44	30	10
Therefore the Moon's true distance from the vertex [<i>Ergo » vera dist. à vertice</i>]	0	58	7	25
But it was seen [<i>At visa fuit</i>]	0	58	53	40
Therefore the parallax [<i>Ergo Parallaxis</i>]	0	0	46	15

And hence the distance from the center of the Earth, 63 terrestrial semidiameters and 39' [*Et hinc Distantia à centro Telluris semidiametrorum terrestrium 63.39*].

15. The second was in the year 1646, June 27. For the hour, equated, was 11h55'35" after the meridian. The Moon's center passed through the mid-heaven, and we observed its distance from the vertex, with the refractions removed, as 66°26'40". The remaining conditions of the Moon were as follows:

	Sign.	Gr.	'	"
The Moon's place in the ecliptic [<i>Lunae locus in Eclipt.</i>]	♊	4	52	40
Equated anomaly » [<i>Anomalia » Aequata</i>]	11	25	34	15
Northern latitude [<i>Latitudo Borealis</i>]	0	2	16	55
Therefore southern declination [<i>Ergo declinatio Austr.</i>]	0	21	7	10
Distance of the equator from the vertex [<i>Distantia Aequatoris à vertice</i>]	0	44	30	10
Therefore the Moon's true distance from the vertex [<i>Ergo » vera dist. à vertice</i>]	0	65	37	20
But it was seen [<i>At visa fuit</i>]	0	66	26	40
Therefore the parallax [<i>Ergo Parallaxis</i>]	0	0	49	20

And... [*Et*]

Diagram. A geometric figure for the perpendicular drawn in the lower part of the semicircle. A vertical axis on the right runs from A (top) down through F, C, T to P (bottom); the point L lies to the left, with R and B nearby on the interior. Lines connect L to F, R, C, T.

- A (top of axis): apogee
- L (left): position of the Moon

- R (interior, upper): foot of perpendicular
- B (interior): point on LF
- F (on axis): center of mean motion
- C (on axis): center of orbit
- T (on axis): center of the Earth
- P (bottom of axis): perigee

And hence the distance of the Moon from the center of the Earth is 63 terrestrial semidiameters and 47'. Yet we put more trust in the earlier observation, inasmuch as the Moon was then situated almost at the very apex of apogee; and so we chose the distance of 63 semidiameters 40'.

CAPUT XIX.

On the True Magnitude of the Moon.

1. Since at the Moon's distance of 59 terrestrial semidiameters the apparent semidiameter of the Moon is precisely 16' when the Moon is distant from apogee in syzygies by $14\frac{1}{2}^\circ$, and when it is distant from the Earth by $63\frac{1}{2}$ terrestrial semidiameters, and existing at apogee, it has a semidiameter of $14'48''$, and at perigee $16'12''$ — thus, as observations of solar eclipses, both annular and total, require, after long and elaborate work, we hold that the true semidiameter of the Moon is such as the semidiameter of the Earth is 60. The true semidiameter of the Moon, then, is $16\frac{1}{3}$. But from our *Reformed Geography* the terrestrial semidiameter is $4673495\frac{3}{4}$ paces of the ancient Romans; therefore the semidiameter of the Moon is 1285210 such paces, and the diameter 2570420. But if the diameter of the Earth be taken as 100, the diameter of the Moon will be $27\frac{1}{2}$ of such parts — a little larger than we put it in the *Almagestum Novum*, Book 4, Chapter 27, where we put it at $26\frac{2}{3}$ of such parts. By this proportion, therefore, the remaining measures of the Moon, and of its shadow [*Umbra*], which we set down there, are to be corrected.

CAPUT XX.

On the Latitude of the Moon, the Anomaly of this Motion, and the Reduction of the Moon to the Ecliptic.

1. Besides what we said in Chapter 14 about the motion of the nodes, their mean anomaly, and the equation, we accept the Tychonic, and exhibit it in the tables. We suppose the maximum latitude in syzygies to be 5° , or, as a minimum, $4^\circ58'$ — nearly agreeing with the Tychonic, which in the quadratures is $5^\circ18'$, according to

Book 4 of the *Almagestum Novum*. There too we expound the theory of the latitude in Chapter 12. We expound the maximum latitude of the Moon in Chapter 29, and the reduction of the Moon from its orbit to the ecliptic in Chapter 30. Consult, then, those chapters, lest we be here uselessly prolix in re-treating what has been treated.

BOOK THREE

IN WHICH

LUNAR OBSERVATIONS OUTSIDE OF ECLIPSES

For the Monthly Inequality of the Moon, and for its Variation and Libration.

CAPUT I.

Ancient Lunar Observations outside of Eclipses, from the year 295 before Christ down to the year of Christ 509, with respect to the Places of the Moon in the Heavens.

1. In the year 36 of the first Callippic period, on the 25th day exactly elapsed; or — in Posidonius's reckoning, the month of Nabonassar Phaophi 16, the following day 17 — at the equated hour of 3 hours 24 minutes after midnight, at Alexandria, Timocharis [Timocharis] saw the Moon touching with its northern edge the Northern star of the Front of Scorpius. Ptolemy [Ptolemy], *Almagest* VII.3, says that the Moon was in truth in Scorpius $1^{\circ}41'$, with northern latitude $1^{\circ}20'$, but that it appeared in Scorpius $2^{\circ}0'$, with latitude $1^{\circ}12'$ — which place he assigns to the Moon, and the star to itself.

Lansbergen [Lansbergen], in the *Thesaurus of Lunar Observations*, Class 7, asserts that Ptolemy was deceived: for the culminating degree at Alexandria was $1^{\circ}20'$ of Leo, and the hour from midnight was 2h 30m. He says that the Moon, together with the star, was below the horizon, but seen above it by benefit of Refraction; and that the Moon's true place was in Scorpius $0^{\circ}47'7''$, with northern latitude $1^{\circ}16'49''$, though its seen place was in Scorpius $1^{\circ}38'33''$; and that the latitude of the star Front of Scorpius was $1^{\circ}7'16''$. He further says that the apparent place of the Front of Scorpius was in Scorpius $1^{\circ}26'29''$, with latitude $1^{\circ}15'$. Having therefore computed the Moon's semidiameter as touching the star, [he proceeds]. But Ptolemy says it culminated in the middle of the sign of Leo, and Timocharis says the beginning was at the *tenth* temporal hour, whereas Lansbergen says *Read ninth* [*Lege nona*]. [Margin: *Lansbergen's deceit.*]

This is surely to want to drag the observation to the standard of one's own Tables, and not the Tables to the standard of the Observations. Moreover, that year preceded the vulgar Epoch of Christ by 295 current, and the days [were] 20; on the following 21st of December. [Margin: *Lansbergen's trustworthiness undermined.*] Longomontanus [Longomontanus], however, *On the First Theory* I, chapter 2, says the corrected hour was 3h 30m, and the seen place of the Moon Scorpius $1^{\circ}58'$.

2. In the same year 36 of the first Callippic period, on the 15th of Elaphebolion; or — in the year of Nabonassar 454, Tybi 5, the following 6, beginning at hour 3 — at Alexandria, Timocharis saw the Moon with its extremity, which was toward the eastern rising, reach the Spike; it passed through; Spica separated a third part of the Moon's diameter exactly to the North. Ptolemy, *Almagest* VII.3, says that this was at hour 4 equated before midnight, and that the Moon's true longitude was Virgo $21^{\circ}21'$, with southern latitude $1^{\circ}50'$; but that it was seen in Virgo $22^{\circ}12'$, with latitude $2^{\circ}0'$ — which he likewise attributes to Spica.

Lansbergen, in the *Thesaurus of Observations*, Lunar Class 7, gathering from his own Tables the conjunction of the Moon with Spica after the meridian at hour 8, concludes that the Moon's true place was Virgo $21^{\circ}13'21''$, its seen place Virgo $22^{\circ}3'21''$; and the true latitude $1^{\circ}47'43''$, the seen latitude $1^{\circ}55'15''$. But for a third of the Lunar *diameter* he afterwards employs a third of the *semidiameter* — inconsistent with himself and at odds with Timocharis. That year was before the Epoch of Christ 294, on the following March 9.

3. In the year 47 of the first Callippic period, on the 8th day of Anthesterion; or — in the year of Nabonassar 465, Athyr 29, the following 30, at the end of the third hour — at Alexandria, Timocharis saw the middle of the southern part of the Moon brought to the third part, or to the middle, of the following part of the Virgins. Ptolemy, *Almagest* VII.3, says that this was at the equated hour 3h 30m before midnight, and the true place of the Moon in Taurus $0^{\circ}20'$, with northern latitude $3^{\circ}45'$; but its seen longitude was Moon and star in Aries $29^{\circ}20'$, with latitude $3^{\circ}40'$, very nearly.

Lansbergen, Class 7. He observes that that star is the eastern one of the Pleiades, and the true place of the Moon was in Aries $29^{\circ}55'8''$, but seen in $29^{\circ}8'50''$; and the true latitude $3^{\circ}57'$, the seen $3^{\circ}51'$. That year was before the Epoch of Christ 284, on the following January 29, then 30. Longomontanus, *On the First Theory*, chapter 2, says the hour was 3h 20m, and the seen place of the Moon in Aries $29^{\circ}32'$.

4. In the year 48 of the first Callippic period, on the day of Pyanepsion 6, at hour 9 and a half elapsed, at Alexandria, with Timocharis observing, Spica was seen exactly touching the northern part of the rising side of the Moon above the horizon. Ptolemy, *Almagest* VII.3, says that this was in the year of Nabonassar 466, and the day Thoth 7, the following 8, at the equated hour 2h 30m after midnight; and the true place of the Moon in Virgo $21^{\circ}30'$, with southern latitude $2^{\circ}10'$; but its seen place, and that of Spica, in Virgo $22^{\circ}30'$, with latitude $1^{\circ}15'$; but Spica at $2^{\circ}0'$. Timocharis, however, reported it at hour 4h 7m.

Lansbergen, Class 7. He observes — he gathers from his own Tables the Moon's true place in Virgo $21^{\circ}21'35''$, seen at $22^{\circ}26'47''$; and the true latitude $2^{\circ}20'3''$. But the longitude of Spica he gives as Virgo $22^{\circ}12'21''$, with latitude $2^{\circ}0'$. That year was before the Epoch of Christ 283, on the following November 8, then 9.

Longomontanus, however, *On the First Theory* I, chapter 2, in his Commentary on the Fixed Stars, says the corrected hour was 3h 54m, and the seen place of the Moon in Virgo $22^{\circ}40'$.

5. In the year 50 of the third Callippic period, on the day with the first hour begun and 40 minutes elapsed, Hipparchus [Hipparchus] at Rhodes observed the Moon to be distant from the Sun in the preceding direction by $86^{\circ}15'$. Ptolemy, *Almagest* V.3, says that this was in the year of Nabonassar 620, Epiphi 16, and at the equated hour after the meridian 17h 45m at Rhodes — which is nearly that of Alexandria — and that the Sun was in Leo $9^{\circ}8'20''$; but not in degree $8^{\circ}35'$, as Hipparchus supposed; and that the Moon was in the first quarter. Lansbergen, in the 2nd Class. He observes — he reckons the Sun in Leo $8^{\circ}18'31''$, the Moon in Taurus $12^{\circ}2'52''$, and so the distance $86^{\circ}15'$; but since Ptolemy says the Moon was distant from the maximum longitude of the Epicycle by $257^{\circ}47'$, of which the complement is $102^{\circ}13'$, and that in that situation it is at the maximum of inequality according to the Epicycle — Lansbergen nevertheless says the Moon departed from the eccentric Perigee by 81° , and there occurs nearly the maximum inequality of the Moon. That year was before the Epoch of Christ 128, on August 5, the following 6.

6. In the year 197, at the death of Alexander the Great, on the 11th day of Pharmuthi beginning, at hour 2, Hipparchus at Rhodes observed the Sun in Taurus $7^{\circ}45'$. But the Moon was in Pisces $21^{\circ}40'$ — which truly was in $21^{\circ}43'$ — and so the true distance from the Sun, with respect to longitude, was $314^{\circ}43'$. Ptolemy, *Almagest* V.5, says that this was in the year of Nabonassar 621, at the equated hour 18 after the meridian of day 11 of Pharmuthi, and the middle

distance of the Moon from the Sun $314^{\circ}28'$; and from the maximum of the Epicycle longitude $185^{\circ}30'$.

Lansbergen, in the 3rd Class of Lunar Observations, says the hour was 6h 20m after midnight, and gathers the place of the Sun in Taurus $7^{\circ}40'31''$, and the Moon in Pisces $21^{\circ}23'35''$. That year was before the Epoch of Christ 127, and the days 2 May, the following 3.

7. In the same year 197, at the death of Alexander, on the 17th of Pauni, at hour 3h 20m, at Rhodes, Hipparchus observed the Sun in Leo $29^{\circ}20'$ very closely, but the Moon in Cancer $10^{\circ}54'$. Ptolemy, *Almagest* V.5, says that this was in the year of Nabonassar 621, and at the equated hour 4 after midday, and the distance of the Moon from the Sun $48^{\circ}6'$; but from his own Tables he places the Sun in degree $10^{\circ}40'$ of Cancer. Copernicus [Copernicus] uses this [data], Book IV, chapter 10.

Lansbergen, Class 3. He observes — he gathers the place of the Sun in Cancer $10^{\circ}36'32''$, the Moon in Leo $28^{\circ}42'38''$. That year was before the Epoch of Christ 127, on July 7, the following 8.

8. In the year 12 of Domitian, on the 7th of the month Metroüs beginning, at hour 3 of the night, in Bithynia, Agrippa [Agrippa] saw the Moon with its southern horn occulting the following, Southern part of the Virgins. Ptolemy, *Almagest* VII.3, says that this was in the year of Nabonassar 840, on the day 2, Tybi the following 3, and at the equated hour at Alexandria 5h 20m before midnight; and the Moon by its true motion was in Taurus $3^{\circ}7'$; but in Bithynia $3^{\circ}15'$ apparently, and there too was that star, with northern latitude $3^{\circ}40'$. That year was of Christ 92, on November 30, the following [day].

Lansbergen, Class 7. He observes — he says that this was in the year of Christ 92, and in the months of the leap [bissextile] year 10, and the day 28, and at hour 7h 0m, apparently in Bithynia, the true place of the Moon in Taurus $2^{\circ}25'$; but seen in $2^{\circ}39'31''$, with northern latitude $4^{\circ}21'37''$ — and the star in Taurus $2^{\circ}39'24''$, with northern latitude $3^{\circ}51'$.

9. In the year 1 of Trajan, Menelaus [Menelaus of Alexandria] at Rome, on the day Mechir 15, the following 16, at the exact hour 10, saw Spica of the Virgins entirely covered by the Moon, for it was not visible; but at the end of hour 11 it was seen, in the foregoing manner, distant equally from the centre of the Moon by the horns, but by less than the Moon's diameter. Ptolemy, *Almagest* VII.3, adding that this was in the year of Nabonassar 845, at the equated hour $6\frac{1}{2}$ after midnight at Alexandria, but at Rome 5, and the Moon was in Virgo $25^{\circ}45'$, with southern

latitude $2^{\circ}0'$ — as much as he attributes to Spica also. That year was of Christ 98, on January 10.

Lansbergen, Class 7. He observes — he says that this was in the year of Christ 98, on January 10, the following 11, and at hour 16, apparently at Rome after the meridian. The true place of the Moon was Virgo $25^{\circ}45'29''$, seen $25^{\circ}54'16''$, the true latitude $1^{\circ}22'15''$, seen $1^{\circ}59'49''$; and the longitude of Spica was Virgo $26^{\circ}1'36''$, with latitude $2^{\circ}0'$.

10. In the same year, and on the day 18 of the month, at the eleventh hour of the night ending, Menelaus at Rome saw the southern horn of the Moon in a straight line with the middle, and with the southern part of the Front of Scorpius; but the centre of the Moon truly fell short of that straight line, by as much as the middle was distant from the southern [star], and the Northern of the Front of Scorpius was covered, since it was nowhere to be seen. Ptolemy, *Almagest* VII.3, adding that this was at the equated hour after midnight, the following 6h 10m at Rome, but at Alexandria 7h 30m; and the Moon was in Scorpius $5^{\circ}20'$ apparently, but its true latitude Northern $2^{\circ}10'$; seen at $5^{\circ}55'$; and as the seen places he gives those of the Front of Scorpius, Northern.

Lansbergen, Class 7. He observes — he says that this was in the year of Christ 98, on January 12, the following 13, at the apparent hour at Rome 18; and the Moon's true place was in $5^{\circ}19'52''$, seen $5^{\circ}[?]26''$; and the true northern latitude $2^{\circ}11'22''$, seen $1^{\circ}25'26''$; and that star in Scorpius $5^{\circ}24'36''$, with northern latitude $1^{\circ}15'$.

11. In the year 20 of Hadrian, on the 13th of Athyr, at hour 5h 50m, with the Sun equally setting in Libra $5^{\circ}28'$, Ptolemy at Alexandria, with the Parallactic Rules, observed the meridian distance of the Moon from the vertex to be $50^{\circ}55'$, when it was in Capricorn $5^{\circ}10'$; and from this the true distance was $49^{\circ}48'$; he inferred a *parallax* of latitude $1^{\circ}7'$, *Almagest* V.13, just as in V.12, when the Moon was at the beginning of Cancer he observed the Moon in the Meridian distant from the vertex by $2^{\circ}8'$. Copernicus uses this, Book IV, chapters 15 and 16. The year of Christ was 135, October 1.

12. In the year 2 of the Emperor Antoninus, on the 25th of Phamenoth, in the morning at hour 5h 15m before midday, with the Heaven midway in Sagittarius 4° , Ptolemy at Alexandria, with the Astrolabe, observed the Sun in Aquarius $18^{\circ}50'$, and the Moon in Scorpius $9^{\circ}40'$; and so it was distant from the Sun in longitude $99^{\circ}10'$. Ptolemy, *Almagest* V.3, adds that the Moon lacked a perceptible parallax. The year was of Christ 139, of Nabonassar 886, on the day 9, then 9.

Lansbergen, Class 2. He observes — he places the year of Nabonassar 886, and the Sun in Aquarius $18^{\circ}46'18''$, the Moon in Scorpius $9^{\circ}46'31''$.

13. Again of Antoninus, on the 9th of Pharmuthi, Ptolemy at Alexandria (as he has it, *Almagest* VII.2) observed the Moon distant from Regulus, that from this the place of Regulus might be deduced; but the motion was such that this observation seems useless to me, and proceeds by too uncertain a path; yet they use it.

Lansbergen, in the *Thesaurus*, Class 7, in order to conclude the position of Regulus from the centre of the Moon, in consequence falls short by $57^{\circ}10'$, as Ptolemy and Bullialdus [Boulliau], *Astronomia Philolaica* V, chapter [?], suppose the same distance, and, the parallaxes subtracted, gather the place of the Moon in Gemini $6^{\circ}31'56''$, and conclude that Regulus was in Leo $3^{\circ}42'$. That year was of Nabonassar 886, of Christ 139, the day 23 February.

14. In the year 192 of Diocletian, on the 21st of Athyr, Thius observed that the Moon had got in front of the upper Star of Venus, and was in Capricorn 13° from the Sun, distant from the Sun by 48° . Thus from a manuscript of the Library of the Most Christian King, Bullialdus, Book 3, chapter 12, brings it forth, who says this was in the year of Christ 475, November 18; and he supposes the observation to have been made at Athens at hour 5h 15m after the meridian, and he confirms the conjunction of the Moon with Venus from his own Tables.

15. From the same manuscript, Bullialdus in the same place reports, in the year 225 of Diocletian, Phamenoth 15, the following 16, *after the lamps are lit* [*post accensas lucernas*], that is, at first dusk after the withdrawal of twilight,

it was seen that the Moon followed the bright Hyad by one digit, up to falling short by a half: but it appeared that the Moon itself occulted it, since the Star indeed was placed at the part by which it was bisected, by the very edge of the illuminated Moon; and the Moon, near its true motions, was in Taurus $16^{\circ}30'$. So he observed. Bullialdus subjoins that this was in the year of Christ 509, March 11. And at Athens was observed the emergence of the Eye of Taurus a sesquihour after the setting of the Sun, at hour 7h 20m after the meridian, there; and as the place of the Moon — its true place from his own Tables he gathers in Taurus $20^{\circ}30'26''$; but it was seen in $19^{\circ}52'45''$, the true southern latitude —, whence he concludes that the prior observation was made the more quickly, since the time of the first phase does not square with a sesquihour after the setting of the Sun, but the Eye of Taurus was in $18^{\circ}45'32''$ of Taurus. He adds that it is impossible that the Moon truly occulted the Eye of Taurus. But he is mistaken; for since at the beginning of the night the Moon was now more eastern, were the Hyad the Palilicium [Palilicium], by the semidigit, when the Moon was in Taurus at degree

18°46', it could visibly — and it was able to occult the star with a greater parallax than Bullialdus employs, depressing the Moon toward the setting around the sixth hour after the meridian.

CAPUT II.

Lunar observations of Johannes Regiomontanus [Regiomontanus], Bernhard Walther [Bernhard Walther], Nicolaus Copernicus [Copernicus], and Abraham Zacuto [Abraham Zacuto], with respect to the places of the Moon outside of Eclipses, From the year of Christ 1462 to 1524.

1. In the year 1462, on January 11, Regiomontanus at Rome, at the beginning of the night, when the Moon was seen high at 61°15', and Sirius at 14°30', and Procyon 24°50', saw the Moon distant equally from both, the eye [placed] toward the Eye of Taurus, by as much as the Eye of Taurus is distant from the 13th of the Hyades.
2. In the same year, on January 12, with Sirius high at 26°40', and Procyon at 40°20', the same one, in the same place, saw the Moon joined to the star 19 of Taurus, that is, the extreme of the Southern horn, with respect to longitude, but it seemed more northern by 24 minutes, and that star seemed distant from the southern edge of the Moon by a fourth part of its visual diameter.
3. In the year 1462, on March 21, Regiomontanus at Rome saw the Moon in the Meridian high at 23°, and Jupiter likewise in the Meridian high at 24°30'; and then the Heart of Scorpius [Antares] high at 17°15', and the Moon, with Jupiter and with 7 of Sagittarius, was in one straight line.
4. In the year 1474, Abraham Zacuto, professor of Astronomy at Salamanca, observed Spica, and the application of the Moon to it, in the degree of Libra 17°10', as his pupil Augustinus Riccius [Agostino Ricci] reports in his book *On the Motion of the Eighth Sphere*, chapters 46 and 47.
5. In the year 1478, October 20, Bernhard Walther at Nuremberg, at hour 3½ before the rising of the Sun, saw the Moon distant toward the North from Regulus by about a semidegree; but at hour half before the rising of the Sun, the Moon, near the middle of the Heaven, seemed distant from Regulus by 1°52'.
Lansbergen, Class 7. With the refractions of the Lunar Observations computed, accelerating the rising of the Sun, he says that the prior observation was made at hour 3h 31m after midnight, and the Moon, from his Tables, was in Leo 23°8'10", but apparently in 23°58', with true northern latitude 1°35'. He places Regulus then

in degree $23^{\circ}8'41''$, and so [it was] then conjoined with the Moon — for Bernhard says that distance was [of] latitude.

6. In the year 1482, on January 12. *A second observation half an hour before the rising of the Sun*, says Walther, *the Moon was eclipsing Saturn*; for at that time it was not visible, and beforehand, and after, I noted the *positions written below*. *Since the Moon had been in the last*

quarter, or thereabouts, it certainly was failing at the western part, and when first it was looked at, namely about $2\frac{3}{4}$ hours before the rising of the Sun, Saturn had been more eastern, and as it appeared more southern than the Moon, distant by two Moons; afterward clouds intervened, so that I could not discern the beginning; but I judged it for certain that the Moon had taken Saturn by its southern horn. But after I saw it again, Saturn was distant in diameter by about two digits, or thereabouts, from the northern horn, and so it appeared in turn that it returned: it now passes the middle of this Heaven. At the very time, when I judged the middle of this Eclipse, I took the altitude of the Moon, existing nearly in the Meridian, and I found 32° . Which thing — namely that the Moon first took Saturn by its southern horn — does not seem possible, considering the path I set out above, namely that the Moon first took Saturn; but this indeed evidently appeared, that Saturn was distant in diameter from the Moon at the northern horn by two digits, or it ceased thereabouts. Kepler [Kepler], in the *Astronomia Optica*, page 409, weighed this observation, showing that it was done by the force of the parallax of the waxing of the latitude, and that Saturn, which had thus been more Meridional, afterward became so much nearer to the northern horn, that — wondrous to say, and impossible — it was seen by Walther by the bare motion of latitude.

7. In the year 1486, October 21, in the morning, with Walther observing, the Moon began to cover Regulus, high toward the rising at degree $45'$ [recte: gr. 45° ?]. For it was touching it at the edge. But the exit it was not possible to see, the air being disturbed. So my codex. But Lansbergen, Class 7 of the Lunar Observations, has *the day 20*, and says the hour was 17h 6m after the meridian of day 19, and the Moon was then in Leo $22^{\circ}29'$, but apparently in $23^{\circ}3'25''$, with true northern latitude $0^{\circ}46'10''$, but seen $17'5''$; and Regulus in Leo at degree $23^{\circ}13'44''$, with northern latitude $31'$; but since the Moon's semidiameter was $17'41''$, and added to the latitude it lifted the northern horn of the Moon to $34^{\circ}46''$ [?], it was able to cover Regulus. [Margin: *Lansbergen's error.*]

8. In the year 1487, February 28, Walther has it thus: *At hour 7h 52m after the meridian, namely while the Moon was in the middle of the Heaven, it had latitude*

47 degrees in altitude, and the Great Dog, namely Alhabor, at $23\frac{1}{2}$ in altitude after the meridian, was touching the Moon at its southern horn, the most Northern of the Pleiades. I wonder, therefore, whence Lansbergen, in the *Thesaurus*, and Class 7 of the Lunar Observations, in observation 3, says: *In the year of Christ 1487, when the meridian altitude of the Lesser Dog (not of the Moon) was 47° , Walther observed, &c. The Moon at its southern horn was touching the most Northern of the Pleiades.* Was the Great Dog [Alhabor] perhaps changed into the Lesser Dog? or was the Moon transformed into the Lesser Dog? Moreover, from his own calculation it was more northern. The Pleiades in Taurus $22^\circ 55'$, with northern latitude 4° ; the seen place appearing in Taurus $22^\circ 47'$, with latitude seen $4^\circ 45'$.

9. In the year 1497, Copernicus, as he himself relates Book IV, chapter 27, at Bologna, on the Ides of March, after the setting of the Sun observed the Moon about to occult the bright Hyad, or Palilicium; he saw the Star applied to the part of the Lunar body in shadow, and now disappearing between the horns of the Moon, at the hour nearer indeed to the southern horn, by about a third part of the Lunar diameter. He adds that Palilicium was in Gemini $2^\circ 52'$, with southern latitude $5^\circ 10'$; and so the centre of the Moon appeared to have preceded the Star by half a diameter, and so the seen place of the Moon was in Gemini $2^\circ 36'$, and in latitude $5^\circ 2'$ nearly, but the true place of the Moon in Gemini $3^\circ 24'$, with latitude $4^\circ 35'$; but that then the Moon was distant from the Pole of the Horizon by degree 84.

Hence Lansbergen, Class 7. He observes — he says the hour was 10h 45m from the meridian, but he assumes the altitude of the pole at Bologna [to be] $43^\circ 54'$, when it is $44^\circ 30' 20''$; whence his calculations are corrupted, from which he gathers the seen place of the Moon in Gemini $3^\circ 0' 45''$, with latitude seen southern $5^\circ 30'$; which latitude he assigns to Palilicium, with longitude in degree $3^\circ 15'$ of Gemini.

10. In the year 1522, on the fifth before the Calends of October, at hour 5h 40m after midday, Copernicus at Frauenburg, with the parallactic Rules, observed the distance of the Moon from the vertex [to be] degree $82^\circ 50'$; and, computing from his Tables the true distance of 82 degrees, he deduced the true parallax of altitude to be 50 minutes; thus he, Book IV, chapter 16.

11. And in the year 1524, on the seventh of the Ides of August, at hour 6 after the meridian, the same one in the same place observed the distance of the Moon from

from the vertex $81^{\circ}55'$; but from the calculation it comes out as $80^{\circ}55'$. From this he infers a parallax of 1° . So Copernicus, *De Revolutionibus* IV.16.

CAPVT III.

Tycho's Lunar Observations outside Eclipses, selected with regard to the places of the Moon.

1. In the year 1582, on 25 February at hour $4:2\frac{1}{2}$, Tycho [Tycho Brahe] observed with armillary instruments the western limb of the Moon in Pisces at $26^{\circ}3\frac{1}{2}'$; and from this he computes the place of the Moon's center to be in Pisces 26° . [Margin: Octans 1.] It is, moreover, recorded in the observations recently published at Vienna under the care of Lucius Barretus [Albert Curtz] — that is, *Albertus Curtius* of the Society of Jesus, who enclosed his own name in an anagram — where many other [observations] are likewise contained, but most of them are azimuthal, and not of much precision, as Tycho himself in the end acknowledged. Besides, the times were frequently noted by rotary clocks, which are subject to error; and so I have selected only a few.
2. In the same year, on 26 February at hour $1:37'$, [Tycho] observed the western limb of the Moon in Taurus $9^{\circ}55'$ [as it became] visibly [visible], when the altitude of the upper limb was $48^{\circ}56'$ toward the west; and at hour $2:13'$ he saw the same western limb in Taurus $10^{\circ}10'$, the upper limb being at $51^{\circ}26'$. From this he concludes that the Moon had traversed a space of $33'$ in the interval. He computes the [correction made by] $15'$.
3. Likewise in the year 1582, on 26 February at hour $7:20\frac{1}{2}$, from the Tychonic observations the upper horn of the Moon was seen to be distant from Aldebaran $23^{\circ}12\frac{1}{2}'$, and at that time this horn was seen to be at an altitude of $35^{\circ}15'$; and at hour $7:25\frac{1}{2}$ the same horn was seen to be distant from the Lucida of the Head of Aries [α Arietis] $12^{\circ}18'$, when it was seen at the same altitude of $32^{\circ}36'$.
4. In the year 1582, on 28 February at hour $4:36'$, the Moon was seen at the 90th degree from the Ascendant, and its [upper limb] [Margin: $\square$] was at an altitude of $58^{\circ}16\frac{1}{2}'$, in azimuth from the meridian toward the rising in the east by $14^{\circ}11'$.
5. Again in the year 1582, on 5 March at hour 11, the Moon being situated near the nonagesimal, its limb stood nearer [and] was distant from the heel of Gemini $46^{\circ}51\frac{1}{2}'$, when [the heel] was seen at an altitude of $43^{\circ}40'$; and at

hour 11:5' it ceased to be distant from Regulus 8°25', when [Regulus] was seen at an altitude of 43°20'.

In the year 1587, in January, Tycho exhibits three observations of the Moon in the *Letters to the Landgrave of Hesse*, page 59, together with the Alphonsine and Copernican calculation, as below:

Day of January	H. p.m.	M.	Moon	Longitude — Sign	G r M . .	Latitude — Gr.	M . / B	A
6	9	6:5 8	Observ ed	♐	1 0 ½	4	2 8	A
			Alphon sine		2 0	3	4 9	
			Copern ican		1 4 5	3	5 0	
7	14	13: 40	Observ ed	♑	1 3 0 9	5	5 5	A
			Alphon sine		9 5 9	4	2 4	
			Copern ican		1 6 0	4	2 3 ½	
8	15	15: 5	Observ ed	♑	2 3 5 8 ½	4	1 9	A
			Alphon sine		2 3 4 4	3	3 9	
			Copern ican		2 4 4 2	3	3 8	

But because the Moon had been observed near the nonagesimal from the Ascendant, and the observed longitude coincided with the true longitude, therefore only the discrepancy of the observed latitude from the true latitude — that is, the parallax of latitude — is noted, as below.

[Margin: Parallax.]

January Day	9 — Gr.	M . 14 — Gr.	M . 15 — Gr.	M .
Observed Latitude	4	2 5 8	5 4	1 9
True Latitude of the Moon	3	5 4 9	3 3 5	4 6
Parallax of latitude	0	2 0 9	3 0 0	3 3

9. In the same year 1587, on 18 August at hour 17:25' a.m., Tycho observed the true place of the Moon in Gemini 26°23'; so he himself, *Progymnasmata* vol. 1, ch. 1 — but *Longomontanus*, [*Astronomia Danica*] I.6, puts it at 21½.

10. In the same year, month, and day, at hour 7:25' a.m., he observed the Moon in quadrature [□], and its true southern latitude as 5°13'15". Tycho, in the same place.

11. In the year 1592, on 12 February at hour 8:12', Tycho observed the true northern latitude of the Moon as 16'5"; *Progymnasmata* vol. 1, ch. 1. In the year 1594, in the month of December, Tycho at Uraniborg observed the longitudes and true latitudes of the Moon written out below, which Kepler exhibits before the Ephemeris for the year 1617, page 13, adding that it is most difficult to represent all of them by a tabular calculation.

Decembris — D.	H . M.	Longitude	MS (Sig . . n)	Latitude (Austral/Boreal) — Gr.	A M/ . B
12	1 4:0 0	6	4 4 ♀ 7 5	3	3 A 8
13	1 5:6 1	19	2 4 ♀ 0 0	2	1 A 8
14	1 8:3 4 4	29	5 2 ♂ 0	1	6 B
15	1 9:5 5 6	13	1 5 II 3 0	2	1 B 9
16	2 3:5 0 0	13	4 3 ♀ 9 0	4	2 B 7
17	2 6:0 1	29	4 3 ♀ 4 0	3	5 B 9

Decembris — D.	H . M.	Longitude	» — Gr.	MS (Sig . . n)	Latitude (Austral/Boreal) — Gr.	A M/ . B
18	2 6:3 2 0	14		2 4 𐌆 8 5	3	2 B 8
19	2 7:3 3 6	29		2 5 𐌆 7 0	2	2 B 4
20	2 9:4 6 0	12		3 2 𐌆 0	2	1 A 5
21	2 10: 7 10	25		2 0 𐌆 6	2	1 A 5
22	2 7:4 8 5	7		5 2 𐌆 0 0	3	1 A 1

Boulliau [Ismaël Boulliau], in his *Astronomy* [*Astronomia Philolaica*] III.12, reduced [these] to the mean time of Uraniborg by a calculation adduced from the Tables, in order to exhibit that Variation which the Tychonics ascribe to the Moon in the octants from the syzygies and the quadratures — [maintaining that it is] not always of the same magnitude. He is worthy to be consulted.

23. In the year 1595, on 18 February at hour 5:43' a.m., the true northern latitude of the Moon was observed to be 5°20" by Tycho, as *Progymnasmata* vol. 1, ch. 1 has it.

24. In the year 1596, on 4 January at hour 11:43' p.m., the southern latitude of the Moon was observed to be 4°31', but the true [latitude] 4°59'3", Tycho observing; *Progymnasmata* vol. 1, ch. 1.

In the year 1600, on 10 April, old style, at hour 7:27½, Tycho at the fortress of Benátky near Prague observed the western limb of the Moon to be distant from Regulus 18°19'; and at hour 7:45½' after midday, distant from Procyon 21°18½'. From this he concludes that on 10 April at hour 7:32½ the Moon was in Leo 6°20'22", with southern latitude 1°33'40", as Snel [Willebrord Snel] reports in the *Bohemian Observations*.

CAPVT IV.

Several Lunar Observations of Kepler, Lansbergen, and Longomontanus outside Eclipses, from the year 1598 to 1608.

1. In the year 1598, on 29 March, old style, Kepler [Kepler] at Graz in the evening at hour 8 saw the Moon joined to the western [stars] in the quadrilateral of the Pleiades in such a way that it receded no more than a sixth part of a lunar diameter from the nearest [star]; but it was distant from the bright [lucida] of the Pleiades [by] the breadth of its [the Moon's] body — for the Moon was three days old, tending toward apogee. Kepler, *Astronomia Optica* [*Paralipomena ad Vitellionem*], page 347. Lansbergen [Philips van Lansbergen], in his *Thesaurus*, Class 7, observed: the Moon, from his own tables, is found in the Pleiades in Taurus $23^{\circ}35'$, with northern latitude $4^{\circ}12'$; and the bright [lucida] of the Pleiades in Taurus $24^{\circ}23'$, with latitude $4^{\circ}6'$; and the more northerly Pleiad in Taurus $24^{\circ}2'$, with latitude $4^{\circ}29'$. But the seen place of the Moon in Taurus was $23^{\circ}43'16''$, with northern latitude $4^{\circ}31'57''$. [continues p. 156]
2. In the same year, on 17 July, old style, Kepler in the morning between hours 2 and 3 saw the Moon, with its horns turned away from the Pleiades, so that, [a line] drawn perpendicular [and] from the lower horn, it would graze the Pleiades from above. The Moon had already passed beyond the Pleiades — indeed, beyond the brightest of them — and was distant by more than a Palilician [the distance of Aldebaran]; that is, from the nearest [star] by little less than a [span], with the horns turned toward the rising [in the east], [the Moon] thus passing across the Pleiades. So [Kepler] writes, *Astronomia Optica*, page 347.
3. In the year 1600, on 26 March, old style, Lansbergen at Goes observed the Moon equally at the meridian, distant from the Sun in consequence $89^{\circ}50'$; he judged it to be in Aries $1^{\circ}25'$, and the Sun in Cancer $1^{\circ}15'$, near the nonagesimal, where the seen longitude does not differ from the true [longitude]. But because the Moon was at the eccentric perigee 82° , near which the place is computed in his *Thesaurus*, Class 2, where the tables he uses present [the matter] thus: he himself in his *Thesaurus* finds the Moon's place in Cancer $1^{\circ}15'$, with northern latitude $2^{\circ}18'47''$. He makes no mention of parallax. [Margin: Parallax.]
4. In the same year and day — indeed, at the same hour 6 — at midday at the meridian, [Lansbergen] there [observed] the Moon's meridian altitude of

the upper limb [to be] $64^{\circ}7\frac{1}{2}'$; and because he puts the semidiameter of the Moon at $16\frac{2}{3}'$, therefore he supposes the seen [altitude] of the center to be $64^{\circ}7\frac{1}{2}'51''$ [recte: 64° ? — the printed value chains as $64.7\frac{1}{2}.51$ and the seconds reading is ambiguous], and the true [altitude] to have been $64^{\circ}17\frac{1}{2}'$; and therefore, the altitude diminished, the seen [altitude] of the center [to be] $26^{\circ}30''$, that is, in his *Thesaurus*. [Margin: Parallax.]

5. Likewise in the year 1600, on 26 March, old style, Lansbergen at Goes observed the Moon at the meridian, distant from the Sun in precedence [in antecedentia] $96^{\circ}36'$, because the Sun was seen in Aries $16^{\circ}19'$, and the Moon in Capricorn $10^{\circ}3'$, when it was in degree 89 from the eccentric apogee. From this, and from other observations, he contends that the maximum difference occurs when the Moon is at dichotomy distant from the eccentric apogee 98° ; and that it amounts to no more than $7^{\circ}28'$, as Tycho holds — but he himself [puts it at] $7^{\circ}40'$. So he observed in his *Thesaurus*, Class 2.
6. In the year 1600, on 17 August, new style, Kepler at the border of Styria and Hungary, beneath the pole at $47^{\circ}24'$, in the evening saw the Moon, an hour before its own setting, joined with the heart of Scorpio [Antares]: for it entered with the heart of Scorpio in the more northerly part, so that [it was] almost a third part of the section [that] projected above [the heart], and [the part] hidden below differed but little from a straight line. The Sun was in Leo 2° , yet [the Moon] was seen much broader than that little star [the heart of Scorpio], inasmuch as it intercepted the brighter part of that section, lucid above and [by reason of] the larger remaining part placed beneath. Kepler, *Astronomia Optica*, page 117. Lansbergen, in Class 5 of his Lunar Observations, supposes the Moon there to have been at hour 7:40' at the meridian: at occultation [hour] 8:50', and at egress [hour] 9:40'; and from this, from his tables, he gathers the place [at hour] 8:[?], to have been seen in Sagittarius $4^{\circ}29'$, with true southern latitude $3^{\circ}42'$; the place seen [at hour] 8:17½, with latitude truly southern $3^{\circ}[?]2'$; but the heart of Scorpio in Sagittarius $4^{\circ}30'23''$, with southern latitude $4^{\circ}26'$.
7. In the year 1601, on 29 November, old style, Lansbergen at Goes at hour 11:15' after midday observed the meridian altitude [of the Moon] $61^{\circ}23'$, [and] compared it with the true [value] $61^{\circ}55\frac{1}{2}'$; he sets out the parallax of altitude $0^{\circ}32''$, adding [that] the observation is certain, because [it was] made not many hours [removed] from the very aspect of the section's dichotomy, since the shadow of the Moon at perigee, vividly illuminated by

a higher dioptric instrument, could be discerned in the dioptric instrument set in a lower plane. Lansbergen, in Class 5 of his Lunar Observations. [Margin: Parallax.]

8. In the year 1602, on 26 September, old style, Lansbergen at Goes observed the Moon's meridian altitude $59^{\circ}39'$, and judged it to have been $60^{\circ}12\frac{1}{2}'$; and therefore the parallax of altitude $33'30''$; and because the shadow of the Moon was seen [there]... Lansbergen, Class 5 of his Lunar Observations. [Margin: Parallax.]
9. In the year 1602, on 21 December, new style, in the evening, [Lansbergen] says (Kepler, in his *Astronomia Optica*, page 237) that, not having regard to the quadrature hour, the Moon: "I see [it]," he says, "in dichotomy at an hour and a half after the sixth past midday; but because I had come to the determination of the dichotomy [late]" — for the Sun was in Capricorn $9^{\circ}29'30''$ — "from this I conclude the delineation of the waxing and waning of the Moon [is] such as Albategnius [al-Battānī] teaches in his chapter 51."
10. In the year 1603, on 14 March, old style, Kepler, contemplating the new phasis of the Moon, saw the entire circle of [the Moon] illuminated, [and] that it was deficient at no semicircle. This, however, he demonstrates in his *Astronomia Optica*, page 345: that the Moon's diameter, for the most part, is greater than the Sun's diameter as seen [visualis], and therefore that the whole Sun can be covered by the Moon. [Margin: Diameter.]
11. In the year 1608, on 12 February, old style, Lansbergen at Goes, a third of an hour after the seventh hour of the evening, saw the Moon enter with its dark part into the Palilician [Aldebaran]; the more northerly star of the Moon's center, by a quadrant [dodrans], [was] nearly a semidiameter [from] the Pleiades. So I write, [Lansbergen], Class 5 of the Lunar Observations, where, from his tables, he computes the true place of the Moon in Gemini $4^{\circ}15'$, with latitude seen $4^{\circ}15'52''$; and with northern latitude truly seen $5^{\circ}10'43''$; and the place of the Palilician [Aldebaran] in Gemini $4^{\circ}23'48''$, with southern latitude $5^{\circ}30''$.
12. Likewise in the year 1608, on 12 February, old style, Longomontanus at Hafnia [Copenhagen] in the morning at hour 8:43' observed the conjunction of the upper horn of the Moon with Aldebaran, when the Moon was nearly at quadrature and had withdrawn from the middle course; this same conjunction was seen at Wittenberg at hour 8:46', as Melchior Levitlinus writes; and Longomontanus reports [it] in his

Astronomia Danica I.6, where, from his tables, he computes the longitude of Aldebaran in Gemini $4^{\circ}16'20''$, with southern latitude $5^{\circ}31'$; and the true place of the Moon in the ecliptic [in] Gemini $4^{\circ}16'48''$, where he gathers the parallax of longitude greater than $30'$, since the apparent [place] had been $4^{\circ}16\frac{2}{3}'$ of Gemini, and the seen latitude to have been nearly $5^{\circ}47'$.

Lansbergen, Class 7, observed: he says the Lunar [observation] at Hafnia to have been at $8^{\circ}36'$, not $43'$, because Hafnia he supposes more easterly than Goes by $11^{\circ}15'$, that is, from the place of the Palilician [Aldebaran], or [from] Aldebaran [it] differs from Longomontanus by $7\frac{1}{3}$. Boulliau, in his *Astronomia Philolaica* III, retains [the value] $8^{\circ}43'$ in his narration, because nevertheless the Sun was in Pisces $3^{\circ}42'44''$, and the Moon was at $39^{\circ}45'$ apparent [recte: gr. $45'$? — the printed " 39.45 " runs the degree and minute together; reading ambiguous]; whence he gathers the true altitude $49^{\circ}35'$; therefore he gathers the hour $8:36'$, and, time added, the equation $11'7''$; the mean time at Hafnia [being] hour $8:47'$, at which time, from his tables, he gathers the true place of the Moon in Gemini, with true latitude $5^{\circ}12'43''$, but seen [latitude] $5^{\circ}44'4''$ southern; he adds [that] the Moon had not yet, by the quadrature, reached perigee, as had been supposed nearly $5^{\circ}47'$.

13. Afterward, subjoining the observation of the same conjunction, [Longomontanus] reports it as made by his father in his own *Inniodunum* [Lange's farmstead] at hour 7 in the evening, when the Moon began to occult Aldebaran — "of which conjunction," he says, "we were ourselves a witness when the other limb of the Moon appeared next to the star." He adds [that] the altitude of the pole at Inniodunum is $48^{\circ}1'$; and from his tables [he holds] the occultation to have begun there at hour $6:54'$, the end indeed to have been at hour $7:54'$, and the true place of the Moon [in] Gemini $4^{\circ}31'$; but [as for] whether [the matter] itself is seen, if one pleases, by a manifold practical calculation. [Margin: □]

CAPVT V.

Lunar Observations outside Eclipses by Boulliau, Gassendi, Hevelius, Hodierna, Hortensius, Michael Florent van Langren, and Vicenç Mut, from the year 1623 up to the year 1653, with regard to the places of the Moon.

1. In the year 1623, on 5 July, Boulliau at Paris, at hour $9:30'$ after midday, [observed] Spica occulted by the Moon at an altitude of $17^{\circ}7'$; the Moon being at an altitude of $17^{\circ}20'$. Boulliau, *Astronomia Philolaica* III, ch. 10. He

says that on that occasion Spica was in Libra $18^{\circ}34'$, with southern latitude $1^{\circ}59'$, and the true place of the Moon in Libra $18^{\circ}35'10''$; and the center of the Moon... [continues p. 157]

the latitude of the Moon as seen he held to be $1^{\circ}46'$, the parallax of latitude $59'50''$; and the true latitude $46'10''$. He had observed the center [of the Moon] from the bright northern [star] Spica, distant $1^{\circ}5'$.

2. In the year 1624, in September, Michael Florentius Langrenus [Michael Florent van Langren], cosmographer to the Catholic King, at Brussels, when the equator culminated at the meridian, [observed] the Eye of Taurus [Aldebaran] at $35^{\circ}1'10''$; he saw the Oculus Tauri [Aldebaran] left behind at the dark margin of the Moon. So [Langren] in letters written to me, as I noted above. [Margin: □]
3. In the year 1626, on 3 February, Michael Florentius Langrenus at Brussels, the equator culminating, [observed] the Moon at an altitude of $45^{\circ}12'$; he saw the eleventh [degree] of Taurus, which is above the nose, covered by the dark part of the Moon, and in that very instant a wind arose, [a thing] most difficult, [such] as scarcely anyone has ever excited [discerned], who put a stop to the hour, about... So [Langren] in letters written to me, by himself.
4. In the year 1627, on 22 February, Michael Florentius Langrenus saw the Eye of Taurus [Aldebaran] emerge from the part of the Moon a little higher than the middle of the Caspian spot [Mare Crisium], or [the Sea] of the Caspian Crisium; perpendicular minutes [being] $10\frac{1}{2}'$; Sirius transiting the meridian, from which he gathered [it] to have culminated at hour $9:7'21\frac{3}{4}'$. So [Langren] himself in letters written to me.
5. In the same year 1627, on 18 February, old style, Martinus Hortensius [Maarten van den Hove (Hortensius)] at Leiden at hour $5:36'$ after midday saw, by a telescope, the Heart of the Lion [Regulus] distant from the limb of the Moon by about two lunar digits, or at that time by minutes $5\frac{1}{2}'$; but the center of the Moon [was] more easterly than Regulus, according to longitude, by lunar digits $10\frac{2}{3}'$, and southerly by digits $6'$, [or rather] truly by minutes [recte: digits] $19'$. Lansbergen, in his *Thesaurus*, Class 7 of the Lunar Observations.
6. In the year 1627, on 17 February, Gassendi [Pierre Gassendi] at Digne at hour $10:30'$ after midday, [the] tail of the Lion [being] at its setting at an altitude of $25^{\circ}13'$, saw, by a Basilican [Regulus] telescope, that it touched

the eastern limb [and] the dark part [with] the lower horn, through about a quadrant of the Moon. Boulliau [*Astronomia Philolaica*] III, ch. 12, and Gassendi himself in his *Epicurus*, page 901. But Boulliau takes it thus: the quadrant of that [limb], as the Basilican [Regulus] stood distant from the center of the Moon at its setting, [up] to the highest minute 11'; and therefore he places the Moon's place in Leo 24°59', [and] the true [place] of the Moon in degree 24°55'; and Gassendi saw it to be in degree 24°27'·1", observing it at hour 7:32'. But he prefers this observation, made by telescope, to that made by the naked eye at occultation at hour 9:35', because by the splendor of the Moon the occultation of the Basilican [Regulus] appears sooner to oneself than [it] truly happens. But Gassendi judged he understood the place of the Moon as the one distant from Regulus at its setting, not from the distance of Regulus at occultation, but from the situation by which the Moon touched Regulus.

7. In the year 1633, on 14 February, Gassendi observing at Digne at hour 11:30', the Moon nearest [to] the fully fashioned dichotomy on its obscure part, and at the twentieth or twenty-fifth obscure minute of the limb, beneath the lowest horn the star preceding the most projecting [one] in the tail of Aries; Gassendi in his *Epicurus*, page 902.
8. In the year 1634, on 30 December, Boulliau at Iuliodunum [Jonzac?] near the Pictones [Poitou] in the evening at hour 5:42', [observed] the other [star], Aldebaran, [at] 32°42'; he saw the bright [star] of the Pleiades occupy the margin of the obscure Moon [at] the inferior limb [by] minutes 4'. Boulliau, *Astronomia Philolaica* III, ch. 12, who adds that that star was in Taurus 24°52', with latitude southern 4°8', and the place of the Moon as seen in Taurus 24°18 $\frac{2}{3}$ '; the true [place] in degree [Taurus] 24°17'·53", with latitude as seen northern 4°8'·21"; the true [latitude] in degree 4°45'·48".
9. In the year 1635, on 23 January, [Gassendi] observing, Michael Florentio Langreno [Michele Florenzio Langreno] at Brussels [observed] the Moon occulting Taygeta of the Pleiades, when the equator culminated at degree 132°55 $\frac{2}{3}$ '; and the Sterope of the Pleiades culminating at degree 138°11 $\frac{1}{2}$ '. So [Langren] in letters written to me. But [it was] Taygeta itself, [the] star 33, in southern Taurus, at Bayer [Bayer]. [Margin: □]
10. In the year 1635, on 26 August, Gassendi at Digne saw the Moon, near full moon, approach beneath the preceding star of the two in the tail of Capricorn at the very part of its limb internal, that is, [the part] near the [region] of the spot which we have in our *Almagest* [the *Almagestum*

Novum] noted. Hevelius [Johannes Hevelius] so concludes from the things said by Gassendi in his *Epicurus*, page 902.

11. In the year 1636, on 25 November, in the same [year], Michael Florentio Langreno [Michele Florenzio Langreno] at Brussels observing, when the equator culminated at degree $345^{\circ}8'$, [observed] the knee of the Twins [Gemini] emerge from the limb of the Moon in a line drawn through the mountain Guthschovii [and] Moret, distant from the Moret mountain by as much as Moret is distant from Eugenia.

In our *Selenographia* — that is, in our [own *Almagestum Novum*], the *New Almagest*, lib. 4 — is set forth Guthschovius [as] Ariadaeus, and Moretus, Proclus, and Eugenia Vitruvius.

12. In the year 1637, on 29 March, at Paris in the evening at hour 8:19', Boulliau observing — [the Moon] indeed near sextile of Gassendi — saw Aldebaran [at] degree $20^{\circ}55'$; that is, at hour 8:43'·36". The Moon constricted [strinxit] [it], that is, [the Moon] occulted the angle of the four [quadrilateral] of the Pleiades a quadrant of its southern [part]; for that day the bright [star] of the Pleiades, in the preceding [part], [was] entering at the middle of the bright [star] [from] the angle of the Corner of the Lunar [limbs] from the southern cusp, [it] being seen at hour 9:26'. The Moon occulted the star [at] the angle of the southern limb of the Moon, [at] about the seventh [part] from the southern cusp; and at hour 9:40'. The star at the angle was occulted [and] emerged a little beneath the middle of the Moon, near [the middle] toward the north, nor either so distant [from] the limb [as] more than a dotted [hundredth] of a minute. The Moon occulted at hour 9:54' the bright [star] of the Pleiades [at] three sevenths of the obscure limb; from the southern cusp it emerged 8'; the angle of the northern [limb] emerged [at] the bright [star], one minute beyond — and so distant as 8" — from the bright limb; [the star] which lay in the middle near the angle [at] the northern cusp, and [at] the Sea of the Spot of the Crisium [Mare Crisium], Boulliau in his *Epicurus*, page 902. He adds: Boulliau [*Astronomia Philolaica*] III, ch. 12, at Paris [observed] the highest margin impending over the northern angle of the Pleiades, higher [than] that 8', and in the same azimuth [it was] to have been at that time in Taurus, by the degree $24^{\circ}55'28''$; and at the occultation [at] quadrature in degree $24^{\circ}22'28''$; and the occidental [setting] at quadrature in Taurus $24^{\circ}22'28''$; truly indeed in degree $24^{\circ}56'22''$.

13. But Michael Florentius Langrenus, on the same year and day, on 29 March, at Brussels saw Maia occulted by the Moon, or the more northerly Sterope of the Pleiades, when the equator culminated at degree $140^{\circ}29\frac{2}{3}'$; and the most northerly Asterope of the Pleiades, [the] seventh culminating at degree $152^{\circ}9'18''$; and Electra, that is [at] the angle of the western [limb] culminating at degree $161^{\circ}56'18''$; he reckons the intervals of the temporal [moments] by the oscillations [of the pendulum] perpendicular, or he himself wrote it to me.
14. Likewise in the year 1638, on 14 January, Gassendi at Digne in the evening saw at hour 7:21', the bright [star] of the Pleiades transit near [the] preceding angle of the quadrilateral of the Pleiades, [at] the western angle, nor either so distant [as] more than the tenth part [of] the diameter of the Moon. At hour, indeed, 7:31', [it] touched the southern angle [with] the obscure limb, by about four [of] the parts of the eastern southern [cusp at] the same southern cusp boreal. At hour 8:21', the southern angle emerged, distant from the limb obscure [by] one [of] the twelfth [part] of the diameter of the Moon; and [at] three of the [parts] of the same limb, about a seventh from the northern cusp distant — in the meantime [it] touched the eastern Pleiad. At hour 9:19', the bright [star] of the Pleiades emerged, distant [from] a third of the limb obscure boreal [by] one [of] the diameter of the Moon; and the third [part] of the limb boreal [by] one [of] the diameter of the Moon; the most southern Pleiad emerged [at] degree $10^{\circ}20'$; the most eastern Pleiad emerged from the bright limb, distant; and either part [at] 48 [of] the diameter of the Moon: Gassendi in his *Epicurus*, page 902, and Boulliau [*Astronomia Philolaica*] III, ch. 12, concerning which [I have spoken] in the end of the following observation.
15. Likewise in the year 1638, on 11 December, Boulliau observing at hour 4:37' after the middle of the night, [saw] the Moon, in the part eastern, occult the dark limb [of] the western [star]; [it was] that [star which is] at the extreme pede [foot] of Castor, anteceding [preceding] the other, which lies at the foot of the preceding Twin [Gemini] of Gassendi in his *Epicurus*, page 902. Boulliau likewise [*Astronomia Philolaica*] III, ch. 12. He reports, as Gassendi observed, [that the star is] in Gemini $7^{\circ}3'$ at hour 8:5'; he reckons the place of the Moon as seen [to have been] beneath the fifth [cusp] from the boreal cusp. From this he gathers the center of the Moon to be a fifth minute distant from the star, in longitude existing in Taurus degree $24^{\circ}56'18''$; and so the place of the Moon as seen [to have been] in

Taurus $24^{\circ}51'18''$; and [with] true latitude in degree $4^{\circ}55'$; seen in degree $5^{\circ}44'48''$.

16. In the year 1639, on 13 February, in the same sextile, Gassendi observing the transit of the Moon over the preceding of the two [stars] in the foot of Gemini, at degree $7^{\circ}45'$, having indeed [the Moon at] $10^{\circ}19'$; he noted [that] the [two stars] which were in the same line met [in] longitude, distant [by] minutes 1", from the obscure horn; and so [the place of the Moon] in degree $5''$. Boulliau [*Astronomia Philolaica*] III, ch. 12, [says] this star was in Gemini $7^{\circ}5'$, observing the true place of the Moon in Gemini $28^{\circ}48'48''$; and the parallax in longitude to fall as $5'48''$, [with] latitude $5'22''$.
17. In the year 1639, on 7 April, Boulliau at Paris, [the] high [star] Procyon [being] at degree $33^{\circ}52'$, that is, at hour 9:8', saw the Moon [at] the limb obscure...

Caput V (continued) — Selected lunar observations outside eclipses

18. In the year 1641, on April 13, Boulliau [Ismaël Boulliau] at Paris observed at sunrise that, with the Moon's eastern horn toward the setting point, hour 24 [recte: of the preceding civil reckoning], the fifth-magnitude star which lies in the origin of the northern horn of Gemini was occulted by the lower horn — this being the Tychonic [reading]. The Moon occulted, with two fifth-magnitude stars somewhat obscured from the lower horn, and the Moon's latitude was northern, $46'$. The center of the Moon was 4° distant from the preceding [star] of Gemini, in $4^{\circ}13'$; whence by Boulliau, lib. 3, cap. 12, where the star is said to have been in Capricorn, gr. 29, $5'$; with the latitude seen, Bor. gr. 4, $41'$; and from this the Moon's place is seen in Capricorn $29^{\circ}40'54''$, with the latitude seen gr. 4, $8'$. Bor. & Parallax, longitude $9'13''$, latitude $32'$.

19. In the same year 1641, and in the month of April, Michael Florentius Langrenus [Michael Florent van Langren] at Brussels observed the eye of Taurus in a straight line with the maculae, which he himself culminated in his *Selenographia*, with the equator at $149^{\circ}26'$. As I have it in writing addressed to me.

20. In the year 1641, on June 24, Boulliau at Paris, also toward sunset, Arcturus gr. $41^{\circ}37'$. He saw the third-magnitude star which lies lower in the horns of Capricorn next to its margin; whence by Boulliau, lib. 3, cap. 12, the star is said to have been in Capricorn gr. 29, $5'$; with the latitude seen Bor. gr. 4, $41'$; and from

this the Moon's place is seen in Capricorn gr. $29^{\circ} 40' 54''$, with the latitude seen gr. 4, 8'. Bor. & Parallax, longitude $9' 13''$ [recte: $9' 13''$], latitude $32'$.

21. In the year 1643, on October 2, with Markab in the meridian of Brussels, Michael Florentius Langrenus observed the eye of Taurus in a straight line with the maculae which he himself in his *Selenographia* calls Promontorium Bæri, and Mons Bæri, so that the eye of Taurus would be a little more remote from Mons Bæri than Promontorium Clavij is distant in the same Bæri. Thus he wrote in his letters. With us, in our *Selenographia*, Mons Bæri is called Hercules, [the place] distant; the latitude is in the macula, the particular of 7, since the lunar diameter appears to be 200. And so the eye of Taurus is then more western, and at egress from the Moon.

22. In the year 1643, on November 10, at hour 7, at midnight, Johannes Hevelius [Johannes Hevelius] at Danzig saw with the telescope the last Phase of the aged Moon, the day before the conjunction in 2 gr. of Scorpio (*Selenographia*, cap. 44).

23. In the year 1643, on November 26, at hour 11 after noon, Johannes Hevelius at Danzig saw the Moon decrease in its horns by the opposite movement; nor more than 30 hours after the flux it had already sensibly decreased; the telescope showed [it]. (*Selenographia*, cap. 27.) Here he refuted Biancani [Giuseppe Biancani] and Argoli [Andrea Argoli], thinking this decrement by no means double, since indeed it can be discerned by opposition on different days. And he learnedly demonstrates that it does not always appear from the lower limb of the Moon when this decrement appears.

24. In the year 1644, on April 13, at hour 9 after noon, Hevelius at Danzig observed the Moon in the first quadrature, in the chart cap. 23, around the maximum Libration, and yet the lines of the sections separate the obscure parts from the luminous, notably differing at a determined center of the tenth lunar day, by that part of the lunar diameter. Which he himself attributes to libration, cap. 18 (*Selenographia*). But to this concurs the equation of parallaxes.

25. In the year 1644, on October 8, at hour 7 after noon, Hevelius at Danzig observed the Moon before the true quadrature, of which the lines of the sections separate notably; it would exceed the center of the lunar disk, so that it would already appear in much greater [degree], the seventh lunar day having been completed (*Selenographia*, cap. 18).

26. In the year 1644, on November 13, Hevelius at Danzig observed the eclipse of Palilicium [Aldebaran] by the Moon, beginning to be occulted at hour 3, minute 5; at the middle of the eastern limb; emerging at hour 4, 5'; above the middle of the

western limb, & hour 4, 10' ½. Palilicium distant from that limb, in the duodecimal parts of the lunar diameter (*Selenographia*, pag. 472).

27. In the year 1645, on April 5, on feast-day 5, hour 8, in the evening, Hevelius at Danzig saw the first Phase of the Moon, the other after [continues].

A new full moon, with the Moon in Taurus, the sign of long descensions, and in Perigee, and in maximum austral latitude, elapsing toward the conjunction with the Sun at hour 42 (Hevelius, pag. 278, *Selenographia*).

28. In the year 1645, on October 8, Hevelius at Danzig observed the eclipse of Palilicium by the gibbous Moon, beginning to be covered at the eastern limb, the dimidiation [half-disk] of the limb also remaining; at the other higher limb gr. 38, 48'; it is here at 1, 47'; nevertheless at night, an emersion at the middle of the western limb above the bright shoulder of Orion gr. 38, 45'; namely hour 2, 57'; & the line seen most assuredly from the lower center of the Moon, to which time the middle of the Tychonic [reading] would have been; it was hour 1, 14'; hour vero 3, 30'. The Moon arrives at the nonagesimal of the Ecliptic (Hevelius in *Selenographia*, pag. 473).

29. In the year 1645, on November 17, Hevelius at Danzig saw the aged Moon's last phase at hour 27, before the conjunction; for the Moon was turned in gradu 13 Scorpio; and in maximum northern latitude (Hevelius, *Selenographia*, cap. 43).

30. In the year 1645, on December 2, with the Moon in Perigee & in opposition to the Sun, the eastern limb being occulted; the Moon high & rising gr. 43, 30'; from the southern limb, so that the middle of the western limb, rising in the west, would emerge higher gr. 49, 28'; D. Vicenç Mut [Vicenç Mut] at Majorca observed; & wrote it out to me.

31. In the year 1647, on April 8, D. Vicenç Mut at Majorca, with the high Auriga toward sunset gr. 35, 14'; that is, hour 8, 19'; saw with the optical tube the appulse of the Moon at the Hyades star, which is higher in the southern horn of Taurus, that which the star seen at ingress [obscured] by nearly the third part as the Moon's dark Septentrional [edge] (*Just as in the letter to me*).

31 [bis]. In the same year 1647, on April 12, D. Vicenç Mut at Majorca saw Jupiter entering the northern part of the Moon, high toward sunset of Regulus gr. 57, 18'; that is, hour 9, 56'; then the egress of Jupiter & the Moon obscured, the Moon high to Regulus toward sunset gr. 49, 12'; namely hour 10, 48'; so that it would have lain hidden for 52 minutes. *So the same man in his letters to me.*

33. In the year 1647, on June 6, Hevelius observed the high Lyra gr. 53, 16'; that is, hour 10, 10' ½; at Danzig, by the corniculated [reading] in the straight line drawn through the apices of the Moon's horns, & distant from the lower cusp, the fifth part of the lunar diameter. So he wrote, & engraved it in a most beautiful schema (Hevelius, among other things most liberally transmitted to me).

34. In the year 1650, on August 4, with the Moon in the very nonagesimal, around the quadrature, & nearly with the full latitude, D. Vicenç Mut at Majorca with the naked eye saw the Moon still hollow [cava], but with the optical tube not hollow at all, the hour being 9, 30'; its lines of section remained in the straight-line section of the dichotomy; but the relics of the parts, except at the horns, were somewhere hollow, somewhere running forward toward the line of section of the dichotomy toward the west, & still at hour 10, 15'; with the naked eye the hollow [Moon] would be seen somewhere as in Kepler [Kepler], *Astronomia Optica* pag. 237. So through the quadrature hour the Moon was seen still hollow. So D. Vicenç Mut wrote in the same year to me, whose many Epistles full of Astronomical erudition I preserve.

35. In the year 1653, on the 19th day of May. D. Io. Baptista Hodierna [Giovanni Battista Odierna], the most expert Sicilian Astronomer, after — as in the *Almagestum Novum* — the dichotomies & the Dichotomy of the Moon had been indicated, [found] the Moon depending on the Dichotomy beneath the meridian at 15, 46'; in the meridian of Palma, which lies between Gela the more eastern, & Agrigentum the more western; for then the line of the section of dichotomy persisting toward the western Margin of Anaxagoras, & cut in two Archimedes, & Alpetragius; in the luminous part there were still the whole Plato, & Tycho, & the western margin of Cunium, & the whole Biancanus. See in lib. 4 of the *Almagestum* [Novum] the situation of the new maculae. And so, with Aquila culminating with gr. 39¼ at hour 8 of the night, 15, 46'; the Moon was seen perfectly dichotomous with the horns prominent. He admits, nevertheless, that it is difficult to discern with certainty in this Phase the deception of the half-hour. It is also in his most courteous & most learned Epistles to me, which I preserve.

36. In the year 1654, on May 1. With D. Vicenç Mut at Majorca observing, the Moon began to cover Regulus, high & toward sunset, & Rigel gr. 34, 16'; that is, hour 8, 6' ½. Regulus emerged from the Moon, high toward the western reddish shoulder of Orion, that is, hour [continues].

CAPVT VI.

Continuation of the heading running into the upper margin of the table page:

... 9' 7". The Angle of the Ecliptic & of the Moon's path was gr. 12; & thus the Moon was seen in Leo at gr. 24, 48', with northern latitude. Let it have been to Lansbergen [Philips van Lansbergen] in gr. 25, 24', with latitude 34' 15". To the Danish [tables] indeed, & to Argoli [Andrea Argoli] in gr. 24, 57'; & to Boulliau in gr. 25, 2'; with the latitude seen 35, 45'. Thus Mut [Vicenç Mut] in his most erudite letter addressed to me.

Table title (printed as a vertical block in the source): *A table is here presented of XXIV Lunar Observations with the calculation of Ismaël Boulliau, which he himself promised in Lib. 3, cap. 12 of the Astronomia Philolaica*, but afterward deferred to page 175 of his* Tables*. And it has been reduced by Io. Boulliau to the mean time, [and] reduced to the Meridian of Uraniborg [Uraniborg]. The remaining X [observations] are by D. P. Gassendi [Pierre Gassendi].**

The 24-observation table follows. **In the source it is printed rotated 90° counterclockwise** (see Parsing notes). The columns are: index; Year [*Anni*]; Month [*Menses*]; *Temp. Med.* (mean time: D[ay]·H[our]·I[']·II["]); *Locus Solis verus* (Sig·Gr·I·II); *Locus* › *secundo Aequatus*; *Locus* › *observatus & reductus*; *Differentia* (of the equated from the observed); *Anomalia simplex*; *Distantia Lunae à Sole*; *Motus latitudinis aequatus*; *Reflectio maxima in limite & futura* (Add./Subtr.); *Differentia variationis observatae à Tychonica*.

The bracket note in the *Menses* column spans the eleven 1594-December entries — rows 4–14 (*Decemb. I* through *XI*) — and reads: "**Haec XI. loca observata sunt Anno 1594. Decembri diebus stylo veteri.**" ("These eleven places were observed in the year 1594, in December, by the old style.")

Zodiac sign glyphs in the Sig. sub-columns are rendered by their standard abbreviations (♈ Ari, ♉ Tau, ♊ Gem, ♋ Cnc, ♌ Leo, ♍ Vir, ♎ Lib, ♏ Sco, ♐ Sgr, ♑ Cap, ♒ Aqr, ♒ Psc). The *m.* / *p.* prefixes on the *Differentia* and *Diff. à Tychonica* columns (= *minus* / *plus*) are transcribed as printed.

M e n s e s	Tem p. Med. D·H·I ·II	Locus Solis verus Sig·Gr ·I·II	Locus » aequ atus Sig·Gr ·I·II	Locus » obser vatus Sig·Gr ·I·II	Diff ere nti a I·II	Anom alia simpl ex Sig·Gr ·I·II	Dista ntia » à Sole Sig·Gr ·I·II	Motu s lat. aequ atus Sig·Gr ·I·II	Refle ctio (Add./ Subtr.) I·II	Diff. à Tych onica I·II
S e p t e m b r .	22·15 ·1·52	♌ 9·21·2	♊ 6·59·3 5	♊ 7·31·5 4	p. 32·[?]	[?]	[?]	[?]	[?]	[?]
I a n u a r ij	9·7·5· 19	♍ 29·18· 57	♋ 1·44·3 0	♋ 1·7·28	m. 37·[?]	[?]	[?]	[?]	[?]	[?]
I a n u a r ij	15·15 ·16·3 8	♍ 5·46·1 6	♌ 25·10· 12	♌ 25·31· 31	p. 21·[?]	[?]	[?]	[?]	[?]	[?]
D e c e m b r .	10·3· 59·0	♊ 28·27· 19	♊ 7·4·4	♊ 6·41·3 1	m. 22·[?]	[?]	[?]	[?]	[?]	[?]
I D	11·5·	♊ ♊	♊ ♊	[sign:	m.	[?]	[?]	[?]	[?]	[?]

M e n s e s	Tem p. Med. D·H·I ·II	Locus Solis verus Sig·Gr ·I·II	Locus » aequ atus Sig·Gr ·I·II	Locus » obser vatus Sig·Gr ·I·II	Diff ere nti a I·II	Anom alia simpl ex Sig·Gr ·I·II	Dista ntia » à Sole Sig·Gr ·I·II	Motu s lat. aequ atus Sig·Gr ·I·II	Refle ctio (Add./ Subtr.) I·II	Diff. à Tych onica I·II
e c e m b · I I	6·0	9·41·2 7	19·53· 52	?] 19·16· 0	37·[?]					
I I I	14·8· 34·39	♊ 2·54·8	♋ 29·46· 59	♋ 29·9·3 7	m. 37·[?]	[?]	[?]	[?]	[?]	[?]
I V	15·9· 57·20	♊ 3·58·5 2	♌ 13·46· 11	♌ 13·20· 15	m. 25· 56	[?]	[?]	[?]	[?]	[?]
V	19·15 ·53·1 2	♊ 8·19·8	♍ 13·8·2 6	♍ 13·48· 11	p. 29· 48	[?]	[?]	[?]	[?]	[?]
V I	20·18 ·3·39	♊ 9·25·5 7	♍ 28·57· 38	[sign: ?] 29·39· 45	p. 42·[?]	[?]	[?]	[?]	[?]	[?]
V I I	21·18 ·34·4	♊ 10·28· 30	♎ 13·49· 37	♎ 14·22· 5	p. 32· 28	[?]	[?]	[?]	[?]	[?]
V I I I	22·19 ·40·2 9	♊ 11·32· 38	♏ 28·59· 56	♏ 29·20· 58	p. 21·[?]	[?]	[?]	[?]	[?]	[?]
I X	25·21 ·45·4 1	♊ 14·41· 45	♏ 12·38· 24	♏ 12·55· [?]	m. 34·[?]	[?]	[?]	[?]	[?]	[?]

M e n s e s	Tem p. Med. D·H·I ·II	Locus Solis verus Sig·Gr ·I·II	Locus » aequ atus Sig·Gr ·I·II	Locus » obser vatus Sig·Gr ·I·II	Diff ere nti a I·II	Anom alia simpl ex Sig·Gr ·I·II	Dista ntia » à Sole Sig·Gr ·I·II	Motu s lat. aequ atus Sig·Gr ·I·II	Refle ctio (Add./ Subtr.) I·II	Diff. à Tych onica I·II
X	6·22· 8·5	♊ 15·43· 26	[sign: ?] 26·25· 41	[sign: ?] 25·29· 41	m. 56·[?]	[?]	[?]	[?]	[?]	[?]
X I	27·19 ·51·2 6	♊ 16·38· 51	♊ 8·26·4 6	♊ 8·4·8	m. 22· 38	[?]	[?]	[?]	[?]	[?]
I u n ij	17·11 ·4·27	♋ 26·10· 12	♋ 24·23· 5	♋ 24·58· 2	p. 34· 57	[?]	[?]	[?]	[?]	[?]
[?]	9·8·3 7·17	♋ 18·44· 34	♋ 27·55· 2	♋ 27·39· 19	m. 15· 43	[?]	[?]	[?]	[?]	[?]
[?]	30·7· 0·30	♋ 9·14·3 1	♋ 25·18· 42	♋ 24·22· 19	m. 56· 23	[?]	[?]	[?]	[?]	[?]
[?]	29·9· 24·0	♋ 9·30·3	♋ 24·27· 30	♋ 24·51· 22	p. 23· 52	[?]	[?]	[?]	[?]	[?]
[?]	24·8· 47·0	♋ 5·5·31	♋ 25·34· 13	♋ 24·57· 38	m. 36· 45	[?]	[?]	[?]	[?]	[?]
[?]	13·11 ·4·14	♋ 25·12· 41	♋ 29·44· 17	♋ 28·50· 1	m. 54·[?]	[?]	[?]	[?]	[?]	[?]
A p r il .	7·10· 6·24	♋ 17·53· 26	♋ 7·19·2	♋ 7·35·3 7	p. 16·[?]	[?]	[?]	[?]	[?]	[?]

M e n s e s	Tem p. Med. D·H·I ·II	Locus Solis verus Sig·Gr ·I·II	Locus » aequ atus Sig·Gr ·I·II	Locus » obser vatus Sig·Gr ·I·II	Diff ere nti a I·II	Anom alia simpl ex Sig·Gr ·I·II	Dista ntia » à Sole Sig·Gr ·I·II	Motu s lat. aequ atus Sig·Gr ·I·II	Refle ctio (Add./ Subtr.) I·II	Diff. à Tych onica I·II
A p r il . [?] [?]	13·8· 52·42	Υ 24·12· 58	Π 3·33·5 7	Π 3·59·5 9	p. 26·[?]	[?]	[?]	[?]	[?]	[?]
	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]
	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]	[?]

CAPVT VII.

Selected Lunar Observations out of many made at Bologna by the Fathers Io. Baptista Riccioli [Giovanni Battista Riccioli] & Franc. Maria Grimaldi [Francesco Maria Grimaldi] of the Society of Jesus, for the Moon's places outside Eclipses.

1. In the year 1642, on April 14, the night following, an eclipse was observed, of which see the eclipse observations; that part of the night, the meridian altitude of the Moon's center was seen gr. 35, 31'; and from the transit of Arcturus the [stars] were numbered by M.C. perpendicular 28° 16'.

2. In the year 1642, on June 18, the night following, minutes 34½; after the transit of Aquila across the middle of the Heaven, the meridian altitude of the Moon's center was seen gr. 24, 25'; the same center from Fomalhaut [Fomalhaut] gr. 33, 18' apparent, & after three minutes of time the altitude of Fomalhaut was seen gr. 20, 4'.

3. In the year 1642, on July 7, the night following, the meridian altitude of the upper limb of the Moon was seen gr. 10, 28'; from the transit of the middle Star in the front of Scorpio we numbered 44° 5'. On the eighth day truly the night following [it] was seen gr. 27, 18'; from the transit of the lower horn of Scorpio per M.C. we numbered 11° 40'.

4. In the year 1642, on July 15, the night following, from the transit of Fomalhaut per M.C., the eastern margin of the Moon waxed [flowed] gr. $42^{\circ} 26'$; & then the altitude of the lower limb of the Moon was seen gr. $47, 14'$; & from the physical rising of the Sun we numbered $42'$.
5. In the year 1642, on July 18, in the morning at sunrise, the meridian altitude of the Lunar center was seen gr. $51, 59'$; & after 2 times, the altitude of the center was seen gr. $7, 2' \frac{1}{2}$.
6. In the year 1642, on August 6, in the evening, from the transit of Ophiuchus we numbered $14^{\circ} 8'$; & after the transit, the meridian altitude of the Lunar center was seen gr. $25, 55'$.
7. In the year 1642, on August 16, in the morning, the altitude of the upper margin of the Moon was gr. $56, 24'$; & a little after, [that] of the lower margin gr. $55, 56'$; then after $2'$, the Lucida of Aries transits per M.C.
8. In the year 1642, on August 20, in the morning $24' \frac{1}{2}$, before sunrise, the Moon was seen with its northern & eastern horn distant from the eastern Capella gr. $20, 27'$; the altitude indeed of the western horn of Capella was gr. $30, 29'$.
9. On the same day, in the morning $21' 18''$, after the transit of the Lucida of Aries per M.C., the Moon's center was seen distant from the bright shoulder of Orion gr. $10, 12' \frac{1}{2}$; & after the time $2' 50''$, it was distant from Rigel [Rigel] gr. $47, 57'$; & for exploring the refractions the times are to be noted in the times written below, & the altitudes seen [as follows].

Tempora post transitum lucidae Υ per M.C.	Altitudo visa centri Lunae orientalis			
M.	Secund.	Gr.	M	S
			.	.
32	24	28	1	0
			6	
48	30	31	1	0
54	20	32	2	1
				0
60	20	33	4	3
				0

10. In the year 1642, on August 23, in the morning 48'; before the true rising of the Sun, the Moon's center was seen distant from the bright shoulder of Orion gr. 41, 16'; & after 4 min. distant from Rigel gr. 56, 21' ½.

11. In the year 1642, on October 15, in the morning, from the transit of Sirius per M.C., namely from hour 7 after noon, 17, 12'; we numbered 18' 52"; in which end the Moon's center was seen distant from Sirius gr. 34, 10'; whence we numbered 7' 42"; & then the altitude of the Moon's center was seen distant from the bright shoulder of Orion gr. 23, 47'; whence to the meridian transit of the Lunar center we numbered 10' 16"; & then the meridian altitude of the Moon's center was seen gr. 62, 14' ½; & not long after the beginning of Cancer, opportune for exploring parallaxes. The hour was 17, 49' p. merid. of day 14.

12. In the year 1642, on October 19, in the morning, minutes 5' 10"; after the transit of Sirius per M.C., the Moon's center was seen distant from the heart of Hydra [Cor Hydrae] gr. 20, 38'; whence after min. 7' 12"; it was seen distant from the tail of the Lion gr. 20, 19'.

13. In the year 1642, on October 30, in the evening, at the same moment in which the western bright altitude of Aquila was seen gr. 51, 21'; the Moon's center transits per M.C., & its meridian altitude was seen gr. 30, 49'; the hour was 7, 56' 16"; after noon.

14. In the year 1642, on November 2, in the night, the meridian altitude of the Moon's center was seen gr. 43, 14'; from which transit we numbered 5' 37"; we captured Aldebaran [Palilicium] in altitude gr. 24, 9'.

15. In the year 1642, on November 10, in the morning under the civil hour 11½; when the Moon would be in the beginning of Cancer, & the southern limit was taken nearby, the altitude of the western [limb] was gr. 58, 37'; from this the transit of Procyon per M.C. was 4' 16"; & then the meridian altitude of Procyon was gr. 51, 36'.

16. In the year 1642, on December 5, the night following, the meridian altitude of the Moon's center near the full Moon was gr. 62, 41'; from this to the transit of Rigel per M.C. we numbered the meridian altitude [which] was gr. 36, 49' 50".

17. In the year 1642, on December 16, the night following, from the transit of Procyon per M.C. we numbered min. 27' 41"; the center of the Moon transits per M.C. & was seen distant from it by 2 altitudes, in the meridian by two observations gr. 61, 12'; whence we numbered min. 27' 52"; the Moon near the full

Moon would be seen high gr. 60, 36'; at sunset, & near the beginning of Cancer, & not long from the Apogee.

18. In the year 1643, on January 31, the night following, from the transit of the Lunar center per M.C., the altitude of its meridian was gr. 68, 8'; we numbered min. 6'; & then [the altitude] of the eastern Procyon, gradum 50, 17'; whence, would the Moon be in gradu nearly 9 of Cancer, & in the very Nonagesimal, it could from this elicit parallax.

19. In the year 1643, on February 3, in the evening, two minutes before the transit of the heart of Hydra per M.C. — that is, the very thing — at hour 12 after midday, the altitude of the meridian center of the Moon was seen gr. 57, 20'; when it would be in the Apogee, & at the hour around the full Moon, two minutes or so from the full Moon.

20. In the year 1643, on February 12, in the morning a little after Quadrature, the meridian altitude of the Moon's center was seen gr. 29, 14'; whence we numbered min. 5' ½; the rising altitude of the heart of Scorpio was seen gr. 19, 50'; the Moon would appear already hollow at about half [an hour].

21. In the year 1643, on March 5, the meridian distance of the Moon's center from the vertex was seen gr. 57, 36' ½; the hour after midday 12, 21' 34"; & it was established from Regulus.

22. In the year 1643, on March 13, the Moon was seen in the Meridian gr. 26, 40'; at the same moment the rising bright Aquila toward the height was gr. 42, 41'.

23. In the year 1643, on March 26, in the evening the altitude of the Moon's center was seen gr. 63, 19'; whence to the transit of Procyon per M.C. there flowed 80'; in the end of which the meridian altitude of Cancer was gr. 51, 37'. On the day following, the meridian altitude of the Moon was seen gr. 62, 40'; whence we numbered min. 11'; the altitude of Procyon toward the rising gr. 51, 24'; on the same night by my request P. Theodorus Moretus [Theodorus Moretus, S.J.] at Breslau, where the altitude of the Pole [is] gr. 49, 21'; observed the Meridian altitude of the Moon gr. 57, 17' 25"; finally on day 28, the meridian altitude of the Moon's center was seen by us gr. 58, 59' 15"; at the same moment the altitude of the rising austral Cancer center [was] high gr. 51, 45'.

24. In the year 1643, on April 3, the night following, the meridian altitude of the Moon's center was seen gr. 41, 30' ½; whence we numbered min. 9' 41"; the altitude of the rising Spica [Spica] gr. 35, 48'; whence we shall then reckon the

hour after midday [to be] 11, 52' 44"; & therefore the transit of the Moon was at hour 11, 42'.

(Caput VII, "Lunares Observationes selectae... pro Lunae locis extra Eclipses," continues. The numbered entries are Riccioli & Grimaldi's selected Bologna lunar observations.)

25. Year 1643, June 7. In the morning the Moon, near perigee [perigeum], was seen on the meridian at an altitude of $32^{\circ} 38'$. From there to the observed altitude of the Sun, gr. $8^{\circ} 6'$, 60' 10" of time elapsed; [Margin: Perig.] in that interval the Moon's center appeared, from setting, at an altitude of $31^{\circ} 29'$.

26. Year 1643, July 7. The observed meridian altitude of the Moon's center was 41° , precisely, from which $4^{\circ} 8'$ was reckoned; and the observed altitude of the Sun was $16^{\circ} 52'$, before noon, at hour $5^{\circ} 55'$. The Moon still appeared gibbous, from which we are certain that the quadrature had not yet occurred in appearance, and we derived that the Moon's transit had taken place at hour $18^{\circ} 0' 52''$, after the meridian of the eighth day. [Margin: □]

27. Year 1643, July 21, the following night. The Moon's center was seen to be distant from Arcturus by $34^{\circ} 33'$. Then after 4 minutes it was distant from Spica by $15^{\circ} 13'$; and after 2 minutes from the haunches of Leo [a clunibus Leonis], $30^{\circ} 45'$; and after 6 minutes the western altitude of Arcturus was $51^{\circ} 18'$. And after 2 minutes the Moon's center was seen to be distant from the tail of Leo [cauda Leonis] by $21^{\circ} 6'$; and from the vertex by $73^{\circ} 25'$.

28. Year 1643, August 3. In the morning, before the Moon's Trigon with the Sun [ante Trigonum Lunae cum Sole], the eastern altitude of the bright star of Aries [lucida Arietis] was $60^{\circ} 48'$; and after 5 minutes it stood at $41^{\circ} 35'$. From the Moon's center it appeared to stand high, at $40^{\circ} 54'$ toward setting; then after another 5 minutes, the Moon's center was seen to be distant from the bright star of the Jaw of Cetus [lucida Mandibulae Ceti] by $48^{\circ} 15'$. [Margin: △]

29. Year 1643, August 7. In the morning, the Sun being visibly above the horizon by $12^{\circ} 32'$, the Moon's center was on the meridian; and its altitude was $58^{\circ} 56'$.

30. Year 1643, August 11. In the morning the eastern altitude of Aldebaran [Aldebarae] was $47^{\circ} 5'$. From there, 17 minutes were reckoned. The Moon's center was seen to be distant from Aldebaran by $36^{\circ} 31'$. From there, after 5 minutes, the altitude of the Moon's center was $17^{\circ} 2'$; and it was distant from the bright shoulder of Orion [ab humero lucido Orionis] by $28^{\circ} 26' 3'$.

31. Year 1643, August 15. In the morning the Moon, a little past the eighteenth degree [paulo plus gradibus 18], was distant from its following conjunction with the Sun. Nonetheless it still appeared at an altitude of $2^{\circ} 10'$; and it was distant, on the eastern side, by $57^{\circ} 35'$ from the margin of Regal [a margine à Regal]. Then after 1 minute it was seen at an altitude of $4^{\circ} 30'$; and then it was distant from the eastern limb of Orion [ab Orionis humero lucido] by $43^{\circ} 27'$. [Margin: Phasis vltima]

32. Year 1643, August 22. In the evening, the Sun's center still being above the horizon, the Moon crossed the M.C. [Medium Caeli] at $10^{\circ} 40'$. The Moon then passed across at a meridian distance from the vertex of $60^{\circ} 56'$; it was $5^{\circ} 44'$ after the meridian. [Margin: □]

33. Year 1643, August 25. The Moon's center on the meridian was seen to be distant from the vertex by $63^{\circ} 14' 3''$; and after 5 minutes of time the eastern rising of Aquila [Aquilae ortiva] was distant from the vertex by $37^{\circ} 14' 3''$. [Margin: Octant.]

34. Year 1643, August 27, the following night. When the bright star of Aquila [lucida Aquilae] stood distant from the vertex by $40^{\circ} 9' 3''$, the meridian distance of the Moon was seen to be $58^{\circ} 56'$. [Margin: ∞]

35. Year 1643, August 30. In the evening the western bright star of Aquila [lucida Aquilae occiduae] was distant from the vertex by $36^{\circ} 48'$; the Moon was seen to be distant from the vertex by $60^{\circ} 18'$. Then after 2 minutes the Moon was distant from the head of Andromeda [a capite Andromedae] by $49^{\circ} 11'$; and then after 4 minutes it was distant by $20^{\circ} 34'$; and it was distant from the head of Andromeda by 29° .

36. Year 1643, September 5. In the morning, half an hour before the rising of the physical body of the Sun [ante ortum Solis physicum], the Moon appeared somewhat smaller than a half-disk; whereas, when it shone to us as a half-disk, this was at hour $16^{\circ} 32'$. After the meridian of the preceding day, the comparison had been carried out a little earlier, on the same day, against all the tables of quadrature [iuxta omnes tabulas quadraturae]; from this, by Aristarchus's problem, the Sun's distance from the Earth is shown to be much greater than the Tychonic. [Margin: Dichot.] [Margin: □]

37. Year 1643, October 3. In the morning the Moon's center, seen from the vertex by means of two quadrants [duobus Quadrantibus], was distant by $26^{\circ} 50'$; and then, from the eastern altitude of the bright shoulder of Orion [humeri lucidi Orionis], we concluded the apparent time to be $17^{\circ} 48' 3''$ after the meridian.

38. Year 1643, October 20. In the evening, at hour 2 before sunset, the Moon, examined by telescope [Telescopio inspecta], manifestly appeared a little larger than a half-disk. But afterward, when the western bright star of Aquila [lucida Aquilae occidua] was distant from the vertex by $36^{\circ} 53'$, at the same moment the Moon's center was seen to be distant from the vertex by $61^{\circ} 19' 3''$. [Margin: Dichot.] [Margin: $\square$]

39. Year 1643, October 31. The meridian distance of the Moon's center from the vertex was seen to be $27^{\circ} 5'$. From there, $27^{\circ} 35''$ was reckoned. Procyon was at the M.C.

40. Year 1643, November 3. In the morning the meridian distance of the Moon's center from the vertex was seen, by double quadrant [duplici Quadrante], to be $30^{\circ} 30'$; and then the western Sirius [Sirius occidentalis] was seen to be distant from the vertex by $67^{\circ} 42'$.

41. Year 1644, March 22, the following night. The Moon's center was seen to be distant from the vertex by $43^{\circ} 20' 3''$; and then Spica stood distant from the vertex by $56^{\circ} 26'$, toward rising. [Margin: $\oslash$] [Margin: Apog.]

42. Year 1644, April 13. The Moon's center on the meridian, by double quadrant [duplici Quadrante], was seen to be distant from the vertex by $62^{\circ} 43' 3''$. From there, $3' 2''$ was reckoned. The observed altitude of the Sun in the west was $6^{\circ} 36'$; and therefore it was hour $6^{\circ} 36'$ after noon. [Margin: $\square$]

43. Year 1644, June 12. In the evening the Moon's center on the meridian was seen to be distant from the vertex by $42^{\circ} 49'$ on the one quadrant, and on the other by $42^{\circ} 48'$; and then the Sun's altitude was $11^{\circ} 26'$. [Margin: $\square$]

44. Year 1644, June 28. In the morning, the Moon being at the very perigee [in ipsissimo Perigaeo], at the apparent rising of the Sun [ortu apparenti Solis] it was seen to be distant from the vertex, toward rising, by $52^{\circ} 38'$. Then when the Sun was seen high at $23^{\circ} 14'$, the Moon crossed the M.C.; and then it was seen to be distant from the vertex by $40^{\circ} 45'$. [Margin: Octant. 3.] [Margin: Perig.]

45. Year 1644, November 13, the following night. At the moment when the rising Aldebaran [Aldebara ortiua] was distant from the vertex by $31^{\circ} 42'$, the Moon's center reached the meridian, and was seen to be distant from the vertex by $32^{\circ} 11' 3''$; but on the other quadrant by $32^{\circ} 12'$. [Margin: $\oslash$] [Margin: Perig.]

46. Year 1644, November 21. In the morning, together with Regulus, the Moon was seen to be distant from the vertex, toward rising, by 31° . The Moon was seen to be a half-disk, or — to the witness of the telescope [Telescopio teste] — a very

little less than a half-disk. But when Regulus stood distant from the vertex by $31^{\circ} 11'$, the Moon's center had been on the meridian a little before, with the observed distance from the vertex being $33^{\circ} 50'$. The hour of the Moon's transit across the M.C. was $11^{\circ} 53' 45''$ p.m. [Margin: $\square$] [Margin: Dichotom.]

47. Year 1644, November 26. In the morning the eastern Arcturus [Arcturi orientalis] stood distant from the vertex by $45^{\circ} 22'$; and after two minutes of time the Moon's center was seen to be at an altitude of 22° , precisely, distant from Arcturus by $29^{\circ} 24' 3''$. From there, after 1 minute, the Moon's center was seen to be at an altitude of $22^{\circ} 36'$; and distant from Spica by $13^{\circ} 11' 3''$. [Margin: Octant.] [Margin: Apog.]

48. Year 1645, March 11, the following night. When Arcturus stood distant from the vertex by $41^{\circ} 32'$, the Moon's center crossed the meridian; and it appeared distant from the vertex by $38^{\circ} 11'$. [Margin: $\odot$]

49. Year 1645, March 20. In the morning the Moon appeared just a little larger than a half-disk; but its meridian distance, seen from the vertex, was $64^{\circ} 9' 3''$. From there, to the rising of the upper limb [supremi limbi] of the Moon, $12' 16''$ was reckoned; and from this, to the observed altitude of the center of $3^{\circ} 18'$, the measured time was $25^{\circ} 15'$. [Margin: Dichot.]

50. Year 1645, April 2. In the evening, at the moment when the Sun's center was seen high at $9^{\circ} 28'$, the Moon's center was on the meridian, and was then seen to be distant from the vertex by $25^{\circ} 35' 3''$, most exactly [exactissimè]. [Margin: $\square$]

51. Year 1645, April 10, the following night. The Moon's center on the meridian was seen to be distant from the vertex by $45^{\circ} 9'$; and then the eastern Arcturus [Arcturus orientalis] stood distant from the vertex by $24^{\circ} 47'$. [Margin: $\odot$]

52. Year 1645, April 19. In the morning, before sunrise, the Moon appeared almost a half-disk; it crossed the meridian afterward, and was seen to be distant from the vertex by $63^{\circ} 23'$, the Sun appearing high at $11^{\circ} 10'$. [Margin: $\square$]

53. Year 1645, May 10, the following night. When Spica was at an altitude, from setting, of $27^{\circ} 50'$, the Moon's center on the meridian was seen to be distant from the vertex by $58^{\circ} 53'$. [Margin: $\odot$] [Margin: Apog.]

54. Year 1645, October 4, the following night. The Moon's center at the M.C. was seen to be distant from the vertex by $46^{\circ} 44' 3''$; and after 30' of time Aldebaran stood distant from the vertex by $56^{\circ} 15'$. But on the 5th day, the following night, the meridian distance of the Moon's center, seen from the vertex, was $41^{\circ} 34'$; and then Aldebaran stood distant from the vertex by $46^{\circ} 48'$. [Margin: $\odot$]

55. Year 1645, October 27, the following night. The Moon's center was seen at the M.C. to be distant from the vertex by $63^{\circ} 43' 3''$; and after $2' 46''$ the western bright star of Aquila [*lucida Aquilae ad occasum*] stood distant from the vertex by $37^{\circ} 55'$. [Margin: $\square$]

56. Year 1645, November 3, the following night. The Moon, seen at the M.C., was distant from the vertex by $34^{\circ} 8'$; and after $5' 46''$ the eastern Aldebaran [*Aldebara orientalis*] stood distant from the vertex by $33^{\circ} 46'$. [Margin: $\circ$]

57. Year 1646, March 1, the following night. The meridian distance of the Lunar center, seen from the vertex, was $36^{\circ} 12' 3''$. From there, $23' 3''$ was reckoned. The bright star of the tail of Leo [*lucida cauda Leonis*] crossed the M.C. But on the 23rd day, at hour $5^{\circ} 30' 36''$ p.m., it was seen to be distant from the vertex by $24^{\circ} 56' 30''$, near perigee [*prope Perig.*]. [Margin: *Perig.*] [Margin: $\square$]

58. Year 1646, March 30, the following night. From the transit of the tail of Leo [*a transitu caudae Leonis*] across the M.C., $58' 26''$ was measured up to the transit of the Lunar center across the meridian, at which it was seen to be distant from the vertex by $43^{\circ} 44'$. [Margin: $\circ$]

59. Year 1646, May 8. In the morning the Moon's center on the M.C. was seen to be distant from the vertex by $61^{\circ} 20'$. From there, $6' 10''$ was reckoned. The Sun's center was seen to be distant from the vertex by $71^{\circ} 32' 3''$. [Margin: $\square$]

60. Year 1646, May 28, the following night. The Moon's center on the meridian was seen to be distant from the vertex by $61^{\circ} 32'$. From there, $4' 34''$ was reckoned. Antares crossed the M.C. [Margin: $\circ$]

61. Year 1646, June 19. The Moon's center was seen to be distant from the vertex, on the meridian, by $38^{\circ} 29' 3''$. From there, after $5' 41''$, the Sun's center was seen, from the western horizon, to be distant by $72^{\circ} 32'$. [Margin: $\square$]

62. Year 1646, June 27, the following night. The meridian distance of the Moon's center from the vertex was seen to be $66^{\circ} 24'$; and after $7' 12''$ of time the eastern rising of Aquila [*lucida Aquilae ortiva*] was distant from the vertex by $35^{\circ} 20' 3''$. [Margin: *Apog.*]

63. Year 1646, July 6. In the morning, with the Sun rising, the Moon manifestly appeared to us smaller than a half-disk, but truly the moment of Dichotomy must take account of the Parallax [*habenda est ratio Parallaxis*]. [Margin: *Dichot.*]

64. Year 1646, July 9. In the morning the Moon's center was seen to be at an altitude of $20^{\circ} 58'$; and it was distant from the bright side of Perseus [*a lucido*

latere Persei] by $35^{\circ} 37'$; and at the same moment Capella stood distant from the vertex by 61° , precisely. When it stood distant by $60^{\circ} 36'$, the Moon's center was seen to be at an altitude of $21^{\circ} 3'$; and it was distant from Capella by $34^{\circ} 45'$.

[Margin: Octant.]

65. Year 1646, July 27, the following night, on which there was an Eclipse of the Moon [Eclipsis Lunae]. Its center on the meridian was seen to be distant from the vertex by $64^{\circ} 18'$. From there, after 7' of time, the western bright star of Aquila [lucida Aquilae cidua] stood distant from the vertex by $39^{\circ} 46'$. [Margin: $\circ$]

66. Year 1646, August 4. The meridian distance of the Lunar center, seen from the vertex, was $35^{\circ} 39' 3''$. From there, after $10' 30''$, the Sun's altitude was seen to be $9^{\circ} 30' 3''$. The Moon would appear a half-disk on account of the Parallax [ob Parallaxim], but in reality it was not yet so. [Margin: $\square$] [Margin: Dichot.]

67. Year 1646, September 16. The Moon's center was seen to be distant from the vertex by $64^{\circ} 24' 3''$. From there, after [?] the Sun's center, in the west, was seen to be distant from the vertex by $86^{\circ} 46' 3''$. [Margin: $\square$]

68. Year 1646, October 16. In the evening the Moon's center on the meridian was seen to be distant from the vertex by $66^{\circ} 26'$. From there, after $11' 16''$, the western bright star of Aquila [Aquilae lucida occidentalis] was distant from the vertex by $36^{\circ} 44'$. But at a high altitude it appeared, to the Sun [apparenter Sole], at $3^{\circ} 40'$; seen with the naked eye [nudo oculo] a half-disk, and so seen it was nearly past the half [ferè per semihoram]; but after an hour it manifestly appeared more than a half-disk. It had, however, been in apogee on the preceding day [in Apog.]. The hour of the Lunar transit was $8^{\circ} 8' 20''$ p.m. [Margin: Dichot.] [Margin: Apog.]

69. Year 1646, November 15. The Moon's center on the meridian was seen, in the morning, to be distant from the vertex by $60^{\circ} 56'$. From there, after $4' 31''$, the bright star of Aries [lucida Arietis] stood distant from the vertex by $51^{\circ} 56'$; and the Moon did not yet appear a half-disk. [Margin: $\circ$]

70. Year 1646, November 22. The Moon's center was seen to be distant from the vertex by $28^{\circ} 36'$. From there, after $6' 38''$, the eastern bright shoulder of Orion [lucidus humerus Orionis orientalis] stood distant from the vertex by $42^{\circ} 10' 3''$. [Margin: $\circ$]

71. Year 1647, March 28. In the morning the distance of the Lunar center from the vertex was seen to be $67^{\circ} 47'$; and after $9' 10''$ the Sun's center was seen to be at an altitude of $5^{\circ} 34'$. But truly, on the one quadrant [vno quadrante], and more,

before the rising of the Sun the Moon appeared smaller than a half-disk, but more manifestly so with the Sun rising. [Margin: Dichot.] [Margin: □]

72. Year 1647, May 18. The Moon's center on the meridian was seen to be distant from the vertex by $62^{\circ} 33' 3''$. But since the meridian declined a little toward the East, we noted $62^{\circ} 34'$. From there, after $4' 48''$, Lyra rose high, at an altitude of $26^{\circ} 42'$. [Margin: Meridiana correctio.]

73. Year 1647, May 26. In the morning the Moon's center on the M.C. was seen to be distant from the vertex by $60^{\circ} 12'$; and after [?] the Sun's center was seen at an altitude of $16^{\circ} 1'$. [Margin: □]

74. Year 1647, June 10. In the evening, together with the western Spica [Spica occidentalis], it stood distant from the vertex by $54^{\circ} 44'$. The horns of the Moon [Lunae cornua] appeared in the same vertical; and then its center was seen to be distant from the vertex by $46^{\circ} 16'$. [Margin: Nonagesim.]

75. Year 1647, June 16. The Moon's center on the meridian was seen to be distant from the vertex by $66^{\circ} 54'$. From there, after $3' 30''$, the eastern bright star of Aquila [lucida Aquilae orientalis] stood distant from the vertex by $44^{\circ} 41'$. [Margin: ☉] [Margin: Med. dist.]

76. Year 1647, July 16, the following night. The meridian distance of the Lunar center from the vertex was seen to be $67^{\circ} 25' 3''$; and after $8' 53''$, the head of Andromeda [caput Andromedae] crossed toward rising, distant from the vertex by $47^{\circ} 45'$. [Margin: ☉]

77. Year 1648, March 25. In the evening, with the Sun set, the first phase of the Moon [prima phasis Lunae] was seen to be of about two minutes, in diameter [in diametro] — that is, the horns then nowhere [?]; 35[?] after the preceding New Moon [praecedens Novilunium]. At full Moon likewise, preceding this month, see the observation cited at Book 2, Chapter ult., number 3. [Margin: Prima phasis.]

78. Year 1648, June 13. In the morning, computing from the Solar altitudes [ex altitudinibus Solis], the Dichotomy of the Moon [Dichotomia Lunae] of doubtful time was seen by us to occur at hour $5^{\circ} 19' 52''$ before noon; but earlier, truly, at hour $5^{\circ} 43' 52''$, the Moon's center had crossed the M.C.; and then it was seen to be distant from the vertex by $52^{\circ} 50'$. [Margin: □] [Margin: Dichot.]

79. Year 1649, September 8. In the evening the first phase of the Moon appeared, the Moon having completed two days from conjunction with the Sun — just as in

the year 1650, on March 4, the first phase of the Moon was seen by us at 2 1/3 days after conjunction with the Sun.

80. Year 1650, May 8, the following evening. The Moon appeared to us in crescent, up to the setting altitude of Procyon [ad Procyonis occiduam altitudinem] of $21^{\circ} 40'$; after this, by reckoning from the hour entered as $7^{\circ} 54' 11''$, and after the meridian — for then first the doubt arose whether it was crescent or half — when, of the doubtful half-disk, it appeared by the reckoning of 107' of minutes; we began to doubt whether it was a half-disk or rather gibbous it appeared; whence the second moment of doubt was at hour $9^{\circ} 41' 11''$ after noon. The mean time for Dichotomy was at hour $8^{\circ} 47' 36''$.

81. Year 1650, October 24. In the morning the last phase of the Moon [ultima Lunae phasis] was seen by telescope [Telescopio] up to the rising of the Sun itself, namely at hour 22 1/2, very nearly before conjunction with the Sun. [Margin: Ultima phasis.]

82. Year 1650, December 29. The Moon's center at the M.C. was seen to be distant from the vertex by $44^{\circ} 36'$; and after 4' 10" the eastern Aldebaran [Aldebara orientalis] stood distant from the vertex by $54^{\circ} 34'$. The Moon, however, was manifestly distant from Dichotomy.

83. Year 1651, August 5. In the morning the last phase of the Moon was seen by Telescope; this very phase occurred at hour 22, near conjunction with the Sun.

84. Year 1652, July 17. In the evening the Moon's center was seen to be at an altitude of $24^{\circ} 28'$, and distant from Regulus by $15^{\circ} 31'$; then, when it was seen at an altitude of 4° , precisely, it was seen distant from the bright star of the haunches of Leo [lucida iubae Leonis] by $15^{\circ} 52'$. The following evening the Moon's center was seen to be at an altitude of $9^{\circ} 10'$, and distant from Spica by $57^{\circ} 6'$; soon when it was seen at an altitude of $7^{\circ} 5'$, the Moon was distant from the tail of Leo [cauda Leonis] by $26^{\circ} 15' 3''$. [Margin: 1. Octant.]

85. Year 1652, July 14. The Moon stood distant from the vertex by $65^{\circ} 18'$ (this distance was deduced from the time itself at hour $8^{\circ} 13'$); the Moon's center was then seen to be distant from the vertex by $65^{\circ} 2'$. And Spica stood distant from the vertex by $14^{\circ} 14'$; then the Vindemiatrix [Vindemiatrix] stood distant from the vertex by $53^{\circ} 15'$; and then the Moon's center was seen to be distant from the vertex by $66^{\circ} 26'$; and Vindemiatrix by $53^{\circ} 15'$, from which P. Grimaldi then computed the Refractions, and by an analysis of Parallaxes through Triangles [per Triangulorum analysim] derived the place of the Moon at $3^{\circ} 0' 25'$ in Scorpio [in Scorpj]; this is according to the Danish Tables [Danicae Tabulae], to which

Lansbergius [Lansbergen] posits 4° ; Argolus [Argoli] $4^{\circ} 12'$. But the Southern latitude, by P. Grimaldi's calculus, was $2^{\circ} 40' 33''$. [Margin: 2. Octant.]

86. Year 1652, July 24. In one morning, about the first hour before the observed rising of the Sun, the Moon stood distant from the vertex by $54^{\circ} 25'$; and from the bright star of Aries [lucida Arietis], $51^{\circ} 9'$; and a little after, the same center was seen to be distant from the vertex by $54^{\circ} 40'$; and from the bright star of the tail of Cetus [lucida caudae Ceti] by $23^{\circ} 14'$, distant from the vertex by $64^{\circ} 44'$; and a little after, the Moon's center was seen to be distant from the vertex by $55^{\circ} 5'$; and from the jaw of Cetus [mandibula Ceti] by $56^{\circ} 42' 3''$, distant from the vertex by $55^{\circ} 9'$. [Margin: 3. Octant.]

87. Year 1653, August 1. In the morning the Moon's center was seen to be distant from the vertex by $68^{\circ} 50'$; and from Aldebaran by $30^{\circ} 26'$, distant from the vertex by $55^{\circ} 42'$; soon the Moon's center was seen to be distant from the vertex by $67^{\circ} 55'$; and from the preceding shoulder of Orion [humero praecedente Orionis] by $27^{\circ} 36'$, distant from it by $70^{\circ} 2'$. [Margin: 4. Octant.]

88. Year 1653, May 8. In the evening, when the eastern Spica [Spica orientalis] stood distant from the vertex by $58^{\circ} 18'$, the Moon's center was seen to be distant from the vertex by $51^{\circ} 22'$; and from Arcturus by $34^{\circ} 47'$. Soon it was seen to be distant from the vertex by $51^{\circ} 19'$; and from Spica by $11^{\circ} 16'$. [Margin: 2. Octant.]

89. Year 1653, December 23. The Moon's center, expected at the western azimuth of precisely 25 degrees, was seen to be distant from the vertex, in that position, by $67^{\circ} 1' 10''$. From there, $35' 10''$ of time being reckoned, the western bright star of Aquila [lucida Aquilae occiduae] stood distant from the vertex by $61^{\circ} 41' 30''$. [Margin: 1. Octant.]

90. Year 1654, January 25. In the evening, then for the first time the Moon was seen dichotomous, when Aldebaran stood distant from the vertex by $28^{\circ} 38'$; but the Moon by $38^{\circ} 27'$. Then, 27' of minutes having elapsed, the Moon began to appear gibbous [gibbula], apparently distant from the vertex by 42° . [Margin: □] [Margin: Dichot.]

(*continuation of §90:*) $42^{\circ} 55'$; then, expected at the western azimuth of $1^{\circ} 65'$, it was seen to be distant from the vertex by $44^{\circ} 9'$; and from there, $5' 20''$ of time being reckoned, the bright star of Aries [lucida Arietis] stood distant from the vertex by $44^{\circ} 31'$.

91. Year 1654, March 1, the following night. The Moon covered Regulus [Luna textit Regulum], when the western Sirius [Sirius occidentalis] stood distant from

the vertex by $62^{\circ} 48'$. The Moon began then to cover it with that part of its own limb which was in a direct line, with the macula Pitati [macula Pitati] and Kirchmann [Kriftmanni] toward the eastern margin. Then Regulus emerged from the little portion of the Lunar limb which was in a straight line with the macula Bedae [macula Bedae], and with the middle of the Terra Vigoris [Terra Vigoris]; and from the moment of emergence $9' 40''$ was measured, after which Sirius stood distant from the vertex by $70^{\circ} 21'$. [Margin: Regul. à ☾ tellur.]

92. Year 1655, May 9. In the evening, with Procyon high at $25^{\circ} 20'$, the Moon's center was seen to be at an altitude of $30^{\circ} 43'$; and distant from the head of Pollux [Pollucis capite] by $11^{\circ} 2'$. Then after 2 minutes of time the Moon's center was seen to be at an altitude of $29^{\circ} 40'$; and distant from Procyon by $21^{\circ} 45'$. [Margin: 1. Octant.]

93. Year 1655, from the 6th of July up to the 16th, on continuous nights, we observed the Moon's place, but here, for the sake of brevity, we set down a single observation for the quadrature of the Moon [pro Quadratura Lunae] on the 10th, on the middle day at the Earth's mean distance [in media à Terra distantia], on whose evening the distance of Spica from the vertex was taken, toward setting, at 66° , precisely; and from there, $10' 18''$ was reckoned. The Moon's center, expected at the azimuth of 45° , was seen, in that position, to be distant from the vertex by $70^{\circ} 49' 3'$. [Margin: ☐] [Margin: Media distantia.]

94. Year 1655, August 5. In the evening, the Moon's center, expected at the western azimuth of 75 degrees, was seen, in that position, to be distant from the vertex by $38^{\circ} 57' 40''$. From there, $5' 20''$ of time being reckoned, Arcturus crossed at the same azimuth, distant from the vertex by $45^{\circ} 36'$. [Margin: 1. Octant.]

This is the manner of observing we used on the following nights; but from among them we select one outstanding observation for the third octant of the Moon [pro tertio Lunae octante].

95. Year 1655, August 21. The Moon's center, expected at the western azimuth of 15 degrees, was seen, in that position, to be distant from the vertex by $36^{\circ} 30' 3'$. From there, $10' 4''$ being reckoned, the bright star of the tail of Cetus [lucida caudae Ceti] reached the same azimuth, and stood, in that position, distant from the vertex by $61^{\circ} 4' 3'$. [Margin: 3. Octant.]

96. Year 1655, September 23. In the morning, about three hours before the rising of the Sun, when the tail of Cygnus [cauda Cygni] stood distant from the vertex by $8^{\circ} 6'$, the Moon appeared so very small, that a little earlier it would have been judged as appearing dichotomous; although, by the estimate of our people, the

Dichotomy had occurred when the bright star of the Pleiades [lucida Pleiadum] was on the meridian, namely at hour 3° 6' after midnight; from the tail of Cygnus, at hour 3° 20'. [Margin: Dichot.]

97. Year 1656, August 16. In the morning, one quadrant before the rising of the Sun [quadrante vno ante Solis ortum], when the tail of Cygnus [cauda Cygni] stood distant from the vertex by 47° 9', the Moon was seen to be distant from the vertex by 62° 20'. Then when it was seen distant from the vertex by 61° 45', it was seen also to be distant from the preceding shoulder of Orion [ab humero praecedente Orionis] by 22° 19'.

98. Year 1657, March 18. In the evening, and somewhat more after the setting of the Sun, the distance of the Lunar center, seen from the vertex, was 55° 11' 3'. From there, 25' of minutes being reckoned, Aldebaran stood distant from the vertex by 41° 2' 3', toward setting. But for the lunar azimuth Aldebaran was expected at the same azimuth, in which the Moon had been; and in that position Aldebaran stood distant from the vertex by 58° 17'. [Margin: Octant 3.]

99. Year 1657, November 12, the following night. The Moon, seen on the meridian, was distant from the vertex by 56° 10' 40". And from there, 6' 50" of time being reckoned, the bright mouth of Pegasus [lucidum os Pegasi] crossed the meridian. [Margin: □]

At Bologna, on the 13th of May, the following night, 1661.

A Conjunction of the Moon with Saturn was thus observed.

At about the second hour after the setting of the Sun, the Moon appeared to be distant from Saturn by scarcely more than one apparent diameter of the Moon. And the line of Saturn's companion [linea Comitum Saturni] tended toward the Moon's center, so that if this had advanced along that line, Saturn would have seemed about to be eclipsed [eclipsatura], and covered by the middle of the Moon, or to be conjoined with it centrally, with respect to the observer's eye. But since the line of the companion is parallel to the Equator [linea Comitum parallela est Aequatori],

(continuation, right column of folio 163:) and since the Moon was proceeding with northern latitude, it was advancing along a path nearly parallel to the Ecliptic; and each — both Planet [Saturn] beyond the middle of Scorpio — for this reason it came about that the Moon avoided Saturn, and left it toward the North [reliquerit ad Boream]. There was, to be sure, some Parallax in the Moon, but this was diminished, since the Moon had not yet reached the Meridian, nor reached

the Nonagesimal [Nonagesimum]; and therefore, even with this Parallax not standing in the way, the Moon would have seemed, before conjunction, to be in a line drawn with the line of the companion; then, after the decrease of Parallax, it ought not to have been made Australian [Australior], as it appeared lower than Saturn [depressior Saturno], had not the Moon's advance been made along the oblique line aforesaid; and so it is proved from this that such a line is oblique to the Ecliptic, but seen otherwise, and from the position too in which it was then observed, it is certain that this same line is parallel to the Equator.

Therefore, when the Moon was seen as close as possible to Saturn, the altitude of Spica of the Virgin was taken by quadrant, and its distance from the vertex was gr. $60^{\circ} 23'$. But truly, toward the West, the Moon stood distant from Saturn toward the South [versus Austrum], by as much as the latitude of Caspia [latitudo Caspij] between the Lunar maculae; and the part of the limb which had most closely approached Saturn was near the Stagnum glaciei [Stagnum glaciei], toward Euctemon [Euctemonem].

From this it will easily be established that the Ephemerides of Argolus [Argoli] assign this conjunction more quickly than is fitting, by as much as they are constructed for the Roman Meridian [Meridianum Romanum]; unless perhaps the Parallax should vitiate the observation, and the correction of it favor Argolus.

CAPVT VIII.

On the Distances of the Moon outside Syzygies [De Lunae Distantijs extra copulas].

1. As, in Book 3, in the last chapter, we determined the distances of the Moon from the center of the Earth at New Moons and at Full Moons, with the Eccentricity, and with the Horizontal Parallaxes, and with the Equations of the first inequality of the Lunar motions [Aequationes primae inaequalitatis Lunarium motuum]: so now, for the remaining inequalities, which the Moon undergoes outside syzygies with the Sun [extra copulas cum Sole], we ought to determine the distances of the Moon from the center of the Earth at the quadratures to the Sun [in Quadratis ad Solem aspectibus]. For these, among others, we select two from our observations, two in which we are more confident.
2. The first was in the year 1646, March 23. For at the equated hour [Hora aequata], $5^{\circ} 37' 50''$ after the meridian at Bologna, the center of the Lunar Disk crossed the Meridian; and its distance from the vertex, taken by us, was gr. $24^{\circ} 56' 30''$. The Moon's circumstances [conditiones] were then as follows:

	Sign.	Gr.	'	"
The Moon's place in the Ecliptic [<i>Locus Lunae in Ecliptica</i>]	♊	26	22	10
Its equated Anomaly [<i>Eius Anomalia Aequata</i>]	♈	27	20	0
Southern latitude [<i>Latitudo Australis</i>]		3	26	38
Therefore the Northern declination [<i>Ergo Declinatio Boreal.</i>]		20	1	10
Distance of the Equator from the vertex [<i>Distantia Aequatoris a vertice</i>]		44	30	10
Therefore the Sun's [☉] true distance from the vertex [<i>Ergo ☉ vera dist. a vertice</i>]		24	29	0
But the observed distance was [<i>At visa fuit</i>]		24	56	30
Therefore the Parallax [<i>Ergo Parallaxis</i>]			27	30

From this there results, by the analysis of Triangles [per *Triangulorum analysim*], the distance of the Moon from the center of the Earth of 52° 46' terrestrial semidiameters [*semidiametrorum terrestrium*]. The Moon was near the coming quadrature [*prope quadraturam futuram*], after 13 hours, and near Perigee [*prope Perigeum*], as is established from the Anomaly.

3. The second was in the same year 1646, October 16. For when the western altitude of Aquila [*Aquilae occidua altitudo*] became apparent, at hour 8° 8' 20" after noon, the Moon's center crossed our Meridian, and its distance from the vertex, as observed by us, was gr. 66° 26'. The Moon, however, was situated as below [*vt infra*].

	Sign.	Gr.	'	"
Place of the Moon ♏ in the ecliptic [<i>Locus ♏ in Ecliptica</i>]	♏	24	3	20
Equated anomaly [<i>Anomalia Aequata</i>]	♏	3	24	20
Northern latitude [<i>Latitudo Borealis</i>]			14	2
Therefore the southern declination [<i>declinatio Austr.</i>]		21	10	0
Distance of the equator from the vertex [<i>Distantia Aequatoris à vertice</i>]		44	30	10
Therefore the true distance of the Moon ♏ from the vertex		65	40	10

	Sign.	Gr.	'	"
But it was observed to be		66	26	0
Therefore the parallax [<i>Parallaxis</i>]			27	30

And from this the distance of the Moon from the center of the Earth comes out as 68;50 terrestrial semidiameters. But the Moon had passed beyond the place of quadrature by nearly 2 hours, and beyond the apogee by 3 degrees. From this we gather that in quadrature itself, and at the apogee, it was distant from the center of the Earth by a full 69 terrestrial semidiameters.

4. Now since, as was said in Book 3, Chapter [vlt.] (the last chapter), the mean distance of the Moon from the center of the Earth is 61 terrestrial semidiameters, and since its difference in the quadratures from the apogee distance is, by what has just been said, 8 terrestrial semidiameters, then if these are subtracted from the terrestrial semidiameters — that is, if they are taken away from the semidiameters of the Earth — the distance of the perigee of the Moon from the center of the Earth in the quadratures will remain as 53 terrestrial semidiameters. The nearest distance found by our observation, repeated [?], was 52;46. And since, as 61 is to 100000, so is 8 to 13114, the aforesaid difference is therefore 13115 parts. [recte: the text gives both 13114 and, just after, 13115 for the same difference — transcribed as printed.] For this reason the semidiameter of the lunar orbit is taken as 100000. Yet because, as was said in the same Book 3, Chapter [vlt.], the eccentricity of the Moon's first inequality, bisected, is 4343 parts — and if we triple this, the eccentricity in the quadratures comes out as 13029 parts, somewhat less than 13114 [?]. Now since, as 100000 is to 61, so is 13029 to a semidiameter [*semid.*] of the Earth, that is, 7;57. Therefore, if that ideal elegance is to be preferred, the distance of the center of the lunar orbit from the center of the Earth, taken as triple, must be somewhat corrected, so that some of the lunar distances in the quadratures come out slightly otherwise. Thus the apogee comes out as 68;57 terrestrial semidiameters, and the perigee as 53;3.

It follows then, from this hypothesis, that the maximum composite equation of the Moon, made up of the first and the second inequality, is 7°29'10". Closest to that is the value the Tychonists found, namely 7°28', as did [Tycho Brahe], and 7°30' as [Longomontanus], and as [Kepler] and [Bullialdus], which last lies midway among ours.

CAPVT IX.

A Theory of the Lunar Motion in Longitude is proposed, for the composite inequality made up of the first and the second.

1. Here we assume, from the observation of many ages, that the motions of the Moon noted by various authors — but chiefly with a view to this present matter — fall under four heads, namely: *the Periodic, the Synodic, the Variation, and the Libration.*
2. The Periodic motion of the Moon is that by which the Moon completes its revolution of the zodiac about the Earth in 27 hours [recte: days] [?] 7;43, or thereabouts. This motion is unequal and irregular, yet it returns to regularity; for it completes the Periodic anomaly absolutely in 27 days 13 hours [?] 12, or thereabouts. This inequality is referred to the line drawn from the center of the eccentric to the center of the Earth, and to the apogee of the Moon — the line on which, as the Moon's body returns, no equations are required, but the mean motion of the Moon coincides with the true, and with what appears to us on Earth. This revolution is called Absolute, since it is free from the motion of the Sun.
3. The Synodic motion of the Moon is that by which the Moon traverses the zodiac in such a way that it always overtakes the Sun, by as much as the Sun has meanwhile measured out; and therefore the Synodic revolution is completed in 29 days 12 hours [?] 44, and so on, and it is restored from one conjunction of the Moon and Sun to the next. Hence this revolution is not absolute, but depends on the motion of the Sun. It is, however, periodic, but depends on the configuration of the Moon with the Sun and with the Earth; and it is restored from new moon to full moon, and from full moon to new moon, and is referred to a line, the line that passes through the center of the Earth and of the Sun, on which line, if the Moon should be, the Synodic line is said to occur. The motions of these are mixed in such a way that, when the Synodic line coincides with the line of the apsides, the maximum Synodic inequality befalls through the whole lunation; but if the Synodic line falls upon the mean longitudes, there is almost no second inequality through the whole lunation.
4. Hence it comes about that when the Synodus occurs at the 270th degree of the Anomalistic revolution, no second inequality occurs through the whole Synodic revolution. But as the Synodic line proceeds toward the apogee of the Periodic revolution, the Synodic inequality is increased little by little.

When, however, the Synodus meets with the apogee, the first inequality ceases, but then the second inequalities are at their greatest; and these afterward decrease, until the Synodus, hastening on by 90 degrees from the apogee, where there is again no inequality. The second inequalities are spread through the whole lunation. Therefore, with the Synodic line running on from the 270th degree of anomaly to the 90th, and in the first semicircle of the Synodic revolutions — that is, from new moon to full moon — the second equations are *additive*; and in the second semicircle of the inequalities they are *subtractive*.

5. But when the mean longitudes are surpassed, the Synodic line tends toward the perigee of the eccentric, that is, toward the 180th degree of the anomaly. The inequalities grow according to the second [head], until the Synodus and the perigee come together; and they then decrease, until they vanish at the mean longitudes. Meanwhile, as the Synodic line goes on to the 90th degree of the anomaly, the Synodic equations of the inequality, in the prior semicircle — namely from ϕ and ϕ^o [conjunction and opposition] — are *additive*, and in the posterior, from ϕ^o and ϕ , *subtractive*. Hence the beginning of the second inequality is at the 90th degree of anomaly, near the apogee of the periodic revolutions, and the first semicircle is from the 270th to the 90th of anomaly. Hence it is that, since these two inequalities are by their nature diverse, they concur something at one time — when one is additive while the other is subtractive — and at another time conversely. This happens when the Synodic line falls between the 270th degree of anomaly and the apogee of the periodic revolutions, or between the 90th of anomaly and the perigee.

Finally, when, through the lunations and the synodic revolutions, the second inequality grows or decreases — or, at the actual new moon or full moon, when there is no second inequality, but in the quadratures the maximum appears.

6. Concerning the *Variation* and the *Libration* it will be spoken of below. Meanwhile, to represent the two preceding inequalities, astronomers have devised various Hypotheses — of circles, of eccentrics, of epicycles, or of ellipses — which we set out at length in Book 4 of the *Almagestum Novum* [*Almagesti Novi*], Chapter 26 to 29, having also indicated our own little contribution, and leaving judgment to others.

Now, however, considering that the proper motion of the Moon — by which it appears to be carried from the West to the East, contrary to the diurnal motion which they call from the East to the West, and at the same time to the fluidity of

the Heaven [or: of the planets], and to the rest of the Earth, of which in Book 9 of the *Almagestum Novum* Section 4 — cannot be reconciled, unless by some single spiral motion in the East to the West, we do not dare propose any geometrically measured Theory of the lunar motion as exactly answering to all the phenomena. Yet among them all we prefer the one that uses a manifold eccentric, a circle, and an ellipse, because it is not as dangerous, nor in the use of epicycles, as the lunar Spots represent it; and it answers the matter itself somewhat better than another foreign figure. And indeed the Ellipse — which [Blaise de Pagan] [*Comes Paganus*] chose in his *Theory of the Planets*, published at Paris in the year 1657. As for the Circle of the eccentric, we chose it together with [Giovanni Antonio Magini] [*Io. Antonio Magino*] in Book 4 of the *Almagestum Novum*, Chapters 26 and 28. Yet that Theory must now be reformed by us, if anyone is unwilling to disdain it.

7. And so in the figure here adjoined, from the center A of the Earth, I describe the ecliptic GXT — though this figure represents the lunar orbit much more remotely than [it should], so that in it, in the line of the apsides GT, with the portion AB deceived [?], of 4343 parts, of which the radius, or semidiameter, of the prior eccentric

Diagram. A geometric figure illustrating the lunar-eccentric theory of the composite inequality. A large outer circle (the eccentric / lunar orbit) carries a smaller inner circle and an array of labelled points. The construction shows nested circles with the center of the Earth, the centers of the eccentrics, and the apsidal line.

- G (top): point on the apsidal line / ecliptic
- H (upper left interior): center / point of an eccentric
- C (interior, near center): center
- B (interior, near center): center of the equal motions
- V (interior, near center): center of the eccentric
- M (left): point on the outer circle
- Y, Z (right): points on the outer circle
- D, A (lower center): A is the center of the Earth
- E (lower interior): point on the construction
- θ (theta) (lower center, below A): point on the apsidal line
- F (bottom): point on the apsidal line / ecliptic

— tric DH, is 100000; and with the center placed at D, I describe the circle HIFY, and by doubling the eccentricity AD — that is, taking AB as 8686 parts — and with the center made at B, and BC as the semidiameter, of 4343 parts, I describe the

little circle CDV, on whose periphery the center of the lunar eccentric is carried; and from the apogee C of this little circle I describe another eccentric, equal to the prior one, which is GIEY.

	Gr.	'	"
The Maximum Equation of the First Inequality [<i>Aequatio Maxima Primae Inaequalitatis</i>] founded on AB	4	58	28
The second together with the first, founded on AC [<i>Secundae simul, ac primae fundata in AC</i>]	7	29	10

I. PROBLEMA.

To find the eccentricity of the lunar eccentric outside the syzygies [Excentricitatem Lunaris excentrici extra syzygias reperire].

8. Furthermore, the center of the equal motions for the first inequality is at B, where the angle of the anomaly is considered; but for the second inequality it is at the center of the eccentric carried in the little circle CD, and the whole eccentricity, for the equations of the first inequality, is AB, of 8686 parts. But for both, the inequality is variable, yet the maximum is AC, of 13029 parts, of which the Radius of the eccentric, taken either way, is 100000. Now the absolute anomaly is reckoned from the apogee, and the eccentricity through the motion of the center of the eccentric made on the periphery of the little circle CD, in consequence from D toward V, and at any given point made about the center put in V, if this anomaly is the arc DV. I describe HGL, then, from G, with VB perpendicular to IV. Let therefore the angle DV be of 60 degrees, that is, the angle DBV; for here the sine of the first is 86602, of which BV is 100000, and the second sine BI is 50000, but BV is 4343 parts, of which the Radius VL is 100000. Therefore of such parts the first will be IV 3761, and BI 2176. Take BI from BD: of 4343 parts there remains ID, of 2167 parts; this has added the right line AD, which AB is 4343; and there will be in the right-angled triangle AIV, right-angled at I, the side AI 6510, and IV 3761; therefore by Trigonometry the angle IAV comes out, of 30°1'; and hence the eccentricity sought is AV, of 7518 parts. To this, in the direction added Radius VG, of 100000 parts: the maximum distance of the Moon from the Earth then possible is AG, of 107518 parts, such as it would be if the Moon were at the very apogee G; whence, the orbit of its own anomaly being subtracted, the maximum would be AP, if the Moon were then in the perigee P, which would be made of 100000 parts; and indeed from VP, of 100000 parts, it would be, in this

case 92482. But if the Moon should be elsewhere, say at L, its distance AL will be as just now [shown].

II. PROBLEMA.

To investigate the distance of the Moon from the center of the Earth outside the syzygies, together with the second equation of the inequality [Distantiam Lunae à Centro Terrae investigare extra syzygias una cum Aequatione secunda inaequalitatis].

9. The line of the mean longitudes is that which cuts the apsidal line at right angles at the center of the eccentric V, if the center of the eccentric is at D, it will be the line MDL; but if at C, it will be the line IY. A little below, these lines will touch the maximum Equations; the rest can easily be deduced from what has been said above, partly in Book 4 of the *Almagestum Novum*, Chapter 26. It is enough, in synopsis, to set forth briefly the measure of this Theory, as a foundation for the lunar intervals, and of those things which depend on the intervals.

	Radius 100000. parts	Semidiam. Terrae	I ' "
Radius DH, or CG	100000	61	0
The whole eccentricity to the center [<i>Excentricitas tota centri</i>], the motion of the mean in $\odot$ and $\oslash$ AB	8686	4	4 2
But bisected, AD [<i>Bissecta autem AD</i>]	4343	2	2 1
The whole eccentricity in quadrature AC [<i>Excentricitas tota in $\square$ AC</i>]	13029	7	3
Apogee distance of the Moon $\oslash$ from the center of the Earth in $\odot$ and $\oslash$ AH [<i>Distantia Apogea $\oslash$ à centro Terrae in $\odot$ ac $\oslash$ AH</i>]	104343	63	4 0
But the perigee, AF [<i>Perigea autem AF</i>]	95657	58	2 1

	Radius 100000. parts	Semidiam. Terrae	I ' "
Apogee distance in quadrature AG [<i>Distantia</i> <i>Apogea</i> in $\square$ AG]	113029	67	5 7
Perigee in quadrature AF [<i>Perigea</i> in $\square$ AF]	86971	53	3

Diagram. A second geometric construction for the lunar eccentric and the distance problem. A large circle with several internal radii and labelled points; an outer chord runs to L on the right, and a point P sits at the bottom.

- H (upper left): point on the circle
- K (top): point on the circle
- G (upper right): true apogee of the Moon
- C (interior, upper): center of the little circle
- B (interior): center of the equal motions
- I (interior, left of center): foot of the perpendicular
- V (interior, center): center of the eccentric
- D (interior, lower center): point on the apsidal little circle
- L (right): position of the Moon
- A (lower center): center of the Earth
- P (bottom): perigee point

— [parts] 100000, to investigate by Trigonometry, then the angle of the second inequality, the angle LAV, then hence the distance AL of the Moon from the center of the Earth.

12. We shall therefore in the Tables, in their own place, set forth the lunar eccentricities, even outside the syzygies, for this purpose, and the Radius 100000. And the angle comprehended by them, and from the anomaly of the orbit known, the equations and the lunar distances from the Earth can easily be gathered. But we shall also set forth another Table of the lunar distances outside the syzygies, so that through it the Horizontal Parallaxes [*Parallaxes Horizontales*] may at once be inquired into, and under these the remaining parallaxes of altitude.

CAPVT X.

On the Lunar Variation [De Variatione Lunari].

1. A certain third inequality, which modifies the second, [Tycho Brahe] in his *Progymnasmata*, Tome 1, asserts to be detected in the motion of the Moon, and he names it the *Variation* — which in the syzygies and the quadratures is null, but in the octants — that is, between the quadratures and the syzygies — toward the aspects of the Moon to the Sun [?], that is between the quadratures and the syzygies, is the maximum, as he says. At new moon, to the first quadrature, it is to be added to the motion of the Moon, already corrected by the first and second equation; from quadrature to full moon it is to be subtracted; again from full moon to the second quadrature it is to be added, and from the second quadrature to new moon it is to be subtracted. The maximum Variation, or the actual subtraction, is of 45° , and $13\frac{1}{2}^\circ$, $225'$, and $31\frac{1}{2}$, the distance of the Moon from the Sun, and so on at 45° .
2. This third inequality, the second and the third [in the order] of those constituting [it], [Longomontanus] took up in the Elongation from the Earth of the centers of both luminaries in the epicycle. He conjectures, in fact, in a center of the solar epicycle, that an off-flowing virtue, which the motion of the Moon under the maximum vision-angle moves; this depends on the means of vision more remote from us, and he has it in Book 1 of the *Theoricae*, Chapter 6. But [Kepler], in Book 4 of his *Astronomia Copernicana*, page 614, refers this Variation to the Light of the Sun; for he thinks the Moon to be moved by a double virtue, one of which is from the light, or from the species of the Sun, off-flowing unequally, the other dispensed unequally. [Bullialdus] is an astronomer of the same Philolaic [school], Chapter 6. Neither of these two asserts the true reason of the cause of the inequality; he refers the cause of the monthly inequality, and refers the cause to the motion by which the Moon is carried about the Earth in a spiral; we have set this out at length above in Book 4 of the *Almagestum Novum*, Chapter 27. He calls it indeed the *Euectio*, by which the Apogee of the Moon is transferred, so that it does not remain in the parallel position; but the *Reflexio* by which the same Apogee from the first quadrature to full moon, and from the second quadrature to new moon is reflected against the order of the signs.
3. We are not certain, indeed, from what has been said in Book 9 of the *Almagestum Novum*, Section 8, of the Earth's rest, and of the Moon, just as of the other Planets, moved by a single spiral motion with a motive intelligence —

ab Oriente in Occidentem moveri [from the East toward the West moved] — with looser or more contracted spirals, and with other inclinations, now more remiss in motion, so that all those inequalities are made, near the end intended by God the Best and Greatest, and according to the laws of Arithmetic rather than of Geometry. Therefore from the Phenomena, and observations, things astronomical are to be estimated [or: by the Astronomical Tables].

4. Furthermore, [Bullialdus] in Book 3, Chapter 12, page 24. The observations which, both we above [in this Book] Chapter 4, affirm, that this Variation in the syzygies indeed accepts a certain limit of the Adiectia [additions], and in the quadratures the Subtractia [subtractions]; but it is uncertain whether it begins from the syzygies themselves, and the quadratures, and in the octants has its greatest limits; or whether each has its limits, but yet some other inequality may be superinduced upon these. And it persuades astronomers to attend, in posterity, to the so-called reciprocation of the Lunar Disk [*Disci Lunaris*] — for perhaps it will indicate the Anomaly of the Variations. Meanwhile, [Kepler] reckoned the maximum Variation at 51', as it pleased Kepler, and 40°30', as it pleased Tycho; until the abstrusity of this matter, with a greater light gathered from experience, may assist — Tables indeed best of all for this end, [Kepler] for the Euection, and the Reflexion, constructed. Finally, he advises that even [Ptolemy], from observations, surmised this Variation to be: [Greek: περί τὰς μηνοειδεῖς καὶ ἀμφικύρτους ἀποστάσεις (*peri tas mēnoeideis kai amphikurtous apostaseis*, "concerning the crescent-shaped and gibbous distances")], that is, in the points intermediate between the syzygies and the dichotomies — certain diversions, abscesses [departures] from the ordinary motion.
5. For us, until the Diary of the Tychonic observations should come to light, the other observations — more than those which in Chapters 2, 3, 4, and 5, we adduced outside the syzygies — are made by Astronomers, [and] it would be by counsel that it occurs, that ordinarily the places of the Moon from the said observations selected, in one aspect we may confer, and from the region of those we may put our own computation from our lunar Tables, as far as the first inequality, and the Tychonic, as far as the Second and the Third; and so from the comparison it may appear how far thus far Astronomy in this part has profited, or still falls short and ought to profit.
6. From Chapter 5 therefore, we chose the observations 2, 4, 9, 26, and 32; and from Chapter 7 we chose, in order, namely 3, 5, 6, 14, 19, 43, 44, 50, 59, 61, 73, 85, 89, 93, 97. For these twenty are enough, we thought, to test the

Astronomers, which is now our purpose. And so, the time reduced to the Bologna Meridian, from the quarter, I computed to the moment of the observation of the said Moon, the Mean places indeed from our Tables, but afterward the Tychonic equated, I conferred; then, with the place of the Moon, which from observations rightly made were derived, the parallaxes in longitude and altitude taken into account — nay even the Refractions, if anyone should be mistaken, which the Moon's place perturb — and in the analysis of the Triangles, and of the rest, which the obliquity of the ecliptic, or the distance of the poles of the equator and the ecliptic include, my opinion in Book 1 [as] I established, I followed. Because indeed the Moon's places are observed with respect to the Ecliptic, therefore the places of these computed are reduced to the Ecliptic. Here then is a synopsis of these.

Table of twenty selected lunar observations reduced to Bologna

This table presents the twenty observations Riccioli selected to test the Tychonic lunar Variation, reduced to the meridian of Bologna. The observations are grouped by their source — those drawn from Chapter V (five eclipse-derived observations) and those from Chapter VII (the remaining fifteen, taken outside eclipses). The column headings, read left to right:

- **Ordo Observationum** — the serial number of the observation (in Riccioli's master sequence).
- **Tempus Aequatum Bononiæ post Meridiem** — the equated time at Bologna after noon: Year, Month, Day | Hours, ' (minutes), " (seconds).
- **Solis locus ex Nostris Tabulis** — the Sun's place from our Tables: Sign, Degrees, ', ''.
- **Lunæ locus ex iisdem Tab. primò æquatus** — the Moon's place from the same Tables, first-equated: Sign, Degrees, ', ''.
- **Anomalia Lunæ primò æquata** — the Moon's anomaly, first-equated: Sign, Degrees, ', ''.
- **Lunæ locus ultimò æquatus Tychonicè, ac reduct. ad Eclipt.** — the Moon's place finally equated by the Tychonic method, and reduced to the ecliptic: Sign, Degrees, ', ''.
- **Locus Lunæ observatus respectu Eclipticæ** — the Moon's observed place with respect to the ecliptic: Sign, Degrees, ', ''.
- **Excessus, vel Defectus computati, ac observati** — the excess or defect of the computed value against the observed (d = defect, e = excess): ', ''.

Ordo	M A e n n . s.	So l Si g.	Lu na Sig .	An om. Sig.	Luna ult. Sig.	Luna obs. Sig.
Ex Cap. V.						
2	1 S 6 e 2 p 4 t.	♍	♊	10	♊	♊
4	1 F 6 e 2 b 7 r.	♋	♊	7	♊	♊
9	1 I 6 a 3 n 5 .	♊	♏	7	♏	♏
26	1 N 6 o 4 u 4 .	♌	♊	7	♊	♊
32	1 A 6 p 4 r 7 il .	♍	♊	3	♊	♊
Ex Cap. VII.						
3	1 I 6 u 4 li 2 j	♎	♌	4	♌	♌
5	1 I 6 u	♎	♍	8	♍	♍

Ordo	M A e n n . s.	So l Si g.	Lu na Sig .	An om. Sig.	Luna ult. Sig.	Luna obs. Sig.
	4 li					
	2 j					
6	1 A	♌	♌	4	♌	♌
	6 u					
	4 g					
	2 .					
14	1 N	♍	♋	7	♋	♋
	6 o					
	4 u					
	2 .					
29	1 A	♌	♏	8	♏	♏
	6 u					
	4 g					
	3 .					
43	1 I	♊	♎	11	♎	♎
	6 u					
	4 n					
	4 ij					
44	1 I	♊	♈	6	♈	♈
	6 u					
	4 n					
	4 ij					
50	1 A	♈	♊	7	♊	♊
	6 p					
	4 r					
	5 il					
	.					
59	1 M	♏	♎	1	♎	♎
	6 a					
	4 ij					
	6					
61	1 I	♊	♎	8	♎	♎
	6 u					

Ordo	M A e n n . s.	So l Si g.	Lu na Sig .	An om. Sig.	Luna ult. Sig.	Luna obs. Sig.
	4 n					
	6 ij					
73	1 M	♄	♃	0	♃	♃
	6 a					
	4 ij					
	7					
85	1 I	♄	♊	1	♊	♊
	6 u					
	5 li					
	2 j					
89	1 D	♄	♊	3	♊	♊
	6 e					
	5 c.					
	3					
93	1 A	♄	♌	8	♌	♌
	6 u					
	5 g					
	5 .					
97	1 M	♃	♄	1	♄	♄
	6 a					
	5 r					
	7 t.					

§7

From Boulliau's Table [Bullialdi], then — which I set out in Chapter VI — together with what precedes it from our own, it is clear that not even our third Equation, that is, the Tychonic Variation, is satisfied at every point by the observations. And although it sometimes agrees within one or another minute, it more often diverges by a good many minutes [*scrupula*]. I do not deny that some part of this disagreement can be assigned to the observations themselves, and to the multitude of elements that combine to establish the Moon's place. Yet because up to now we have nothing better, we must wait until from these data all the Tychonic observations come to light, so that the others made by astronomers may

be carried through every degree of the lunar anomaly, the Moon recurring at the same distance from the Sun. Since from the two aforementioned Tables we have nothing but the following comparisons — and many other observations, drawn from those just set out, are suspect to us, and these same ones are themselves very irregular and at variance with the Tychonic Variation — let this Table of observations, twenty-four by Boulliau and twenty by ourselves, stand in the meantime.

[The faint inverted text near the foot is offset show-through from the facing page: "*Hoc loco inferendæ ... aliàs exhibitæ in Primo Tomo Almagesti Noui / Libro 4. pro Selenographia.*"]

Table from the Tables of Chapters VI & VII

[Title: *Ex Tabula Capitis VI. & VII.*]

This table tabulates, against the Moon's distance from the Sun and its anomaly (each in Signs and Degrees), the defect or excess of the Tychonic Variation. Column headings:

- **Distantia** ☽ à ☉ — the Moon's distance from the Sun: Sign, Degrees.
- **Anomalia** ☽ — the Moon's anomaly: Sign, Degrees.
- **Defectus, vel Excessus Tychonicæ Variationis** — the defect or excess of the Tychonic Variation (d = defect, e = excess): ' (I), " (II).

Distantia Sign.	Distantia Grad.	Anomalia Sign.	Anomalia Grad.	d		
				/	'	"
1	10	11	27	e	1	58
					3	
1	10	1	14	d	2	52
					4	
1	14	5	4	e	1	37
					6	
1	14	3	22	d	3	18
					7	
1	15	3	3	d	5	12
					2	
1	19	8	12	d	5	17
1	21	5	13	e	2	59

Distantia Sign.	Distantia Grad.	Anomalia Sign.	Anomalia Grad.	d / e	'	"
					2	
2	21	7	13	d	1	0
					7	
2	25	8	12	e	2	49
					4	
3	0	7	2	d	2	32
					4	
3	3	11	11	d	7	25
3	9	0	27	d	1	6
					0	
3	10	1	20	d	1	12
					2	
3	17	2	29	e	2	25
					1	
3	21	1	11	d	1	57
					0	[?]
3	23	4	6	d	5	39
4	3	1	15	d	0	12
4	6	3	27	d	1	36
					5	
4	10	4	26	e	7	0
4	12	7	11	d	2	19
					0	
4	14	4	6	d	1	56
					0	
4	15	7	9	d	1	54
					5	
4	27	2	22	d	0	32
5	1	5	17	d	1	24
					0	
5	9	3	5	e	1	52
					0	

Distantia Sign.	Distantia Grad.	Anomalia Sign.	Anomalia Grad.	d / e ' "
5	10	3	6	e 0 2
6	11	7	1	e 5 6 4
6	19	4	8	e 3 48
6	26	7	10	e 4 52
7	4	5	1	d 2 17
7	19	5	16	d 1 57
8	0 (☉)	2	5	e 2 54
8	2	5	29	e 0 54
8	16	6	13	d 2 14
8	22	10	15	d 1 3
8	23	8	16	d 1 57 7
8	25	0	15	e 1 5 3
9	2	1	19	e 4 38
9	7	8	7	e 2 10 0
9	12	6	2	d 1 0 0
9	27	7	23	d 1 57
10	10	8	6	d 1 13 6
10	21	8	17	e 1 1 7

CAPVT XI.

De Libratione Lunarior Corporis, eaque occasione de Selenographia.

(On the Libration of the Lunar Body, and on that occasion concerning Selenography.)

§1. The questions that bear on the Moon's light, and on its spots, mountains, and the like, I treated long ago in Book 4 of the *Almagestum Novum* [*Almagesti Novi*], from Chapter 5 through Chapter 9. In Chapter 7 I inserted a figure of the Selenography drawn from our own observations, and above all from the most accurate observations of Father Francesco Maria Grimaldi [*Francisci Mariæ Grimaldi*], repeated over many years through the constant and most attentive inspection of the individual regions. He undertook to delineate the Moon's disc not at full Moon only — when the lunar disc, rightly illuminated by the Sun, does not present its spots with the same distinctness it shows in its other phases — but also before and after full Moon, in its various phases. For since he had undertaken to delineate no part of the Moon's face without being certain of its position, shape, magnitude, and the quality of its darkness (its blackness) or brightness (its whiteness), he therefore left out many small features which could neither be plainly noted nor counted with any sure distinction. This perhaps gave occasion to some to assert that our Selenography does not agree with the Selenographies of others, in which the very smallest features are marked out. Whether those features are correctly drawn, or are some arbitrary thing, or are a refutable appearance, let those very men have seen to it themselves. For our part, we were prepared to set out for our examiners — but with greater regard for the truth — that many of the larger features which are lacking in others' Selenographies (those, at least, which have come into our knowledge), or are wrongly designated, occur especially in those regions where that whole portion of the Moon which is thought to resemble a Sea is represented as a uniform blackness — which is plainly far from the truth.

§2. Moreover, at the end of this Chapter we decided to repeat the two figures of our Selenography just as they stand in the *Almagestum Novum*, so that nothing concerning the libration to be treated below should, through some defect of these figures, turn out the more obscure. For we must answer the points which the most learned man, Johannes Hevelius [*Io. Hevelius*], that most expert authority on the face of the Moon, wrote out to us in a most courteous and most learned letter, published in most elegant typography. But because this perhaps came into the hands of few, we will set out the whole of it after the two Selenographic figures

just mentioned; the rest, which we said concerning the Lunar Libration in Book 4 of the *Almagestum Novum*, Chapter 9, are here to be presupposed, so that we may not now go over the matter again.

[The large rule and display lines at the foot continue from the show-through note above and introduce the plate that follows: "*Hoc loco inferendæ sunt duæ Magnæ Figuræ Lunæ, aliàs exhibitæ in Primo Tomo Almagesti Novi Libro 4. pro Selenographia.*" — "Here are to be inserted the two great figures of the Moon, otherwise exhibited in the First Volume of the *Almagestum Novum*, Book 4, for the Selenography."]

Diagram. A full-page engraved selenographic plate, oriented landscape (turned 90° relative to the text folios). At the center is a large circular full-Moon map showing the lunar maria, craters, and ray systems in fine hatching. Flanking it are four smaller circular figures of the Moon in different phases — two at the left margin, two at the right margin — each numbered. The plate is the principal selenography Riccioli credits to Grimaldi.

- Center (large disc): the full-Moon selenography. Engraved caption above: "SELENOGRAPHIA P. FRANCISCI MARIÆ GRIMALDI SOC. IESV — Selenography of Father Francesco Maria Grimaldi of the Society of Jesus, selected with the best telescope from many phases of the Moon, in which he in part confirmed, in part so corrected and augmented the Selenographies of Langrenus [Langreni], Hevelius [Hevelii], Eustachio [Eustachij], Sirsalis, etc., that he attained clear evidence of even the smallest features from several phases."
- Top left ("5. Fig."): a gibbous/crescent phase figure of the Moon.
- Lower left ("4. Fig."): a phase figure of the Moon.
- Top right ("2. Fig."): a crescent phase figure of the Moon.
- Lower right ("3. Fig."): a phase figure of the Moon.
- Below the central disc (caption block): "1. Figura inserenda Almagesto Novo P. Io. Bapt. Riccioli, statim post 1. tomi pag. 204. Quæ non est Plenilunij, sed ex pluribus phasibus collecta" — "Figure 1, to be inserted in the *Almagestum Novum* of Father Giovanni Battista Riccioli, immediately after page 204 of Volume 1. It is not [a figure] of the full Moon, but gathered from several phases."
- Lower-left margin: "Delineavit ipse P. Grimaldus." — "Father Grimaldi himself drew it."
- Lower-right margin: "Dominicus Fontana Sculp. Bononiæ, año 1651." — "Domenico Fontana engraved it, at Bologna, in the year 1651."

No interior point-letters or grid labels are present on the disc; the maria and craters are rendered pictorially without alphabetic keys. All caption text is legible and transcribed verbatim above.

Diagram. A full-page engraved circular Moon map — the famous Riccioli–Grimaldi selenographic nomenclature plate. The engraved caption across the top reads "VI. FIGVRA PRO NOMENCLATVRA ET LIBRATIONE LVNARI" ["Sixth figure, for the nomenclature and libration of the Moon"], flanked by two mottoes: at left "Nec Homines Lunam incolunt" ["Neither do men inhabit the Moon"] and at right "Nec Animæ in Lunam migrant" ["Nor do souls migrate to the Moon"]. The lunar disk is divided by eight radial lines into eight octants, labelled around the rim "I. OCTANS" through "VIII. OCTANS", with "Nodus Orientalis" ["Eastern Node"] at left and "Nodus Occidentalis" ["Western Node"] at right. A graduated scale-bar runs along the bottom from "X" to "Z", marked 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200. Reference letters appear around the outer rim (P, B, G, R, S, C, M, H, D, I, Z, X, and others).

The disk is mapped with Riccioli's grand named regions and a dense scatter of named craters. The major named regions, as engraved:

- OCEANVS PROCELLARVM [Ocean of Storms] (the western maria expanse)
- TERRA SICCITATIS [Land of Dryness] (upper centre)
- TERRA VITÆ [Land of Life] (upper right)
- TERRA SANITATIS [Land of Health] (lower centre)
- TERRA FECVNDITATIS [Land of Fruitfulness] (right)
- TERRA STERILITATIS [Land of Sterility] (lower left)
- TERRA CALORIS [Land of Heat] (left)
- TERRA MANNÆ [Land of Manna] (right)
- TERRA NECTARIS [Land of Nectar] (lower right)
- TERRA VIGORIS [Land of Vigour] (right)
- TERRA PRVINÆ [Land of Hoar-frost] (upper left)
- TERRA GRANDINIS [Land of Hail] (upper centre)

Named seas, marshes, bays, lakes, islands, and peninsulas:

- Mare Imbrium [Sea of Showers]
- Mare Frigoris [Sea of Cold]
- Mare Serenitatis [Sea of Serenity]
- Mare Vaporum [Sea of Vapours]
- Mare Tranquillitatis [Sea of Tranquillity]

- Mare Nubium [Sea of Clouds]
- Mare Humorum [Sea of Moisture]
- Mare Crisium [Sea of Crises]
- Mare Nectaris [Sea of Nectar]
- Mare [Fecunditatis — Sea of Fruitfulness, near "Mannæ Fecundi"]
- Palus Nebularum [Marsh of Mists]
- Palus Putredinis [Marsh of Decay]
- Palus Nimborum [Marsh of Storms]
- Palus Somni [Marsh of Sleep] [?]
- Sinus Roris [Bay of Dew]
- Sinus Iridum [Bay of Rainbows]
- Sinus Medius [Central Bay]
- Sinus Æstuum [Bay of Heats]
- Sinus Epidemiarum [Bay of Epidemics]
- Lacus Mortis [Lake of Death]
- Stagnum Glaciei [Pool of Ice]
- Insula Ventorum [Isle of the Winds]
- Peninsula Deliriorum [Peninsula of Frenzies]
- Peninsula Fulgurum [Peninsula of Lightnings]
- Littus Eclipticum [the Ecliptic Shore] (at left rim)

The named craters, transcribed octant-by-octant under magnification (source spelling | gloss; [?] only on the ~14 that remain genuinely unresolved even at the highest magnification). The plate is engraved **South-up** in the old convention; positional descriptors refer to location on the printed plate.

Upper-left limb / NW rim: Cleostratus, Pythagoras, Xenophanes, Oenopides, Anaximander, Anaximen. [Anaximenes], Philolaus, Harpalus, Heraclides, Helicon.

Upper rim / N: Anaxagoras, Euctemon, Meton, Epigenes, Plato, Timæus, Archytas, Democrit. [Democritus], Thales (ref. G), Zoroaster.

Upper-right limb / NE: Endymion, Hercules, Atlas, Hermes, Mercurius, Cepheus, Messala (engr. "Messhala"), Geminus, Cleomedes, Macrobian. [Macrobius], Berosus (ref. R), Seneca, Plutarch., Proclus.

Right limb / E (Mare Crisium, Terra Vigoris): Firmicus, Taruntius, Langrenus [van Langren].

Central-upper (Mare Imbrium / Serenitatis / Vaporum): Archimed. [Archimedes], Autolycus, Aristillus [?], Timocharis, Pytheas [?], Aratus, Conon, Eratosthenes, Stadius [?], Dom. Maria [Dominicus Maria Novara] [?], Calippus, Theætet. [Theaetetus], Eudoxus, Posidonius, Sulpic. Gall. [Sulpicius Gallus], Menelaus, Vitruuius, Plinius, Manilius, Higinus [Hyginus], Iul. Cæsar, Agrippa, Sosigen. [Sosigenes], Ariadæus.

Mare Tranquillitatis / Terra Vitæ boundary: Hypatia, Theon sen., Theon iun., S. Dionys. Areop., Censorinus, Beda, Exiguus [Dionysius Exiguus], Alcuin, Mart. Capella, Goclenius.

West / left (Oceanus Procellarum): Ecphantus, Aristarchus, Seleucus, Cardanus [Cardano], Marius [Simon Marius], Bessarion, Cataneus [?], Galilæus [Galileo], Caualerius [Cavalieri], Reinerus [Reiner], Keplerus [Kepler], Milichius, Hortens. [Hortensius], Reinhold, Lansbergius [Lansbergen], Linemannus [Linemann].

Lower-left limb (Riccioli, Grimaldi, Terra Caloris): Ricciolus [Riccioli], Grimaldus [Grimaldi], Eustachius, Rocca, Billy, Sirsalis [Sersale], Crügerus [Crüger] (ref. S), Eichstadius [Eichstadt], Fontana, Zupus [Zupi], Deriènes [?], Herigonius [Hérigone], Gassendus [Gassendi], Mersenius [Mersenne], Byrgius [Bürgi], Vieta [Viète], Origanus, Kritmanus [?], Schikardus [Schickard], Hainzelius [Hainzel], Phocylides, Bayerus [Bayer], Schillerus [Schiller] (ref. D), Zucchius [Zucchi], Bettinus [Bettini], Bartolus [Bartoli], Kircher, Caluisius [Calvisius] [?], Cabeus [Cabeo].

Lower-left maria (Mare Humorum / Nubium): Campanus, Capuanus, Cichus, Bulliadus [Boulliau], Munosius [Muñoz], Rothmannus [Rothmann], Gulielm. Hass. [Wilhelm of Hesse], Saßerides [Sascerides] [?].

Lower-centre / S (Terra Sterilitatis, the great south craters): Ptolemæus, Alphonsus [Alfonso X], Alpetragius [al-Biṭrūjī], Arzachel [al-Zarqālī], Albategn. [al-Battānī], Thebit [Thābit], Purbachius [Peurbach], Regiomontan. [Regiomontanus], Pitatus [Pitati], Gauricus [Gaurico], Walterus [Walther], Blanchinus [Bianchini], Vernerus [Werner], Apianus [Apian], Aliacensis [Pierre d'Ailly], Azophi [al-Ṣūfī], Abenezra [ibn Ezra], Geber [Jābir ibn Aflaḥ], Almæon [?], Tatius [Achilles Tatius] [?], Fernelius [Fernel], Gemma Frit [Gemma Frisius], Nonius [Nunes], Maurolycus [Maurolico], Stœffler [Stöffler], Licetus [Liceti], Barocius [Barozzi], Homelius [Hommel], Piscus [Pitiscus], Hagecius [Hájek], Lilius [Lilius], Tannerus [Tanner], Mutus [Mut], Curtius [Curtz], Simpeliu[s] [Sempill], Manzinus [Manzini], Schomberger [Schönberger], Malapertius [Malapert].

Lower-centre south crown (the Tycho group): Tycho, Longomontan.
[Longomontanus], Scheiner, Blancan. [Biancani], Clavius [Clavius], Maginus
[Magini], Gruemberger [Grienberger], Moretus, Cysatus [Cysat], Saussurius [?].

Lower-right (Terra Sanitatis / Nectaris / Fecunditatis): Abulfeda, Alfraganus [al-Farghānī], Sacrobosc. [Sacrobosco], Pontanus [Pontano], Zagut [Zacuto], Rab. Leui [Levi ben Gershon / Gersonides], Riccius [Ricci], S. Theophil., S. Cyrill., S. Catharina, Stiborius [Stöberl], Fracastor [Fracastoro], Piccolomin. [Piccolomini], Neander, Metius, Reitha [Rheita], Fabritius [Fabricius], Muselius [?], Claramontius [Chiaramonti], Snellius [Snell], Furnerius [Fournier], Steuinus [Stevin], Santbec. [Santbech], Vendelin. [Wendelen], Petavius [Pétau].

LIBER III. — DE LVNA.

CAPVT XII.

To the most Reverend, most Distinguished, and most Learned man, Father Giovanni Battista Riccioli of the Society of Jesus, most celebrated Professor of Philosophy, Theology, and Astronomy at Bologna — Johannes Hevelius [Johannes Hevelius] sends greetings.

[Margin: Habet super quod agat etiam Posteritas.] [There is something on which posterity, too, may work.]

Were it not for your great devotion to study, and your humanity and kindness toward me — both abundantly known to me — I would surely have feared to break in with so bold a letter upon the tranquillity of your weighty studies. But I approach you all the more confidently in proportion as, in your incomparable *Almagestum Novum* [*Almagestum Novum* / *New Almagest*], you have offered me an occasion to address you — especially since not a few things contained in it pertain to our common studies, and are no less useful, which I am perhaps fortunate to possess. About these I wish freely, in the philosophical manner, to exchange words with you, and most earnestly to seek your judgement on them all. For although there is no one — let all suspicion of flattery be far off — more practised than you in that class of matters about which I now intend to deal with you, yet I also know that no one will grasp my meaning better, nor sift, weigh, and examine these very things more exactly. And so I shall not hesitate, in my burning zeal — and with my mind most well-disposed toward you — to make you the interpreter of those things which have proceeded from the highest ardour of

astronomical study. I in turn — believe me — pledge you my service, and my singular study in every kind of good office.

[Margin: *Multa praeclara in Selenographicis peragenda.*] [Many distinguished things remain to be accomplished in selenographic matters.]

For my part, I am well aware that very many most abstruse things, in every kind of the sciences, have been happily discovered by most praiseworthy Antiquity, and that a great many more lie hidden as yet, wrapped in the shadows of ignorance, left to be uncovered by us and by posterity. Who will deny it? Astronomy alone — let me pass over the rest — is witness enough, and more, to this. For although, with incredible fervour, labour, and constancy, it has been cultivated from the very first beginnings of the world, it is nonetheless by no means finished off in all its parts down to the last; [Margin: *Antecessores nostri reliquerunt Astronomiam; sed quotidie habemus in quavis illius parte quod corrigamus, adjiciamus, exornemus.*] [Our predecessors left us astronomy; but every day, in whatever part of it, we have something to correct, to add, to embellish.] our predecessors left us astronomy, but every day, in whatever part of it, we have something to correct, to add, to adorn.

[Margin: *Pariter in Selenographicis quantum nuper actum, & quantum adhuc superest.*] [Likewise in selenographic matters: how much has lately been done, and how much still remains.]

Likewise in selenographic matters: how much has been brilliantly accomplished in recent years, and how happily worked through, and how much still remains to be carried out beyond — that rests above all with you, the most knowledgeable of men in these matters, among whom I would rightly name you the leader. Be the judge yourself. Now among the chief matters that arise in scrutinizing the Moon, the motion of lunar libration holds (as you, not unknowing, can witness for me) by no means the last place. [Margin: *Motus Lunae Libratorius nondum hactenus satis fuit compertus.*] [The motion of the Moon's libration has not, up to now, been sufficiently ascertained.] To have it accurately discovered and grasped by perspicacity, and to deduce indubitable laws of it, is assuredly of much moment for astronomy — and especially for observations, that I may pass over very many things, namely for the right determining of lunar eclipses: since without that motion neither the Moon's limb, nor its centre, nor any of its phases and quantities, can be rightly delineated.

[Margin: *Autor sedulam dedit operam ut motum istum inveniret.*] [The author gave diligent effort to discovering that motion.]

For that reason, in our *Selenographia* [Hevelius, *Selenographia*] too, I laboured with all my powers and with various and manifold observations; and this motion of libration I determined, demonstrating it to all, as far as could be done within so short a span of time — that is, with sufficient diligence (in my own judgement at least) from the year 1643 down to 1645. First of all I detected, by what means and at what time our observations were carried out, that there was a libration; namely that in the year 1644 the greatest libration was observed in Cancer, and the least in Capricorn, and that the whole revolution was completed roughly in a monthly interval; [Margin: Maxima libratio An. 1644. in Cancro extitit.] [The greatest libration appeared in the year 1644, in Cancer.] and that the part of the Moon at which the terms of the libration occurred — and all these things — have their origin in nothing but the motion of longitude, of latitude, of the nodes, and of the limits.

[Margin: Maxima libratio paulatim ex Cancro exiuit.] [The greatest libration gradually departed out of Cancer.]

These same things, indeed, I have likewise found in the following years up to now to hold in fact entirely, and in great part — beyond doubt, by ascertained observations — except that, in the course of a longer time, the greatest libration has departed out of Cancer, and the least out of Capricorn, just as on page 438 of the *Selenographia*. I suspected this not badly, and I remember it clearly enough: I mean that I was plainly of the opinion that, even if the terms of the libration should in future remain at the very same observed point, nonetheless the greatest and least motions of the libration would not constantly remain in the very same signs — namely Cancer and Capricorn. [Margin: An. 1646. Maxima libratio in Virgine deprehensa.] [In the year 1646, the greatest libration was detected in Virgo.] This too I at once observed in the year 1646: my selenography, carried nearly to the central point, made it luminously evident — namely that the greatest terms of libration had passed out of Cancer entirely, following the order of the signs, and had then lodged in Virgo. From this, my mind exerted itself toward fuller and more complete investigation; and so, in the following years, I bent all my powers with the highest eagerness to disentangle this so very intricate motion. [Margin: An. 1648. motus librationis ab autore rectè & integrè detectus.] [In the year 1648, the motion of the libration was rightly and fully detected by the author.] But for a long time it vexed me, kept me in suspense, and held me back, so that I could establish nothing certain about it; yet at last, with the divine breath inspiring, and with me tirelessly scrutinizing it, the work succeeded according to my wish, and in the year 1648 I seemed to myself to have found that period — namely at what interval of time the greatest libration

returns to the same sign of the Moon, and on what foundation it rests. Of these things more fully in their place below. [Margin: Tabula libratoria constructa.] [A table of libration constructed.] Once that was thoroughly investigated, I at once constructed a table according to that hypothesis; and indeed for the integral, this present running century — and yet to be examined more exactly, both through our own and through others' observations, however many exist.

[Margin: Quare tabula ab autore non citius fuerit edita?] [Why was the table not published sooner by the author?]

It was not, then, without reason that I would have deferred for astronomy this matter, hitherto unknown — setting aside all delay — with these considerations especially: that all those things which I was hereafter to note about this matter, since I was to communicate them to the mathematicians (as if pledged, and on my honour, on page 439 of the *Selenographia*), I would have made public by right; but at the same time certain other matters, especially cometographic ones, were to be committed to the press at their own time, and I gladly chose to put off that business until then; not unwilling. But in very truth, once your work had been read through — distinguished work (a copy of which, by I know not what left-hand fate, was first given me at the beginning of this year) — it added the greatest stimuli to my purpose, that I should recall those selenographic observations which, on account of various most weighty matters, both public and private, occupations had until now made me lay quite aside. [Margin: Occasio scribendi.] [The occasion of writing.] There was added the fact that, in Book IV on the Moon, many distinguished things have been inserted: partly things I would gladly see, partly things that seemed to concern our *Selenographia*.

[Margin: Lunam librari certum est.] [That the Moon undergoes libration is certain.]

For which reason I have hastily seized the pen, to cast onto paper as much about the investigation of the libratory motion as about the things that bear upon its use and the construction of the table that follows, together with certain other things necessary to be added — so far as it pertained. What chiefly has been reached in this business, and what is to be corrected and augmented by those very persons in time, remains. But let us approach the matter itself.

[Margin: Lunam librari certum est.] [That the Moon undergoes libration is certain.]

That the Moon librates — now toward the West, now toward the Orient, now toward the South, now toward the North, within a certain interval of time — has

been luminously demonstrated, and not by me alone, in chapter 8, page 238 of our *Selenographia*; but, more than enough, by you in Book IV, cap. 9 of the *Almagestum Novum*, and has been confirmed by very many most painstaking men — Gassendi [Gassendi], Boulliau [Boulliau], Langrenus [Langrenus], Francesco Maria Grimaldi [Francesco Maria Grimaldi], Niccolò Zucchi [Zucchi] = Niccolò Zucchi, Daniele Bartoli [Bartoli], and Girolamo Sirsali [Sersale]. [Margin: *Latitudo huiusque genuina librationis periodus.*] [The breadth, and the genuine period, of the libration.] But the question is in what manner the greatest libration (that is, when the interval between the Marsh Mæotis [Palus Mæotis] and the lunar Sea of Crises [Mare Crisium], the limb, is the greatest of all), or the least (that is, when the interval between the Mæotid Marsh — by you otherwise called the macula of Grimaldi [Grimaldi] — and the Moon's limb is the least), changes and

varies: namely, whether the greatest always remains in Cancer, and the least in Capricorn — and of what sort, and how great, the genuine period of this variation is. This, up to now indeed, has not been sufficiently ascertained. [Margin: *Maxima libratio perpetuò in Cancro permansuram nunquam asseruit Autor.*] [The author never asserted that the greatest libration would remain perpetually in Cancer.] You urge upon me, indeed, in Book IV, cap. 9 (if I am not mistaken), that I was altogether of the opinion that the greatest libration of the Moon is in Cancer, and the least in Capricorn (as in fact happened around the year 1644), and that it would also henceforth appear continuously in the said signs; but — by your leave, most Reverend man — that was assuredly never my mind. For although I said many times in the *Selenographia* that in our time, or at these times, the greatest libration stood out in Cancer and the least in Capricorn, [Margin: *Id quod Selenographia satis superq; testatur.*] [Which the *Selenographia* testifies abundantly.] in no way would I have it understood as if I had said this for our whole age. As is set forth in chapter 9 of Book IV from your statements, those things might be so interpreted; but I thought only that it had so come to pass in the time of my observations — namely, from the year 1643 down to 1645, the time at which the greatest part of our phases was observed and delineated — that I plainly noticed nothing otherwise than that the greatest libration is in Cancer, and the least in Capricorn.

[Margin: *Id quod Selenographia satis superq; statuit, & redarguit.*] [Which the *Selenographia* abundantly establishes, and refutes.]

Accordingly, too, throughout the *Selenographia*, lest anyone snatch up my words in too ample a sense, I took sufficient precaution beforehand — in chapter 47,

page 421, where I treated of the greatest libration — wishing it so in these words: *Which, however, I assert with this exception: that if the Moon should hereafter keep its terms of libration in this same way in the said signs perpetually, and its motion in the manner in which it has been observed in the nearest elapsed years, it will so continue; but not otherwise — especially with the retrocession of the nodes (which, however, I deny to be in the least impossible) — should some inequalities arise, of which, by similar continued observations of lunations over a longer span of time, one might be made more certain.* Likewise, as you know, chapter 54, page 438, on the same matter: *But whether, in the manner already said, the greatest and least libration constantly and perpetually persevere in Cancer and Capricorn; or whether, in the train of a more lasting time, the libration suffers certain inequalities; or whether the thing be otherwise — I can certainly not affirm for the present; but this I can do above all: that hitherto, in the time of my observations, I have detected nothing otherwise than that continuously in those signs, Cancer namely and Capricorn, the terms of the libration were observed.* [Margin: Autor limites in Cancro, & Capricorno observavit An. 1644.] [The author observed the limits in Cancer and Capricorn in the year 1644.] *And since, within so brief a span of time — of a few years, that is (as those who weigh the existence of heavenly things will easily grant) — it could not be detected by us, it will therefore be of the highest necessity that all and each of the watchers of the heavenly vault, tireless and with the greatest diligence, with constancy applied, should thereafter attend whether the motion of libration of this kind persists in the Moon through all things with the progress of time, or does not; and whether it be bound up by the constant laws of many years' observations, agreeing with nature, and indubitable, and so forth.*

[Margin: Autor limites in Cancro, & Capricorno observavit An. 1644.] [The author observed the limits in Cancer and Capricorn in the year 1644.]

From these things, and from very many others, it is hence luminously plain in our *Selenographia* that I observed the limits of the libration in Cancer and Capricorn in about the year 1644, and in those same signs; and that (which is well noted) I foretold soon after, most aptly, that these limits would not remain perpetually there, and that thus too the quadrature sections of the Moon's terms exist in each; that the greatest libration, existing through the same maculae, would never be carried across under the same term; but that it would vary, as the greatest and least libration would tarry now in one sign, now in another; and likewise the limits, and the poles too, with certain variations — just as I indicated, in clear words, at pages 237 and 244 of the *Selenographia*, that they would be liable to vary. There was no need, then, to impugn those things which I never

affirmed for certain; nor was it so much in space, nor (as above) is it manifest with the things cited, that I was able to establish them; but it sufficed to have demonstrated and indicated the greatest libration about

the Marsh Mæotis no longer in Cancer, and the least no longer in Capricorn, to exist — as indeed was observed around the year 1636 by Gassendi, and in the year 1644 by Boulliau, and by me about the year 1644. [Margin: Maxima libratio vicissim An. 1649. in Capricorno apparuit.] [The greatest libration appeared in turn, in the year 1649, in Capricorn.] But truly in the year 1649, with the most ingenious Grimaldi attesting it, the greatest libration was in turn detected in Capricorn, and the least in Cancer; which I too firmly attest, so that it truly came to pass with this libration of ours, in the manner said, at the time.

For I have at last observed — when out of my several continuous observations, and out of those of others, it has befallen me to see — that the limits of the libration (that is, the greatest libration) vary altogether with the progress of time, and from the sign of Cancer move on by steps to the rest, in proportion as one may compare the signs; [Margin: Quanta sit librationis periodus, & quamdiu reposita in intervallum excurrat prius quam maxima libratio ad idem redeat punctum.] [How great the period of the libration is, and over how long an interval, stored up, it runs before the greatest libration returns to the same point.] and that, after some nine years or so of absolute interval (or, to speak more accurately, after the greatest and least of this libration has returned to the same point of the zodiac in the space of 8 Egyptian years, 311 days, 1 hour, and about $\frac{1}{3}$ — and daily it is promoted by 6 signs, 41 minutes, 41 seconds in the consequence of the signs).

[Margin: Libratio pro motu longitudinis, & latitudinis Lunæ variatur.] [The libration is varied with respect to the motion of longitude and of latitude of the Moon.]

For it is most true, as we said often enough in the *Selenographia*, that the motion of libration follows the motion of longitude and of latitude; and this indeed of the simple latitude. [Margin: In Australi latitudine Regio Hyperborea ampliatur; in Septentrionali coarctatur.] [In the southern latitude the Hyperborean region is enlarged; in the northern, it is constricted.] That is to say, when the Moon has its greatest southern latitude, that space toward both limbs, looking Zenith-wards — namely the Hyperborean region, Sarmatia — is greatly enlarged, so that the Moon's limb stands as far as possible from the Sarmatian mountains and from the Iacubean Hyperboreans [*Iacubi Hyperborei*] (or, as it pleased you to name them, from the maculae of Meton, Thales, and Endymion). The lower interval, on

the other hand, terminated meanwhile by those two limbs of the Moon, around the point of Nadir, plainly vanishes (as in the figure inserted near at hand, or in the following epistle, according to the full moon, page 164 of the *Selenographia*): so that the Moon's limb, around the lower part — having the Trojan Mountain [?], the Meridional Mountain, M. Hæmalon [?], and Techisandam (or, which is the same, the maculae of Schickard [Schickard], Zucchi [Zucchi], Kircher [Kircher], and Sempel [Sempel]) — is then nearest of all to all of them. By contrast, when the Moon has its greatest northern latitude, the space looking Nadir-wards — namely the part of Lybia [?] and Arabia (the land of sterility and of fruitfulness) — is found to be most extended; so that at that time the Moon's limb, with the said maculae — namely the Trojan Mountain, the Meridional Mountain, and Techisandam — is most lengthened away, while in the upper interval the interval meanwhile compresses itself wholly, so that the upper part of the limb — the maculae, namely the Hyperborean lakes and the Sarmatian mountains — is as near as it ever could be. And in this way, for the variation in respect of the Moon's latitude, the interval perpetually grows and shrinks, now above, now below.

[Margin: Libratio longitudinis non solùm Lunæ motui longitud. sed Apogæo & Apogæo respondet.] [The libration of longitude answers not only to the Moon's motion of longitude, but also to the Apogee and Apogee.] [?]

But the matter has itself somewhat otherwise with the libratory motion of longitude, which is detected around the western and eastern shore of the Moon, near the Marsh Mæotis and the Mæotid Marsh. For it is reckoned not simply from the motion of the Moon's longitude, but at the same time accommodates itself to the motion of the lunar Apogee. Hence, for the variation of the Apogee, the greatest libration in the Moon's western region, and the least in the eastern, around the Marsh Mæotis, always falls back: the Moon's limb either accedes more and more to those maculae, or recedes from them, around the Mæotid Marsh; and by like reasoning, in the upper and lower parts (as I remarked above), the limb varies toward the diverse latitudes of the Moon. [Margin: Maxima & minima libratio semper in plagis medijs remotionis Apogæi & Perigæi accidit.] [The greatest and least libration always occurs in the middle regions of the remotion of the Apogee and Perigee.] By this expressed law, with the Moon's Apogee turning in Cancer, the greatest libration is in Aries, and the least in turn in Libra; but with the Apogee placed in Leo, the greatest libration is in Taurus, and the least in Scorpio — and so consequently. By this reasoning (since I have set forth a few things, that I may unfold them), the greatest and least libration — that is, when the Marsh Mæotis and the Sea of Crises (or the macula of Grimaldi, and of

the Sea of Crises) has its greatest access to, or recess from, the Moon's periphery — perpetually occurs at the points of the middle remotions of the Apogee and Perigee. Just as this happens in various ways, I myself, with the observations of some years added by the grace of this epistle, and then with all the rest, am ready to demonstrate it — and especially you Bolognese are well placed to do so.

And so this is the chief cause from which that most intricate —

the Moon's libration arises, which up to now has wearied and tormented us so greatly. Some, no doubt, will be astonished — indeed, they will laugh at us — that, when the foundations of this librational motion are so very well known and so easy, and we delight in them, we should have reduced it to definite tables no sooner than we did, and only after the most thorough scrutiny. But of such half-learned judgments we take no account, especially when that most acute philosopher Seneca foretold this to us clearly long ago, in these words (*Natural Questions* VII): "*The time will come when our descendants will be astonished that we were ignorant of things so plain.*" Let us, then, be content to have investigated, explained, and laid this matter open thus far, and leave the rest, which perhaps still remains, to others. *For the time will come*, as Seneca goes on, aptly, in the same place, *when those things that now lie hidden will be drawn into the light of day by the diligence of a longer age.* But let us return to our purpose.

[Margin: From what foundation the librational table is constructed.]

Granted, then, the foundation just stated, the following table has been computed and extended for the present century, and — if anyone should prefer it — for several years more; and this is most easily done. For a given year, and for the beginning of any month you please, collect the motion of the Moon's apogee [Apogaeum Lunae], from which, if you subtract 3 signs, the true place remains in the signs and degrees, etc., in which, at that time, the greatest libration in longitude toward the Marsh of Maeotis [Palus Maeotis] occurs; whereas if you add 3 signs, the place of the least libration in longitude toward Maeotis comes out, and the greatest toward the opposite Marsh of Maeotis. Meanwhile, the greatest librations of the Marsh of Maeotis alone (since the least of these are evident from these) lie confined within the lattice, as is plain in their order; and indeed we have arranged them for the beginning of each month. We could likewise have extended this motion through the individual days, but to do so would have been excessively laborious to no purpose, since such great precision is not needed: it suffices to know the greatest libration of the Moon in any month. But if anyone should desire something more, let him use the proportional part; or — what is better — let him add, from the tables of the Moon's apogee, the motion

for the days and hours, if need be, to that librational motion for the beginning of a given month, and he will have, precise to the day and even to the hour, the greatest libration in longitude sought.

[Margin: The use of the table.]

The use of the table is this. For a given year, and the place of the greatest libration in longitude found — namely toward the Marsh of Maeotis. This being known, and the Moon being at some place in the ecliptic for a given day, how great its libration there is — whether greater or less, by the help of the little table inserted — is learned with no trouble: namely, whether it is at its maximum or its minimum, and at the same time by how much it has receded from the maximum, and from the minimum, librational limit.

[Margin: How the reticule shown in the *Selenographia* is here exhibited.]

Before we teach how the genuine libration belonging to any time is to be drawn from these, it is necessary, in order that we may have a general diagram of the phases ready beforehand — around whose center the librational motion both in longitude and in latitude is delineated. In our *Selenographia*, pages 262 and 410, we exhibited such diagrams, which possess about the center some reticule [reticulum] described, by whose aid the librational center of the Moon ought to be moved; but one must know, since the Moon's greatest libration — as has now often been stated, not more — occurs at that time when the least libration in longitude is in Capricorn: and for that reason that reticule does not suffice for every time; but only when the libration is greatest (as happened in the year 1644) it stays in Cancer, the Moon at the same time having its greatest southern latitude.

[Margin: When the greatest libration will in turn occupy Cancer.]

But that some, on the other hand, fix the greatest southern latitude at the close of the year 1661 and the beginning of 1662 — as on page 417 of the *Selenographia* we hinted; likewise for the years 1679 and 1697 — we shall see clearly come to pass.

[Margin: By what method the libration of every kind can best be delineated.]

Therefore it was greatly needful to devise another method, by whose help the libration, answering to these times both in longitude and in latitude, might be rightly described. You imagine, indeed, on page 214 of Book IV of the *Almagestum Novum*, that this could best be done by a little circle drawn about the center; but, the matter well considered, this is utterly impossible to perceive. And so it was

necessary to return once more to our reticule — though we have drawn it somewhat differently, and have reduced it, as far as we have so far been able from the given observations, in such a way that, in our opinion at least, of this...

Diagram. A rhombus-shaped (diamond) reticule grid occupying the lower right of the page, used for plotting the Moon's librational center in both longitude and latitude. The grid is filled with a regular lattice of crossing lines (triangular cells), with numbered scale divisions running along each of the four slanting edges. The figure is oriented as a square set on one corner; its two diagonal axes are labelled for libration in longitude and in latitude.

- Top vertex region: **minimum** (one upper corner) — marked *minimum*; the opposite scale running 0 through 5.
- Upper-left to lower edge (one diagonal): **Libratio Longitudinis** [Libration in longitude], with an *inter. medium* [intermediate] marking near the upper run.
- Right diagonal edge: **Libratio ... D Latitud. Austr.** [Libration / southern latitude], and at the far right **D Nodoru. / Latitud. Bor.** [of the nodes / northern latitude].
- Left diagonal edge (descending): **Latitudinis Austr.** [of southern latitude] over **Libratio D Latitud. Bor.** [Libration / northern latitude], with **Lin. Bor.** [northern line] and **Libr.** marked near the lower-left corner.
- Lower vertex: **Libratio Longitudinis** [Libration in longitude] with **minima** [least] at the bottom corner.
- Edge scale divisions: numbered runs 0, 1, 2, 3, 4, 5 and intermediate marks (10, 15, 20, 25 etc.) along the lattice edges on all four sides.

more and more, so that around the number 6, where the two outer circles intersect each other, the greatest libration is always reckoned; with a corresponding relation to the following reticule, in which the librational center of the Moon is moved — as will presently be said more clearly. But the upper interstice you see divided, in the line of limits, into 10 equal parts; the lower one likewise into equal parts. For when the Moon is in southern latitude — say only some 5 degrees about southward — and is extended some degrees toward the north, it will be necessary, that point, the middle point, to distribute into so many parts; that middle point refers to the limb when the Moon is situated about the Nodes, or in the ecliptic, having no latitude at all: the upper [parts] show the southern latitudes, the lower the northern latitudes.

[Margin: The difference between the old reticule and the new.]

According to these [divisions], the divisions of both longitude and latitude — this reticule moves about its center, or rather the center is moved within it, not indeed actually through itself, but by the relation of the peripheries to be described at all times — is delineated. And it agrees with that earlier reticule on page 242 of the *Selenographia* in nearly this: that the motions of the center are likewise completed by transverse lines absolutely; otherwise it is certainly mixed, the motion in latitude and in longitude never being separately describable. But it differs in turn from the earlier one in this: that it bears not the signs of the Zodiac, but the degrees of latitude; and on its front [top] and its foot [bottom] it exhibits the quantity of the libration of longitude divided into 6 parts, just as in the preceding larger reticule it appears more distinctly and clearly.

[Margin: Description of the new reticule.]

In the line a b, toward the left, when the center is situated so that the Moon possesses the least libration about the Marsh of Maeotis — the libration in longitude; but in the remaining parallel lines 1, 2, 3, 4, 5, the same libration grows in proportion, up to the number 6, namely the line c d, in which, the Moon being placed about the center, the greatest libration in longitude is described; and thence again from number 6 it decreases in the same way down to 0. But the remaining lines, parallel to the Nodes, exhibit the true place of the Moon's center according to all the latitudes, and indeed five [each]: the upper ones the southern, and the lower ones the northern latitudes, are jointly displayed.

And so, the quantity of the libration in longitude being given under a certain number (which from both is learned by the table) — and not the true latitude of the Moon — the center is also given, namely under the intersection of those two thicker lines of the libration of latitude and of longitude, for delineating the genuine periphery of the Moon, which by longitude and by latitude — as we have signified — is moved truly by the finer transverse lines. For example: if the Moon possesses a latitude of 4 degrees southern, then the center, in the line a b, about the number 3, will lodge in the upper [position]; from this point (if the latitude grows) through the points 10, 2, 12, 18, 24, 1, 34, 38, 42, 46, etc., it is carried further. But if the Moon, obtaining a southern latitude of two degrees and the least libration, then the center, in the line a b, about the number 2, is found in the upper [position]; and afterward, from this place (if likewise...

the latitude grows) through the number 15, 11, e, 13, 19, 2, 29, 33, 37, 41, 45, 4, and so on in succession it moves; but if the latitude decreases, from the said number 2, downward, through the points 25, 31, 37, 43, 49, 4, etc., the center of the Moon is carried; as will easily be evident to anyone looking more deeply into the

matter. And if anyone should desire to know more fully, let him read, if he please, pages 241 to 245, where almost everything is treated there about that reticule, and agrees well with this one of ours.

[Margin: The poles and the limits of the libration are moved.]

From this motion of the lunar center it necessarily follows — and we ought never to subside in the same place. By this reasoning, indeed: when the greatest libration is toward Maeotis, together with the greatest southern latitude; likewise the least libration there, with the greatest northern latitude, is given — then the axis, namely of latitude, or rather its western pole about A (in the Selenographic figure preceding), or, more accurately, when it lodges within FE, by reason of the differing northern and southern latitude, turns. But when the contrary happens — namely when the greatest libration, with the greatest northern latitude, exists, and again the least libration with the greatest southern latitude — then the librational axis of latitude, or rather its western pole about B, or rather within G and H, lodges. But at another time, about the intermediate librations and latitudes, between B and A, it librates pretty nearly always; so that, in my judgment, it descends in a measured way to about 35 degrees. With like reason, the limits also, or the line of limits (when this differs from the line of the Nodes by 90 degrees perpetually), are distant by about 35 degrees: this is plainly necessary.

[Margin: By what reasoning the poles librate.]

Which opinion both I have hitherto always held, although the boundaries of the poles and of the librational limit were unknown to me. For, when I had laid down (as I have often recalled, especially on page 244 of the *Selenographia*) that the poles of libration are continually moved, and never lodge on the same periphery in the same place — but by reason of the libration of the center, now ascending, now descending — it follows also that the limits are of necessity movable. Therefore indeed I marvel from where you might be persuaded (as on page 212 of Book IV of the *Almagestum Novum* it is read) that I had laid down the limits to be perpetually immovable: since the contrary shines forth more clearly from what I have said.

[Margin: The author always laid down that the poles and limits are moved.]

Moreover, if we look more deeply into this librational motion, we shall see not only — by that, namely, the given hypothesis — that there is one axis, or those two, AA, the poles of latitude, of which mention has now been made; but in the Moon there is given still another axis, or two poles besides, about the line of limits, which it pleases us to call the poles of longitude; which likewise by nearly

the same reasoning as the poles of latitude are moved hither and thither, by whose benefit the librational motion in longitude is represented. And thus our twofold motion of libration, mixed of longitude and of latitude, is easily explained by these two axes: what you, indeed, may think of the matter, you will set forth in your own time, not unwillingly.

[Margin: The twofold librational motion requires also a twofold axis.]

Tabula nova motus Lunae Libratorii maximum librationis terminum circa Pal. sc. Maeotidem Occid. versus, quovis anno & mense currente huius seculi exhibens.

[New table of the librational motion of the Moon, exhibiting the greatest term of libration toward the Marsh of Maeotis on the west, for any year and current month of this century.]

For each month, three sub-columns are given: **O.** = degrees [gradus], **1** = minutes, **S.** = sign of the Zodiac [signum]. The year column is headed **Anni Christi curr.** [current years of Christ].

Anni Christi curr.	Ian. O.	Ma		S Apr . O.	S Mai . O.	S. S.	Iun . O.	S.
		S Feb . O.	S r. . O.					
1600	8	♊ 12	♊ 15	♊ 19	♊ 22	♊	25	♊
1601	19	♈ 23	♈ 26	♈ 29	♈ 3	♎	6	♎
1602	0	♎ 3	♎ 7	♎ 10	♎ 13	♎	17	♎
1603	10	♍ 14	♍ 17	♍ 21	♍ 24	♍	27	♍
1604	21	♌ 25	♌ 28	♌ 1	♌ 5	♌	8	♌
1605	2	♋ 5	♋ 9	♋ 12	♋ 15	♋	19	♋
1606	13	♋ 16	♋ 19	♋ 23	♋ 26	♋	0	♋
1607	23	♋ 27	♋ 0	♋ 3	♋ 7	♋	10	♋
1608	4	♋ 7	♋ 11	♋ 14	♋ 17	♋	21	♋
1609	15	♋ 18	♋ 21	♋ 25	♋ 28	♋	2	♋
1610	25	♋ 29	♋ 2	♋ 6	♋ 9	♋	12	♋
1611	6	♋ 9	♋ 13	♋ 16	♋ 20	♋	23	♋
1612	17	♋ 20	♋ 23	♋ 27	♋ 0	♌	4	♌
1613	27	♌ 1	♌ 4	♌ 8	♌ 11	♌	14	♌

Anni Christi curr.	Ma							
	Ian. O.	S Feb . O.	S r. . O.	S Apr . O.	S Mai . O.	S.	Iun . O.	S.
1614	8	≈ 12	≈ 15	≈ 18	≈ 22	≈	25	≈
1615	19	✠ 22	✠ 26	✠ 29	✠ 2	Υ	6	Υ
1616	29	Υ 3	ϣ 6	ϣ 10	ϣ 13	ϣ	16	ϣ
1617	10	Π 14	Π 17	Π 20	Π 24	Π	27	Π
1618	21	⊖ 24	⊖ 28	⊖ 1	⊡ 4	⊡	8	⊡
1619	2	⌚ 5	⌚ 8	⌚ 12	⌚ 15	⌚	19	⌚
1620	12	⊖ 16	⊖ 19	⊖ 22	⊖ 26	⊖	29	⊖
1621	23	⌚ 26	⌚ 0	✠ 3	✠ 6	✠	10	✠
1622	4	Υ 7	Υ 10	Υ 14	Υ 17	Υ	21	Υ
1623	14	≈ 18	≈ 21	≈ 24	≈ 28	≈	1	✠
1624	25	✠ 28	✠ 2	Υ 5	Υ 8	Υ	12	Υ
1625	6	ϣ 9	ϣ 12	ϣ 16	ϣ 19	ϣ	23	ϣ
1626	16	Π 20	Π 23	Π 27	Π 0	⊖	3	⊖
1627	27	⊖ 1	⊡ 4	⊡ 7	⊡ 11	⊡	14	⊡
1628	8	⌚ 11	⌚ 14	⌚ 18	⌚ 21	⌚	25	⌚
1629	19	⊖ 22	⊖ 25	⊖ 29	⊖ 2	⌚	5	⌚
1630	29	⌚ 3	✠ 6	✠ 9	✠ 13	✠	16	✠
1631	10	Υ 13	Υ 17	Υ 20	Υ 23	Υ	27	Υ
1632	21	≈ 24	≈ 27	≈ 1	✠ 4	✠	7	✠
1633	1	Υ 5	Υ 8	Υ 11	Υ 15	Υ	18	Υ
1634	12	ϣ 15	ϣ 19	ϣ 22	ϣ 25	ϣ	29	ϣ
1635	23	Π 26	Π 29	Π 3	⊖ 6	⊖	10	⊖
1636	3	⊡ 7	⊡ 10	⊡ 13	⊡ 17	⊡	20	⊡
1637	14	⌚ 18	⌚ 21	⌚ 24	⌚ 28	⌚	1	⊖
1638	25	⊖ 28	⊖ 1	⌚ 5	⌚ 8	⌚	12	⌚
1639	5	✠ 9	✠ 12	✠ 16	✠ 19	✠	22	✠
1640	16	Υ 20	Υ 23	Υ 26	Υ 0	≈	3	≈
1641	27	≈ 0	✠ 4	✠ 7	✠ 10	✠	14	✠
1642	8	Υ 11	Υ 14	Υ 18	Υ 21	Υ	24	Υ

Anni Christi curr.	Ian. O.	S . . O.	Ma S r. . O.	S Apr . . O.	S Mai . . O.	S. S.	Iun . O.	S.
1643	18	♊ 22	♊ 25	♊ 28	♊ 2	♊	5	♊
1644	29	♊ 2	♊ 6	♊ 9	♊ 12	♊	16	♊
1645	10	♊ 13	♊ 16	♊ 20	♊ 23	♊	27	♊
1646	20	♊ 24	♊ 27	♊ 0	♊ 4	♊	7	♊
1647	1	♊ 4	♊ 8	♊ 11	♊ 14	♊	18	♊
1648	12	♊ 15	♊ 18	♊ 22	♊ 25	♊	29	♊
1649	22	♊ 26	♊ 29	♊ 3	♊ 9	♊ [?]	9	♊ [?]
1650	3	♊ 7	♊ 10	♊ 13	♊ 17	♊	20	♊

[Liber III — De Luna. Caput XII (lunar libration), continued]

The three folios in this opening continue the **New Table of the Moon's librational motion, displaying the greatest term of libration toward the West, near the Palus Maeotis [Sea of Azov], for any year and any current month of this century** (*Tabula noua motus Lunæ Libratorij maximum librationis terminum circa Pal. sc. Maeotidem Occid. versus, quouis anno & mense currente huius seculi exhibens*).

The first folio (174) completes the July–December half of the 1600–1650 century begun on the preceding folio. The next two folios (175–176) give the corresponding table for the 1651–1700 century: January–June on folio 175, July–December on folio 176.

In each month the three sub-columns are headed **O.** (*gradus*, degrees), the minutes column (printed with a prime mark), and **S.** (*Signum*, the zodiacal sign). Zodiacal signs are transcribed by their standard three-letter abbreviations: Ari (♈), Tau (♉), Gem (♊), Cnc (♊ Cancer), Leo (♌), Vir (♍), Lib (♎), Sco (♏), Sgr (♐), Cap (♑), Aqr (♒ Aquarius), Psc (♓).

Folio 174 — July–December, years 1600–1650

Y J	J A	A S	S	N	N D	D
e u	u u	u e	e O	O o	o e	e
a l Jul	l g Au	g p Se	p ct Oct	ct v No	v c De	c
r O ' S	O g' S	O p' S	O ' S	O v' S	O c' S	S
1 2 10	C 2 37	L 6 4	L 9 25	L 1 52	L 1 12	L

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
6 0 0	9		n c			e o			e o			e o	2		e o	6		e o
1 6 0 1	9	56	V ir	1 3	23	V ir	1 6	50	V ir	2 0	11	V ir	2 3	38	V ir	2 6	58	V ir
1 6 0 2	2	36	L ib	2 4	3	L ib	2 7	30	L ib	0	51	S c o	4	18	S c o	7	39	S c o
1 6 0 3	1	16	S g r	4	43	S g r	8	10	S g r	1 1	31	S g r	1 4	58	S g r	1 8	18	S g r
1 6 0 4	1	56	C a p	1 5	23	C a p	1 8	50	C a p	2 2	12	C a p	2 5	38	C a p	2 8	58	C a p
1 6 0 5	2	43	A q r	2 6	10	A q r	2 9	37	A q r	2	58	P s c	6	25	P s c	9	45	P s c
1 6 0 6	3	22	A ri	6	49	A ri	1 0	16	A ri	1 3	37	A ri	1 7	4	A ri	2 0	24	A ri
1 6 0 7	1	2	T a u	1 7	29	T a u	2 0	56	T a u	2 4	17	T a u	2 7	44	T a u	1	4	G e m
1 6	2	42	G e	2 8	9	G e	1	36	C n	4	57	C n	8	24	C n	1 1	44	C n

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
08			m			m			c			c			c		c	
1609	5	32	L e o	8	56	L e o	12	23	L e o	15	44	L e o	19	11	L e o	22	31	L e o
1610	16	9	V ir	19	36	V ir	23	3	V ir	26	24	V ir	29	51	V ir	3	12	L ib
1611	26	48	L ib	0	15	S c o	3	42	S c o	7	3	S c o	10	30	S c o	13	50	S c o
1612	7	28	S g r	10	55	S g r	14	22	S g r	17	43	S g r	21	10	S g r	24	30	S g r
1613	18	15	C a p	21	42	C a p	25	9	C a p	28	30	C a p	1	57	A q r	5	17	A q r
1614	28	55	A q r	2	22	P s c	5	49	P s c	9	10	P s c	12	37	P s c	15	57	P s c
1615	9	35	A ri	13	2	A ri	16	29	A ri	19	50	A ri	23	17	A ri	26	37	A ri
1616	20	15	T a u	23	42	T a u	27	9	T a u	0	30	G e m	3	57	G e m	7	17	G e m

[illegible]

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
1 6 2 5	2 6	33	T a u	0	0	G e m	3	27	G e m	6	48	G e m	1 0	15	G e m	1 3	35	G e m
1 6 2 6	7	13	C n c	1 0	40	C n c	1 4	7	C n c	1 7	28	C n c	2 0	55	C n c	2 4	15	C n c
1 6 2 7	1 7	53	L e o	2 1	20	L e o	2 4	49	L e o	2 8	8	L e o	1	35	V ir	4	55	V ir
1 6 2 8	2 8	33	V ir	2	0	L ib	5	27	L ib	8	48	L ib	1 2	15	L ib	1 5	35	L ib
1 6 2 9	9	20	S c o	1 2	47	S c o	1 6	14	S c o	1 9	35	S c o	2 3	2	S c o	2 6	22	S c o
1 6 3 0	1 9	59	S g r	2 3	26	S g r	2 6	53	S g r	0	14	C a p	3	41	C a p	7	1	C a p
1 6 3 1	0	39	A q r	4	6	A q r	7	33	A q r	1 0	54	A q r	1 4	21	A q r	1 7	41	A q r
1 6 3 2	1 1	19	P s c	1 4	46	P s c	1 8	13	P s c	2 1	34	P s c	2 5	1	P s c	2 8	21	P s c
1 6 3 3	2 6		A	2	33	A	2	0	A	2	21	T	5	48	T	9	8	T

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r	
6 3 3	2		ri	5		ri	9		ri			a u			a u		a u		
1 6 3 4	2	46	G e m	6	13	G e m	9	40	G e m	1 3	1	G e m	1 6	28	G e m	1 9	48	G e m	
1 6 3 5	1 3	25	C n c	1 6	52	C n c	2 0	19	C n c	2 3	40	C n c	2 7	7	C n c	0	27	L e o	
1 6 3 6	2 4	5	L e o	2 7	32	L e o	0	59	V ir	4	20	V ir	7	47	V ir	1 1	7	V ir	
1 6 3 7	4	52	L ib	8	19	L ib	1 1	46	L ib	1 5	7	L ib	1 8	34	L ib	2 1	54	L ib	
1 6 3 8	1 5	32	S c o	1 8	59	S c o	2 2	26	S c o	2 5	47	S c o	2 9	14	S c o	2	34	S g r	
1 6 3 9	2 6	12	S g r	2 9	39	S g r	3	6	C a p	6	27	C a p	9	54	C a p	1 3	14	C a p	
1 6 4 0	6	52	A q r	1 0	19	A q r	1 3	46	A q r	1 7	7	A q r	2 0	34	A q r	2 3	54	A q r	
1 6	1 7	38	P s	2 1	5	P s	2 4	32	P s	2 7	53	P s	1	20	A ri	4	40	A ri	

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
4 1			c			c			c			c						
1 6 4 2	2 8	18	A r i	1	45	T a u	5	12	T a u	8	33	T a u	1 2	0	T a u	1 5	20	T a u
1 6 4 3	8	58	G e m	1 2	25	G e m	1 5	52	G e m	1 9	13	G e m	2 2	40	G e m	2 6	0	G e m
1 6 4 4	1 9	38	C n c	2 3	5	C n c	2 6	32	C n c	2 9	53	C n c	3	20	L e o	6	40	L e o
1 6 4 5	0	24	V ir	3	51	V ir	7	18	V ir	1 0	39	V ir	1 4	6	V ir	1 7	26	V ir
1 6 4 6	1 1	4	L ib	1 4	31	L ib	1 7	58	L ib	2 1	19	L ib	2 4	46	L ib	2 8	6	L ib
1 6 4 7	2 1	44	S c o	2 5	11	S c o	2 8	38	S c o	1	59	S g r	5	26	S g r	8	46	S g r
1 6 4 8	2	24	C a p	5	51	C a p	9	18	C a p	1 2	39	C a p	1 6	6	C a p	1 9	26	C a p
1 6 4	1 3	10	A q r	1 6	37	A q r	2 0	4	A q r	2 3	25	A q r	2 6	52	A q r	0	12	P s c

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r	
r	O	'	S	O	g'	S	O	p'	S	O	'	S	O	v'	S	O	c'	S
9																		
1	2	50	P	2	17	P	0	44	A	4	5	A	7	32	A	1	52	A
6	3		s	7		s			ri			ri			ri	0		ri
5			c			c												
0																		

Folio 175 — January–June, years 1651–1700

Y e a r	J a n u a r y		J a n u a r y	F e b r u a r y		F e b r u a r y	M a r c h		M a r c h	A p r i l		A p r i l	M a y		M a y	J u n e		J u n e
r	O	'	S	O	b'	S	O	r'	S	O	r'	S	O	i'	S	O	'	S
1	14	13	A	1	40	A	2	56	A	2	21	A	2	42	A	1	9	T
6			ri	7		ri	0		ri	4		ri	7		ri			a
5																		u
1																		
1	24	53	T	2	20	T	1	36	G	5	1	G	8	22	G	1	49	G
6			a	8		a			e			e			e	1		e
5			u			u			m			m			m			m
2																		
1	5	40	C	9	7	C	1	21	C	1	48	C	1	9	C	2	36	C
6			n			n	2		n	5		n	9		n	2		n
5			c			c			c			c			c			c
3																		
1	16	19	L	1	46	L	2	2	L	2	27	L	2	48	L	3	15	V
6			e	9		e	3		e	6		e	9		e			ir
5			o			o			o			o			o			
4																		
1	26	59	V	0	26	L	3	42	L	7	7	L	1	28	L	1	55	L
6			ir			i			i			i	0		i	3		i
5						b			b			b			b			b
5																		
1	7	39	S	1	6	S	1	22	S	1	47	S	2	8	S	2	35	S
6			c	1		c	4		c	7		c	1		c	4		c

Y e a r	Ja n O	Jan '	Ja n S	F e b O	Fe b '	F e b S	M a r O	Ma r '	M a r S	A p r O	Ap r '	A p r S	M ai O	Ma i '	M ai S	J u n O	Jun '	J u n S
5 6			o			o			o			o			o			o
1 6 5 7	18	26	S g r	2 1	53	S g r	2 5	7	S g r	2 8	34	S g r	1	55	C a p	5	22	C a p
1 6 5 8	29	6	C a p	2	33	A q r	5	49	A q r	9	14	A q r	1 2	35	A q r	1 6	2	A q r
1 6 5 9	9	46	P s c	1 3	13	P s c	1 6	20	P s c	1 9	54	P s c	2 3	15	P s c	2 6	42	P s c
1 6 6 0	20	25	A ri	2 3	52	A ri	2 7	8	A ri	0	33	T a u	3	54	T a u	7	21	T a u
1 6 6 1	1	12	G e m	4	39	G e m	7	53	G e m	1 1	20	G e m	1 4	41	G e m	1 8	8	G e m
1 6 6 2	11	52	C n c	1 5	19	C n c	1 8	35	C n c	2 2	0	C n c	2 5	21	C n c	2 8	48	C n c
1 6 6 3	22	32	L e o	2 5	59	L e o	2 9	15	L e o	2	40	V ir	6	1	V ir	9	28	V ir
1 6 6	3	12	L i b	6	39	L i b	9	55	L i b	1 3	20	L i b	1 6	41	L i b	2 0	8	L i b

Y e a r	Ja n O	Jan '	Ja n S	F e b O	Fe b '	F e b S	M a r O	Ma r '	M a r S	A p r O	Ap r '	A p r S	M ai O	Ma i '	M ai S	J u n O	Jun '	J u n S
4																		
1 6 6 5	13	58	S c o	1 7	25	S c o	2 0	41	S c o	2 4	6	S c o	2 7	27	S c o	0	54	S g r
1 6 6 6	24	38	S g r	2 8	5	S g r	1	21	C a p	4	46	C a p	8	7	C a p	1 1	34	C a p
1 6 6 7	5	19	A q r	8	46	A q r	1 2	2	A q r	1 5	27	A q r	1 8	48	A q r	2 2	15	A q r
1 6 6 8	15	58	P s c	1 9	25	P s c	2 2	41	P s c	2 6	6	P s c	2 9	27	P s c	2	54	A ri
1 6 6 9	26	44	A ri	0	11	T a u	3	27	T a u	6	52	T a u	1 0	13	T a u	1 3	40	T a u
1 6 7 0	7	24	G e m	1 0	51	G e m	1 4	7	G e m	1 7	32	G e m	2 0	53	G e m	2 4	20	G e m
1 6 7 1	18	4	C n c	2 1	31	C n c	2 4	47	C n c	2 8	12	C n c	1	33	L e o	5	0	L e o
1 6 7 2	28	44	L e o	2	11	V ir	5	27	V ir	8	52	V ir	1 2	13	V ir	1 5	40	V ir

Y e a r	Ja n O	Jan '	Ja n S	F e b O	Fe b '	F e b S	M a r O	Ma r '	M a r S	A p r O	Ap r '	A p r S	M ai O	Ma i '	M ai S	J u n O	Jun '	J u n S
1673	9	30	L i b	12	57	L i b	16	11	L i b	19	38	L i b	22	59	L i b	26	26	L i b
1674	20	10	S c o	23	37	S c o	26	53	S c o	0	18	S g r	339	S g r	76	S g r		
1675	0	50	S g r	47	S g r	733	S g r	158	S g r	04	19	S g r	17	46	S g r			
1676	11	30	C a p	14	57	C a p	18	13	C a p	21	38	C a p	24	59	C a p	28	26	C a p
1677	22	17	P s c	25	44	P s c	28	58	P s c	225	A ri	546	A ri	913	A ri			
1678	2	56	T a u	623	T a u	939	T a u	14	T a u	36	25	T a u	19	52	T a u			
1679	13	36	G e m	17	3	G e m	20	19	G e m	23	44	G e m	27	5	G e m	032	C n c	
1680	24	16	C n c	27	43	C n c	059	L e o	424	L e o	745	L e o	112	L e o				
1	5	3	V	8	30	V	1	44	V	1	11	V	1	32	V	2	59	V

Y e a r	Ja n O	Jan '	Ja n S	F e b O	Fe b '	F e b S	M a r O	Ma r '	M a r S	A p r O	Ap r '	A p r S	M ai O	Ma i '	M ai S	J u n O	Jun '	J u n S
6 8 1			ir			ir	1		ir	5		ir	8		ir	1		ir
1 6 8 2	15	43	L i b	1 9	10	L i b	2 2	26	L i b	2 5	51	L i b	2 9	12	L i b	2	39	S c o
1 6 8 3	26	23	S c o	2 9	50	S c o	3	6	S g r	6	31	S g r	9	52	S g r	1 3	19	S g r
1 6 8 4	7	2	C a p	1 0	29	C a p	1 3	45	C a p	1 7	10	C a p	2 0	31	C a p	2 3	58	C a p
1 6 8 5	17	49	A q r	2 1	16	A q r	2 4	30	A q r	2 7	57	A q r	1	18	P s c	4	45	P s c
1 6 8 6	28	29	P s c	1	56	A ri	5	12	A ri	8	37	A ri	1 1	58	A ri	1 5	25	A ri
1 6 8 7	9	9	T a u	1 2	36	T a u	1 5	52	T a u	1 9	17	T a u	2 2	38	T a u	2 6	5	T a u
1 6 8 8	19	49	G e m	2 3	16	G e m	2 6	32	G e m	2 9	57	G e m	3	18	C n c	6	45	C n c
1 6	0	35	L e	4	2	L e	7	18	L e	1 0	43	L e	1 4	4	L e	1 7	31	L e

Y e a r	Ja n O	Jan '	Ja n S	F e b O	Fe b '	F e b S	M a r O	Ma r '	M a r S	A p r O	Ap r '	A p r S	M ai O	Ma i '	M ai S	J u n O	Jun '	J u n S
8 9			o			o			o			o			o			o
1 6 9 0	11	15	V ir	1 4	42	V ir	1 7	58	V ir	2 1	23	V ir	2 4	44	V ir	2 8	11	V ir
1 6 9 1	21	55	L i b	2 5	22	L i b	2 8	38	L i b	2	3	S c o	5	24	S c o	8	51	S c o
1 6 9 2	2	35	S g r	6	2	S g r	9	18	S g r	1 2	43	S g r	1 6	4	S g r	1 9	31	S g r
1 6 9 3	13	21	C a p	1 6	48	C a p	2 0	2	C a p	2 3	29	C a p	2 6	50	C a p	0	17	A q r
1 6 9 4	24	1	A q r	2 7	28	A q r	0	44	P s c	4	9	P s c	7	30	P s c	1 0	57	P s c
1 6 9 5	4	41	A ri	8	8	A ri	1 1	24	A ri	1 4	49	A ri	1 8	10	A ri	2 1	37	A ri
1 6 9 6	15	21	T a u	1 8	48	T a u	2 2	4	T a u	2 5	29	T a u	2 8	50	T a u	2	17	G e m
1 6 9	26	7	G e m	2 9	34	G e m	2	48	C n c	6	15	C n c	9	36	C n c	1 3	3	C n c

Y e a r	J a n O		J a n S	F e b O		F e b S	M a r O		M a r S	A p r O		A p r S	M a i O		M a i S	J u n O		J u n S
7																		
1 6 9 8	6	47	L e o	1 0	14	L e o	1 3	30	L e o	1 6	35	L e o	2 0	16	L e o	2 3	43	L e o
1 6 9 9	12 [?]	27	V ir	2 0	54	V ir	2 4	10	V ir	2 7	35	V ir	0	56	L i b	4	23	L i b
1 7 0 0	22	7	L i b	1	34	S c o	4	50	S c o	8	11	S c o	1 1	36	S c o	1 5	3	S c o

Folio 176 — July–December, years 1651–1700

Y e a r	J u l O		J u l S	A u g O		A u g S	S e p O		S e p S	O c t O		O c t S	N o v O		N o v S	D e c O		D e c S
1 6 5 1	4	30	T a u	7	57	T a u	1 1	24	T a u	1 4	45	T a u	1 8	12	T a u	2 1	32	T a u
1 6 5 2	1 5	10	G e m	1 8	37	G e m	2 2	4	G e m	2 5	25	G e m	2 8	52	G e m	2	12	C n c
1 6 5 3	2 5	57	C n c	2 9	24	C n c	2	51	L e o	6	12	L e o	9	39	L e o	1 2	59	L e o
1 6	6	36	V ir	1 0	3	V ir	1 3	30	V ir	1 6	51	V ir	2 0	18	V ir	2 3	38	V ir

Year	June	July	August	August	August	September	September	September	October	October	October	November	November	November	December	December			
1954	16	17	Lib	20	43	Lib	24	10	Lib	27	31	Lib	0	58	Sc	40	18	Sc	
1955	2	7	56	Sc	10	23	Sc	40	50	Sc	8	11	Sc	1	38	Sc	14	58	Sc
1956	8	43	Ca	12	10	Ca	15	37	Ca	18	58	Ca	22	25	Ca	25	45	Ca	
1957	1	23	Aq	22	50	Aq	26	17	Aq	29	38	Aq	3	5	Ps	6	25	Ps	
1958	0	3	Ar	3	30	Ar	6	57	Ar	10	18	Ar	13	45	Ar	17	5	Ar	
1959	1	42	Ta	14	9	Ta	17	36	Ta	20	57	Ta	24	24	Ta	27	44	Ta	
1960	2	29	Ge	24	56	Ge	28	23	Ge	1	44	Cn	5	11	Cn	8	31	Cn	
1961	1	9	Le	5	36	Le	9	3	Le	12	24	Le	15	51	Le	19	11	Le	

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r	
2																			
1 6 6 3	1 2	49	V ir	1 6	16	V ir	1 9	43	V ir	2 3	4	V ir	2 6	31	V ir	2 9	51	V ir	
1 6 6 4	2 3	29	L ib	2 6	56	L ib	0	23	S c o	3	44	S c o	7	11	S c o	1 0	31	S c o	
1 6 6 5	4	15	S g r	7	42	S g r	1 1	9	S g r	1 4	30	S g r	1 7	57	S g r	2 1	17	S g r	
1 6 6 6	1 4	55	C a p	1 8	22	C a p	2 1	49	C a p	2 5	10	C a p	2 8	37	C a p	1	57	A q r	
1 6 6 7	2 5	36	A q r	2 9	3	A q r	2	30	P s c	5	51	P s c	9	18	P s c	1 2	38	P s c	
1 6 6 8	6	15	A ri	9	42	A ri	1 3	9	A ri	1 6	30	A ri	1 9	57	A ri	2 3	17	A ri	
1 6 6 9	1 7	1	T a u	2 0	28	T a u	2 3	55	T a u	2 7	16	T a u	0	43	G e m	4	3	G e m	
1 6 7 0	2 7	41	G e m	1	8	C n c	4	35	C n c	7	56	C n c	1 1	23	C n c	1 4	43	C n c	

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
1 6 7 1	8	21	L e o	1 1	48	L e o	1 5	15	L e o	1 8	36	L e o	2 2	3	L e o	2 5	23	L e o
1 6 7 2	1 9	1	V ir	2 2	28	V ir	2 5	55	V ir	2 9	16	V ir	2	43	L ib	6	3	L ib
1 6 7 3	2 9	47	L ib	3	14	S c o	6	41	S c o	1 0	2	S c o	1 3	29	S c o	1 6	49	S c o
1 6 7 4	1 0	27	S g r	1 3	54	S g r	1 7	21	S g r	2 0	42	S g r	2 4	9	S g r	2 7	29	S g r
1 6 7 5	2 1	7	C a p	2 4	34	C a p	2 8	1	C a p	1	22	A q r	4	49	A q r	8	9	A q r
1 6 7 6	1	47	P s c	5	14	P s c	8	41	P s c	1 2	2	P s c	1 5	29	P s c	1 8	49	P s c
1 6 7 7	1 2	34	A ri	1 6	1	A ri	1 9	28	A ri	2 2	49	A ri	2 6	16	A ri	2 9	36	A ri
1 6 7 8	2 3	13	T a u	2 6	40	T a u	0	7	G e m	3	28	G e m	6	55	G e m	1 0	15	G e m
1	3	53	C	7	20	C	1	47	C	1	8	C	1	35	C	2	55	C

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
6 7 9			n c			n c	0		n c	4		n c	7		n c	0		n c
1 6 8 0	1 4	33	L e o	1 8	0	L e o	2 1	27	L e o	2 4	48	L e o	2 8	15	L e o	1	35	V ir
1 6 8 1	2 5	20	V ir	2 8	47	V ir	2	14	L ib	5	35	L ib	9	2	L ib	1 2	22	L ib
1 6 8 2	6	0	S c o	9	27	S c o	1 2	54	S c o	1 6	15	S c o	1 9	42	S c o	2 3	2	S c o
1 6 8 3	1 6	40	S g r	2 0	7	S g r	2 3	34	S g r	2 6	55	S g r	0	22	C a p	3	42	C a p
1 6 8 4	2 7	19	C a p	0	46	A q r	4	13	A q r	7	34	A q r	1 1	1	A q r	1 4	21	A q r
1 6 8 5	8	6	P s c	1 1	33	P s c	1 5	0	P s c	1 8	21	P s c	2 1	48	P s c	2 5	8	P s c
1 6 8 6	1 8	46	A ri	2 2	13	A ri	2 5	40	A ri	2 9	1	A ri	2	28	T a u	5	48	T a u
1 6	2 9	26	T a	2	53	G e	6	20	G e	9	41	G e	1 3	8	G e	1 6	28	G e

Y e a r	J u l y		J u l y	A u g u s t		A u g u s t	S e p t e m b e r		S e p t e m b e r	O c t o b e r		O c t o b e r	N o v e m b e r		N o v e m b e r	D e c e m b e r		D e c e m b e r
8 7			u			m			m			m			m		m	
1 6 8 8	1 0	6	C n c	1 3	33	C n c	1 7	0	C n c	2 0	21	C n c	2 3	48	C n c	2 7	8	C n c
1 6 8 9	2 0	52	L e o	2 4	19	L e o	2 7	46	L e o	1	7	V ir	4	34	V ir	7	54	V ir
1 6 9 0	1	32	L ib	4	59	L ib	8	26	L ib	1 1	47	L ib	1 5	14	L ib	1 8	34	L ib
1 6 9 1	1 2	12	S c o	1 5	39	S c o	1 9	6	S c o	2 2	27	S c o	2 5	54	S c o	2 9	14	S c o
1 6 9 2	2 2	52	S g r	2 6	19	S g r	2 9	46	S g r	3	7	C a p	6	34	C a p	9	54	C a p
1 6 9 3	3	38	A q r	7	5	A q r	1 0	32	A q r	1 3	53	A q r	1 7	20	A q r	2 0	40	A q r
1 6 9 4	1 4	18	P s c	1 7	45	P s c	2 1	12	P s c	2 4	33	P s c	2 8	0	P s c	1	20	A ri
1 6 9	2 4	58	A ri	2 8	25	A ri	1	52	T a u	5	13	T a u	8	40	T a u	1 2	0	T a u

Y e a r	J u l y	J u l y	A u g u s t	A u g u s t	S e p t e m b e r	S e p t e m b e r	O c t o b e r	O c t o b e r	N o v e m b e r	N o v e m b e r	D e c e m b e r	D e c e m b e r						
5																		
1 6 9 6	5 38		G e m	9 5		G e m	1 32		G e m	1 53		G e m	1 20		G e m	2 40		G e m
1 6 9 7	1 6	24	C n c	1 9	51	C n c	2 3	18	C n c	2 6	39	C n c	0 6		L e o	3 26		L e o
1 6 9 8	2 7	4	L e o	0 31		V ir	3 58		V ir	7 19		V ir	1 0	46	V ir	1 4	6	V ir
1 6 9 9	7 44		L ib	1 1	11	L ib	1 4	38	L ib	1 7	59	L ib	2 1	26	L ib	2 4	46	L ib
1 7 0 0	1 8	24	S c o	2 1	51	S c o	2 5	18	S c o	2 8	39	S c o	2 6		S g r	5 26		S g r

[End of the librational-motion tables for the 1600–1700 centuries. Caput XII continues on the following folio.]

Liber III — De Luna (continued)

Caput XII (continued) — Lunar Libration

TABLE OF THE LIBRATORY MOTION

TABULA MOTUS LIBRATORII. *Given the maximum libration of the Palus Maeotis, from the preceding table, together with the place of the Moon, to find the libration that corresponds to it.*

This table is read by entering with the libration argument of the Palus Maeotis (the column-head values 0–6, marked *Maxima libration* / *Minima libration*) and with the zodiacal sign of the Moon's place; the cells contain the zodiac sign that gives the corresponding libration. The page is laid out as two mirror-image halves, the left half headed *Libratio Decrescens* (decreasing libration) over *Intermedia* (intermediate) values, the right half headed *Libratio Crescens* (increasing libration), with the head and foot of each half giving the entry arguments in opposite senses so that the table can be read either way. The cell entries are zodiacal-sign symbols.

Top header band:

Maxima libratio P. Maeotid.	Libratio Decrescens — Intermedia	Minima libratio P. Maeotid.	Libratio Crescens — Intermedia
6	5	0	1
Minima libratio P. Maeot. (0)	Libratio Crescens — Intermedia	Maxima libratio P. Maeot. (6)	Libratio Decrescens — Intermedia
(0)	1	(6)	5

Body of the table (zodiacal-sign entries). Each row corresponds to the sign of the Moon's place; reading across gives the libration-sign for each argument value. Left half (entry signs, columns headed 1–5 under *Intermedia*) and right half (columns 1–5):

(Moon's sign, left)	col 1	col 2	col 3	col 4	col 5	(Moon's sign, right)	col 1	col 2	col 3	col 4	col 5
♊ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♐ Sagittarius	♑ Capricorn	♒ Aquarius	♓ Pisces	♈ Aries	♉ Taurus	♊ Gemini
♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♐ Sagittarius	♑ Capricorn	♒ Aquarius	♓ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer
♍ Virgo	♎ Libra	♏ Scorpio	♐ Sagittarius	♑ Capricorn	♒ Aquarius	♓ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo

(Moon's sign, left)	col 1	col 2	col 3	col 4	col 5	(Moon's sign, right)	col 1	col 2	col 3	col 4	col 5
	a	pio	ttari	rico	ariu		s	rus	min	cer	
♎ Libra	♍ Scorpio	♏ Sagittarius	♐ Capricorn	♑ Aquarius	♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo
♏ Scorpio	♏ Sagittarius	♐ Capricorn	♑ Aquarius	♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra
♏ Sagittarius	♐ Capricorn	♑ Aquarius	♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio
♐ Capricorn	♑ Aquarius	♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♏ Sagittarius
♑ Aquarius	♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♏ Sagittarius	♐ Capricorn
♒ Pisces	♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♏ Sagittarius	♐ Capricorn	♑ Aquarius
♈ Aries	♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♏ Sagittarius	♐ Capricorn	♑ Aquarius	♒ Pisces
♉ Taurus	♊ Gemini	♋ Cancer	♌ Leo	♍ Virgo	♎ Libra	♏ Scorpio	♏ Sagittarius	♐ Capricorn	♑ Aquarius	♒ Pisces	♈ Aries

(Moon's sign, left)	col 1	col 2	col 3	col 4	col 5	(Moon's sign, right)	col 1	col 2	col 3	col 4	col 5
♈	♈	♈	♈	♈	♈	♈	♈	♈	♈	♈	♈
Gemini	Can	Leo	Virg	Libr	Scor	Sagitt	Cap	Aqu	Pisc	Arie	Tau
ni	cer		o	a	pio	arius	rico	ariu	es	s	rus

Bottom header band (mirror, read upward):

Minima libratio P. Maeot.	Intermedia — Libratio Crescens	Maxima libratio P. Maeot.	Intermedia — Libratio Decrescens
6	5	0	1
Maxima libratio P. Maeotid.	Intermedia — Libratio Decrescens	Minima libratio P. Maeotid.	Intermedia — Libratio Crescens

(folio 178)

A general figure of the phases has now been set out, with its four maximum variation-limits — that is, with the boundaries, and with certain definite points or distinct dots marked on it — both along the longitude line (which is the line of the latitude-limits, of the libration in longitude, where the latitude is greatest or least) and along the latitude line (which is the longitude line, where the latitude is intermediate but the motion is genuinely new). With this figure carefully drawn, and with the reticule [reticulum] fitted around the center of the disk — by means of which, given the time, the Moon's libration is accurately set in motion — and given also the Moon's place, the time's libration of the Palus Maeotis is rightly described; and by its benefit we may show the use of both of our tables, and how the libration competent to all times is drawn from them, and how readily this may indeed be done from a single example.

[Margin: Eclipsis Lunae An. 1652, dieque 17 Septembr. ad eam declarationem usurpata. — The lunar eclipse of the year 1652, on the 17th day of September, employed for this demonstration.]

Let it then be sought, for the current year 1652, on the 17th day of September — at the time of a lunar deliquium (eclipse) which fell out at that place [hic Gedani — here at Danzig], and which I therefore had the occasion to observe carefully,

since that observation, not yet committed to common print, you have willingly wished me to communicate, eager as you are for such matters — the place [shall be] the maximum libration of the Palus Maeotis [Palus Maeotidis]; and as great as the libration of that same day is, by which the limb of the Moon was painted to the same iconism [icon/picture], may rightly be described. In the margin, therefore, with the left part of our table the motion of the libration is set; there the year is sought along the front, but the month in the column corresponding to it; and the maximum at 22 degrees 4 minutes of Gemini is found to be the libration.

[Margin: Quomodo ex tabula maxima libratio sit excerptenda. — How the maximum libration is to be extracted from the table.]

Now to enter upon the matter that follows, the minimum, and indeed under the title of the maximum libration of that same Palus Maeotis: investigate in the margin, likewise from the left, that same sign of Gemini; then, taking the right side toward the same, progress onward, [until] the sign in which the Moon at that time is found (if it is the case, unless from elsewhere, or through the calculation itself, it is otherwise established) is noted carefully; whose place by titles in front, and indeed at once it indicates whether the libration is increasing, or decreasing; the maximum, the intermediate, the minimum; and so on. Then let the little column respond (in which the sign of Gemini, at the place the Moon then occupies, is found); as great is the libration at the egress of the Palus Maeotis from the minimum, or maximum libration of the longitude, in the numbers above expressed: which numbers, in the lunar schema around the Palus Maeotis, answer entirely.

[Margin: Usus tabulae minoris. — The use of the smaller table.]

For example: if the sign of Gemini is repeated at the maximum's turn in the lesser table, the libration in the lesser table, under the title of the maximum libration of the Palus Maeotis, plainly in the end is the minimum (since the Moon at that time turns within 22 degrees and a little more of Pisces [Piscium], at the time of the eclipse, established): from there the right side along the little column of the number is found. It is established, therefore, that as much both by the number under the said title, the libration at that time was, [whether] intermediate increasing, or in the middle of the remotions, the maximum, and the minimum libration.

[Margin: Quomodo secundum longitudinem, ac latitudinem libratio describenda. — How the libration is to be described according to longitude and latitude.]

Next, with these found, and the latitude likewise given — namely near the Node, by a fitting radius understood with the compass — in the general figure (which we have drawn around the disk of the Moon), let the numbers be marked, both in the longitude line and in the limit line, in the region of the more northerly part (since the latitude is then there if the Moon has no latitude); but if it has been seated, the time's latitude being given, plainly at once it is intersected; and so in the schema of the following eclipse it was done; you see, the Moon's limb, with the time being given, and the Moon's place may be definitely determined. Or — what is preferable — by means of the reticule drawn around the center of the Moon, where the things may be expedited much more easily: if a minor libration in the description, and the latitude diverse, unless that, things to be carefully painted, may be intersected by drawing through the proper points; and as we may paint the limb.

[Margin: Tabulae libratoriae, ac alii cui revocandae observationes. — The libration tables, and to which the observations are to be referred back.]

Similarly then, as it is rightly gathered, the operation is, even if the libration under some other number of the lesser table is repeated, both ways; that the latitude is plainly diverse, unless that, things to be diligently rendered, by which the limb may be painted through the proper points.

[Margin: Modus item hoc describendi, ac operatio, etiamsi libratio sub alio quodam numero minoris tabellae reperiatur, similiter; latitudo prorsus alia diversa, nisi quod ut tendendas diligentissime, quo limbus per debita puncta, ostendi atque declaratur exemplo. — The manner likewise of describing this, and the operation, even if the libration is found under some other number of the lesser table, likewise; the latitude entirely otherwise diverse, except that, as it is to be drawn most diligently so that the limb [is painted] through its proper points, is shown and declared by example.]

(folio 178, second column)

of the longitude and latitude, and may justly be carried. For example: let there be described the limb of the full moon, which falls in the year following, 1655, on the 30th day of April, in the evening, the Moon existing in the beginning of Scorpio, and around the fifth degree of southern latitude. Seek therefore — as in the table, the great [table] is at the principle [sub-table] — the time of the maximum libration in longitude; and you will find it turned over to the month in the seventh degree of Libra. And that sign again under the title of the maximum libration of the Palus Maeotis, on the left side, seek, and you will find the sign of

Scorpio of the true place of the Moon, in that same line on the right side, under the numbers of the minimum: hence, therefore, it appears that the libration of the Moon at that full-moon time was decreasing, and indeed in part, partly around the Palus Maeotis itself. This being known, place the circuit (in respect of the greater reticule) in the upper line of the latitude, around 5, at the intersection of the 5 — since the latitude is southern, [at] the 5th degree; and so be it that the genuine center described from the periphery of this full moon is to be described. And so, at any time given, by mediation of the two of those little tables, given likewise the true place of the Moon, both in the ecliptic and in the latitude — that is, with the libration of the Palus Maeotis [found], the Moon's disk is rightly determined. The libration of the Palus Maeotis is found by that same libration, which facilitates the investigation; and there, in the lesser table, the minor numbers are attended to; you will have likewise [the value], indeed the libration between the limb and the Palus Maeotis at any time. As to what is more commodious here, both from the things that can be, the peculiar schema of the phases shown generally is less, with the whole limb in no way constructed; but on the right side, around the Palus Maeotis with nothing except that six of those libratory points of longitude, and on the part of the higher Moon, [at] the upper sixth those points of latitude have not been noted there: around the center indeed the reticule, of which, and of those points of beneficial libration, let nothing here from the business of all time, the limb under another libration of the longitude to be described, of the whole integer in number. Such is the archetype that here is, which from the eclipse phases of the year 1652 I have described. As are the things — if perhaps you, some of them, or others, cultivators of these matters may need — I freely communicate.

[Margin: *Eclipsis Lunae An. 1652. Gedani descripta hic et delineata.* — The lunar eclipse of the year 1652, described and drawn here at Danzig.]

[Margin: *Quae sit libratio Maeotidis ad investigandas phases generalis.* — What the libration of the Maeotis is, for investigating the phases generally.]

[Margin: *Cur ex minori schemate phasium phases generales [investigandae].* — Why the general phases [are to be investigated] from the lesser schema of the phases.]

But do not marvel that our table of the Moon's libratory motion measures only the degrees, the minutes set aside, of the first [equation], and refers it to the second altogether [as] minimum. Indeed, in business of this kind, where the motion of the libration is by no means to be divided to the eye, in vain it is, since

to be solicitous about the minutes [is], on the contrary, the minute itself — the first, the second, and, with all error, with no risk, and to neglect it altogether.

[Margin: Cur tabula maior ad gradus, et minora scriptura, tum sit suspecta. — Why the larger table [reckons] to degrees, and the smaller [is] written [more finely], and why it is then suspect.]

For the rest, we have taught — indeed sufficiently fully, as it exists — in what way the libration of the Moon may be compared, and how from the preceding table it may at any time be found, that it may be excerpted: I say the maximum, since the table itself at any time agrees most aptly with the heavens. But it will be no grievance to us that someone may believe — most truly, indeed — that not only from ours, indeed from those of others, but also of other most distinguished men — such as Gassendi, Boulliau, and also your most loving [friend], with Grimaldi by his much most diligent observations — that they should demonstrate to us, and reach our hands, the table of hypotheses; that our [table] rests on a solid foundation. For which reason, both for the brevity of the matter, that to anyone of ours [it] may be more clearly evident, let all observations be recalled, and the following tables: first, [a] second column of our observation; the Year, the Months, and the Day; third, the hour. Of the observations; fourth, the longitude of the Moon; fifth, the Moon's latitude; sixth, whether the libration is around the Palus Maeotis; seventh, how great the distance is in the numbers, near those which in the archetype we have noted; in what observation; and eighth, how great the same may be of equal intent in seconds; the table, and the difference, which it may be more clearly here; the animadverted. Furthermore, we have added these too — not useless, as I think — certain annotations; especially as those maculae [the lunar sea-spots] of the quadrature-sections may pass over; which certainly all things make less, that it may be more clearly admonished below, to rightly investigate our libratory motion. Truly, then, I do not at all doubt the highest [thing], thus far, between observations, both ours and those of all the rest, agreeing in tables. Nonetheless, indeed, although by very few observations, excessive, or defective, in respect of the table, of one inch defective: yet this discrepancy, then by no means of moment, then [to] the observer...

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it is altogether imputed to the observer. And if it is impossible — as (it is established to you, the most expert of these matters) — to discern by an inch, indeed even by two distances, so accurately, and that by the naked eye, by the inspectors, unless by the most exercised — the diverse latitudes of the Moon always to be accurately attended to, the observations may be carried through.

Not, however, [is it] a long observation that by a continuous series I have learned: the interstice of the Palus Maeotis, than [that of] the Marrota [Mare], and indeed the hyperborean lake [lacus], somewhat greater the maximum and the minimum, always appears greater; if at the same time the southern latitudes the Moon may have, in a space something less they always conspire; with first chiefly around the upper part of the Palus, and at the time the Moon had the same southern latitude [as the] Boreal; and so in others, and at other latitudes, a little also otherwise; and otherwise: that this is shown for any of you, in our general Selenographic schema of the phases at the greater page 8, inserted, sufficiently above; it is manifest. These things, since they are exceedingly subtle, for that reason also by no means easily can all be well animadverted [observed]: and so it is more clearly, as we have indicated, in determining the libration to err by an inch.

[Margin: Maxima librationis interstitium non semper univocum, sed genuino aequalia. — The interstice of the maximum libration [is] not always univocal, but [the] genuine [parts are] equal.]

For the rest it must be noted, that sometimes also the limb, according to our table, by the inspected things [observations] may respond — not always according to the table described, [but] now into this, now into that part declining: but as the first front may appear, nevertheless the imperfection of our tabular hypotheses; for that reason [it is] not at once to be judged. Now indeed it is altogether impossible, just as at all times, and from every part, the peripheral maculae [the rim sea-spots] are nearer, especially around the Palus Maeotis, well [and] accurately I look: when around the Marrota [Mare] well distant justly, [it] is to be looked at accurately. Since indeed of the diverse libration, in respect of the limb, around the most diverse it may be compressed, or dilated: which indeed, in one given schema in no way to exhibit can we possibly. Hence, it comes about that the limb is nearer to the Inferior Mare Caspium [Langren's name] approaching, [it] may appear in our iconism, than ever in the Moon itself can be given: the ratio of this is, that since the limb of the said maculae approximates, at the same time also the Caspian Mare with all its adjacent parts gradually contracts itself; the space lessening, the more ample. A similar appearance is to be observed around the contrary parts; that is, [around] the longitude-line, near the hyperborean parts. For also at other times [the Moon's] sections, so that scarcely the numbers may appear, by no reason of the observation [are they] to be perceived; but always somewhat distant from the hyperborean Sinus [Bay] to be distant, it will be seen: the cause [is] the same, the said dilation, and compression.

[Margin: Infinitis schematibus, opus, si omnis varietas dilationis, et compressionis macularum exprimi debeat. — Infinite schemata [are] needed, if every variety of the dilation and compression of the maculae must be expressed.]

If indeed such various diversities, by reason of the dilation and compression arising, by no means we wish to avoid, infinite would be the schemata to be drawn; and as we [draw] each macula at each [point] of the limb, by reason of the libration variously, and each macula at each [point]; by reason of the dilation and compression rightly to be founded: which, since it is altogether impossible in figured number, on that account, the variety of the phases plainly is; for which reason in a single phase-figure (which is the maximum libration) plainly: ideo it is that around the Palus Maeotis, [as] the Moon in the southern limit equally, [is] to be content from us, [it] is painted; [it] behooves [us]. And so it must not be imputed to us hereafter for some such fastigium [summit]: deeply, however, I am persuaded, [it] never can altogether be done, [that] the schemata may [match]; but that the business may be necessarily required, that all such variation, or of the maculae compressed, or dilated, the most minute things may be described.

[Margin: Tabula libratoria, et alii cui revocandae observationes. — The libration table, and to which the observations are to be referred back.]

Moreover, lest we omit anything pertaining to it, [as to] examining the libratory motion of the table, conducing — all those things observed, which in the *Almagest* book IV, Caput IX, Question 7, in the first, second, third, and fourth, [are] argued — [I] have annotated, scrupulously and religiously expended, [and] examined; and so I have found by exam, to answer to all, and to be saved by all the rest of your observations of all the best. Three of the later observations, namely [those of] 1649, the 22nd, 24th, 25th, [and] 27th of September, and the 21st, [and] 26th of November. Likewise in the year 1651, the 1st [and] 26th of August [the eclipse] was held, when the macula Grimaldi (Palus Maeotis) and the Mare Crisium (Palus Maeotis) by an entire ratio indeed agreed, as I noted, to...

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the limb of the Moon accessed, and from that receded; the table also consenting to ours. Plato, however, and Tycho, do not always at one moment in all that time substitute; but indeed sometimes a little (as is plain from the table) item also the limb accessed, sometimes also the limb receded; and indeed as I think within, in those observations the macula of Plato circled around — and Tycho's also somewhat to the side. For altogether I am persuaded, by long and skilled experience, [that] the macula of Plato (M. Sinai of the major [maculae]) and of

others [is] far from the periphery of the Moon to be distant, and to recede around the limb, the same accessory; and is not to be observed; or indeed the rest by closeness of the macula: such as P. Maeotis, and P. Aniadocae [Palus Amadoca], etc. And although, both from the said distances, that truly far from the smaller maculae [it] is appealed [to], it suffices to note for any time rightly: especially, that here I keep silent of the parallaxes, which also at so little in rising, and setting, the librations adulterate, when around the maximum, and minimum the librations, where certainly the rising, and of the labors, in the most minute particles [is] the libratory motion, as is determined (*Almagest* page 2003, lib. IV. *Almagest*).

[Margin: Accessus, et recessus M. Sinai, ac lacus nigris maioris differt; servatur. Artis est observari. — The access and recess of the M. Sinai, and of the major dark lake, differs; [it] is preserved. It is a matter of skill to observe [it].]

[Margin: Parallaxes corrumpunt librationes. — The parallaxes corrupt the librations.]

Meanwhile then nobody exists, who may think the M. Sinai, and the major dark lake, etc., not able to be observed; but I say only this, that of those maculae the observation [is] not so much, as the rest of the maculae, to the limb nearer may be attributed; and that hence easily an error may arise, even a little [too] easy, also Rev. P. Grimaldi, around the said maculae of Plato, and of Tycho, [was] hindered. When, however, both around the observations to one, and the other Rev. P. Grimaldi, then also mine, and others' observations, those — around the said maculae of Tycho, and Plato perfected — in number the rest may not be received. Therefore, as I have said, the things accustomed we can [observe], thus far; nothing have I found, or [it is] to be observed, in which whatever the table of the libration may nutate [waver]; which, however, in the following years, as the centuries come, [whether] the number may always retain the same tenor, indeed [whether] with time in part, and in so much to be corrected; future generations by longer diligence will be able to divide [the question].

[Margin: Num motus libratorius sibi perpetuo sit aequalis, tempus docebit. — Whether the libratory motion is perpetually equal to itself, time will tell.]

Finally, since in the table of our observations, that also around the maximum, [and] from the diligently annotated observations, the sections of the limit, or of the quadratures [we] may examine, [yet] we ceased, and item per the motion of the Moon's libratory we examine. For indeed, by these, if at any time the true quadratures were animadverted [observed], not less, as for the intermediate of

the maximum, and the maximum quantity is known of the libration; and vice versa it may be sought: that from the table by the maximum [libration], so that at any time the section so much of the quadratures, as of the other phases of the maximum may be found. But this libration [is] of the highest order: and indeed [it is] truly the limit adhibited [applied], from there, believe, and [it is] more clearly [evident], how little [it] may profit.

[Margin: Sectiones quadraturarum non semper transeunt per easdem maculas. — The sections of the quadratures do not always pass through the same maculae.]

For my part, [it is] most true, [as] is set out, also passim [here and there] in the *Almagest*, [and] passim also in the *Selenographia* we declare, [that] the sections of the quadratures [do] not always pass through the same maculae; but per others, and others, [and] by the reason of the variant libration: hence, the diligently observed section of the quadratures also, the Moon's libration. Before we teach in what way the matter [is] to be carried through, [it is] to be said — indeed we have hindered the sections to be omitted at all times, both in the *Selenographia*, and in the *Almagest*, fully set out, [and] indeed sufficiently; and that these matters' cultivators we may put away. We have said, however, that by brief [things to be] comprehended, the section of the Lunar dichotomy, [at] the maximum libration around the Palus Maeotis, [it] transfers per the Inferior Besbicam [Besbicus], the western parts of the Mount Olympus, Didymus, and Cydifis [?] about; and at the time of the section, [where] the maximum [is], the western [parts] exist; but indeed [at] the minimum libration, and of the Palus Maeotis, the sections of the quadratures transfer [through] the Mont Sinai, [and] the Insula Cyprum, [the] Inferior Lesbos, the Sinus Tarantinus, and the Lacum [Lake] near the maximum, [it is] said, around the more eastern: about, I say [around] them; for at all times, [and] chiefly in respect of...

[Margin: Data maxima, et minima libratione, per quasnam maculas sectiones quadraturarum [transeant]. — Given the maximum and minimum libration, through which maculae the sections of the quadratures [pass].]

[Margin: On the inclination of the Moon's horns.]

of the southern and northern parts, they do not always keep the same course or direction, but, depending on the varying position of the Moon, the horns point now westward by some degrees, now eastward, never quite parallel — as for instance in the *Selenographia* I noted carefully, and as you too will find in the *Almagestum Novum*, p. 203, § 3, quest. 3, where I treat the same matter of the horns a little differently. Doubtless those horns, with respect to the nodes, point

now toward the limits, where they incline more toward the perpendicular; otherwise we cannot make them out, except near the Moon's middle. Near the parts adjacent to the limb, by contrast, the horns can scarcely mark out these lines.

And so these are the ways of the two extreme sections when there is a fixed libration of the Moon. But to know this alone is by no means enough for accurately determining the various librations of the Moon — namely, when, since none of them is sufficient for us, I have at least set down by how much I remember; and what maculae the intermediate sections pass through, especially by reason of that division of the librating figure, I trace upon our selenographic map, as we said, in order to be brief.

[Margin: The seven principal sections of the quadratures.]

How much, then, I attain by repeated observation, I have found and set in order, I shall now relate.

The first section, namely the one toward the west, occurs when the libration is at its greatest, that is, at the Palus Maeotis [Palus Maeotis], at libration-number 6 of our table above, which figure I have transferred onto our selenographic chart, as we said. It passes through the Catena Mundi, the western shores of Mt. Olympus, Mt. Didymus, and Mt. Cydissus.

[Margin: The fourth section of the quadratures, number 6.]

The second section: when the libration is at number 5, it crosses Mt. Pangaeus, the eastern parts of Mt. Olympus and Mt. Didymus, the western edge of Mt. Cadmus, and Mt. Antilibanus.

[Margin: The fourth section of the quadratures, number 5.]

The third: when the libration is about number 4, the section passes through Mt. Seir, Mt. Cadmus, between Mt. Sipylus and Mt. Montuniatum, and through the Ligustinum.

[Margin: The fourth section of the quadratures, number 4.]

The fourth line of the section: when the libration is about number 3, a line is drawn through the middle of Mt. Libanus, the western parts of Mt. Cragus and Mt. Sipylus, through the intermediate places of the Adriatic Sea, the lake Trasimenus, and so on.

[Margin: The fourth section of the quadratures, number 3.]

The fifth section: when the libration is about number 2, a line is given that is carried through Mt. Seir, the upper part of Mt. Libanus, through Mt. Masicytum, the eastern parts of Sipylus, between Propontis and the Sinus Hypponiates, and Mt. Argentarium.

[Margin: The fourth section of the quadratures, number 2.]

The sixth: when the libration is about number 1, the line passes through Mt. Tabor, Mt. Phoenicem, Mt. Latmus, and the promontory of the Moon.

[Margin: The fourth section of the quadratures, number 1.]

The seventh and last: when the libration is at its least, that is, at 0, the section crosses Mt. Sinai, the lower part of Mt. Cyprum, Mt. Lesbos, the corner of Mt. Tarantium, and the larger black lake. But when the libration is counted toward the Palus Maeotis, then, since the rules for judging the sections of the quadratures hold good, but in the reverse order, it is necessary that they be applied. For example, if...

[Margin: The fourth and last section of the quadratures, that is, 0.]

the libration is 0, the section found will not be the seventh but the first; and if it is at the greatest, the sixth section is to be taken, the second being assumed from the libration-number 1, and so on consequently.

By these foregoing rules anyone may quite fully examine our libration-table from whatever observations he has made of the Moon. As to the bisections by the light's confines, careful attention must be paid — as I touched on above — to the sections in such a way that, by close attention, those very sections, either before the true quadrature by the space of one hour, or after the true quadrature, may be observed, while at other times they will in no way answer to the rules; but they will be found within, or beyond, the proper limits, as is shown — and this must be judged and reckoned. If, however, the fourth hour before the quadrature shall have been noted, then the next preceding rule will be the norm; and the same is to be observed for the preceding rule of libration. And if the fourth hour before the quadrature shall have been noted, then the next preceding rule will be the norm, with the preceding rule of libration likewise observed. The more light the Moon acquires, or the more is wanting to it for the true quadrature — just as we said copiously on pp. 330 and 331 of our *Selenographia* — all of which is correctly observed from the sections. The quadratures of one observed time, indeed, will not greatly err from those of another, provided that the librations are observed at the quadratures; but if the given libration agrees from any times of

the sections of the Moon at the bisections, attend carefully — but if it can be done both at once, from the various latitudes of the rising Moon, or about five, counted at the limb of the Moon, you will rightly attend to the varying. But the greatest variation about each, if there be a node, and indeed about the northern node, with the upper horn so many degrees about the eastern part as so many degrees about the southern node toward the eastern part, the said horn turns; as we set forth on pp. 334 and following, up to pp. 340. With selenography abounding, we have demonstrated these matters more plainly through these very diagrams, and that almost to the eye.

[Margin: If the quadrature is not to be observed at the true quadrature, but before it.]

[Margin: Whence the inclination of the horns of the Moon arises and is fixed.]

To all who carefully attend to these things, by experience, and I scarcely doubt, both ours and yours, the sections of the dichotomized Moon will answer rather precisely to our table; and likewise the tabulated sections will answer well enough to the bisected Moon, in this way, and as it were both ways, just as the sections of the bisected Moon — yet more cautiously and according to the libration befitting the quadratures and of all the others — as we taught on pp. 444, 445, and 446. We undertake this task, that we may bring it about; yet we can do so with peril, but I am convinced this is hardly far from the mark. We therefore foretell some sections of the quadratures for the years next following, with their times, and the true quadratures to be observed. And in order to set forth this matter the more briefly, in what follows we shall present a table of the future bisected sections of the Moon. First, the year, month, day, hour — these are indicated; afterward the longitude and latitude of the Moon, and, with the libration of that time, through which maculae the sections of the quadratures will then be carried, we shall display.

[Margin: The table is likewise to be observed of all the quadratures of the others, and the sections... you will be able.]

Year	Month, day	Hour	Longit. Moon	Latitude Moon	Librati on	Dist. libr.	Through which maculae the lines of the future sections of the Quadratures will be carried
		Ves	°	°	'		

Year	Month, day	Hour	Longit. Moon	Latitude Moon	Libration	Dist. libr.	Through which maculae the lines of the future sections of the Quadratures will be carried
1655	Febr. 13	p. 12	25 ☿	5 11 S	P. Mœot.	2	nearly. The line of the section passes through Mt. Seir, the upper part of Mt. Libanum, through Mt. Masicytum, through the eastern parts of Mt. Sipylus between Propontis, and the Sinus Hypponiatem, and through Mt. Argentarium.
1655	Maij 12	8½ V.	22 ♄	2 0 A	P. Mœot.	4½	The line of the section advances through Mt. Ligustinum, Mt. Montuniatem, to the eastern roots of Mt. Didymus, and the western shores of Mt. Cadmus, and through the upper Antilibanum.
1655	Sept. 23	2 m.	29 ♀	2 50 S	P. Marao t.	4	The line of the decreasing Moon passes through Mt. Seir, the upper Libanum, through Mt. Masicytum, the

Year	Month, day	Hour	Longit. Moon	Latitude Moon	Libration	Dist. libr.	Through which maculae the lines of the future sections of the Quadratures will be carried
1655	Dec. 20	2 m.	28 ♏	4 34 A	P. Marao t.	1¼	eastern parts of Sipylus, between Propontis and the Sinus Hypponiatem, and through Mt. Argentarium.
1656	Januar . 4	11 V.	15 ♏	5 6 S	P. Mœot.	¾	The section crosses the promontory of the Moon, Mt. Cadmum, Mt. Phoenicem, and Mt. Tabor, etc.
1655	Aug. 26	8 V.	4 ♏	3 34 A	P. Mœot.	6	The section is drawn through the Catena Mundi, the Insula Besbicam, the eastern shores of Mt. Olympi, Didymi, and Cydissi.
1655	Dec. 23	10 V.	4 ♏	5 14 S	P. Mœot.	2½	The section passes through the middle of Mt. Libani, the

Y e a r	Month, day	Ho ur	Longit. Moon	Latitude Moon	Librati on	Dist. libr.	Through which maculae the lines of the future sections of the Quadratures will be carried
6							eastern parts of Mt. Masicyti, through the middle of Sipyli, between Propontidem and the Sinus Hypponiatem, near the eastern roots of Mt. Argentarii.
1 6 5 7	Nou. 12	10 V.	22 ♁	4 30 S	P. Mœot.	5	The section is carried through Mt. Pangaeum, the eastern parts of Olympi, and Didymi, and the western shores of Cadmi, and through Antilibanum.
1 6 5 8	April 10	11 V.	22 ☿	3 15 A	P. Mœot.	½	The section advances through Mt. Sinai, the island of Cyprus [Insula Cyprum], Mt. Latmum, between Mt. Christi and the larger black lake.
1 6 5 8	Dec. 1	6½ V.	10 ♃	5 14 S	P. Mœot.	6	The section is carried through the Catena Mundi, the Insula Besbicam, the eastern shores of Mt. Olympi,

Y e a r	Month, day	Ho ur	Longit. Moon	Latitude Moon	Librati on	Dist. libr.	Through which maculae the lines of the future sections of the Quadratures will be carried
							Didymi, and Cydissi.
1 6 6 1	Octob. 30	10 V.	8 $\approx$	4 30 S	P. Mœot.	1	The section crosses Mt. Tabor, Phoenicem, Latmum, and the promontory of the Moon.
1 6 6 1	Dec. 28	4 V.	9 Υ	0 30 A	P. Mœot.	3	The section passes through the lower part of Mt. Libani, the western roots of Mt. Cragi, the center of the Moon and of the reticule, and the western roots of Mt. Argentarii.
1 6 6 5	Febr. 21	1	9 X	5 10 A	P. Mœot.	$\frac{1}{2}$	The section is drawn through the western part of Mt. Sinai, the island of Cyprus [Insula Cyprum], the Insula Ebissum, Maioricam, and likewise through the western part of the larger black lake.

[Margin: How the phases of future Eclipses are foretold, and the loss of the entire body of all observations.]

Such predictions cannot but be pleasing to the worshippers of divine Urania, nor was it ungrateful to me, that an occasion might at once be given to signify and show by what benefit of ours the tables of librations (the rest, that I may pass over the very many things in silence, which I have rejected elsewhere) are to be more fully and completely treated, when at any time, or by reason of the maculae, they exhibit those phases of whatever Eclipses, at the same time also setting forth the phases of present things. This matter is certainly most clear, and likewise very useful: it is to be wished, therefore, that some imposer of Ephemerides among our writers would exhibit the types of future Lunar Eclipses, so that the reckoning might be set forth less toilsomely to the world, and might profit the spectators no little, and refresh them.

Let there be ready at hand, then, a certain general figure of the phase of the Moon, much like that one in which we delineated the Eclipse of the Year 1652, or a smaller one, if it so please, since this time we have used that one; and let it be constituted in this way: with a genuine periphery, drawn according to our libration from the table, and the radius divided into six equal parts, let those same parts of the six circles be drawn through eleven dividing digits. Then, with the perpendicular drawn through the center for the center of the schema; but let it be made in such a way that, according to that point in the periphery of the upper full moon — see *Selenographia* p. 264, the inserted and inclined revolving full moon. As to the inclination of the perpendicular according to the libration and the nodes (otherwise it will go quite far astray), let it be rightly attended; and likewise the other, which is normally intersected by the perpendicular at the place of the Moon's orbit, let a line be drawn. Afterward, on some large paper, let the earth's shadow be described, as is usually done about the types of Eclipses, the proper proportion of the schema being nonetheless preserved according to the calculation, and the schema given in proportion: which, although it is hardly difficult.

Again, from some thick paper, or membrane, let an arc of 90 degrees of the circle be cut out, larger or smaller, but altogether like the others; then, from the shadow, near the latitudes about the beginning, with the orbit imposed on the arc, let the Moon's orbit be drawn — and the western parts about the Moon's orbit. Let the Archetype of the Moon be so applied to the shadow, and to its orbit, with the shadow's orbit, as one and the same; and let it exhibit the true inclination of the maculae, and the same full moon itself: and then let the point of

contact be noted, namely the beginning of the Eclipse. Afterward, in the same way, both at the right and at the sinister, let the full moon be moved round through all the various positions of the Moon between the circle, namely the shadow, and the arc of the upper full moon, similar in shadow, until the circle touches the first digit; and then let the first phase, or the first digit of the Eclipse, be marked, near the arc of the upper maculae intersected, notable. Then, from the second circle, let the second digit be deduced from the archetype, observed from the full moon of the same; and consequently all the rest, or as you will, and where it has been noted, let it not be unknown. By this calculation of future Eclipses let the types be drawn, with the true inclination of the maculae, which the Moon will exhibit at the time of the greatest obscuration, according to the Tyconic calculation; let these be observed in their places as described, in the adjoined figure, so that from those things it may very clearly appear by which maculae the section will pass; and also how much, and how greatly, the maculae most darkened at any time of the partial Eclipses will exist as the terminus — which is most worthy to be noted of all, plainly and at every time.

[Margin: Eclipse of the Moon, the Year 1656, on the 1st day of January.]

In the first figure, then, the Eclipse, namely that which will fall in the Year 1656, on the 1st day of January, the beginning about 148 degrees from the Palus Amadoca...

that is, toward the rising of Amadoca, from a point of the Nadir, truly through a perpendicular line about 61 degrees, and the end from the same point toward the setting about 60 degrees, or at the Palus Amadoca about 87 degrees, will be marked. Furthermore, the greatest obscuration about the larger black lake, Mt. Serrorum, Mont. Macrocoemius, and the lake hyperborean will be terminated as the end; hence the quantity of this same future Eclipse will be $10\frac{1}{2}$ digits.

[Margin: Total Eclipse of the Moon, the Year 1657, on the 5th of June.]

In the second Eclipse, the beginning falls about 146 degrees at the Palus Amadoca, toward the rising, from a point of the Nadir truly through a perpendicular line about 67 degrees, and the end at the rising about 95 degrees from the said point; but at the Palus Amadoca about 86 degrees, the beginning toward the setting; and the term of the recovery of light will fall about 33 degrees, and at the same end about 12 degrees of the digits. In the third Eclipse the greatest defect will fall, and it will be a total obscuration in part of the upper Moon, that is, about 20 degrees at the Palus Amadoca, and at the term of the numbered light the greatest defect will be 12 digits.

[Margin: Eclipse of the Moon, the Year 1659, on the 6th of May.]

In the third Eclipse, which will be seen in the heavens in the Year 1659 on the 6th of May, the beginning in part of the upper Moon, about 86 degrees from the rising at the Palus Amadoca; the setting about 22 degrees from the said Palus will appear, and its quantity will be $\frac{2}{3}$ of a digit.

[Margin: Eclipse of the Moon, the Year 1659, on the 20th of October.]

In the fourth Eclipse, which will be in the Year 1659 on the 20th of October, the beginning in part of the lower Moon, from a point of the Nadir truly through a perpendicular line, about 67 degrees, the setting toward the said point will be looked for; at the end about 7 degrees, and at 21 minutes it will come. For we shall truly try by what reckoning the calculation agrees with the heaven itself at that time, if we are observers — let us experience it.

Finally, since we have constrained the librating motion of the Moon by certain laws (so far as may be), even to give a demonstration of our hypotheses set before the eye — that this matter, certainly, can scarcely be attempted so easily as it can be made known; nevertheless, in my opinion, I shall set forth at least a better one than it could have been thought up by us — meanwhile I shall not have it perfectly held in numbers as the matter itself. But since two diverse motions concur at once, and the same is seen, by a peculiar schema, I shall first demonstrate the latitudes of the librations, then also the longitudes.

[Margin: Demonstration of the librating motion as to latitude.]

Let there be then, in the following upper schema, A on the Ecliptic, d, the line A, the Moon, constituted about the nodes; the Moon having the greatest northern latitude C, but the Moon truly, the line having the greatest southern latitude from the earth; but truly toward the Moon, the lines are of vision, e g, the pyramids of vision, and e, f, perpendicular to the line of vision. About the nodes, with the perpendicular from e, with the base of vision d, let them coincide, the intermediate one being given between A and the libration: indeed, so much as a part of the lower line of the Moon is looked at. About B, with the Moon existing about the limit boreum, non amplius, with A f e d; sed g d h, ad the aspect of our point arrives; thus, with the place e g, of the upper part, ab oculo verso receding, h f, the particular [?]Moon rising, from the lowest part of it, let us perceive; but truly the contrary happens near C, the Moon turning in the southern limit, where the alternate part appears about the upper limb of the Moon, namely e g, the lower parts of the part f h, vanishing from us, as appears, take note. Hence in the northern latitude the boreal shores of the Moon are contracted, but the austral

shores wider; on the contrary, in the southern Meridional latitude, the boreal shores of the Moon are wider, the austral narrower, as our table shows. About the nodes, the space both ways, as it were equally ample, appears, except that little particle nearly equal, which the parallax originates; and it scarcely extends itself toward the hundredth and sixty-eighth part of the face of the Moon: of which...

[Margin: Whence the variation of latitude of the librations originates from parallax.]

since there is almost nothing of moment, in this matter of libration no account is kept.

But truly the cause of the motion of the libration in longitude is profoundly difficult to demonstrate. Yet I greatly wonder that anything of that has escaped you in your meditations, nothing of it has come into my mind plainly until the Year 1648, that, by the eccentricity of the Moon (namely, that the point of the Moon's eccentricity always remains constant in the same hemisphere, not truly the earth; thence I would say that that librating motion arises from the Moon's longitude, as I touched upon rightly on p. 214, *Almag.* lib. IV — whether this hypothesis can subsist truly: since the eccentricity of the Moon is so great, that it can exhibit a libration of so many parts to us as it is reckoned; but unless this can be excogitated, and indeed it cannot be reached; for unless a truer one be set forth in the meantime — for surely by that reckoning all the variations of libration can be best explained and preserved, just as I have set forth opposite, if matters be accurately considered, it is sufficiently clear.

[Margin: Demonstration of the librating motion as to longitude.]

In this, let A be the earth, B the eccentricity (or as I suppose, as much as is necessarily required) I, the Apogee, C, the Perigee, M, & F, the distance about the intermediate ones; about f d, the libration of the Maeotis, and about c e, the Maeotis exhibited about f d, but truly, with the further straitness about M, the space truly about c e, the Maeotis is grasped as the least of all. Indeed, as it about the smallest part about peripheria g f, and conversely g e, appears the greatest at all times. With the Moon descending into O, in the interstice of the Maeotis f d, gradually it grows, & c e, decreases: as the part of the periphery g f grows, g e, truly diminishes. Then in C, the space is given, namely the middle libration, and so great from the one as great from the other side it is looked at: the reason for the lateral ratio is given, namely f d, as much as about the position of the base of vision, & the eccentricity into one and the same line coinciding, parts of the

periphery g f, & g e, being equal. Afterward, with the Moon receding gradually toward the Perigee D, the space of the Maeotis about f d more and more grows, with the Maeotis c e decreasing again, the interstice of the Maeotis c e the same being said in ratio. And the distance in E, & F, about the intermediate ones the libration is always greatest at the Palus Maeotis f d, and the smallest at the Palus Maeotis c e; take note: because g f is the greatest part of the periphery in this place, of all the greatest; g e, truly the smallest. With the Moon ascending toward the Apogee, the space of the Maeotis grows in the same way, as the descending toward M, growing against the Maeotis interstice c e: as somewhere in G, H, I, K, L, & M, clearly appears.

These then are the matters, most Reverend and most Celebrated Man, which I, with the most eager soul of Astronomical investigation, have poured out to you, although briefly, yet freely, openly, mine, to communicate to you, and which I willingly wished to submit to your especially favorable judgment. With these I conclude, praying God, the Best and Greatest, most fully, that he may most kindly grant you a long life, and no little leisure, by which the rest, which still labor under our hands, and the glory of the divine name, illustrated, may be brought to light by your immense ingenuity, magnificently to be acknowledged and admired; most happily may you protrude into light at your time, if it be possible. Farewell, chief ornament and adornment of Urania, and with the highest love and favor be redeemed to me. I would wish you, most Reverend, and most learned Father, to be greeted as officiously as possible, and to be saluted; and the most learned Father Francesco Maria Grimaldi [Francesco Maria Grimaldi]. I gave this at Gdańsk [Gdańsk] from my museum, in the Year of the Christian Era 1654, on the very day of the Autumnal Equinox.

[Margin: Demonstration of the librating motion as to longitude.]

Observations of the libratory motion, both around the Palus Maeotis and the Palus Maraetis, made at Gdańsk by Johannes Hevelius [Ioanne Hevelio]

[This single observation table runs continuously across the three folios (pp. 183–185); it is presented here as one table. **Column headings (verbatim):** *Annus* (Year) | *Mens. dies* (Month, day) | *Hor.* (Hour) | *Longit. Lunae* — subdivided S. (sign) and O. (degree, i.e. *gradus*) | *Latit. Lunae* — subdivided O. (degree) and ' (minutes) with a following letter A/S (the sense of latitude, *Australis* / *Septentrionalis*) | *Libratio* | *Dist. limbi iuxta Obse.* (distance of the limb according to observation) | *Dist. limbi ex Tab.* (distance of the limb from the table) |

Animadvertenda (Things to be noted). Longitude signs are given by their zodiacal glyphs in the source; they are rendered here by name. The two distance-of-the-limb columns are in units of (twelfths of?) the disk; fractional entries are printed as written, e.g. $\frac{1}{2}$, $3\frac{1}{2}$, $5\frac{1}{4}$, $2\frac{2}{3}$.]

Y Mo e nth a , r day	H r .	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
1 Sep 6 t. 4 16 3	6	Aquari us	3	3 8 A	P. Mae ot.	$\frac{1}{2}$	1	
Sep t. 25	1 1	Pisces	5	2 0 A	P. Mae ot.	$3\frac{1}{2}$	3	The limb of the Moon [»] was at its mean distance from the Palus Maeotis.
Sep t. 27	1 1	Aries	5	0 54 A	P. Mae ot.	3	$3\frac{1}{2}$	Opposition [☾]. Eclipse.
1 Oct 6 ob. 4 20 3	7	Aquari us	·1	4 18 S	P. Mae ot.	1	1	[☐] The line of section ran through the Promontor y [»?], through M. Phoenicem, M. Tabor, and the desert of Zin; it was carried about Hour 5 after the

Y Mo e nth a , r day	H r .	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								quadrature [□].
Oct ob. 21	9	Aquari us	14	4 30 S	P. Mae ot.	2	2	
Oct ob. 22	6 ½	Aquari us	28	2 14 S	P. Mae ot.	2	2	
1 Oct 6 ob. 4 24 3	1 0	Pisces	27	0 17 A	P. Mae ot.	3	3	Intermediat e distance.
No v. 4	5	Leo	20	3 0 A	P. Mar aeot .	1	1½	
No v. 5	5 ½	Virgo	2	2 0 A	P. Mar aeot .	1½	2	
1 No 6 v. 7 4 3	7	Virgo	26	2 44 S	P. Mar aeot .	2	3	Libration increasing.
No v. 20	7	Pisces	24	0 18 S	P. Mae ot.	2½	3	
No v. 21	7	Aries	7	1 7 A	P. Mae ot.	3	3½	
1 No 6 v. 4 25	1 0	Gemini	6	4 46 A	P. Mae ot.	5½	5½	Closest space [narrowest]

Y Mo e nth a , r day	H r .	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
3								interval].
No v. 26	1 1	Gemini	21	4 58 A	P. Mar aeot .	0	0	
No v. 27	1 1	Cancer	4	4 51 A	P. Mar aeot .	0	0	Mount Sinai was 31 [parts] from the lower limb of the Moon [»]; it was distant by parts of which the radius of the Moon was 100.
1 6 4 3	No v. 29 3	1 Cancer	20	4 28 A	P. Mar aeot .	1	1	
Dec . 2	4	Leo	27	2 0 A	P. Mar aeot .	2	2	
Dec . 3	5	Virgo	10	0 0	P. Mar aeot .	2	2	[□] The line of section passed across the eastern roots of M. Aurei,

Y Mo e nth a , r day	H r	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								through M. Pangaeum, Olymp., Didym., Antilib., and Mount Fortem; Hour 3 before the quadrature [□].
1 Dec 6 .5 4 3	6 ½	Libra	4	1 0 S	P. Mar aeot .	2	2⅔	
Dec .14	V e s p .	Aquari us	7	3 30 S	P. Mae ot.	½	1	
Dec .19	V e s p .	Aries	19	1 42 A	P. Mae ot.	3½	3½	
1 Dec 6 .31 4 3	3	Virgo	17	0 9 A	P. Mar aeot .	2½	2½	Mount Sinai stood 36 parts from the periphery.
1 Ian 6 uar 4 .1 4	3	Virgo	29	0 45 S	P. Mar aeot .	2½	3	[□] A section from M. Argentariu

Y Mo e nth a , r day	H r .	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								m through the gulf to the Hellespont, [through] M. Masicytum, M. Tabor, between Phoenicem and M. Cragum, observed at the true time [of quadrature, □].
Ian. 2	6	Libra	12	1 55 S	P. Mar aeot	3	3	
1 6 4 4	Ian. 12	Pisces	1	1 33 S	P. Mae ot.	1	2	
Ian. 13		Pisces	16	0 8 S	P. Mae ot.	1½	2½	
Ian. 21		Cancer	8	4 45 A	P. Mae ot.	6	6	The interval, of all the most conspicuou s, was dilated.

Y Mo e nth a , r day	H r	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								Mount Sinai was 30 [parts] distant from the limb, of those parts of which the radius of the Moon [»] was 100.
1 Ian. 6 22 4 4		Cancer	21	4 15 A	P. Mae ot.	5	5¼	Widest interval.
Feb r. 17		Cancer	3	5 0 A	P. Mae ot.	6	6	
Feb r. 19		Leo	1	3 40 A	P. Mae ot.	5	5	It was beginning to decrease.
1 Ma 6 rt. 4 15 4	7	Cancer	1	5 12 A	P. Mae ot.	6	6	[□] The line of section advanced near M. Lygustinum and M. Montuniate m, through the eastern roots of M. Olympi and

Y Mo e nth a , r day	H r	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								M. Didymi, and through the lower M. of Antilibanus ; Hour 2 after the true [quadratur e, □].
Ma rt. 16		Cancer	14	4 51 A	P. Mae ot.	6	6	
Apr il. 9	8	Taurus	27	4 50 A	P. Mae ot.	14½	14½	
1 Apr 6 il. 4 10 4		Gemini	12	4 45 A	P. Mae ot.	4	5	
Apr il. 11		Gemini	26	5 5 A	P. Mae ot.	1½	1	
Apr il. 12		Cancer	10	4 44 A	P. Mae ot.	6	6	The upper Hyperborea n lake [Lacus hyperboreu s], and also the lower [Inf.] of the Mare Caspium, were

Y Mo e nth a , r day	H r	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
1 Apr 6 il. 4 13 4		Cancer	23	4 5 A	P. Mae ot.	6	6	distant from the limb by 11 parts, of those parts of which the radius of the Moon [»] was 100. [□] The line of section grazed the eastern shore of the Pontus Euxinus, through M. Catena Mundi, [grazing] the eastern margin of the Insula Besbica, and crossed through the western part of M. Didymi, and through M. Cydisium. Hour 2

Y e a r	Mo nth , day	H r .	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
									before the true [quadrature, ☐].
Apr il. 18	1	0	Virgo	24	0 40 S	P. Mae ot.	3½	3½	
Apr il. 20	1	0	Libra	18	2 40 S	P. Mae ot.	3	3	

[The table continues. Same column structure as above.]

Year	Month, day	Long. $\oslash$ (sign)	Long. $\oslash$ ($^{\circ}$)	Lat. $\oslash$ ($^{\circ}$ ' sense)	Libration	Dist. limb (obs.)	Dist. limb (tab.)	Notes
1644	April 21	Aquarius	1	3 33 S	P. Maeot.	1½	2	Opposition [$\oslash$]. The Moon was not yet quite completed in light at the eastern limb, but on the lower part — namely the southern [Aust.] — it was still notably rough. Hour 4

Y e r	Mo nth, day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								before the opposition [$\circ^{\circ}$].
	Apr il. 23	Aquari us	14	4 15 S	P. Mar aeot	4	4	Space sufficiently ample.
					.			
	Apr il. 26	Sagitta rius	23	5 0 S	P. Mar aeot	5½	5½	
					.			
1 6 4 4	Apr il. 27	Capric orn	7	4 45 S	P. Mar aeot	6	6	It turned out altogether very ample.
					.			
	Mai j 10	Cancer	18	4 8 A	P. Mae ot.	6	6	
	Mai j 11	Leo	1	3 20 A	P. Mae ot.	6	5½	Decreasing.
1 6 4 4	Mai j 12	Leo	14	2 30 A	P. Mae ot.	5	5	[□] The line of section [ran] about the cliffs, hyperbolic[ally], through M. Pangaeum, to the eastern roots of M. Olympi, and

Year	Month, day	Long. λ (sign)	Long. λ ($^{\circ}$)	Lat. δ ($^{\circ}$ ' sense)	Libration	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								was carried through part of M. Dydimi, and through M. Fortem; Hour $5\frac{1}{2}$ after [□].
	May 13	Leo	26	1 43 A	P. Mae ot.	$3\frac{1}{2}$	$4\frac{1}{2}$	[□] A similar section, as occurred on the day 18 March observed at hour 6 before [□].
	May 14	Virgo	8	0 30 A	P. Mae ot.	4	4	
	16 May 4	Virgo	20	0 30 S	P. Mae ot.	4	4	
	May 18	Libra	26	2 35 S	P. Mae ot.	3	3	Intermediate distance.
	May 21	Sagittarius	1	4 51 S	P. Mae ot.	$\frac{1}{2}$	1	
	16 June 4	Aquarius	28	4 50 S	P. Mae ot.	1	$1\frac{1}{2}$	

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
4							
Iun ij 19	Sagitta rius	25	4 50 S	P. Mae ot.	0	½	
Iuli j 1	Virgo	1	0 49 A	P. Mae ot.	5	5	It was decreasing.
1 Iuli 6 j 11 4 4	Libra	19	3 17 S	P. Mae ot.	2	3	[☐] A section through M. Ligustinum and M. Montuniate m, and it crossed through M. Cragum [atq; Cragum transiit].
Iuli j 14	Aquari us	25	5 0 S	P. Mae ot.	2	2	
Iuli j 16	Sagitta rius	20	5 0 S	P. Mae ot.	1	1	
1 Iuli 6 j 19 4 4	Capric orn	28	3 20 S	P. Mae ot.	0	0	Minimum libration.
Iuli j 23	Pisces	13	0 30 A	P. Mar aeot	4	4	

Y e r	Mo n t h, d a y	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
	Iuli j 24	Pisces	29	1 50 A	. P. Mar aeot	4	4	
1 6 4 4	Iuli j 26	Aries	26	3 53 A	. P. Mar aeot .	3	3	[□] Similar, nearly, to that section which was observed on 8 October of the year 1644 at hour 1 after [□]. It advanced, moreover, through M. Argentar., Mesogis, the western shore of Sipyli, Tabor, etc.
	Aug . 10	Aquari us	20	5 0 S	P. Mae ot.	1½	2	
	Sep t. 7	Aquari us	28	5 12 S	P. Mae ot.	2	2	
1 6 4	Sep t. 9	Sagitta rius	23	5 3 S	P. Mae ot.	½	1	[□] The line of section [ran]

Year	Month, day	Long. $\oslash$ (sign)	Long. $\oslash$ ($^{\circ}$)	Lat. $\oslash$ ($^{\circ}$ ' sense)	Libration	Dist. limb (obs.)	Dist. limb (tab.)	Notes
4								through the western part of the larger black lake [lacus nigri maioris], [past] Insula Lesbos, Insula Cyprum, M. Abarim, and one[?]; the third part was carried toward M. Sinai, westward. Hour 1 before [□]. And nonetheless it appeared somewhat convex.
	Sep t. 12	Aquarius	1	3 7 S	P. Maeot.	$\frac{1}{2}$	0	
	Sep t. 18	Aries	19	3 13 A	P. Maeot.	3	3	Opposition [$\oslash$]: through M. Aur. to the

Year	Month, day	Long. $\oslash$ (sign)	Long. $\oslash$ ($^{\circ}$)	Lat. $\oslash$ ($^{\circ}$ ' sense)	Libration	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								eastern shore, [past] Insula Besbicam, through Olympum, by $\frac{1}{4}$ [part]; to the eastern part of M. Didym., by as much; at an interval from M. Sin., by as much as the larger black lake was distant. True time [tempore vera].
1644	Sep 6 t. 4 23 4	Gemini	29	4 45 A	P. Maraeot.	4	5	[□] Opposition [$\oslash$]: through the Pyramid, M. Mesog., along the western shore, [past] M. Sipyli and M.

Y e a r	Mo nth, day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								Masicytum, between the Mare Pamphylium [Mare Pamph.] and M. Lib., through M. Tab. from M. Sin., by one diameter of the said mountain. Hour 7 before [□].
	Oct ob. 8	Capric orn	13	4 10 S	P. Mae ot.	½	0	The Hyperborean lake was observed almost beneath the limb itself.
	No v. 5	Capric orn	22	3 26 S	P. Mae ot.	0	0	On both sides the Hyperborean lake lay very near to the limb.
1 6 4 4	No v. 6	Aquari us	6	2 30 S	P. Mae ot.	0	0	
	Dec	Aquari	14	2 38 S	P.	0	0	

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
. 4	us			Mae ot.			
Dec . 19	Virgo	6	0 30 S	P. Mar aeot	1	1	
1 Dec 6 . 21 4 4	Libra	5	2 0 S	P. Mar aeot	2	2	Increasing.
Dec . 22	Libra	17	3 15 S	P. Mar aeot	2	2½	
1 Feb 6 r. 4 28 5	Aries	14	3 38 A	P. Mae ot.	2	2	
1 Ma 6 rt. 4 4 5	Gemini	10	5 6 A	P. Mae ot.	4	4	
Ma rt. 7	Cancer	22	3 5 A	P. Mae ot.	5	5	Increasing.
Ma rt. 12	Virgo	10	1 0 S	P. Mae ot.	4½	5	Decreasing.

[The table continues and concludes on this folio. Same column structure as above.]

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
1 Ma 6 rt. 4 31 5	Gemini	7	5 10 A	P. Mae ot.	3	3½	Intermediat e distance.
Apr il. 3	Cancer	20	4 3 A	P. Mae ot.	5	5	
Apr il. 7	Virgo	12	1 8 S	P. Mae ot.	4½	5	
1 Apr 6 il. 4 19 5	Capric orn	28	2 28 S	P. Mar aeot .	4	5	[□] A boundary through the larger black lake [lacum nigri mai.], [past] S. Tarant., Phoenic., and Tab., and through the western shore of the desert of Zin it passed across. Hour 4 before [□].
Mai j 2	Leo	12	1 10 A	P. Mar aeot .	5	5½	[□] The line of section through M. Aureum,

Y	e Mo	Long.	Long.	Lat. 》 (° ')	Libr	Dist.	Dist.	
a nth,	》	(sign)	》 (°)	sense)	atio	limb	limb	Notes
r day					n	(obs.)	(tab.)	
								Mysium, Olymp., and between the Antilibanus and M. Cydisum it appeared at hour 2 before [□].
Iun. 8	Sagittarius	12	4 45 S	P. Maraeot.	3	3	3	Opposition [♌]: that part Euro-Australis [SE-South] from the Lacus Maraeotis as far as M. Dalang. was vehemently rough and uneven.
1 Sep 6 t. 5 4 5	Pisces	10	2 0 A	P. Maeot.	0	0	0	Opposition [♐]: with the eastern limb being rough, the upper and lower parts were seen sufficiently rounded and

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
							smooth. Hour 4 before [☉].
Sep t. 13	Gemini	22	4 17 A	P. Mar aeot .	2	2½	[☐] A boundary of light, and a shadow [umbra] about the larger black lake [lac. nig. mai.]: L. Trasim., M. Cadm., between Lib. and Antil., passing; M. Seir crossed at 4½ hours after [☐].
Oct ob. 5	Gemini	1	4 55 A	P. Mae ot.	3	3	[☐] The northern parts of the periphery appeared sufficiently rugged.
1 Oct 6 ob. 4 27 5	Aquari us	5	0 53 S	P. Mae ot.	11	11	[☐] A section to the western roots of the larger black lake [lacus

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
							nig. mai.], toward the eastern roots of M. Sipyli and M. Libani, between Tabor and M. Liban., occurred at the true time [tempore vera, ☐].
No v. 27	Pisces	21	3 3 A	P. Mae ot.	0	0	
Dec . 21	Aquari us	9	0 4 S	P. Mae ot.	0	1	
1 Dec 6 . 25 4 5	Aries	1	3 52 A	P. Mae ot.	2	1	
Dec . 31	Gemini	27	3 31 A	P. Mae ot.	3	3	Intermediat e distance.
1 Apr 6 il. 4 29 6	Cancer	1	4 1 A	P. Mae ot.	3½	4	Opposition [☉]: the limb of the Moon [☾] [was] on all sides nearly round,

Y e Mo a nth, r day	Long. » (sign)	Long. » (°)	Lat. » (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
							except only that on the part more to the south [Austr.] it was notably rough and winding [scabrosus et flexuosus], so that the roughness extended itself to about 90 degrees [90 gr. circ.].
1 Jun 6 ij 4 27 6	Capric orn	4	2 15 S	P. Mar aeot .	2½	2¾	Opposition [♌]: the limb came nearly to the western Palus [Palud. occidental.], to the smaller one.
Iuli j 2	Aquari us	26	2 0 A	P. Mar aeot .	4½	4½	
Iuli	Pisces	10	3 0 A	P.	5	5	

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
j 3				Mar aeot .			
1 Iuli 6 j 4 4 6	Pisces	21	3 50 A	P. Mar aeot .	5	5½	Sufficiently ample space.
Iuli j 5	Aries	1	4 30 A	P. Mar aeot .	5½	5⅔	The limb had withdrawn yet farther from the Palus.
Iuli j 6	Aries	14	5 0 A	P. Mae ot.	5½	6	[□] The section crossed through the western roots of the larger black lake [lacus nigri maioris], by the Prom. Lunae, to the eastern roots of Sipyli, and the western [roots] of Latmi, between the Mare Pamphiliu

Y e Mo a nth, r day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
							m and Libanum, [past] Tabor, and the western confines of the desert of Zin. Hour 1 before [□].
1 Aug 6 . 25 4 6	Aquari us	27	1 5 A	P. Mae ot.	1	1½	Ample space.
Sep t. 24	Aries	2	2 30 A	P. Mae ot.	½	½	Opposition [☾]: very near indeed to the limb of the P. Maeotis.
Oct ob. 22	Aries	8	4 45 A	P. Mae ot.	½	½	The limb was very close to the Maeotis; from the lakes, however, the Hyperborean one was sufficiently elongated, just as the Palus

Y e r	Mo nth, day	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
								Amadoca shone forth conspicuou sly.
1 6 4 19 6	No v.	Aries	16	5 0 A	P. Mae ot.	0	0	
1 6 19 4 7	Ian.	Cancer	14	0 45 A	P. Mae ot.	3	2½	
	Ma rt. 20	Libra	1	4 45 S	P. Mae ot.	3	2 1/2	Opposition [♌]: the lower part of the limb was seen winding and rough [anfractuosa aspera;].
1 6 4 12 7	Apr il.	Cancer	28	1 5 S	P. Mae ot.	3	2½	
	Sep t. 4	Sagitta rius	1	3 30 S	P. Mae ot.	6	6	Quite ample interval.
	Sep t. 6	Sagitta rius	25	1 35 S	P. Mae ot.	5½	5½	
1 6	Sep t.	Aquari us	24	3 20 A	P. Mae	3	3	

Y e r	Mo n t h, d a y	Long. ☾ (sign)	Long. ☾ (°)	Lat. ☾ (° ' sense)	Libr atio n	Dist. limb (obs.)	Dist. limb (tab.)	Notes
4	11				ot.			
7								
	Sep t. 21	Gemini	28	0 48 A	P. Mar aeot	5½	5½	Intermediat e remoteness.
					.			
	Oct ob. 4	Capric orn	3	0 20 S	P. Mae ot.	5	+5	Decreasing.
1	Oct ob. 4 5	Capric orn	15	0 35 A	P. Mae ot.	5	4½	
7								
	Oct ob. 6	Capric orn	27	1 40 A	P. Mae ot.	4	4	
	Oct ob. 17	Gemini	1	2 55 A	P. Mar aeot	6	6	Maximum remoteness of the limb.
					.			
1	No v. 3 4	Aquari us	5	2 40 A	P. Mae ot.	4	4	The Palus Amadoca was clearly observed.
7								
	No v. 6	Pisces	11	4 40 A	P. Mae ot.	3	3	
	No v. 12	Taurus	25	3 18 A	P. Mae ot.	0	½	The interval appeared very narrow.

Observations of the librational motion, both around the Palus Maeotis and around the Maraeotis, made at Gdańsk by Johannes Hevelius [Johannes Hevelius].

The table that follows continues without interruption across these three folios. Its columns are: the **Year** [Annus]; the **Month and day** [Mēs., dies]; the **Hour** [Hor.]; the **Longitude of the Moon** [Longit. Lunæ], given as zodiac sign and degrees [O. S.]; the **Latitude of the Moon** [Latit. Lunæ], given as degrees and minutes with **A** (austrina, south) or **S** (septentrionalis, north) [O. I]; the **Libration** [Libratio], i.e. the reference spot, marked **P. Mœot.** (Palus Maeotis) or **P. Maraeot.** (Palus Maraeotis); the **Distance of the limb as actually observed** [Dist. limbi iuxta Obse.]; the **Distance of the limb from the table** [Dist. limbi ex Tab.]; and the **Remarks** [Animadvertenda].

Source page 186:

A n u s	H Mēs ., dies	o r Lunæ (sign , °)	Longit. Lunæ (sign , °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
1 6 4 8	Ian. 3	Aries 20		5 0 A	P. Mœ ot.	2	2	Waning [Decrescen s].
	Ian. 4	Taurus 3		4 40 A	P. Mœ ot.	1½	1½	
	Ian. 5	Taurus 15		3 56 A	P. Mœ ot.	1	1	
1 6 4 8	Ian. 6	Taurus 28		3 7 A	P. Mœ ot.	0	½	Waning [Decrescen s].
	Ian. 8	Gemini 25		0 55 A	P. Mœ ot.	0	½	Waxing [Crescens].
	Feb 1	Taurus 13		4 0 A	P.	1	1	□ The line

Annus	Menses	Diebus	Horæ	Longit. Lunæ (sign. °)	Latit. Lunæ (° ' A/S)	Libratio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadvertenda
r. 1	1					Mœot.			of section ran near the larger black lake [lacum nigr. mai.], along the shore of Promontorium Lunæ, likewise the shore of S. Tarant. [Sinus Tarantinus]; it grazed nearly the western part of M. Phoenicis and Tabor; M. Sinai, with the upper cusp (on the upper graduated circle) at 35, and the lower cusp at 207 degrees.

A n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
1 6 4 8	Feb r. 3	Gemini 7	2 20 A	P. Mœ ot.	0	$\frac{1}{4}$	
	Feb r. 4	Gemini 20	1 0 A	P. Mœ ot.	0	0	
	Feb r. 5	Cancer 3	0 0	P. Mœ ot.	0	$\frac{1}{3}$	The gap most extremely narrowed [Interstitiu m quàm maximè coarctatum].
1 6 4 8	Feb r. 6	Cancer 17	1 15 S	P. Mœ ot.	1	1	□ Section of 29 degrees on the northern side, and on the southern 117 (but it touched 117 on the upper graduated circle); thus by way of M. Fortem, Didym.,

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								Olymp., near Ligust., it passed through at true time of the [last quarter] □.
	Dec. 21	1 0	Aries 1	5 10 A	P. Mœ ot.	4	4	
	1 6 4 8	Feb r. 19	6 Gemini 3	0 52 A	P. Mœ ot.	2	2	
	1 6 4 9	Mar t. 24	9 Leo 15	4 34 S	P. Mœ ot.	0	½	The gap was so thinned that it could scarcely be narrower [Valde erat attenuatum interstitiu m, ut vix arctius possit].
	Mar t. 26		6 Virgo 13	5 0 S	P. Mœ ot.	1	1½	
	Apr il.		Cancer 15	3 6 S	P. Mœ	0	½	Very close to the limb

A n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	18			ot.			[Admodum vicina limbo].
1 6 4 9	Apr il. 19	Cancer 26	4 0 S	P. Mœ ot.	0	0	⋃ The Moon observed least full on the lower side [Minimè plenum a parte infer. observatu m].
	Apr il. 26	Aquarius 7	2 26 S	P. Mœ ot.	3	3	The gap was so narrowed as it could ever come to be [Interstitiu m adeò erat coarctatum , ut fieri unquam potuerit].
	Mai j 17	Leo 7	4 33 A	P. Mœ ot.	0	0	
1 6 4	Nou . 15	Aries 16	3 28 A	P. Mœ ot.	4	4½	

A n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Lunæ (sign (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
9							
	Nou . 17	Taurus 11	1 34 A	P. Mœ ot.	3½	4	
	Nou . 18	Taurus 23	0 38 A	P. Mœ ot.	3	3	nearly [ferè].
1 6 4 9	Nou . 27	Virgo 6	5 13 S	P. Mar aeot .	6	6	□ The boundary of light and shadow ran across the larger black lake [lac. nigr. mai.], near the western shore of Sin. Tarant., by way of M. Tabor, Hermonis; it was led toward the western roots of M. Sinai: on the lower circle it marked at degrees 38

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								and 208, at true time □.
	Dec. 9		Pisces 6	5 10 A	P. Mar aeot	6	6	
					.			
	Dec. 24	6	Cancer 27	4 30 S	P. Mar aeot	4	4½	
					.			
1 6 4 9	Dec. 25	7	Leo 9	5 0 S	P. Mar aeot	5	5	Waxing [Crescens].
					.			
	Dec. 26	7	Leo 22	5 14 S	P. Mar aeot	5½	5½	
					.			
1 6 5 0	Ian uar. 10 0		Taurus 4	2 0 A	P. Mœ ot.	3½	4	
1 6 5 0	Feb r. 11 0	1 0	Cancer 1	3 6 S	P. Mœ ot.	2	2¼	Waning [Decrescen s].
	Feb r. 12		Cancer 12	3 45 S	P. Mœ ot.	2	2	
	Feb r.		Leo 6	4 46 S	P. Mœ	1	1	

A n u s	Mēs ., dies	H o Longit. r Lunæ (sign . °)		Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	14				ot.			
1 6 5 0	Feb r. 15	Leo 19	4 56 S	P. Mœ ot.	½	⅓		The hyperborea n lakes [Lacus hyperborei] nearly deceived the sight.
	Feb r. 16	Virgo 3	4 54 S	P. Mœ ot.	0	0		The gap nearly the narrowest [Interstitiu m ferè strictissimu m].
	Mar t. 6	6 Taurus 7	1 10 A	P. Mœ ot.	4	4		
1 6 5 0	Mar t. 7	Taurus 20	0 0	P. Mœ ot.	3½	3⅔		Roughly mid- distance [Media circiter distantia].
	Mar t. 9	Gemini 13	2 3 S	P. Mœ ot.	3	3		nearly [ferè].
	Mar t. 13	Leo 1	4 47 S	P. Mœ ot.	1	1		
1	Mar	Virgo 10	4 43 S	P.	0	0		The limb of

A n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
6 5 0	t. 16			Mœ ot.			the Palus was very near; still, the southern part of the limb appeared rough and uneven on its side [Limbus Pal. vicinissimu s erat; adhuc pars limbi Australis ex parte videbatur aspera, et inæqualis].
	Mar t. 17	Virgo 24	4 10 S	P. Mœ ot.	0	½	nearly [ferè].
	Mar t. 18	Libra 9	3 16 S	P. Mar aeot .	5	5	

Source page 187:

A n u s	H		Longit. Lunæ (sign , °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	Mēs ., dies	o r						
1 6 5 0	Apr il. 10	Leo 10	5 8 S	P. Mœ ot.	1	1		
	Apr il. 13	9 Virgo 18	4 12 S	P. Mœ ot.	0	0		A gap we have scarcely ever seen tighter [Interstitiu m vix unquam vidimus arctius].
	Apr il. 15	Libra 16	2 55 S	P. Mœ ot.	1	1		
1 6 5 0	Mai j 12	Libra 10	3 16 S	P. Mœ ot.	1	1		
	Iulij 7	1 Libra 28 0	1 36 S	P. Mœ ot.	1	1		
	Aug . 3	9 Libra 25	1 35 S	P. Mœ ot.	1	1		
1 6 5 0	Aug . 4	Aquarius 8	0 25 S	P. Mœ ot.	1½	1⅓		
	Aug	Aquarius 5	4 54 A	P.	4	4⅓		

A n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	. 10			Mœ ot.			
	Aug . 11	Aquarius 20	4 56 A	P. Mœ ot.	5	5	
1 6 5 0	Sept . 8	9 Aquarius 28	4 47 A	P. Mœ ot.	5	5	♂ The northern periphery from M. Alabastrino as far as the hyperborea n lake [lacum hyperb.] was notably winding on its lower side, and was observed rough [insigniter anfractuos a, et aspera fuit observata].
	Sept . 9	Pisces 12	4 16 A	P. Mœ ot.	5½	5½	
	Sept	Aries 26	1 6 S	P.	0	½	The

A n u s	Mēs ., dies	H o Longit.		Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
		r	Lunæ (sign . °)					
	. 13				Mar aeot .			Stagnum Miris seemed to cling to the limb itself [Stagnum Miris quasi ipso limbo adhærebat] .
1 6 5 0	Nou . 4	8	Aries 1	3 14 A	P. Mœ ot.	6	6	The gap was very nearly the greatest of all, and the upper one quite ample too [Interstitiu m fuit ferè omnium maximum, necnon superius satis amplum].
	Nou . 5	7	Aries 15	2 14 A	P. Mœ ot.	6	6	Never, so far as I know, have I seen a wider interval [Nunquam,

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								quod sciam, vidi amplius intervallu m].
	Dec. 3	6	Aries 24	1 20 A	P. Mœ ot.	6	5½	It appeared dilated almost to the maximum [Maxima ferè apparuit dilatatio].
1 6 5 1	Apr il. 29	1 0	Virgo 1	4 31 S	P. Mœ ot.	1	2	
	Mai j 1	1 0	Virgo 26	3 0 S	P. Mœ ot.	1	1	
	Mai j 4	9 ½	Aquarius 6	0 30 A	P. Mœ ot.	0	0	
1 6 5 1	Mai j 5	9 ½ 20	Aquarius	1 43 A	P. Mœ ot.	1	1	The Palus Amadoca was seen almost beneath the limb itself [Palus Amadoca sub ipso

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								ferè limbo conspecta].
	Mai j 27		Virgo 10	4 0 S	P. Mœ ot.	1	1½	
	Mai j 29		Libra 4	2 24 S	P. Mœ ot.	1	1	
1 6 5 1	Iun. 1	1	Aquarius 0 14	1 5 A	P. Mœ ot.	0	½	The limb passed very close to the Palus [Limbus per quam vicinus Paludi].
	Dec. 19		Pisces 4	1 20 A	P. Mœ ot.	4	3½	
	Dec. 20		Aries 16	0 0	P. Mœ ot.	4	5	
1 6 5 1	Dec. 25		Gemini 23	4 30 S	P. Mœ ot.	0	0	The limb very close indeed [Limbus propinquis simus].
1 6 5 2	Ian. 15		Pisces 28	1 24 A	P. Mœ ot.	4	4	Waxing [Crescens].

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	Ian. 21		Gemini 19	4 30 S	P. Mœ ot.	5	5	
1 6 5 2	Ian. 22		Cancer 1	4 50 S	P. Mœ ot.	5	5	The limb had reached the larger western lake; but the space between Ins. Maris Caspij and the limb was very ample [Limbus ad lacum mai. occid. pervenerat. Spatium verò inter Ins. Maris Caspij, et limbum valde fuit amplum].
	Feb r. 21	8	Leo 5	4 46 S	P. Mœ ot.	4	4	
	Feb r. 22		Leo 17	4 15 S	P. Mœ ot.	5	4½	

A n n u s	Mēs , dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
1 6 5 2	Feb r. 24		Virgo 10	2 44 S	P. Mœ ot.	3	3	The limb had withdrawn as far as possible from the Palus [Limbus a Palude quàm longissimè discesserat] .
	Mar t. 15	7	Gemini 12	4 35 S	P. Mœ ot.	6	6	
	Mar t. 16	1 1	Gemini 25	5 0 S	P. Mœ ot.	5½	5¼	□ The line of section ran by way of M. Aureum, near Ins. Besb., to the right side of M. Didym., passed through M. Armenia; 1 hour before [last quarter] □.
1	Mar	1	Cancer 8	5 14 S	P.	5	5	

A n u s	H Mēs o		Longit. r Lunæ (sign		Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	., dies	.	°)						
6 5 2	t. 17	0				Mœ ot.			
	Sept . 17	8	Pisces 25		0 30 A	P. Mœ ot.	2½	3	Eclipsing full Moon [Plenilunium Eclipticum] .
	Oct ob. 12	7	Aquarius 19		4 23 A	P. Mœ ot.	2½	2	
1 6 5 2	Oct ob. 17	8	Taurus 4		2 42 S	P. Mœ ot.	4	4½	The Palus Amadoca beneath the limb itself [Palus Amadoca sub ipso limbo].
	Oct ob. 19	9	Gemini 3		4 10 S	P. Mar aeot .	4	4½	The Stagnum Miris clung as it were to the edge: still, the limb leaned strongly toward the Sinus Apollinis [Stagnum

Annus		Menses		Hæc dies		Longitudo		Latitudo		Libra		Distans		Ex Tab.		Animadvertenda
u.	s.	dies	h.	m.	s.	sign.	grad.	'	"	sign.	grad.	limbi	Obse.	limbi	ex Tab.	
						Gemini	17	4	44	S	P.	0		0		Miris margini quasi adhærebat: adhæc limbus, Sinui Apollinis valde imminebat] . The limb passed very close indeed: moreover the Stagnum Miris had reached almost to the very edge [Limbus fuit per quam vicinissimus: Stagnum insuper Miris ad ipsum ferè marginem pervenerat
Oct.		20	9			Gemini	17	4	44	S	P.	0		0		The limb passed very close indeed: moreover the Stagnum Miris had reached almost to the very edge [Limbus fuit per quam vicinissimus: Stagnum insuper Miris ad ipsum ferè marginem pervenerat

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
1 6 5 2	Oct ob. 21	1 0	Cancer 1	5 12 S	P. Mar aeot .	0	0	]. The gap nearly never offered itself to us tighter; and the Stagnum Miris so near the limb, and so attenuated, that it would nearly elude the sight even of a practised observer [Interstitiu m ferè nunquam se se nobis obtulit strictius; stagnumqu e Miris adeò limbo propinquu m, atque extenuatu

A		n		H													
n		Mēs		o		Longit.											
u		.,		r		Lunæ (sign		Latit. Lunæ		Libr		Dist. limbi		limbi ex		Animadver	
s		dies		. °)				(° ' A/S)		atio		iuxta Obse.		Tab.		tenda	
m extitit, ut pene visum etiam exercitati observatori s el uderet].																	
Oct	1	Cancer	14	5	0	S		P.	0				½	The space appeared a little above the middle; so that the western lake was beheld beneath the limb itself [Spatium paulò supra medietate m apparuit; sic ut lacus occid. mai. sub ipso limbo spectaretur].			
ob.	1							Mar									
22								aeot									
								.									
Nou	9	Aries	27	2	15	S		P.	4				4				
. 13								Mœ									
								ot.									

Source page 188:

A n n		H Mēs o		Longit.	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
u s	., dies	r	Lunæ (sign . °)						
1 6 5 2	Nou . 14	8	Taurus 12	3 25 S	P. Mœ ot.	4½	4½		A little larger it was, so that both lakes are seen; the larger lake, however, clung as it were to the limb [Paulo maius extitit, sic ut uterque lacus conspicitur ; maior tamen lacus limbo quasi adhærebat] .
	Nou . 15	8	Taurus 27	4 13 S	P. Mœ ot.	5	5		More and more, while waxing, it dwindled by turns with the upper gap [Magis magisque crescente, decrecent

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								e vicissim superiori interstitio].
	Dec. 16	9	Cancer 16	4 51 S	P. Mar aeot .	0	0	The Stagnum Miris very near the limb [Stagnum Miris limbo vicinissimu m].
1 6 5 2	Dec. 17		Leo 1	4 12 S	P. Mar aeot .	1	1	It grew [Crevit].
1 6 5 3	Ian. uar. 9	6	Gemini 1	4 20 S	P. Mœ ot.	5	5	
	Ian. 13	6 ½	Cancer 25	4 20 S	P. Mœ ot.	5½	5½	A very great distance [Distantia valde magna].
1 6 5 3	Ian. 14	7	Leo 8	3 33 S	P. Mar aeot .	1	1	
	Feb r. 6		Gemini 12	5 2 S	P. Mœ	5	5	

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	Feb r. 9		Cancer 21	4 40 S	ot. P. Mœ ot.	6	6	
1 6 5 3	Feb r. 11		Leo 18	3 0 S	P. Mœ ot.	5	5	♂ A notable roughness was detected from Ins. Cercinna as far as the Cithaeronia n mountains [Asperitas insignis ab Ins. Cercinna usque; Montes Cithæranos deprehensa].
	Mar t. 4	9 ½	Taurus 24	4 46 S	P. Mœ ot.	6	4½	□ The section appeared plainly such as it had stood on 27 November of the year

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								1649, at true time □ [Sectio plane apparuit talis, qualis die 27. Nouemb. Anno 1649. temp. vera extitit □].
	Apr il. 4	9 ½	Cancer 15	4 31 S	P. Mœ ot.	6	6	
1 6 5 3	Mai j 3		Leo 8	3 40 S	P. Mœ ot.	5½	5½	
	Mai j 6		Virgo 14	0 53 S	P. Mœ ot.	4	4	
1 6 5 3	Dec. 4		Gemini 15	4 56 S	P. Mœ ot.	4	4	♂ The periphery from the lowest part was observed extremely uneven and rough [Peripheria ab infima parte,

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								admodum inæqualis, et aspera observata fuit].
1 6 5 4	Feb r. 11		Sagittarius 18	5 6 A	P. Mar aeot .	4	4	
	Feb r. 29		Leo 24	1 0 S	P. Mœ ot.	6	6	
	Apr il. 23	9	Leo 24	2 37 S	P. Mœ ot.	5	5	
1 6 5 4	Apr il. 26		Virgo 13	0 50 A	P. Mœ ot.	4½	4½	□ The line of section to the naked eye appeared concave in part; but to the armed eye it had already overcome the straight line, and seemed as it were convexly joined in part. The

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								section, moreover, passed across by way of M. Audum, Mysium, Olimp. Didym., and Antilib.; thus it grazed at 24 and 219 degrees on the lower limb. Hour 1 after [last quarter] □.
	Mai j 25		Libra 5	2 34 A	P. Mœ ot.	5	5	
	Mai j 29		Aquarius 24	4 55 A	P. Mœ ot.	3	3½	
1 6 5 4	Iuni j 8	3	Aries 2	2 42 S	P. Mar aeot .	5	5	□ The section to the naked eye appeared concave, but to the armed eye

A n n u s	Mēs ., dies	H o r Lunæ (sign . °)	Longit. Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
							convex. The Stagnum Miris was the more removed from the limb the more the M[are] Eoum was removed; the section ran along the very roots of the larger black lake, by way of Prom. Lunæ, Sin. Tarantinus, by way of M. Latmum, Tabor, and was carried toward the roots of M. Sinai.
Iuni j 18	9	Leo 22	0 30 S	P. Mœ ot.	5	5½	

A n u s	Mēs ., dies	H o Longit. r Lunæ (sign . °)		Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	Iuni j 19	1 0	Virgo 6	0 45 A	P. Mœ ot.	5½	6	
1 6 5 4	Iuni j 25	1 22	Aquarius	5 2 A	P. Mar aeot .	3½	3½	The libration waning [Libratio decrescens] .
	Iuni j 27	9 15	Sagittarius	4 50 A	P. Mœ ot.	2½	2½	
	Iulij 1	1 1	Aquarius 3	1 50 A	P. Mar aeot .	5	5	
1 6 5 4	Iulij 31	1 0	Pisces 7	1 16 S	P. Mar aeot .	6	6	A very ample gap [Amplissim um interstitiu m].
	Aug . 1	1 0	Pisces 22	2 15 S	P. Mar aeot .	5½	5½	It had decreased very little indeed [Parum admodum decreverat] .
	Aug . 3	1 0	Aries 19	4 10 S	P. Mar	5	4¾	

A n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
					aeot			
					.			
1 6 5 4	Aug . 23	1 0	Capricorn 14	3 30 A	P. Mœ ot.	2	2	
	Aug . 26	9 12	Aquarius	0 5 S	P. Mœ ot.	1	1	
	Aug . 27	1 0	Pisces 4	0 55 S	P. Mœ ot.	¼	¼	Eclipsing full Moon. The space appeared extremely slight [Plenilunium Eclipticum. Spatium admodum tenue apparuit].
1 6 5 4	Aug . 28	1 0	Pisces 17	1 47 S	P. Mar aeot .	4	4	The greatest eastern libration [Maxima libratio orientalis].
	Aug . 29	1 1	Aries 1	3 0 S	P. Mar aeot .	5½	5½	It was waning [Decrescebat].

A		H							
u s	Mēs ., dies	r .	o °)	Longit. Lunæ (sign	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
	Aug . 31	1	1	Aries 28	4 42 S	P. Mar aeot .	4½	4½	More and more [Magis magisque].
1 6 5 4	Sept . 1 5 4	1	0	Taurus 12	5 6 S	P. Mar aeot .	4	4	□ The section to the naked eye seemed almost concave, though to the armed eye it was really bisected. It passed, however, by way of the smaller black lake, near M. Argent., by way of L. Trasim., the Adriatic Sea, the western third part, M. Sipyli, to the western roots of M. Cragi, by

A n n u s	Mēs ., dies	H o r .	Longit. Lunæ (sign °)	Latit. Lunæ (° ' A/S)	Libr atio	Dist. limbi iuxta Obse.	Dist. limbi ex Tab.	Animadver tenda
								way of Liban., M. Seir, and Techisanda m; so that with the upper cusp on the limb numbered 34 degrees up from the [Sun's] horizon, and the lower cusp it would cut at 211½ degrees. A truly notable section: since the libration stood plainly intermedia te, at the greatest latitude, at true time of September □ [as observed].

Annus		Mens.		Hor.		Longit.		Latit.		Libratio		Dist. limbi		Animadvertenda	
Y.	dies	h.	m.	h.	m.	sign.	°	lat.	'	dir.	libratio	limbi	ex Tab.	animadvertenda	
1639	Sept. 3	1	1			Gemini	11	5	0	S	P. Maraeot.	3	3		
	Sept. 6	2				Cancer	11	3	44	S	P. Maraeot.	2	2		

Observations of the Librational Motion by Pierre Gassendi [Petrus Gassendi], both about the Palus Maeotis and about the Palus Maraeotis

The table records, by date, the observed position of the Moon and the state of the libration relative to its limb. The columns are: Year [Annus]; Month and day [Mens., dies]; Hour [Hor.]; the Moon's longitude [Longit. Lunae], in degrees [O.] and zodiacal sign [S.]; the Moon's latitude [Latitud. Lunae], in degrees [O.] and minutes ['], with the direction (S = south / A = north [Australis / Aquilonaris]); the libration [Libratio] (toward the Palus Maeotis [P. Moeot.] or the Palus Maraeotis [P. Maraeot.]); the distance of the limb from the table [Dist. limbi ex Tab.]; and the libration according to the observations [Libratio secundum Observationes].

Year		Month		Hour		Longitude		Latitude		Libration		Distance of limb		Libration according to observations	
Y.	dies	h.	m.	h.	m.	sign.	°	lat.	'	dir.	libratio	limbi	ex Tab.	animadvertenda	
1639	Sept. 6		23			♊	15	2	0	S	P. Maraeot.	1½		The eastern spot was seen near the rising limb.	
	Sept. 24					♋	1	1	0	S	P. Maraeot.	1		Still seen nearby.	

Year	Month, day	Hour	Long. $\oslash$ (° sign)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
	Sept. 25		13 $\oslash$	0 0	P. Mara eot.	$\frac{1}{2}$	More contracted.
1863	Oct. 8		1 $\approx$	0 50 A	P. Moeot.	1	The interval between the Caspian spot and the western limb of the Moon was so reduced that I never saw it narrower.
	Oct. 9		15 $\approx$	0 45 A	P. Moeot.	$\frac{1}{2}$	The same interval, very narrow.
	Oct. 20	m .	14 $\mathfrak{E}$	2 0 S	P. Mara eot.	$1\frac{1}{2}$	The eastern spot was observed very close to the limb.
1863	Nov. 9	V .	3 Υ	4 0 S	P. Moeot.	1	Very slight: if ever at other times there was an interval between the Caspian and the limb, here it was barely $\frac{1}{4}$ — and even that more contracted than usual.
	Nov. 11		2 $\oslash$	4 56 S	P. Moeo	2	The interval between the

Year	Month, day	Hour	Long. $\oslash$ (° sign)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
					t.		limb and the Caspian appeared to have increased noticeably.
	Nov. 19	m 23	$\oslash$	1 0 A	P. Mara eot.	$\frac{1}{2}$	The eastern spot very close to the limb.
1636	Nov. 20	3	$\oslash$	2 0 A	P. Mara eot.	0	The same, very close.
	Nov. 21	18	$\oslash$	3 10 A	P. Mara eot.	$\frac{1}{4}$	A little farther off.
	Dec. 5	16	$\oslash$	3 15 S	P. Moeot.	0	The Caspian close to the edge.
1636	Dec. 10	26	$\oslash$	4 50 S	P. Moeot.	2	The Caspian noticeably farther off.
1637	Febr. 27	V 17	$\oslash$	4 50 S	P. Moeot.	1	The Caspian very close to the limb.
	Febr. 28	1	$\oslash$	5 8 S	P. Moeot.	$1\frac{1}{3}$	Closer to the limb.
1637	Mart. 1	13	$\oslash$	5 0 S	P. Moeot.	$1\frac{3}{4}$	It had receded little from the limb.

Year	Month, day	Hour	Long. $\oslash$ (° sign)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
	Mart. 9		6 $\mathfrak{M}$	2 40 A	P. Moeot.	5½	The Caspian still farther from the limb, and the interval appeared more abundant in longitude by half, etc.
	Mart. 10		20 $\mathfrak{M}$	3 40 A	P. Moeot.	6	The distance of the Caspian the same.
1637	Iunij 29		14 $\underline{\alpha}$	5 10 A	P. Moeot.	6	The Caspian was distant from the limb by almost as great an interval as it is itself wide; from here the two oblong spots were seen very distinctly.
	Iulij 27		24 $\underline{\alpha}$	5 15 A	P. Moeot.	5½	The Caspian stood off from the limb by almost as much as it is itself wide.
	Oct. 3		7 Υ	4 46 S	P. Moeot.	00	The Caspian fairly close to the western edge: the opposite oval

Year	Month, day	Hour, minute	Longitude (° sign)	Latitude (° ' dir.)	Libration	Distance from limb (Tab.)	Libration according to the observations
							one smaller than [it was] toward the rising, well immersed.
1638	Ian. 24		23 ✕	4 15 S	P. Moeot.	1	The Caspian was close to the limb, and therefore very thin.
	Dec. 30		24 ▯	0 30 S	P. Moeot.	0	The Caspian very close to the limb.
1639	Febr. 13		27 ▯	0 10 S	P. Moeot.	½	The Caspian extremely close, and very near the limb.
1642	April 14		20 ⚭	5 0 A	P. Moeot.	0	The Caspian fairly advanced into the western limb.

Observations of Ismael Bullialdus [Ismael Boulliau]

Same column structure as the preceding table.

Year	Month, day	Hour, minute	Longitude (° sign)	Latitude (° ' dir.)	Libration	Distance from limb (Tab.)	Libration according to the observations
1643	April 1	1	16 ⚭	2 0 A	P. Moeot.	2½	The Caspian stood off from the limb by half the latitude of the

Year	Month, day	Hour	Long. $\oslash$ (° sign)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
	April 24	8 ½	22 $\mathfrak{S}$	5 0 A	P. Moeot.	4½	spot itself. The Caspian stood off from the limb by three-quarters of the spot's latitude.
	April 29	9	21 $\mathfrak{M}$	1 20 A	P. Moeot.	2½	The Caspian stood off by the lesser-half space of the spot's latitude.
1643	Maij 3	8 ½	12 $\mathfrak{M}$	3 0 S	P. Moeot.	½	$\oslash$ The Caspian was distant from the limb by barely a quarter of its own latitude. The adjacent oblong spot had disappeared.
	Maij 30		6 $\mathfrak{M}$	2 50 S	P. Moeot.	1	The Caspian had nearly come up to the limb.
	Maij 31		20 $\mathfrak{M}$	3 35 S	P. Moeot.	½	Still closer.
1643	Iunij 2		17 $\mathfrak{x}$	4 50 S	P. Moeot.	½	$\oslash$ The Caspian was off from the limb by a smaller

Year	Month, day	Hour	Long. $\oslash$ (° sign)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
							interval, the fifth part of its own latitude, etc.
	June 3	1 1 1	$\oslash$	4 58 S	P. Mara eot.	5	The spot, at its rising, stood off [from the limb] by its entire length, and the interstice was distant by as much again.
	Sept. 18	7 28 1/2	$\oslash$	4 35 S	P. Moeot.	1 1/2	The Caspian was nearly grazing the limb, nor did I see it any nearer.
	1 Sept. 6 27 4 3	4	$\oslash$	0 35 A	P. Moeot.	3 1/2	$\oslash$ The Caspian observed [at] half its latitude, or a little more distant, from the limb.
	Sept. 30	18	$\oslash$	3 30 A	P. Mara eot.	1	The eastern spot had come up to the limb, so that the interval could fill its breadth to the utmost.
	Oct. 1	23	$\oslash$	4 10 A	P. Mara eot.	6/7	The eastern spot had been made closer,

Year	Month	Hour	Long. $\oslash$ (°)	Lat. $\oslash$ (° ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
							and was more constricted; nor had I before seen it so near to the limb.
1643	Oct.	27	$\times$	0 0	P. Moeot.	3	The Caspian had receded from the limb by seven-twelfths of the spot's latitude. The oblong spot appeared in the interstice.
	Oct.	7	27 Υ	2 40 A	P. Moeot.	4	$\oslash$ The Caspian stood off from the limb by three-quarters of the spot's latitude; in the interstice two rather oblong spots were seen.
	Oct.	1	15 X	4 0 A	P. Maraet.	1	The eastern spot was distant by a little more than its own latitude.
1661	Nov.	27	V	4 16 S	P. Moeot.	1	The Caspian stood off from

Year	Month	Day	Hour	Long. $\oslash$ ($^{\circ}$ sign)	Lat. $\oslash$ ($^{\circ}$ ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
43						t.		the limb by a quarter of its own latitude.
	Nov.	20		22 $\times$	0 15 S	P. Moeot.	3	The Caspian was off from the limb by a little less interval, half its own latitude.
	Nov.	21		7 Υ	1 0 A	P. Moeot.	3½	The Caspian stood off from the Moon's limb by two-thirds of its own latitude, and one oblong spot appeared in the interstice.
1643	Nov.	22	1 20	20 Υ	2 15 A	P. Moeot.	1	The Caspian stood off from the limb by three-quarters of its own latitude.
	Nov.	30	1 2	5 $\oslash$	3 45 A	P. Maraet.	1½	The eastern spot stood off from the limb by half the longitude of the spot itself.
1663	Mart.	30	8 25	25 Π	0 20 A	P. Moeot.	0	The Palus Maeotis was

Year	Month	Day	Hour	Long. $\oslash$ ($^{\circ}$ sign)	Lat. $\oslash$ ($^{\circ}$ ' dir.)	Libration	Dist. limb (Tab.)	Libration according to the observations
1648						t.		very close to the Moon's limb.
1648	July	22	9 2	$\mathfrak{M}$	4 47 S	P. Moeo t.	2¼	The Palus Maeotis was still very near to the western limb. [Margin: Ex literis Bullialdi auctorem — From the letters of Bullialdus to the author.]
	July	24		1 $\mathfrak{A}$	5 6 S	P. Moeo t.	3	The aforesaid spot had receded noticeably from the edge.
	Aug.	26	8 21	$\mathfrak{A}$	0 6 S	P. Moeo t.	5½	The Palus Maeotis was at its greatest distance from the limb.

Observations of Father Francesco Maria Grimaldi [Francesco Maria Grimaldi]

This page presents the observations as four distance-measurements, each with its own sub-heading, set in two columns. In every table the columns are: Year [Annus]; Month and day [Mens., dies]; the Moon's longitude [Longit. Lunae], in degrees [O.] and sign [S.]; the Moon's latitude [Lati. Lunae], in degrees [O.] with direction (A = north / B = south); the distance [Distantia], qualified as either

greatest [Maxim.] or least [Minim.]; the value from observation [Ex Obse.]; and the value from the table [Ex Tab.]. The distances are expressed in parts of which the Moon's semidiameter is 100.

Distance of the Mare Crisium, or the Palus Maeotis, from the western limb, both by observation and by our table, in parts of which the Moon's semidiameter is 100

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
16 49	Aug. 12	13 ♌	4 B	Minim	6	5
	Aug. 21	20 ♍	5 A	Maxi m.	12	11
	Sept. 18	29 ♍	5 A	Maxi m.	11	11
16 49	Oct. 14	13 ♍	5 A	Maxi m.	13	11
	Nov. 12	5 ♎	5 A	Maxi m.	14	11
	Dec. 11	1 ♏	3 A	Maxi m.	12	10
16 50	Ian. 9	16 ♏	3 A	Maxi m.	11	10
	Mart. 7	14 ♏	0 A	Maxi m.	8	8
	Mart. 10	6 ♐	5 B	Minim	3½	4
16 50	April 11	18 ♐	5 B	Minim	4	4
	Maij 8	13 ♐	5 B	Minim	4	3½
	Iunij 6	4 ♑	5 B	Minim	3	3½
16 50	Iulij 2	18 ♑	5 B	Minim	3	4

Ye ar	Month, day	Long. ⋈ (° sign)	Lat. ⋈ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
	Aug. 1	23 ♍	5 A	Minim	3	3⅓
	Aug. 29	3 ♎	5 A	Minim	3	3⅓
16 50	Sept. 10	21 ♎	4 A	Maxi m.	11	11
	Oct. 7	1 ♏	4 A	Maxi m.	11	11
	Nov. 4	27 ♎	5 A	Maxi m.	11	11
16 50	Dec. 2	7 ♏	2 A	Maxi m.	10½	11
	Dec. 30	17 ♏	2 A	Maxi m.	11	11
16 51	Febr. 25	3 ♏	2 B	Maxi m.	8	9
16 51	Mart. 26	18 ♏	4 B	Minim	7½	8
	April 4	26 ♏	3 B	Minim	3½	4
	Maij 4	4 ♏	1 B	Minim	3¾	4
16 51	Maij 31	26 ♏	1 B	Minim	3½	3⅓
	Iunij 27	21 ♏	0 0	Minim	3	3⅓
	Iulij 25	3 ♏	1 A	Minim	3	3⅓
16 51	Aug. 21	25 ♏	¼ A	Minim	1¼	3½
	Oct. 27	28 ♏	¾ A	Maxi m.	11½	11

Distance of the eastern limb of the Grimaldi spot, or of the Palus Maraetis, from the eastern limb of the Moon, both by observation and by our table, in parts of which the Moon's semidiameter is 100

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
16 49	Iulij 18	1 ♀	4½ A	Minim	4½	4½
	Sept. 2	17 ♂	4 B	Maxi m.	14	11
	Sept. 30	24 ♂	4 B	Maxi m.	11	11
16 49	Nov. 27	7 ♀	5 B	Maxi m.	11½	11
16 50	Febr. 16	28 ♀	5 B	Maxi m.	12½	11
	Mart. 19	17 ♂	2 B	Maxi m.	9	9

Distance of the northern limb of Endymion, or of the lake hyperborean [lacus hyperboreus], from the northern limb of the Moon

[Below the heading, a line of prose: a reference to Hevelius — "...spoke of by Hevelius, page 54 [?], page 438 [?] he said. First, however..." — partly obscured by show-through; figures uncertain.] [?]

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
16 50	April 11	21 ♀	5 B	Minim	3	0
	Iunij 7	21 ♀	4 B	Minim	3	0
	Oct. 8	4 ♂	2¼ B	Maxi m.	10	6
16 50	Nov. 5	14 ♀	2 A	Maxi m.	10	10

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
	Dec. 2	25 ♄	1 A	Maxi m.	10	10
16 51	Maij 26	26 ♈	4½ B	Minim .	2	2
16 51	Iunij 22	22 ♈	4½ B	Minim .	1	1
	Iulij 20	7 ♎	4 B	Minim .	1	1

Distance of the northern limb of Plato, or of the greater black lake [lacus niger maior], from the northern limb of the Moon

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
16 51	Iulij 4	28 ♄	5 A	Maxi m.	28	27
	August 2	4 ♊	4 A	Maxi m.	26	27
	Aug. 29	22 ♊	4 A	Maxi m.	24	26

Distance of the center of Tycho, or of Mount Sinai [Mons Sinai], from the southern limb of the Moon, both by observation and by our table

Ye ar	Month, day	Long. ☽ (° sign)	Lat. ☽ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
16 49	Sept. 23	3 ♉	2 A	Minim .	28	30
	Nov. 24	18 ♊	4¾ B	Maxi m.	40	39
16 50	Febr. 16	1 ♎	5 B	Maxi m.	40	39
16 50	Mart. 18	6 ♋	3 B	Maxi m.	36	37
	April 25	2 ♄	5 A	Minim .	25	27

Ye ar	Month, day	Long. ☉ (° sign)	Lat. ☉ (° dir.)	Distan ce	Ex Obse.	Ex Tab.
	Sept. 8	3 ♄	4½ A	Minim	25	28
				.		
16 51	Febr. 7	25 ♀	3 B	Maxi m.	37	37
	Iulij 9	1 ♀	2 A	Minim	22	31
				.		
	Aug. 3	12 ♄	3 A	Minim	24	30
				.		
16 51	Aug. 29	21 ♀	4½ A	Minim	26	27
				.		
	Nov. 29	7 ♄	3 A	Maxi m.	38	27

[Below the last table, a passage of prose closing the chapter:] Yet again I give thanks to that most learned and most courteous man [Grimaldi], for the occasion he furnished of probing these matters, in a letter which raised an ambiguity. Now [it remains] to compare these other observations against ours in our *Almagestum Novum*... [the remainder runs on, partly obscured by show-through]. [?]

LIBER III — DE LVNA (Book 3 — On the Moon)

CAPVT XIII.

Breuis Responsio ad Heuelij expostulata. (A brief reply to Hevelius's complaints.)

There are altogether two points which Hevelius, in the preceding letter, supposes I have wrongly written against him. *The first* is that, throughout this whole century, the greatest libration remains perpetually in Cancer and the least in Capricorn — not because he expressly stated this, but because no one could interpret his words otherwise from what he says in Book 4 of the *Almagestum* [*Almagestum Novum*], Chapter 5. *The second* is that the immobility of the limits of libration must perpetually be retained — although he himself taught the contrary.

[Margin numeral: 1]

As to the seat of the greatest libration in Cancer and of the least in Capricorn: from what I have said it could be prudently interpreted that, throughout this whole century of ours, Hevelius binds the greatest libration to Cancer and the least to Capricorn. Concerning Hevelius, see page 211, number 16. I added, speaking of Hevelius: *Is he to be suspected of retrograde motions, [whereby] the lunar orbit of the nodes may sometimes also migrate into other signs to be observed, [with] the greatest librations of these?* — Against this, Hevelius, in Chapter 54, page 438, said: *But whether in the way already stated [the greatest and the least libration] constantly persevere, or whether — through the longer interval of time — the Moon still undergoes some inequalities, etc.* And so Bullialdus's [Ismaël Boulliau's] and Gassendi's [Pierre Gassendi's] observation gave no small handle for thinking that more years are required before the libration migrates from Cancer into another sign — though even after a few years it does migrate. But indeed, since Hevelius restricts that same station in Cancer to the years 1643, 1644, and 1645, I have no opinion about the future, but I record only what he himself sufficiently and amply lays out against me; and I freely grant that he explains this more clearly.

[Margin numeral: 2]

[Margin numeral: 3]

As to what concerns the immobility of the limits: I attribute it to him neither absolutely nor rigorously. For in Book 4, page 211, number 17, the limits of libration, from the opinion of Hevelius, retain the same situation: *Or how nearly he taught it.* And in that same Question 7 I said: *It must be granted that Hevelius, and from many of our observations it is certain, [maintains] frequently within knotty limits — that they are nearly the same that he himself assigns.* And yet I have shown elsewhere that the mobile limits which Hevelius once established are not without suspicion, since they are read out one by one with the same eye — yet so that I both maintained those limits and removed them, as he himself expressly stated: *Although the whole of his opinion of the limit is indeed greatest and least of libration in the Moon, with respect to the maculae, will never be varied, yet the motion itself is greatest and least of libration — whether the limits perpetually remain in the same signs, or are at some time, according to the retrocession of the nodes, going to go out backward in Cancer and Capricorn step by step.* By which words it is evident enough that the limits of libration are indeed varied, as far as concerns the lunar limits within the orbit, or with respect to the signs of the zodiac; but always around the same part of the lunar limb, or thereabouts. Therefore, in the letter set forth above, he introduced a far greater

reticule, and recognized the line of the limit as distant by a whole 90 degrees from the line of the nodes, marked at 15 degrees approximately of the signs, from what was said in Book 4 of the *Almagestum Novum*, Chapter 9, Question 7. From which things to be said the matter below will lie open: that those same things, drawn by the books through the middle of the Mare Crisium and the Caspian [Sea], and the macula of Grimaldi [Francesco Maria Grimaldi], differ much more by 35 degrees, so that they are somewhat notably below the line drawn through the middle of the Mare Crisium and the Caspian and the macula of Grimaldi, [and] are somewhat notably above; whence are those limits, which I called by that name, which have the title: *Whether in a determinate part of the lunar limb are the greatest limits of libration, and of the nodes themselves the poles*. They do not, however, cohere perpetually in the same signs. Again I render him thanks for this, that this most learned letter, if it had been published with ambiguity given the occasion, has removed it; and now to other observations not commonly published in our *Almagestum* we must come.

CAPVT XIV.

Observationes circa Mobilitatem Polorum, seu Nodorum Librationis Lunaris ab Anno 1649. ad 1656. (Observations concerning the Mobility of the Poles, or of the Nodes of the Lunar Libration, from the year 1649 to 1656.)

Pro quibus videnda est Figura in Almagesti Noui Lib. 4. Cap. 7. vel supra Cap. 11. (For which the Figure in the *Almagestum Novum*, Book 4, Chapter 7, or above in Chapter 11, should be consulted.)

It pleases me to bring forward here only those observations from which it is in some way immediately established, in the limb of the Moon, where the place of the nodes is congruent, or of the poles of the lunar libration, and likewise also other things which pertain to libration of this kind. For although those observations expound something particular for the most part from one or another macula of libration, [things] which on that day were observed, [I set them forth] in the foregoing manner; yet they are confirmed by the other observations which others perhaps had in those same years; and likewise, in publishing these things, they are made for the conferring and recognizing of the period of this matter, which has indeed been investigated in the lunar libration, but cannot yet be perfectly determined, [as] from those things which have hitherto been observed we recognize. So that the matter may be clearer, and under one view the mobility of these poles may appear, I have deduced from

those same observations again and again that the limb of the Moon — the other of the poles — and because into eight parts, or octants, the very limb itself in our image of the Moon is divided, expressing them separately in a lateral column [with] the number of the octant, in which the other pole turns out to be contained by this single limb. There are indeed a double pair of poles, which can determine something more accurately in the aforesaid limb. From the one pole, then, the place of the other is immediately recognized, inasmuch as it is opposite by a diameter.

Anno 1649. (In the year 1649.)

July, day 18. The macula Grimaldi [Grimaldi, Francesco Maria Grimaldi] was distant from the Limb of the Moon precisely by as much as had been observed on the other preceding days.

Days 30 and 31. Grimaldi was distant from the limb of the Moon more than on the preceding day.

August 1 and 3. Grimaldi did not vary its distance from the limb of the Moon.

Days 8 and 14. The Mare Crisium did not vary its distance from the limb of the Moon as nearest.

Days 15, 18, 19, and 21. The Mare Crisium increased its distance from the limb [of the Moon].

Days 23, 24, and 26. Grimaldi receded from the nearest limb of the Moon.

Day 29. Grimaldi receded from the limb of the Moon, but Plato approached. Whence it is gathered that the place of the poles of the libration had been between these two maculae; this turned out to be in the Octant.

[Margin numeral: I.]

Days 30 and 31. Grimaldi receded from the limb of the Moon.

September 1 and 2. Grimaldi receded from the limb of the Moon.

Days 3 and 4. Grimaldi approached the limb of the Moon.

Days 12, 13, and 14. The Mare Crisium increased its distance from the limb of the Moon.

Days 16, 17, 18, and 20. The Mare Crisium did not vary its distance from the limb of the Moon.

Day 25. Plato receded from the limb of the Moon.

Days 22, 23, 24, and 25. Grimaldi approached the limb of the Moon.

Days 26 and 27. Grimaldi and Tycho [Brahe] [= the crater] receded from the limb of the Moon; therefore the pole turned out to be perhaps in the first octant.

[Margin numeral: I.]

Day 28. Grimaldi and Tycho receded from the limb of the Moon, but Plato approached; therefore the pole turned out to be in the first octant.

[Margin numeral: I.]

Days 29 and 30. Grimaldi receded from the limb of the Moon.

October 10, 11, and 14. The Mare Crisium receded from the limb of the Moon.

November 9. The Mare Crisium receded from the limb of the Moon.

Days 10, 11, and 13. The Mare Crisium and Endymion did not vary their distance from the limb of the Moon.

Day 14. The Mare Crisium approached the limb of the Moon.

Day 21. Grimaldi and the Sinus Roris [Bay of Dew] receded from the limb of the Moon, and the macula in the Terra Siccitatis [Land of Drought] did not vary its distance from the limb of the Moon; the other of the poles turned out to be in the first octant.

[Margin numeral: II.]

Days 22, 24, and 25. Grimaldi receded from the limb of the Moon, but the Sinus Iridum [Bay of Rainbows], Plato, and Tycho did not vary. And therefore one Pole turned out perhaps to be in the second octant.

[Margin numeral: II.] [Margin numeral: III.]

Day 27. Grimaldi receded from the limb.

December 9. The Mare Crisium and Endymion receded from the limb of the Moon; and on that account the Pole was in the first or second octant.

[Margin numeral: I.]

Days 10, 11, and 12. The Mare Crisium and Endymion did not vary their distance from the limb of the Moon.

[Margin numeral: II.]

Days 12 and 13. Pitiscus receded from the limb of the Moon.

Day 22. Grimaldi increased its distance from the limb of the Moon. Tycho and the maculae above Plato did not change theirs. Therefore one Pole was perhaps in the second octant.

[Margin numeral: II.]

Anno 1650. (In the year 1650.)

January 8. The Mare Crisium, Endymion, and Pitiscus did not vary their distance from the limb of the Moon.

Days 9 and 10. The Mare Crisium and Endymion did not vary.

Days 11 and 12. The Mare Crisium and Endymion approached the limb of the Moon.

Day 14. The Mare Crisium and Endymion approached the limb of the Moon, but Tycho receded; and on that account one Pole was in the first octant.

[Margin numeral: I.]

February 9. The Mare Crisium and Endymion approached the limb of the Moon, but Pitiscus receded; therefore one of the Poles was in the first octant.

Days 10, 11, and 12. The Mare Crisium approached the limb of the Moon. Pitiscus did not recede on day 10.

Days 15 and 16. The Mare Crisium did not vary.

Days 17 and 18. Grimaldi approached the limb of the Moon a little. Tycho did not vary.

Day 19. Grimaldi and Tycho scarcely approached the limb of the Moon, but Plato scarcely receded. From which it is gathered that the other Pole was in the first octant.

[Margin numeral: I.]

Days 23. Grimaldi and Tycho greatly approached the limb, but Plato receded greatly; and thus it is confirmed that the Pole was in the first octant.

[Margin numeral: I.]

Days 25 and 26. Grimaldi approached the limb.

March 6, 7, and 8. The Mare Crisium and Endymion did not vary.

Days 10, 11, and 12. The Mare Crisium approached the limb of the Moon.

Day 13. The Mare Crisium approached the limb of the Moon, and Plato and Aristotle receded from the limb, very near to them; on that account one of the Poles was perhaps in the third octant.

[Margin numeral: III.]

Days 15 and 16. The Mare Crisium did not vary.

Day 17. The Mare Crisium receded from the limb of the Moon.

Days 20 and 24. Grimaldi receded from the limb of the Moon; therefore one of the Poles was perhaps in the first octant.

[Margin numeral: I.]

April 6. The Mare Crisium and Endymion approached the limb of the Moon, and consequently the Pole was in the first octant.

Day 7. The Mare Crisium and Endymion approached the limb of the Moon. Pitiscus, however, receded; whence it is confirmed that the other of the Poles turned out to be in the first octant.

[Margin numeral: I.]

Days 9 and 10. The Mare Crisium approached. Endymion did not vary.

Day 11. The Mare Crisium and Endymion did not vary. Tycho scarcely increased its distance from the limb of the Moon.

Day 12. The Mare Crisium did not vary. Tycho approached the limb.

Days 13, 14, and 15. Tycho approached. The Mare Crisium, Endymion, Aristotle, and Plato receded from the limb of the Moon; therefore the Pole turned out to be in the first octant.

[Margin numeral: I.]

Day 16. Tycho approached. Plato receded.

Days 20, 21, and 23. Grimaldi approached.

Day 24. Grimaldi approached, Tycho and Plato did not vary.

Day 25. Grimaldi approached, and on days 26 and 27 did not vary.

May, day 7. Endymion did not vary. The Mare Crisium approached the limb a little.

Days 11, 12, and 13. Endymion and the Mare Crisium receded from the limb.

Day 14. The Mare Crisium, Endymion, and Aristotle receded from the limb of the Moon.

Days 19 and 20. Tycho approached the limb of the Moon. Plato receded. Grimaldi approached the limb a little. From these gather that the Pole had been at the beginning of the octant.

Day 24. Tycho approached, and Plato did not vary.

June 4, 5, and 6. The Mare Crisium did not vary. Endymion approached the limb of the Moon.

Days 10, 11, and 12. The Mare Crisium and Endymion receded from the limb. Tycho approached. Therefore the Pole turned out to be in the octant.

Day 18. Grimaldi approached the limb of the Moon, and on days 23 and 24 receded from the same.

July 4. The Mare Crisium and Endymion receded from the limb of the Moon.

Day 5. The Mare Crisium and Endymion receded from the limb of the Moon. Pitiscus approached. Therefore the Pole was in the octant.

[Margin numeral: I.]

Day 7. The Mare Crisium receded from the limb of the Moon.

Day 12. The Mare Crisium receded. Tycho approached the limb of the Moon; therefore the Pole could be in the first octant.

[Margin numeral: I.]

Days 17, 18, 19, and 21. Grimaldi did not vary.

Days 22 and 23. Grimaldi receded from the limb of the Moon.

August 2, 3, 4, and 5. The Mare Crisium and Endymion receded from the limb of the Moon; from these the other of the Poles is detected in the octant.

[Margin numeral: I.]

Days 6, 7, 8, and 9. The Mare Crisium and Endymion receded from the limb of the Moon.

Days 11 and 13. Tycho and Grimaldi approached the limb. Therefore the other of the Poles turned out to be in the octant.

Days 15 and 16. Tycho and Grimaldi did not vary.

Day 17, up to 22. Grimaldi receded from the limb of the Moon.

Days 30 and 31. The Mare Crisium receded from the limb of the Moon.

September 1 and 4. The Mare Crisium receded from the limb of the Moon.

Days 5, 6, and 7. The Mare Crisium and Endymion receded from the limb of the Moon. Tycho, however, approached. Gather that one Pole had been in the first octant.

[Margin numeral: I.]

Day 8. The Mare Crisium receded from the limb of the Moon. Tycho, Endymion did not vary.

Day 9. The Mare Crisium, Endymion, and Tycho did not vary.

Day 12, up to 18. Grimaldi and Tycho receded from the limb of the Moon. Plato, however, approached. The Pole was at the beginning of the first octant.

[Margin numeral: I.]

Days 19 and 20. Grimaldi receded from the limb of the Moon.

Days 29 and 30. The Mare Crisium receded from the limb of the Moon. Endymion, indeed, and Pitiscus did not vary. Therefore the Pole turned out perhaps to be at the beginning of the octants.

[Margin numeral: I.]

October 2 and 3. The Mare Crisium and Endymion receded from the limb. Pitiscus approached; on that account the Pole turned out to be in the first octant.

[Margin numeral: I.]

Days 7 and 8. The Mare Crisium, Endymion, Aristotle, and Tycho did not vary.

Day 9. The Mare Crisium, Endymion, and Aristotle approached the limb of the Moon. Tycho, however, recedes; on that account the Pole must be said to have been in the octant.

Day 11 and 12. Grimaldi receded from the limb of the Moon. Tycho and Plato did not vary.

Day 15. Grimaldi and Tycho receded from the limb, but Plato approached. It is shown: the Pole [was] in the octant.

[Margin numeral: I.]

Day 16. Grimaldi and Tycho receded from the limb.

Day 20. Grimaldi receded from the limb of the Moon.

Days 21, 22, and 23. Grimaldi approached the limb.

Days 29 and 30. The Mare Crisium and Endymion receded from the limb of the Moon. Pitiscus approached; on that account the Pole could be believed to be in the first octant.

[Margin numeral: I.]

Day 31. The Mare Crisium and Endymion increased their distance from the limb of the Moon.

November 2. The Mare Crisium, Endymion, and the macula in the Terra Siccitatis receded from the limb of the Moon.

Day 5. The Mare Crisium, Endymion approached the limb of the Moon, and Tycho receded; and consequently the other of the Poles turned out to be in the first octant.

[Margin numeral: I.]

Day 6. The Mare Crisium and Endymion did not vary. Tycho receded from the limb.

Days 9 and 10. Grimaldi and Tycho receded from the limb, [but] the Sinus Roris did not vary; on that account the Pole turned out to be in the first octant.

[Margin numeral: I.]

Days 11 and 12. Tycho did not vary. Grimaldi receded from the limb of the Moon.

Day 28. The Mare Crisium increased its distance from the limb of the Moon.

Day 29. The Mare Crisium, Endymion, and Pitiscus receded from the limb of the Moon; on that account one of the Poles was in the second octant.

[Margin numeral: II.]

December 2. The Mare Crisium receded from the limb of the Moon; Endymion and Pitiscus did not vary.

Days 5, 6, and 7. The Mare Crisium and Endymion approached the limb of the Moon. Tycho receded. And the Pole was in the octant.

Day 8. Tycho receded from the limb of the Moon.

Days 12, 13, and 14. Grimaldi and Tycho receded from Harpalus in the Sinus Roris, [and] approached the limb of the Moon; on that account the Pole was in the octant.

[Margin numeral: I.]

Day 18. Grimaldi began to approach the limb of the Moon.

Days 28 and 29. The Mare Crisium receded from the limb.

Day 30. The Mare Crisium did not vary.

Day 31. The Mare Crisium and Endymion receded from the limb of the Moon. Pitiscus receded; therefore the Pole of the libration must be said to have been in the octant.

[Margin numeral: I.]

Anno 1651. (In the year 1651.)

January 1. The Mare Crisium, Endymion, Aristotle, approached the limb of the Moon. Pitiscus receded; therefore the Pole turned out then to be in the octant.

[Margin numeral: I.]

Days 8 and 9. Grimaldi receded from the limb of the Moon. Tycho, and Harpalus did not vary.

Day 14. Grimaldi receded from the limb.

Day 31. The Mare Crisium receded from the limb of the Moon.

February 3. The Mare Crisium and Plato approached the limb of the Moon. Tycho receded; on that account the other of the Poles [was] in the octant.

[Margin numeral: I.]

Days 6, 7. Tycho and Grimaldi receded from the limb of the Moon, [but] Plato approached; from which gather the Pole turned out to be in the octant.

[Margin numeral: I.]

Day 9. Grimaldi did not vary. Plato and Harpalus in the Sinus Roris receded from the limb of the Moon; from which it is argued that the Pole turned out to be in the octant.

[Margin numeral: III.]

Days 11 and 12. Grimaldi, Harpalus, and Plato receded from the limb of the Moon. Tycho did not vary; therefore the Pole must be said to have been in the octant.

[Margin numeral: III.] [Margin numeral: IV.]

Days 13 and 14. Grimaldi did not vary. Tycho approached the limb; whence it was gathered that the Pole [was] in the octant.

[Margin numeral: III.]

Days 15 and 16. Grimaldi approached now to the limb of the Moon.

[Margin numeral: IV.]

Day 27. The Mare Crisium approached the limb of the Moon.

Day 28. The Mare Crisium and Endymion approached the limb of the Moon.

March 1, 2, and 4. The Mare Crisium approached the limb of the Moon. Tycho did not vary.

Day 7. Grimaldi, Harpalus, Plato, and Endymion receded from the limb of the Moon; on that account the Pole [was] in the octant.

Day 8 and 10. Grimaldi receded from the limb of the Moon.

Day 25. The Mare Crisium approached the limb of the Moon.

Day 27. The Mare Crisium and Endymion approached the limb of the Moon a little.

Days 28, 29, and 30. The Mare Crisium, Endymion, and the macula [in the Terra Siccitatis].

The macula in the Terra Siccitatis approached the limb of the Moon, [and] used to; on that account the Pole [was] in the octant.

[Margin numeral: I.]

Day 31. The Mare Crisium approached the limb of the Moon.

April 1 and 2. The Mare Crisium and the macula in the Terra Siccitatis approached the limb of the Moon.

Day 4. The Mare Crisium and Plato did not vary.

Day 5. The Mare Crisium, Plato, and Endymion receded from the limb of the Moon, and consequently the Pole must be said to have been in the octant.

Day 6. Plato receded from the limb of the Moon. Tycho did not vary.

Days 11 and 13. Grimaldi approached the limb of the Moon.

Day 25. The Mare Crisium approached the limb of the Moon.

Day 26. The Mare Crisium and Endymion approached the limb of the Moon.

Day 28. Pitiscus, and the Mare Crisium approached the limb of the Moon. Endymion and Aristotle receded from the limb of the Moon; from which positions one of the Poles was in the octant.

[Margin numeral: III.]

Day 30. The Mare Crisium approached the limb of the Moon. Endymion and Aristotle receded from the limb, and from these it is confirmed the Pole turned out to be in the octant.

[Margin numeral: III.]

May 1, 2, and 3. The Mare Crisium and Tycho approached the limb of the Moon. Endymion and Aristotle receded from these. Therefore the Pole was in the octant.

[Margin numeral: III.]

Day 13. Grimaldi did not vary; the macula in the Sinus Roris receded a little from the limb of the Moon. Tycho approached.

Day 14. Grimaldi approached the limb.

Days 27, 28, and 29. The Mare Crisium approached the limb of the Moon. Endymion indeed, and the macula in the Terra Siccitatis receded from the limb; and thus the Pole must be said to have been in the octant.

[Margin numeral: III.]

Days 30 and 31. The Mare Crisium did not vary. Endymion, and the macula in the Terra Siccitatis receded from the limb. Tycho, however, approached. Therefore the Pole turned out to be in the octant.

[Margin numeral: III.]

July 1, 2, and 3. The Mare Crisium, Endymion, and the macula in the Terra Siccitatis receded from the limb of the Moon. Tycho approached; on that account the Pole must be said to have been in the octant.

[Margin numeral: IV.]

Days 13 and 14. Grimaldi did not vary.

[Margin numeral: vel I.]

Day 23. The Mare Crisium and Endymion did not vary.

Day 24. The Mare Crisium did not vary. Endymion increased its distance a little from the limb of the Moon.

Day 26. The Mare Crisium did not vary. Endymion receded from the limb of the Moon. Pitiscus approached. Therefore the Pole turned out to be one in the octant.

[Margin numeral: IV.]

Day 27. Endymion and Aristotle receded from the limb. Langrenus and Pitiscus approached. Therefore the Pole [was] in the octant.

[Margin numeral: vel I.] [Margin numeral: IV.]

Days 28, 29, and 30. The Mare Crisium, Endymion, and the macula in the Terra Siccitatis receded from the limb of the Moon. Tycho, and Pitiscus approached the limb. Therefore the Pole was in the octant.

[Margin numeral: IV.]

July 1. Langrenus, the Mare Crisium, Endymion, Aristotle, Plato, and the Sinus Roris receded from the limb of the Moon. Tycho approached; from which it turns out the Pole [was] in the octant.

[Margin numeral: IV.]

Day 2. The Mare Crisium and Endymion receded from the limb of the Moon. Tycho approached.

Days 3, 6, and 7. Grimaldi and Tycho approached the limb of the Moon.

Day 8. Grimaldi approached the limb of the Moon.

Day 9. Grimaldi scarcely approached. Tycho did not vary.

Day 11. Grimaldi and Tycho receded from the limb. Harpalus and Plato approached; on that account the Pole turned out to be in the octant.

[Margin numeral: vel IV.]

Day 22, up to 25. The Mare Crisium did not vary. Endymion receded from the limb of the Moon. Pitiscus approached. Therefore the Pole was in the octant.

[Margin numeral: vel IV.]

Day 22, up to August 1. The Mare Crisium and Endymion receded from the limb of the Moon. Tycho approached; which indicate the Pole turned out to be in the octant.

[Margin numeral: I.] [Margin numeral: IV.]

August 3, 4, and 5. Tycho did not vary. Grimaldi, and Harpalus in the Sinus Roris approached the limb of the Moon. Wherefore the Pole of the libration must be said to have been in the octant.

[Margin numeral: I.]

Days 6 and 8. Grimaldi scarcely approached. Harpalus and Plato [receded].

[Margin numeral: III.]

[The libration-pole observation log of *Caput XIV* continues. Each dated entry records which named lunar spots (maculae) were approaching or receding from the Moon's limb, with the octant of the libration pole inferred in the right-hand margin as a Roman numeral I–IV; "vel" ("or") marks an entry where the margin gives an alternative octant tag.]

Plato was approaching the Moon's limb, while Tycho was receding; therefore the pole was in the octant. — III.

Day 9. Harpalus was approaching the Moon's limb; Tycho was receding. — III.

Day 10. Grimaldus, and Harpalus, were receding from the Moon's limb.

Days 11 & 12. Grimaldus was receding from the limb [of the Moon ☾].

Days 20, 21, & 22. Mare Crisium did not vary; Endymion was receding from the limb [☾].

Days 23, 25, & 27. Mare Crisium, Langrenus, and Endymion were receding from the limb [☾]; Pitiscus was barely approaching. Therefore the pole was in the octant. — I.

Days 28, 29, & 30. Mare Crisium, Langrenus, Endymion, and Aristoteles were receding from the Moon's limb; Tycho and Plato did not vary. Therefore the pole was in the octant. — I.

Day 31. Tycho did not vary; Grimaldus, Harpalus, Plato, and Aristoteles were approaching the Moon's limb. The pole therefore was in the octant. — III.

September 1, 2, 3. Grimaldus, Harpalus, and Plato were approaching the Moon's limb, while Tycho was receding. Therefore the pole is said to have been in the octant. — III.

Day 4. Grimaldus did not vary; Tycho was receding from the limb [☾]; Harpalus and Plato were approaching the limb [☾]. The pole was therefore in the octant. — III.

Day 6. Tycho and Grimaldus were receding from the limb [☾]; Harpalus and Plato were approaching the limb [☾]. Therefore the pole was in the octant. — III. *vel* IV.

Days 8 & 9. Tycho and Grimaldus were receding from the Moon's limb; Harpalus was barely approaching. Therefore the pole was in the octant. — IV.

Days 18 & 19. Mare Crisium did not vary; Endymion was receding from the Moon's limb.

Day 20. Mare Crisium was receding a little from the limb [☾]; Endymion was receding strongly; Langrenus did not vary; Pitiscus was approaching. Therefore the other of the poles was in the octant. — I.

Days 22, 23, & 24. Mare Crisium and Endymion were receding from the Moon's limb; Langrenus did not vary. And so the pole was in the octant. — I.

Days 25 & 26. Mare Crisium and Langrenus were receding from the limb [☾]; Endymion and Tycho did not vary. Accordingly the pole was one [and the same] in the octant. — II.

Day 27. Mare Crisium, Langrenus, and Tycho were receding from the Moon's limb; Harpalus and Plato were approaching the limb. Therefore one of the poles was in the octant. — III. *vel* IV.

October 3 & 4. Tycho, Grimaldus, Harpalus, and Plato did not vary.

Day 20. Mare Crisium and Endymion were receding from the Moon's limb.

Day 27. Mare Crisium was receding from the Moon's limb.

November 20 & 21. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion and Aristoteles did not vary. For that reason the pole was in the octant. — II.

Days 22, 23, & 25. Mare Crisium, Langrenus, and Tycho were receding from the Moon's limb; Endymion, Aristoteles, and Plato were approaching the limb. Therefore the pole was in the octant. — III.

Day 26. Mare Crisium did not vary; Langrenus and Tycho were receding; Endymion and Plato were approaching the limb. Therefore the pole was in the octant. — III. *vel* IV.

Day 27. Tycho was receding; Harpalus was approaching the limb [☾]. — IV.

Day 28. Grimaldus and Harpalus were approaching the Moon's limb; Tycho and Plato did not vary.

Day 30. Harpalus and Tycho did not vary; Grimaldus was receding.

December 1. Grimaldus was receding from the limb [☾]; Tycho, Harpalus, and Plato did not vary.

Day 5. Grimaldus, Harpalus, and Plato were receding from the limb [of the Moon ☾]. For that reason the pole was in the octant. — III.

Day 6. Grimaldus and Harpalus were receding from the Moon's limb.

Day 20. Mare Crisium did not vary.

Day 30. Grimaldus, Harpalus, and Plato were receding...

from the Moon's limb; Tycho was approaching. From this it is concluded that the pole was in the octant. — III.

Anno 1652.

[Year 1652.]

January 17, 20, & 21. Mare Crisium did not vary; Endymion was approaching; Langrenus and Pitiscus were receding from the limb [☾], and for that reason the pole was in the octant. — III.

February 1. Grimaldus was receding from the Moon's limb. — *vel* IV.

Day 2. Grimaldus, and Sinus Roris, were receding from the Moon's limb. — IV.

Day 3. Grimaldus did not vary; Sinus Roris was receding from the Moon's limb.

Days 14 & 16. Mare Crisium did not vary; Endymion was approaching; Langrenus and Pitiscus were receding from the Moon's limb; from which the pole is argued to be in the octant. — III.

Days 18, 21, & 22. Langrenus, Mare Crisium, and Endymion were approaching the limb [☾]. Therefore the pole was in the octant. — IV.

Day 26. Tycho was approaching the Moon's limb. — I.

March 26. Grimaldus, and Littus Eclipticum, were receding from the limb [☾].

May 15 & 16. Mare Crisium and Langrenus did not vary; Endymion was receding; Pitiscus was approaching the Moon's limb. Therefore the pole was perhaps in the octant. — IV.

Days 19 & 20. Endymion was receding; Mare Crisium and Langrenus were approaching the Moon's limb; Tycho did not vary. The pole therefore was in the octant. — III.

Day 21. Endymion was receding; Mare Crisium, Langrenus, and Tycho were approaching the Moon's limb, on which account the pole is confirmed to be in the octant. — III.

Day 22. Mare Crisium and Endymion did not vary; Langrenus and Tycho were approaching the Moon's limb a little. — III.

Day 28. Grimaldus did not vary; Tycho was approaching the Moon's limb.

Days 30 & 31. Tycho, Grimaldus, Littus Eclipticum, and Sinus Roris were approaching the limb [☾]. Therefore the pole is said to have been at the beginning of the octant. — II.

June 1. Grimaldus, Littus Eclipticum, and Sinus Roris were approaching the Moon's limb; Kircher and Bettinus were receding from the limb [☾]. And for that reason the pole was in the octant. — III.

Day 3. Grimaldus was approaching the Moon's limb.

Day 12. Endymion was receding from the Moon's limb.

Day 16. Mare Crisium was barely approaching the limb [☾]; Langrenus and Pitiscus were approaching the limb [☾]; but Endymion was receding. The pole therefore was in the octant. — III.

Day 18. Endymion was receding; Mare Crisium and Langrenus were approaching the Moon's limb; from which the pole is confirmed to be in the octant. — III.

Day 19. Endymion was receding; Mare Crisium, Langrenus, and Tycho were approaching the Moon's limb; and thus the pole is again confirmed to be in the octant. — III.

Day 21. Mare Crisium and Langrenus did not vary; Tycho was barely approaching the Moon's limb.

Day 27. Tycho was receding from the Moon's limb; Plato and Sinus Roris were approaching the limb [☾].

Day 28. Tycho was receding; Grimaldus, Sinus Roris, and Plato were approaching the Moon's limb. From this the pole of libration is concluded to have been in the octant. — III.

Day 30. Grimaldus and Littus Eclipticum were approaching the Moon's limb; Zucchi, Bettinus, and Kircher were receding from the limb. From these things the pole is confirmed [to be] in the octant. — III.

July 1. Grimaldus did not vary; Harpalus was approaching; Zucchi, Bettinus, and Kircher were receding from the Moon's limb. Therefore the pole was in the octant. — *vel* IV.

Day 2. Grimaldus did not vary.

Days 10 & 11. Mare Crisium did not vary; Endymion was receding; Langrenus was approaching the Moon's limb. For that reason the pole is to be said to have been in the octant. — IV.

Day 13. Mare Crisium, Langrenus, and Pitiscus were barely approaching the Moon's limb; Endymion was receding. Therefore the pole was in the octant. — IV.

Day 14. Mare Crisium did not vary notably; Endymion was receding; Langrenus and Pitiscus were approaching the limb [☾], and for that reason the pole was in the octant. — III.

Day 15. Mare Crisium, Langrenus, and Pitiscus were approaching... — *vel* IV.

the Moon's limb; Endymion and Plato were receding from the limb. From which it follows that the pole was in the octant. — III.

Days 16 & 17. Mare Crisium, Langrenus, and Endymion did not vary; Tycho was approaching the Moon's limb; Aristoteles was receding.

Day 19. Endymion, Mare Crisium, Langrenus, and Furnerius were barely approaching the Moon's limb; Tycho was approaching. Therefore the pole was in the octant. — I.

Day 20. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Tycho did not vary.

Day 21. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Tycho and Sinus Roris did not vary.

Day 22. Grimaldus was approaching the Moon's limb; Tycho and Sinus Roris did not vary. — *vel*

August 9, 11, 12, & 13. Mare Crisium, Langrenus, and Pitiscus were approaching the Moon's limb; Endymion was receding; at which time the pole is to be said to have been in the octant. — III.

Day 14. Mare Crisium did not vary.

Day 15. Mare Crisium was already receding from the Moon's limb; Endymion did not vary.

Day 16. Mare Crisium, Langrenus, Furnerius, and Tycho were receding from the Moon's limb; Endymion did not vary; and accordingly the pole was in the octant. — III.

Day 17. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion did not vary.

Day 18. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Tycho did not vary; Plato was approaching. Therefore the pole was in the octant. — III.

Day 19. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Tycho did not vary.

Day 20. Grimaldus, Littus Eclipticum, and Plato were approaching the Moon's limb; Tycho did not vary. Therefore the pole was in the octant. — III.

Days 22, 23, & 24. Grimaldus, Littus Eclipticum, Harpalus, and Plato were approaching the Moon's limb; Tycho and Schillerus were receding from the Moon's limb; and so the pole was in the octant. — III. *vel* IV.

Day 26. Grimaldus, Harpalus, and Plato were approaching the Moon's limb; Tycho was receding. The pole therefore was in the octant. — III.

September 9. Mare Crisium and Langrenus were approaching the Moon's limb; Endymion was receding. For this reason the pole of libration was in the octant. — III.

Day 12. Mare Crisium and Langrenus were receding from the limb [☾].

Days 13, 14, & 15. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion did not vary.

Day 16. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; but Endymion was approaching. The pole therefore was in the octant. — III.

Day 17. Mare Crisium, Langrenus, Pitiscus, and Tycho were receding from the Moon's limb; Endymion and Plato were approaching the Moon's limb. And so the pole was one [and the same] in the octant. — III.

Day 18. Tycho was receding from the limb; Grimaldus and Plato were approaching the Moon's limb. And it was so; and for that reason the pole was on the other side in the octant. — III.

Day 19. Grimaldus, Harpalus, and Plato were approaching the Moon's limb; Tycho and Schikardus were receding from the limb. From which the pole is to be said to have been in the octant. — III.

Day 20. Grimaldus was approaching the Moon's limb; but Schikardus was receding. Therefore the pole was in the octant. — III.

Day 22. Grimaldus, Harpalus, and Plato were approaching the Moon's limb; but Schikardus was truly receding; from which it is confirmed that the pole was still in the octant. — III.

Day 26. Grimaldus did not vary; Harpalus was approaching the Moon's limb.

October 13 & 14. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Endymion did not vary.

Day 15. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Endymion was approaching. Therefore the pole was in the octant. — III.

Day 16. Mare Crisium did not vary; Langrenus and Furnerius were receding strongly from the Moon's limb; Endymion was approaching the limb. Therefore the pole was still in the octant. — III.

Day 17. Langrenus, Furnerius, and Tycho were receding from the Moon's limb; Grimaldus and Plato were approaching the Moon's limb. For that reason the pole is said to have been in the octant. — III.

Day 18. Tycho was receding from the Moon's limb; Grimaldus, Harpalus, and Plato were approaching the Moon's limb. From which the pole is confirmed [to be] in the octant. — III.

November 11 & 12. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion was approaching. And so the pole was found to be in the octant. — III.

Day 13. Mare Crisium did not vary notably; Langrenus and Pitiscus were receding from the Moon's limb; Endymion and Plato were approaching the limb.

Day 14. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion and Plato were approaching the limb. From which it again follows that the pole was in the octant. — III.

Day 18. Grimaldus, Harpalus, and Plato did not vary; Tycho was approaching the Moon's limb a little.

Day 27. Grimaldus and Littus Eclipticum were receding from the Moon's limb.

December 6 & 7. Mare Crisium and Langrenus were receding from the Moon's limb; Endymion did not vary.

Days 8 & 9. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion was approaching. Therefore the pole was in the octant. — III.

Day 11. Mare Crisium and Langrenus were receding from the Moon's limb; Endymion was approaching. And this confirms the pole [to be] in the octant. — III.

Day 12. Mare Crisium and Endymion did not vary notably; Langrenus, Furnerius, and Claramontius were receding from the Moon's limb.

Day 13. Mare Crisium, Langrenus, Furnerius, and Claramontius were receding from the Moon's limb; Endymion did not vary; Plato was approaching the Moon's limb. From which it follows that the pole was in the octant. — III.

Days 17 & 18. Grimaldus did not vary; Tycho was approaching the Moon's limb; Harpalus, and Plato, were approaching the limb [☾].

Day 20. Tycho was approaching the Moon's limb; Grimaldus, Harpalus, and Plato were approaching the Moon's limb; consequently the pole was in the octant. — III.

Days 21 & 22. Plato and Tycho did not vary; Grimaldus, Harpalus, and Littus Eclipticum were receding from the limb [☾].

Day 23. Grimaldus, Harpalus, and Littus Eclipticum were receding from the Moon's limb.

Anno 1653.

[Year 1653.]

January 6. Mare Crisium, Langrenus, and Petavius were receding from the Moon's limb; Endymion was approaching. The pole of libration was in the octant. — III.

Day 7. Mare Crisium was receding a little from the limb; Langrenus and Petavius were receding strongly from the Moon's limb; Endymion did not vary.

Day 8. Mare Crisium, Langrenus, Petavius, and Claramontius were receding from the Moon's limb; Endymion did not vary.

Day 9. Mare Crisium was barely receding; Langrenus, Petavius, and Claramontius were receding from the limb [☾]; Endymion was barely approaching, and for that reason the pole was in the octant. — III.

Days 10 & 12. Mare Crisium was barely approaching; Langrenus and Petavius were receding from the Moon's limb; Endymion did not vary appreciably.

Day 14. Tycho, Grimaldus, and Harpalus did not vary.

Day 15. Tycho and Grimaldus did not vary; Littus Eclipticum, Harpalus, and Plato were approaching the Moon's limb.

Day 16. Grimaldus did not vary; Littus Eclipticum, Harpalus, and Plato were receding from the Moon's limb; for that reason the pole is said to have been in the octant. — III.

February 2. Mare Crisium, Langrenus, and Petavius were receding from the Moon's limb; Endymion did not vary.

Day 7. Mare Crisium was receding a little from the limb [☾].

Day 9. Endymion was receding from the Moon's limb.

Day 10. Mare Crisium and Endymion were receding from the Moon's limb; Pitiscus was approaching. Therefore the pole is to be said to have been in the octant. — I.

March 2. Mesthala did not vary; Furnerius was receding from the limb [☾].

Day 3. Mesthala, and Furnerius, were receding from the limb [☾].

Day 7. Mare Crisium and Langrenus were receding from the Moon's limb.

Day 10. Mare Crisium was barely receding from the Moon's limb; Plato was receding from the Moon's limb; Furnerius was approaching; and for that reason the pole is to be said to have been in the octant. — IV.

Day 11. Mare Crisium did not vary; Langrenus and Furnerius were approaching the Moon's limb; Endymion and Aristoteles were receding from the limb. Therefore the pole was in the octant. — III.

Day 12. Mare Crisium, Langrenus, and Furnerius were approaching the Moon's limb; Endymion and Aristoteles were receding from the limb. Therefore the pole of libration was in the octant. — III.

Day 13. Mare Crisium, Langrenus, Furnerius, and Tycho were approaching the Moon's limb; Endymion and Aristoteles were receding from the limb. From which the pole is confirmed [to be] in the octant. — III.

Day 14. Harpalus and Plato were receding from the Moon's limb.

Day 15. Harpalus, and Plato, were receding from the Moon's limb; Tycho was approaching; Grimaldus did not vary.

April 1 & 2. Mare Crisium and Seneca were near that [limb], and Langrenus was receding from the Moon's limb.

Day 3. Mare Crisium and Langrenus were receding from the Moon's limb; Endymion did not vary.

Day 4. Mare Crisium and Langrenus were receding from the Moon's limb.

Day 7. Mare Crisium was barely receding; Endymion too was receding from the Moon's limb.

Day 8. Mare Crisium and Langrenus did not vary; Endymion was receding from the Moon's limb.

Day 10. Endymion was receding from the Moon's limb; Langrenus and Pitiscus were approaching the limb [☾]. Therefore the pole was in the octant. — III.

Days 19 & 20. Grimaldus, and Littus Eclipticum, were barely receding; Tycho did not vary; Plato and Sinus Roris were barely approaching the Moon's limb. — IV.

Day 21. Grimaldus was barely receding from the Moon's limb; Littus Eclipticum and Harpalus were approaching the Moon's limb; and consequently the pole is argued to be in the octant. — IV.

Day 22. Grimaldus was receding from the Moon's limb; Littus Eclipticum was approaching, and this confirms the pole [to be] in the octant. — IV.

May 2 & 3. Mare Crisium, Endymion, and Langrenus were receding from the limb [☾].

Day 4. Endymion and Mare Crisium were receding from the Moon's limb; Langrenus did not vary.

Days 6 & 7. Mare Crisium did not vary; Endymion was receding; Langrenus and Pitiscus were approaching the Moon's limb. The pole therefore was in the octant. — III.

Day 8. Endymion was receding; Mare Crisium, Langrenus, and Pitiscus were approaching the Moon's limb. Therefore the pole was in the octant. — III.

Day 9. Mare Crisium, Langrenus, and Pitiscus were approaching the Moon's limb; Endymion and Aristoteles were receding from the limb. And this confirms the pole [to be] in the octant. — III.

Days 10 & 11. Mare Crisium and Langrenus were approaching the Moon's limb; Endymion did not vary.

Day 14. Tycho, Ricciolius, and Littus Eclipticum were receding from the Moon's limb; Sinus Roris did not vary.

Day 17. Grimaldus, and Littus Eclipticum, were receding from the Moon's limb; Tycho and Sinus Roris did not vary.

Day 19. Tycho and Sinus Roris did not vary; Littus Eclipticum was approaching the Moon's limb; Grimaldus was barely receding.

Day 20. Grimaldus did not vary; Littus Eclipticum and Sinus Roris were receding from the limb.

Days 21 & 22. Grimaldus did not vary; Schikerus was receding; Littus Eclipticum and Sinus Roris were approaching...

the Moon's limb. From which the pole is concluded to have been in the octant. — III.

Day 30. Mare Crisium and Endymion did not vary. — *vel*

Day 31. Mare Crisium did not vary; Endymion was receding from the Moon's limb. — IV.

June 1. Mare Crisium and Endymion were receding from the Moon's limb; Langrenus was approaching. Therefore the pole was in the octant. — IV.

Day 3. Mare Crisium and Endymion did not vary; Langrenus was approaching the Moon's limb.

Day 5. Endymion did not vary; Mare Crisium, and Langrenus, were approaching the Moon's limb.

Days 6, 7, 8, & 9. Mare Crisium, Langrenus, and Pitiscus were approaching the Moon's limb; Endymion did not vary. Therefore the pole [was] in the octant. — III.

Day 10. Endymion, Mare Crisium, Langrenus, and Pitiscus were approaching the Moon's limb. The pole therefore was in the octant. — II.

Day 11. Tycho did not vary.

Day 16. Grimaldus did not vary; Littus Eclipticum was approaching.

Days 18 & 20. Grimaldus, Littus Eclipticum, and Sinus Roris were approaching the Moon's limb; Tycho was receding. Therefore the pole [was] in the octant. — III.

July 1. Mare Crisium and Langrenus did not vary; Endymion was receding from the Moon's limb.

Days 4 & 5. Mare Crisium and Langrenus were approaching the Moon's limb; Endymion did not vary.

Day 7. Mare Crisium, Langrenus, and Pitiscus did not vary.

Day 9. Mare Crisium, Langrenus, and Pitiscus did not vary; Endymion was barely approaching the Moon's limb.

Day 13. Grimaldus was receding from the Moon's limb; Littus Eclipticum was approaching. Therefore the pole of libration was in the octant. — IV.

Day 14. Tycho and Grimaldus were receding from the limb [☾]; Littus Eclipticum and Sinus Roris were approaching the limb; and for that reason the pole was in the octant. — IV.

Day 15. Grimaldus did not vary; Tycho was approaching; Littus Eclipticum and Sinus Roris were approaching the Moon's limb. And consequently the pole was in the octant. — III.

Days 17 & 18. Tycho was receding; Grimaldus, Littus Eclipticum, Sinus Roris, and Plato were approaching the limb [☾]. From which the pole is deduced to have been in the octant. — III. *vel* IV.

Day 21. Grimaldus was approaching and receding from the Moon's limb. [recte: *accedebat et recedebat* — printed thus]

Day 30. Mare Crisium was barely approaching the Moon's limb; Endymion was receding. The pole therefore was in the octant. — III.

August 2, 3, & 5. Mare Crisium and Langrenus were approaching the Moon's limb; Endymion did not vary.

Day 6. Mare Crisium, Langrenus, and Pitiscus did not vary; Endymion was barely approaching the limb [☾].

Days 7 & 8. Mare Crisium did not vary; Endymion was approaching; Langrenus and Pitiscus were approaching the Moon's limb.

Day 11. Tycho was receding; Plato, and Sinus Roris, were approaching the limb.

Days 12, 13, & 15. Tycho was receding; Grimaldus, Sinus Roris, and Plato were approaching the Moon's limb. For that reason the pole was in the octant. — III.

Days 18 & 19. Grimaldus, and Sinus Roris, were approaching the Moon's limb.

October 5. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Endymion was approaching. For that reason the pole was in the octant. — III.

Day 19. Mare Crisium did not vary; Langrenus and Pitiscus were receding from the Moon's limb.

November 1 & 3. Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb; Endymion was approaching. For that reason the pole was in the octant. — III.

Days 28 & 29. Mare Crisium did not vary; Langrenus, Furnerius, and Pitiscus were receding from the Moon's limb.

December 1, 2, & 4. Mare Crisium, Langrenus, and Furnerius were receding from the Moon's limb; Endymion did not vary.

Days 5 & 6. Grimaldus was approaching the Moon's limb.

Days 7 & 8. Tycho, Grimaldus, Sinus Roris, and Plato were approaching the limb [☾]. Therefore the pole was in the octant. — II.

[Continues: **Day...**]

On the 9th: Tycho [Tycho Brahe] was approaching the Moon's limb. Grimaldi [Francesco Maria Grimaldi] did not vary.

On the 29th: Mare Crisium, Langrenus, and Pitiscus were receding from the Moon's limb.

Year 1654.

January 1: Mare Crisium and Langrenus were receding from the Moon's limb.

On the 3rd: Endymion was receding from the Moon's limb. Tycho was approaching.

On the 4th: Tycho was approaching. Grimaldi, Harpalus, and Plato did not vary.

On the 6th and 7th: Grimaldi did not vary. Tycho was approaching. Plato was receding from the Moon's limb.

On the 25th: Mare Crisium did not vary. Endymion scarcely approached. Langrenus and Pitiscus were approaching the Moon's limb.

On the 26th and 27th: Mare Crisium, Langrenus, Furnerius, and Pitiscus were receding from the Moon's limb. Endymion did not vary.

On the 28th: Mare Crisium, Endymion, Langrenus, and Furnerius were receding from the Moon's limb.

On the 29th, 30th, and 31st: Mare Crisium, Langrenus, and Furnerius did not vary. Endymion and Plato were receding from the Moon's limb.

February 1: Mare Crisium, Endymion, and Plato were receding from the Moon's limb.

On the 23rd: Mare Crisium and Langrenus were receding from the Moon's limb. Endymion was perhaps approaching.

March 3: Tycho was approaching. Plato was receding from the limb.

On the 5th: Tycho was approaching. Plato and Harpalus were receding from the Moon's limb. Grimaldi did not vary.

On the 6th: Tycho and Plato did not vary. Grimaldi and Harpalus scarcely receded from the limb.

On the 26th, 28th, and 29th: Mare Crisium and Endymion were receding from the Moon's limb. Langrenus did not vary.

April 1: Mare Crisium and Endymion did not vary. Langrenus and Furnerius approached the limb a little. Tycho did not vary.

On the 2nd: All the aforesaid did not vary.

On the 7th: Littus Ecliptium [the Ecliptic Shore] was receding. Tycho was approaching. Therefore the pole was in the octant. [Margin: III.]

On the 10th and 11th: Grimaldi, Littus Ecliptium, and Sinus Roris [the Bay of Dews] were receding from the Moon's limb. [Margin: vel IV. — "or IV."]

On the 24th: Mare Crisium, Endymion, and Littus Ecliptium were receding from the Moon's limb. Pitiscus did not vary.

On the 25th: Mare Crisium and Endymion were receding from the Moon's limb. Langrenus did not vary. Pitiscus was approaching. Therefore the pole was in the octant. [Margin: I.]

On the 26th: Mare Crisium and Endymion were receding from the limb [Symbol: ☽]. [Margin: vel IV. — "or IV."]

On the 28th and 30th: Mare Crisium and Endymion did not vary. Langrenus and Furnerius were receding from the limb.

May 21 and 22: Mare Crisium, Endymion, and Langrenus were receding from the Moon's limb.

On the 23rd and 24th: Mare Crisium, Endymion, and Democritus were receding from the Moon's limb. Langrenus did not vary. Pitiscus approached the limb. Therefore the pole was in the octant. [Margin: vel IV. — "or IV."]

On the 27th and 28th: Mare Crisium and Endymion did not vary. Langrenus was approaching. Democritus was receding from the limb.

On the 29th and 30th: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion and Tycho did not vary.

June 19 and 20: Mare Crisium, Langrenus, and Endymion receded a little from the Moon's limb.

On the 22nd and 23rd: Mare Crisium, Langrenus, and Endymion did not vary. Pitiscus approached the limb.

On the 24th, 25th, and 26th: Mare Crisium and Langrenus were approaching the limb. Endymion and Pitiscus did not vary.

On the 27th: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion itself was approaching a little.

July 18 and 19: Mare Crisium and Langrenus did not vary. Endymion was receding from the Moon's limb.

On the 27th and 28th: Mare Crisium, Langrenus, and Endymion were approaching the Moon's limb.

August 1: Tycho was receding. Plato and Sinus Roris were approaching the Moon's limb.

On the 18th and 19th: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion was receding. From which it is gathered that the pole of libration was in the octant. [Margin: III.]

On the 20th, 21st, and 22nd: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion did not vary.

On the 23rd, 24th, 25th, and 27th: Langrenus did not vary much. Mare Crisium and Endymion were approaching the limb.

On the 28th and 30th: Grimaldi did not vary. Tycho was approaching the limb.

On the 31st: Grimaldi and Sinus Roris were approaching the Moon's limb. Tycho did not vary.

September 1: Grimaldi and Sinus Roris were approaching the Moon's limb. Tycho did not vary.

October 25: Mare Crisium and Langrenus were receding from the limb [Symbol: $\rceil$]. Endymion and Aristotle did not vary.

On the 26th and 27th: Tycho and Plato did not vary. Grimaldi, Littus Ecliptium, and Sinus Roris were approaching the limb.

November 16: Mare Crisium and Langrenus did not vary. Endymion scarcely approached the limb.

On the 20th: Mare Crisium and Endymion were approaching the Moon's limb. Langrenus was receding. Therefore the pole was in the octant. [Margin: IV.]

On the 23rd: Mare Crisium, Endymion, and Langrenus were receding from the Moon's limb.

December 18 and 19: Mare Crisium and Langrenus scarcely receded from the Moon's limb. Endymion did not vary.

Year 1655.

January 23, 24, and 25: Tycho and Grimaldi were approaching the Moon's limb. Harpalus and Plato were receding from the limb. Therefore the pole was in the octant. [Margin: I.]

February 16, 17, 18, and 20: Mare Crisium, Langrenus, and Endymion were receding from the Moon's limb. [Margin: vel I. — "or I."]

On the 21st: Tycho and Grimaldi were approaching the limb. Harpalus was receding. Therefore the pole was in the octant. [Margin: I.]

March 19 and 20: Mare Crisium and Endymion scarcely receded from the limb. Langrenus did not vary. [Margin: vel IV. — "or IV."]

April 12, 13, 15, and 18: Mare Crisium, Endymion, and Langrenus were receding from the Moon's limb.

On the 19th: Mare Crisium, Endymion, and Langrenus did not vary.

May 10, 11, 12, 13, 14, and 15: Mare Crisium and Endymion were receding from the Moon's limb.

On the 16th and 17th: Mare Crisium, Langrenus, Tycho, and Endymion did not vary.

On the 19th: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion and Tycho did not vary.

June 9, 10, and 11: Mare Crisium, Langrenus, and Endymion were receding from the Moon's limb.

On the 12th: Mare Crisium and Endymion were receding from the Moon's limb. Langrenus did not vary.

On the 13th: Mare Crisium and Endymion did not vary. Langrenus was approaching the Moon's limb.

On the 15th: Endymion did not vary. Mare Crisium and Langrenus were approaching the limb.

On the 16th and 17th: Mare Crisium, Langrenus, and Endymion were approaching the Moon's limb.

On the 19th: Tycho did not vary. Grimaldi and Sinus Roris were receding from the Moon's limb.

July 7, 9, and 10: Mare Crisium, Langrenus, and Endymion were receding from the Moon's limb.

On the 11th and 12th: Mare Crisium and Langrenus were approaching the Moon's limb. Endymion did not vary.

On the 14th, 15th, 16th, and 17th: Mare Crisium, Langrenus, and Endymion were receding from the Moon's limb.

August 10, 11, and 12: Mare Crisium and Langrenus were approaching the Moon's limb.

October 6 and 7: Mare Crisium was approaching the Moon's limb.

Year 1656.

May 7 and 8: Mare Crisium was receding from the Moon's limb.

June 3 and 5: Mare Crisium was receding from the Moon's limb.

July 28, 29, and 30: Mare Crisium did not vary.

On the 31st: Mare Crisium was receding from the Moon's limb.

August 1: Mare Crisium was receding from the Moon's limb.

CAPUT XV.

A judgment on the aforesaid mobility of the poles, drawn from the foregoing observations.

I say, first: One must not conceive the poles, or nodes, of the lunar libration to be true and physical points on the lunar surface — for there is no basis for any such assertion. Indeed, since the other points, or maculae, on the lunar surface are recognizable and preserve the same mutual distances among themselves, one of them could be picked out and said to run here and there across that surface — yet the observations would still require it. I therefore say, rather, that these points are imaginary, or distinct; and that distinct points on the lunar surface take the place of the libration's poles for one and the same libration. And so the axis itself of this libration must be understood to be something imaginary within the lunar body, namely a diameter about which the Moon librates — such that for one libration it is librated about one diameter, but about another diameter, and yet a third, for another libration.

I say, second: This variation of the diameter, or motion of the poles, does not proceed in an orderly, uniform, and even progression. This is manifestly clear from the foregoing observations, in which the poles sometimes appear to be kept for a good while in the same places, at least in the octants of the lunar limb; while at other times they pass over from one octant to another. Besides this, they sometimes pass over from one to another not immediately — or at least with

almost no motion made in between — and then sometimes pass over from one octant to another immediately, and so revert from a later octant to a prior one without crossing the others lying between.

I say, third: It might perhaps be possible to save some more certain and more uniform motion of the libration poles, if we suppose that they are moved not on the lunar limb in our view, but on certain circles having their center either within the aforesaid limb, or in some other, more interior hemisphere either anterior or in some way hidden from us. For the centers of this [motion] cannot be fixed in the same place of the lunar surface, against the most certain observations from the premises.

I say, fourth: Concerning the aforesaid poles, that the axes of libration are made with very notable inequality is to be inferred not only from the fact that some macula is borne with unequal velocity — for that is necessarily so, however the motion proceeds in the superficies of a spherical body — but also from this other respect: namely, it is often observed that the maculae constituted near the libration poles move little, while meanwhile those farther from the poles move more notably. Yet often it has likewise been observed that even those very maculae which are most distant from the poles move little, and sometimes very slightly. Sometimes, by contrast, it is manifestly observed that those maculae situated near the poles move faster, even though they are in such a position that they ought to be apprehended as moving the least. Furthermore, from the foregoing observations it can be inferred that within any one period of libration a greater velocity may belong now to one macula, then to another, while one macula is now recognized as not yet receding, and then, when it manifestly is recognized to recede — and thereafter, while in that same one there appears such a recession notable in its superficies — the progression made is nevertheless greater than in the former. And indeed the very order tends to be preserved in this, by which the maculae are situated around

[p. 199] the Moon's limb — but it is not always preserved. For some macula, in one libration, before another neighboring one shows itself, nevertheless recedes from the Moon's limb; whereas in the next libration the said neighboring macula is recognized to begin receding sooner than the aforementioned. Moreover, in one and the same libration some disturbance of this order is recognized.

Furthermore — and this is the chief point of all — the approach or recession of one macula often cannot be apprehended, except by a kind of stationary point, and by the constancy near that very limb: although it is nevertheless sometimes detected without that stationing. For example: Mare Crisium, which over three

days, or four — or even more days — appears with the same greatest proximity, or greatest remoteness, from the Moon's limb, is nevertheless sometimes apprehended to have approached the lunar limb at some point, and on the very next day to recede again from the lunar limb. Finally, although it is more commonly observed, within a single lunation, that the libration is one and the same, it has nevertheless been observed that not once within the same lunation a macula resumes its approach — that is, after it has receded from the Moon's limb — but proceeds in its receding, indeed to such a notable amount that this could be attributed to parallax, or to a deception of the eye; and that, when some turbation of the lunar [appearance] toward perigee, or toward apogee, would demand rather the contrary appearance.

I say, fifth: The aforesaid varieties apprehended in the libration could perhaps be saved, and reduced to certain rules, if the poles were posited to be moved in circles whose centers, and the [poles] themselves, move at a fixed time — which I have said above to be implicated [in motion]. But I see no real physical basis for this hypothesis, however much it has hitherto been permitted to observe. Yet if in the exposition of the observations I deduce time and again that the poles are in some determinate octant near the Moon's limb, that ought to be taken as in a supposition: namely, that the poles would be moved on that very limb. For thus we are sometimes compelled to argue that one pole is between certain maculae nearer the limb, while the other recedes.

Lastly, from the foregoing observations it must be adverted that the poles, for the most part, conform to the latitude of the same [maculae]: such that, with the latitude ascending, the maculae in the northern hemisphere accede to their limb, and those which are in the southern hemisphere recede from the limb; while, by contrast, with the latitude descending, [it is] the reverse. But there are many observations which contradict this rule; and because there are many such, and because on many successive days they are continually constant, therefore one ought not to doubt that there is some deception of the eye in the observations — and a genuine one is to be sought elsewhere, along with the physical cause of the phenomenon.

CAPUT XVI.

Selected more recent observations of Father Francesco Maria Grimaldi on the limits of the lunar libration, from the year 1651 to 1656. For the examination of Hevelius's table exhibiting the maximum libration of Mare Crisium at each month of this century.

I set forth this table of Hevelius [Johannes Hevelius], in his new little work on the librating motion of the Moon, published in the year 1654, trusting that it would faithfully exhibit the maximum recession of the macula from the Moon's limb — which he himself calls Palus Maeotis — insofar, however, as he himself gathered it from his own observations, and unless some new anomaly of the lunar libration

[p. 200] should be detected by the passage of time. Therefore let us examine whether that table — and consequently the whole theory of the librating motion — corresponds faithfully, over the years next elapsed, and indeed not for this whole coming century, to certain observations of Father Grimaldi, more recent than those we set forth in the first volume of our *Almagest* [*Almagestum Novum*]. Concerning the maximum recession of Mare Crisium from the western limb of the Moon, we at the same time join that [recession] which appears from the Hevelian table, so that it may be recognized by an easy collation whether that maximum recession ought to have appeared felicitously, [and] whether the Hevelian theory proceeds, or is to be corrected by some other principle, which he himself has not yet noticed.

Year 1651.

In the month of October, Hevelius posits that the maximum libration of Mare Crisium will fall in the 5th degree of Taurus — which occurred on the 29th, scarcely before noon. The observations strongly favor Hevelius, placing the maximum aforesaid recession of the macula from the Moon's limb around the 29th day.

November. Hevelius assigns the limit of the libration on the 25th day. The observations, however, set it on the 26th.

December. From Hevelius the limit [falls] on the 23rd. The observations agree with Hevelius for the same 23rd.

Year 1652.

January. From Hevelius, and from the observations, the limit on the 19th day.

February. Hevelius and the observation agree for the 16th.

May. From Hevelius the limit was the 9th — the observations themselves favor it.

June. From Hevelius the limit was the 5th. The observations favor this.

July. From the table of Hevelius the limit is celebrated twice — on the 3rd and on the 30th. For the 3rd: the observations consent, insofar as the macula opposite [it] — that is, Grimaldi — did not vary; from which Mare Crisium is gathered to have been at the extremity of its motion, and as if stationary.

August. Hevelius posits the limit on the 16th day. The observations agree, since the opposing macula Grimaldi was at the highest approach to the Moon's limb.

September. The table of Hevelius assigns the 23rd day. From the observations the same is gathered, from the highest approach of the macula Grimaldi to the Moon's limb.

November. From the table of Hevelius the limit is on the 17th. On that day Grimaldi was as little as possible distant from the western limb. Therefore the observations favor Hevelius.

December. Hevelius posits the limit of libration on the 15th. But from the observation, on the 13th day Mare Crisium was receding, [while] the macula opposite [it] Grimaldi was approaching; on the 16th — up to and including the 19th — it did not vary. Therefore the limit appears to be gathered as having fallen after the 15th day assigned by Hevelius.

Year 1653.

January. From Hevelius the limit was the 12th. But from the observations not before the 13th.

February. From Hevelius the limit fell between the 8th and 9th. But from the observations somewhat after the 10th, since on the 10th Mare Crisium was still receding from the western limb.

March. From Hevelius the limit ought to have been the 8th, before noon. But the observations require the 11th day.

April. From Hevelius the limit falls between the 4th and 5th. But the observations require it after the 8th day.

May. From the table of Hevelius the limit is the 2nd, at noon. But the observations set it after the 4th.

June. From Hevelius the limit was the 26th. But from the observations it appears later, since Mare Crisium did not vary up to the 26th day — the 1st of July included.

July. From Hevelius the limit is the 23rd. The observations appear to favor Hevelius.

August. From the table of Hevelius the limit is assigned for the 20th day. But from the observations, since the macula opposite

[p. 200, col. 2] Grimaldi itself, on the 19th day, was still approaching the limb, the [limit] seems to be argued [to be] Mare Crisium — not yet on the 20th — to have been at the limit of its recession.

December. Hevelius sets the 8th day. But from the observations it seems to be somewhat after the 8th, since on the very 8th day the macula opposite Grimaldi was still approaching the eastern limb.

Year 1654.

January. Hevelius posits the limit on the 5th day. But from the observations, as much as is gathered from the opposing macula Grimaldi, it seems to have been on the 6th.

March. Hevelius posits the limit on the 28th. But from the observations it manifestly ought to be set later, since on the 29th day Mare Crisium was still receding from the Moon's limb — and for four days afterward it continued not to vary.

April. Hevelius posits the limit on the 25th. But from the observations on the 26th, since Mare Crisium was still receding. Therefore here too Hevelius precedes.

May. Hevelius posits the limit on the 22nd. But the observations wish [it on] the 24th.

June. Hevelius gives the limit on the 19th. But the observations [show it] somewhat after the 8th[?].

August. Hevelius posits the limit on the 13th. The observations favor Hevelius.

November. Hevelius posits the limit on the 4th. They favor the observations for that day, insofar as the macula Grimaldi stood as little as possible distant from the eastern limb.

Year 1655.

February. From Hevelius the limit was the 22nd. The observations favor [it], insofar as on the 22nd the macula Grimaldi began not to vary.

April. From Hevelius the limit is held to be the 18th. But the observations give it later, since on the 19th day Mare Crisium begins not to vary.

May. From Hevelius the limit is the 16th. But from the observation, somewhat after the 17th.

June. From Hevelius the limit is the 12th. But from the observation, not before the 13th.

July. From Hevelius the limit is the 10th. The observations consent to this exactly.

August. From Hevelius the limit falls before noon on the 7th. The observation, however, exhibits [it] for the 8th.

Year 1656.

May. From Hevelius the limit is held to be on the 8th. The observation exhibits it later.

June. From Hevelius the limit was the 5th. They consent with the observations.

July. From Hevelius the limit is held to be on the 29th. But the observations transfer it after the 1st of August.

From the foregoing observations, many indeed there are which favor Hevelius; but many likewise there are which prove that his table forecasts, by one day or another, the true limit of the libration of Mare Crisium from west toward east. And although in a matter so subtle, and treated by an estimation of the eye in the observations, one may sometimes doubt the precise day — let alone the moment of maximum libration — when scarcely four days, or some [number of] days, slip by in which no increment or decrement appears in the lunar libration: in many cases it is nevertheless evidently convinced that Hevelius precedes, since increments appeared after that [day] on which, according to Hevelius, [the limit] ought to have been: so that, as has been set forth in its proper places, [the limit] was [later]. And it is indeed remarkable that he never notes a day preceding the

one Hevelius assigned: which confirms that the matter must least be doubted to be one of difficulty in arriving at a certain judgment, depending on the estimation of the eye — since indeed there would be no danger of erring toward one part rather than the other.

BOOK FOUR

IN WHICH SELECTED OBSERVATIONS OF THE FIXED STARS

are weighed, drawn from both the ancients and the moderns, and from these the Tables are constructed and exhibited down to the Year of Christ 1700.

CHAPTER I.

On the Observations of the Ancients concerning the Fixed Stars, and the Manner of Observing Them.

Having passed over those rudimentary observations of the rising, setting, and so forth of the stars of the fixed-star sphere — which are found in the ancient calendars for the benefit of agriculture, medicine, and navigation, in Aratus, Eudoxus, Euctemon, Meton, Calippus, Dositheus, Geminus, Ptolemy, Hipparchus, Bithynus [?], Columella, and likewise in Ovid, Pliny [Pliny], Varro, and others — observations not, in any case, suitable for determining the exact positions of the stars in the heavens at a definite time: of these we shall select only a few, namely those made from the time of Aristyllus [Aristyllus] and Timocharis [Timocharis], that is, from about the year 300 before Christ down to our own day. These have been handed down by others, or have been carried out by us with R. P. Francesco Maria Grimaldi [Francesco Maria Grimaldi] with as much subtlety and diligence as was possible for us. And although the observations of Aristyllus and Timocharis themselves, related by Ptolemy (*Almagest* VII; *Magna Constructio* [*Almagest*] I.1), and explained afterwards by us in Tome I (*Almagestum Novum*), are few and not free of ambiguity [Margin: *The observations of Aristyllus and Timocharis are doubtful.*], yet the observations of Hipparchus himself are more accurate, as Ptolemy in the same place attests — for the observations of Hipparchus concerning the fixed stars, and the ones he adduces, are very fully explained. For Hipparchus himself, as he reports in the same book (Ptolemy, *Almagest* III, ch. 3) in the treatise *On the Magnitude of the Year*, supposed that a motion of the fixed stars takes place at the poles of the zodiac; yet he hesitated — as he asserts — because neither were the observations of Timocharis, made in his

time, regarded as certain (since they had been taken too simply), nor did the time that had elapsed in between suffice for a full understanding of the matter. For this reason he judged that the undertaking of this inquiry should be entrusted to a more careful examination, recording the places of the fixed stars in a solid sphere, of which there is mention in Ptolemy (*Almagest* VII.1, at the end); and, transmitting it together with the whole volume to posterity, he closes with that encomium reported by Pliny (*Natural History* II, ch. 26): "Hipparchus, never sufficiently praised, since no one has more proved [Margin: *Hipparchus praised, and the fixed stars to be observed.*] that the kinship of the stars with man is established, and that our souls are a part of the heavens — discovered a new star, and another that arose in his own time; and, doubting whether this happened more often, whether the stars we deem fixed also move, he dared a deed bold even for a god: to count the stars for posterity, and to check off the heavenly bodies by name in a list, devising instruments by which he might mark out their several positions and magnitudes — so that from this it might easily be discerned, not only whether they perished and were born, but also whether any of them shifted and moved, and likewise whether they grew or diminished; he left the heavens as an inheritance to all, if anyone should be found to claim that inheritance." An impious thing — to reckon up the stars for an atheist writer; too prone to fictions about God, or

[Margin: *Psalm 146.*] —rather more truly impious against our God, the Royal Psalmist: "Who counts the multitude of the stars, and calls them all by their names." And Baruch (ch. 3): "the stars gave their light in their watches, and rejoiced: they were called, and they said, Here we are; and with cheerfulness they shone forth to him who made them." But to return to Hipparchus, I have set this down: that the most evil occasion for observing the fixed stars was the one that prompted Hipparchus — namely the appearance of a great new star in his age, just as in our own age there appeared the new star (which was noted in the year 1572 in Cassiopeia from Tycho's [Tycho Brahe] constellation), about which more was said briefly in Book I. By what reasoning the ancients indicated those stars, must be pointed out.

[Margin: *1.*] First, after the rising, setting, and so forth of the stars, the constant and perpetual figure of the constellations was observed, and the always-equal distance of the individual stars from one another. From this the name *fixed* [Inerrantium], or *non-wandering*, was earned for the fixed stars [Astris]; not because they do not move, but because they always keep a kind of equal interval among themselves — never, indeed, with their configuration changed, once they had received it from divine ordination; and so the sphere itself, called "fixed"

[Affixa], moves with an ordained motion. From this the non-wandering stars [Inerrantes Stellae] are at once distinguished from the planets [Errantibus]. (Ptolemy, *Almagest* VII.1.)

[Margin: *Whence the name of the fixed stars?*] Yet against that thing that has just been said — that they rightly suit those very stars to which the name *non-wandering* is applied — it can be objected: namely, because stars of this kind keep among themselves their lineaments and figures alike, and likewise equal intervals, they are seen in the same configuration always. But because the whole sphere of the spheres, in which they are, as it were, fixed and carried around, seems to make a progress according to the succession of the signs, and a certain ordained motion proper to the Prime Movable [Primum Mobile]; not without reason are they called *non-wandering*. For both these things are found to hold of them: namely those of appearance [Apparentia], by which in so great a length of time they are perceived. (*Audianus* [?], Ptolemy VII.1.) And it is established as sufficiently certain that the figures of the stars, recently seen, are the same as those that were carried around of old in the unaltered sphere, whether by Aratus, or by Eudoxus, or even from the monuments of more ancient ages. And that I shall illustrate in the following chapter with some examples.

[Margin: 2.] Secondly, the distances of these stars, by the Radius or by some other suitable instrument, are measured; for that, once done, brought an incredible later benefit to the whole posterity. I shall speak of the Distances absolutely, where I treat of the distances of the fixed stars from the ecliptic, and from the equator, in the following two chapters.

[Margin: *The motion of the Prime Movable in the fixed stars.*] Secondly, it is easily observed that all the fixed stars, and the whole of their sphere, complete a daily revolution of twenty-four hours from rising to setting, then again from setting to rising, or from the meridian to the same meridian. For what was always above the horizon appeared by its passage across the middle of the heavens above the pole of the world, and what passed below the pole, consumed twelve hours; the whole twenty-four; and so the rest. Those that rose, set, and were carried by a determinate motion from rising to setting, consumed twenty-four hours; from setting they returned to the same setting in twenty-four hours, and so the rest. And this is the most manifest motion of all the motions of the non-wandering stars, at least as to appearance. For whether in reality it is moved thus around its own center by a daily motion, or whether rather it is the Earth itself that, by its own daily motion, turns toward the east, producing this apparent motion before

our eyes (as Niceta [Nicetas], Copernicus [Copernicus], and others would have it), we have treated of fully (Book 9, *Almagestum Novum*).

[Margin: 3.] Thirdly, what neither Hipparchus was ignorant of, nor before him in some manner Timocharis, it was observed that the fixed stars have a proper motion of their own according to the succession of the signs; and Hipparchus indeed in his hypothesis [Margin: *The proper motion of the fixed stars in Longitude.*], as Ptolemy teaches (*Almagest* VII.1.1, on those stars which in the zodiac were judged by the Sun); if indeed, as he relates in the same chapter, he himself recounts: that the *Spica*, observed by Timocharis in his time, was distant from the autumnal point by eight degrees, that is, it had been in Virgo at 22 degrees; but in his own time it was distant by only six degrees, that is, in Virgo at 24 degrees; and so for the rest of the noteworthy stars of the zodiac. Yet whether this motion took place in the circles described about the poles of the world (that is, in the equator, or in circles parallel to it), or rather in circles about the poles of the ecliptic (that is, in circles of latitude through the poles of the zodiac), Hipparchus once doubted. Yet they agree that it can take place by

—circles, and in circles through the poles of the zodiac, and from the poles of the zodiac described — although ambiguously, as Ptolemy hands down (*Almagest* VII, ch. 3) — either because of the excessively coarse intervals of the antecedent observations, or because the interval between them was too brief. But Ptolemy himself (let it be said) asserts that the fixed stars are moved contrary to the Prime Movable, or according to the succession both of the circle of the equinoxes and of the ecliptic — since this same thing follows of itself with respect to the ecliptic — moving with respect to the poles of the equator; yet (he asserts, *Almagest* VII, ch. 2) the fixed stars are moved according to the succession of the ecliptic; and in circles about the poles of the zodiac, described: and this by a twofold argument. First, the arcs of the ecliptic that are intercepted between the circles of latitude of the same star are equal to one another; but the arcs intercepted of the circle of declination are unequal among themselves — and, with the ecliptic compared as the standard, unequal; yet this difference does not emerge perceptibly, except after many years. Secondly, because in that circle the poles always keep the same distance in latitude — but truly observed by Hipparchus, and evidently distinguishing it: Ptolemy, of the fixed stars, supposes the same latitudes, which they have always had once from the ecliptic on this side and on that, varying however the distance from the poles of the equator, which we call declination; he adds examples of this kind: that Our [stars] enter Aries — by a change of this kind, which he adduces. Hence (ch. 4) he renders the reason why in the Catalogue of the fixed stars he set down the longitudes and latitudes rather than the right

ascensions and declinations: because, in fact, the latitudes of the same stars remain perpetually the same, and the distances in latitude likewise truly observed by Hipparchus, and in parallels to the ecliptic, uniform; while these are referred to the ecliptic, the fixed stars keep the same latitudes. [Margin: *Scaliger's opinion on the motion of the fixed stars.*] On this here let Joseph Scaliger [Joseph Scaliger] be consulted, in the *Diatribes on the Anticipation of the Equinoxes* (*Vranologia* III, ch. 3); Paul, if [you wish; Paul of?]; Guldin in the refutation of the *Elenchus* of Calvisius against the Gregorian Calendar (ch. 10, as is sufficiently refuted, as also Bullialdus, *Astronomia Philolaica* ch. 5); and likewise (*Almagestum Novum*), where we say something of this (ch. 3); convincing the principal foundations on which Scaliger relied to show that the equinoctial points recede from the fixed stars in the west, and rather the poles of the equator are moved (*Mobilibus*, divisible), and the poles of the world. (See, etc.)

[Margin: 4.] Fourthly, therefore, the ancients ascribed first the declinations of the fixed stars separately, then the latitudes, and the longitudes of them — the latter determined in the ecliptic by circles of latitude drawn through the poles of the ecliptic and the stars themselves; and likewise others orthogonally cutting the ecliptic. They added besides: the apparent magnitudes — namely which were of the first, or the second, or the third, or the maximum magnitudes, which the first, and so on to the sixth. But in the Ptolemaic Catalogue they added certain notes to some fixed stars of the nature of the planets, in which they partake, for the benefit of Astrology.

On the Methods and Instruments by which the Ancients observed the Fixed Stars.

[Margin: 6.] By what instruments Aristyllus, Timocharis, Hipparchus, and Ptolemy noted those declinations, and the distances from the equator, which Ptolemy reports (*Almagest* VII, ch. 3), I have not found; yet it is credible that they used something of the kind: [Margin: *The manner of observing declinations.*] some altitudes of the meridian of the stars. As to which, the *Magna Constructio* (ch. 11) describes a stable Quadrant, by which the meridian altitudes of the Sun were taken, and likewise that perfected Astrolabe — the Equatorial Astrolabe, or Equatorial Armilla — which they were accustomed to apply for capturing also the meridian declinations, and which they cultivated to perfection: Tycho [Tycho Brahe], as he described in his *Mechanica*, restored the instruments of astronomy (fol. 20, etc.).

[Margin: 7.] But the longitudes and latitudes of the fixed stars they were accustomed to observe by two methods. The first was the more familiar — having previously assumed the certain intervals at which a fixed star is distant from the

Sun, or from the Moon; and at night, by means of the place of the Moon in the zodiac computed from the Tables, they determined the place of the stars by conjecture, as nearly as possible by this observation. Of which sort of observations of Timocharis, Agrippa [Agrippa], and Menelaus [Menelaus of Alexandria], from Ptolemy (*Almagest* VII, ch. 3) we shall report in the chapter. The second was by means of the Astro-

—labe used, and described by Ptolemy (*Almagest* VII.2.4); and it was composed of the Zodiacal Armillae, which is almost the same way that Egnazio Danti [Egnazio Danti] in his Astrolabe, and Tycho in his *Mechanica Astronomica* (fol. 19), with the use of those same things, also describe. For with one circle the Moon was computed — in the ecliptic computed, the other to the Sun near the horizon, with its sights turned, the distances of the Moon from the Sun in the ecliptic were taken, and likewise, by an aetheric arc, the place of the Moon in the ecliptic, established in the Mid-Heaven, was noted at the hour. Then on the immediately following night, the distance of the Moon from some fixed star in the ecliptic, computed in like manner, was taken; and it was intercepted by two circles of latitude, while by the center of the Moon, the other by the star, and by both: through the poles of the ecliptic departing in the Astrolabe — by which, in an analogous way, the heavens had previously been arranged in their position. Now indeed, from the time of the prior observation, the place of the Sun in the ecliptic was computed, and to it, adding the distance of the Moon from the Sun toward the west, observed, the apparent place of the Moon was obtained according to the ecliptic; to this apparent place was added the distance of the Moon from the star observed in the east, and so the apparent place of the star was obtained, as to longitude. But truly they inferred, since it was the same hour, since the Moon had been observed together with the Sun, it was established from the Astronomical Tables; but from the true place of the Moon meanwhile, they corrected the longitude, previously acquired through the distance from the Sun.

[Margin: *Imperfection of the ancient observations.*] But to those good men this correction sufficed; nothing of that they required, except the [correction] which often the Refraction demanded, suspected from the parallax of the Sun. Lastly, the place of the Moon by the parallax of the Sun they used. They used the Armilla afterward, as Tycho notes (Tome I, *Progymnasmata*, p. 140): if indeed by great machines, of their own mass, they were very tractable; but the small did not admit subdivisions of a single degree into single minutes. Certainly Ptolemy in his Catalogue consigned the longitudes for the most part to a maximum, and the latitudes to no more than a half-scruple [half-minute].

[Margin: 8.] Lastly, the latitudes themselves, by sights in a circle of latitude, two foramina [apertures], by which directly through the holes the star was directed; and these I judged sufficient to have set forth, before the more select observations hereafter to be exhibited. I have not pursued the defect of those observations on account of the false obliquity of the ecliptic, which is not of this place to discuss.

CHAPTER II.

On the Stars in the Same Straight Line, observed both of old and more recently.

[Margin: 1.] There are many groupings, threefold or fourfold, of the non-wandering stars, which are observed in the same straight line — exactly, or very nearly — and have so persevered from of old, even before Ptolemy, as he himself reports (*Almagest* VII.1, *Magna Constructio* ch. 1; and from there onward down to Tycho [Tycho Brahe], as I affirm in Tome I, *Progymnasmata*, pp. 234, etc.), and so on down to those days, with the addition of certain figures from our own observation, collected, which are extant either in Aratus, or in the *Phaenomena* of Hyginus, or are gathered from the difference of the latitudes — so that hence, even from the unchanged configuration of the constellation, the immutability of the interval by which they are mutually distant may be confirmed.

[Margin: 2.] There are therefore, and were of old as well, in the same — or as nearly as possible in the same straight line, by the judgment of the eye — the stars written below:

In the southern claw [forfex australis] of Cancer; those that precede it; *Hydra* the splendid one in the preceding head, and that of *Canis Minor* the splendid.

The two stars in the head of *Leo*, and the one which is in the conjunction of the neck of *Leo* with the rest of the body.

The bright star of the tail of *Leo*; the extreme star of the tail of *Ursa Maior*; and that which, between the two aforesaid Unformed [stars], is discerned under the tail of the same *Ursa*.

Spica Virginis [Spica]; the second-to-last in the tail of *Hydra*; and the middle one in *Triangulum*, among the aforesaid lucid stars.

The horse in the head [Equus], the two contiguous ones, and that which is in *Aquarius* on the shoulder following.

The two stars preceding in the head of *Aries*, and the middle one in the base of *Triangulum*.

The two *Hyades* orientales, and the southern star in the membrane of the left hand of *Orion*.

The two more northerly *Arietis* in the head, and the splendid one in the knee of *Perseus*.

Capella, and the one which is in the preceding foot of *Auriga*; and the splendid one of the *Hyades* (that is, the eye of *Taurus*).

Capella likewise preceding; the shoulder of *Orion*, and the one which is on the northern horn of *Taurus*, and on the following foot of *Auriga*.

The two splendid stars in the head of *Gemini*, and the bright one in the neck of *Hydra*.

Ursa in the anterior foot, the two contiguous ones, and the one in *Cancer* of the outermost northern scissors [forficis], and the northern of the *Aselli* [the Asses].

The splendid star of *Canis Minor*, and the more southern of the *Aselli*, and the one which precedes them between the *Hyades*, the head.

Spica Virginis, and the two stars in the elbow [ancon] of *Corvus*.

Spica Virginis, and the one which is in the hinder shank [crus] of *Virgo*, and the one antecedent to *Boötes*, the shank.

In *Libra*, two splendid stars in the forceps; and the one which is in the extreme of *Boötes*, the shank.

Libra the splendid one in the southern forceps; *Arcturus*, and the middle star lucid in the tail of *Ursa Maior*.

Ophiuchus the one in the third spondyle, and the one in the fifth spondyle of *Scorpius*, preceding the two in the sting of *Scorpius*.

Ophiuchus in the knee following the lucid one, and the one in *Sagittarius* in the anterior ankle, southern; and the one which is in the sting of the same *Sagitta*.

Ophiuchus in the preceding knee, and the one which is in the sting of *Sagittarius*, the sting preceding, and the one in the preceding knee, the foot of *Sagittarius*.

The southern mouth [bucca] of *Pisces*, and two; preceding, in the quadrilateral of *Pegasus*.

Add to these three splendid ones in the Belt of *Orion*; likewise three of *Boötes*, which are *Arcturus*, lucid in *Libra*, and the lucid one on the shoulder near the

neck-bone [collorobum?]. Such likewise are three lucid stars of *Perseus*, one in the preceding knee, the other on the splendid side, the third on the following shoulder. Likewise three of *Aquila*, one in the throat, another on the shoulders, the third at the beginning of the left wing. Likewise *Andromeda* the southern foot, the bright one of the Belt, and the right shoulder-blade.

CHAPTER III.

The Declinations of the Fixed Stars, or their Distances from the Pole of the World, observed down to the time of Tycho exclusive, with a Censure of them.

[Margin: 1.] Let the first Class be that of the Declinations which Ptolemy (*Almagest* VII; *Magnae Constructionis* ch. 3) reports as observed by Timocharis at Alexandria in the year 36 before the first Calippic period (this being 295 years before Christ, in round numbers; and from Aristyllus about that same time; and from Hipparchus in the year 50; in the third year of the second Calippic period — namely in the year before Christ 128; and finally from the year 1 to the 2 of Antoninus the Emperor, and in the year 265, after Hipparchus). In the year of Christ 137 and 138, those times Ptolemy designates sufficiently (*Almagest* VII, ch. 2, 3, and 4). He adds however (ch. 3) another observation, made in latitude, in the year 47 of the first Calippic period — which he says was the year [in the era] of Nabonassar 465, that is, before Christ 284, or 285.

Caput III — Declinations / pole-distances of the fixed stars to Tycho's time (continued)

[The declination/pole-distance comparison tables, the *First Class* through *Fifth Class* of observations, and their critical discussion. Page 204.]

Table I. [I. TABVLA.]

Declinations of the fixed stars as observed by the ancients. Columns: star [Stella]; observers [Observatores] — Aristyllus, Hipparchus, Ptolemy, Timocharis; declination [Declinatio] in degrees (G.) and minutes (M.); and a final column "B" (Borealis, northern) or "A" (Australis, southern).

Star	Observer	Decl. G.	Decl. M.	B/ A
Capella	Aristyll.	40	0	B
	Hipparch.	40	24	B
	Ptolem.	41	10	B

Star	Observer	Decl. G.	Decl. M.	B/ A
Castor's head [Castoris caput]	Aristyll.	33	0	B
	Hippar.	33	10	B
	Ptolem.	33	24	B
Pollux's head [Pollucis caput]	Aristyll.	30	0	B
	Hippar.	30	0	B
	Ptolem.	30	10	B
Ursa Major, last of the tail [Vrsæ mai. Caudæ vltima]	Aristyll.	61	30	B
	Hippar.	60	45	B
	Ptolem.	59	40	B
Ursa Major, middle of the tail [Vrsæ mai. media caudæ]	Aristyll.	67	15	B
	Hippar.	66	30	B
	Ptolem.	65	0	B
Ursa Major, first of the tail [Vrsæ mai. prima caudæ]	Arist.	68	30	B
	Hippar.	67	40	B
	Ptolem.	66	15	B
Bright star of Aquila [Aquilæ lucida]	Timoch.	5	48	B
	Hipp.	5	48	B
	Ptolem.	5	50	B
Middle of the Pleiades [Pleiadum media]	Timoch.	14	30	B
	Hippar.	15	30	B
	Ptolem.	16	15	B
Bright star of the Hyades, Aldebaran [Hyadum splendida Aldebar.]	Timoch.	8	45	B
	Hipp.	9	45	B
	Ptolem.	11	0	B
Orion's leading shoulder [Orionis	Timoch.	1	12	B

Star	Observer	Decl. G.	Decl. M.	B/ A
humerus præced.]				
	Hipp.	1	48	B
	Ptolem.	2	30	B
Orion's following shoulder [Orionis humerus sequens]	Timoch.	3	50	B
	Hipp.	4	20	B
	Ptol.	5	15	B
Sirius	Tim.	16	20	A
	Hipp.	16	0	A
	Ptol.	16	45	A
Regulus	Tim.	21	20	B
	Hipp.	20	40	B
	Ptolem.	19	50	B
Spica Virginis	Tim.	1	24	A
	Hipp.	0	36	A
	Ptolem.	0	30	A
Arcturus	Tim.	31	30	B
	Hipp.	31	0	B
	Ptolem.	29	50	B
Heart of Scorpio, Antares [Scorpij Cor Antares]	Tim.	18	20	A
	Hipp.	19	0	A
	Ptol.	20	15	A
Southern Claw of Scorpio [Australis Forceps Scorpij]	Tim.	5	0	A
	Hipp.	5	36	A
	Ptolem.	7	10	A
Northern Claw of Scorpio [Borealis Forceps Scorpij]	Timoch.	1	12	B
	Hipp.	0	24	B
	Ptol.	1	0	A

Star	Observer	Decl. G.	Decl. M.	B/ A
Middle of the Pleiades [Pleiadum media]	Hipp.	15	10	B
	Ptol.	16	10	B

Note below the table: The first of the tail of Ursa Major has, by Hipparchus, gr. 67° 36'; and the Northern Claw of Scorpio, by Timocharis, gr. 1° 2'. [Prima caudæ Vrsæ mai. Hipparcho habet gr. 67. 36'. & Borea forceps Scorpij Timoch. gr. 1. 2'.]

2. The Second Class contains the distances from the world's pole of certain other stars — that is, the complements of their declinations to the quadrant, which, if subtracted from 90 degrees, immediately yield the northern Declination, where A is not added — as they are had in [Petavius], *Uranologion* lib. 3, cap. 3, 6, and 8. He says these distances were observed by Eudoxus and afterwards recorded from Hipparchus, with the distances added that Hipparchus's time required them to have according to Tycho's Tables. Hipparchus seems to be correcting Eudoxus; but it is uncertain whether he corrects the distances of the fixed stars to his own time, or to Eudoxus's. Eudoxus flourished in the year 368 before Christ, that is, 240 years before Hipparchus.

Table II. Distance from the world's pole. [TAB. II. Distantia à Polo Mundi.]

Columns: star/place [Tempore — i.e. the body, "in the time of"]; Eudoxus's value [Eudoxi]; Hipparchus's value [Hipparchi]; and Hipparchus corrected by Petavius [Hipp. correc. à Petavio]. Each in degrees (G.) and minutes (M.).

Star / point	Eud oxi G.	Eud oxi M.	Hippa rchi G.	Hippa rchi M.	Hipp. correc. Petavio G.	Hipp. correc. Petavio M.
Boötes' left shoulder [Bootæ humerus sinist.]	40	13	41	15	41	44
Draco's head [Draconis caput]	37	0	37	0	37	3
Cassiopeia's	39	26	38	0	37	50

Star / point	Eud oxi G.	Eud oxi M.	Hippa rchi G.	Hippa rchi M.	Hipp. corr. Petavio G.	Hipp. corr. Petavio M.
foot [Cassiopeæ pes]						
Castor's head [Castoris Caput]	56	43	56	30	56	29
Pollux's head [Pollucis Caput]	59	48	60	0	59	21
Auriga's left foot [Heniochi pes sinist.]	63	26	63	0	62	53
Cygnus' neck [Cygni collum]	59	27	59	0	59	6
Cygnus' beak [Cygni rostrum]	64	55	65	0	64	49
Ophiuchus' right shoulder [Ophiuchi humer. dext.]	81	31	83	0	82	17
Ophiuchus' left shoulder [Ophiuchi humer. sin.]	74	21	75	0	75	20
The northern of those preceding in the little manger [Cancri borea precedentium in laterculo]	66	1	65	0	64	30
The more southern of the same [Australior earundem]	66	48	66	20	67	5
The Northern	62	56	63	30	63	7

Star / point	Eud oxi G.	Eud oxi M.	Hippa rchi G.	Hippa rchi M.	Hipp. corr. Petavio G.	Hipp. corr. Petavio M.
Ass [♄ Asellus Boreus]						
The Southern Ass [Asellus Australis]	66	10	66	0	66	23
Ophiuchus' head [Ophiuchi Caput]	73	13	73	0	73	58
Tip of Cygnus' left wing [Cygni extrema alæ sin.]	67	54	67	0	67	5
Ophiuchus' left knee [Ophiuchi genu sinist.]	92	51	93	30	94	4
Ophiuchus' right knee [Ophiuchi genu dextr.]	99	33	100 plus		100	36
The Horse's loins [Equi lumbus]	88	22	86	30	86	53
Middle of the three in the spine, the Southern of the Northern Fish [Media trium in spina Australis Piscis Borei]	82	16	80	0	80	39
Ursa Minor, last of the tail [Vrsæ min. caudæ vltim.]	14	4	12	24		

Star / point	Eud oxi G.	Eud oxi M.	Hippa rchi G.	Hippa rchi M.	Hipp. corr. Petavio G.	Hipp. corr. Petavio M.
Middle of the tail [Caudæ media]	12	37	11	10		
Antepenultimat e of the tail [Caudæ antepenult.]	11	24	10	22		
The upper preceding one, in □ [Superior præced. in □]	7	26	8	7		
The upper following one, in □ [Superior succed. in □]	9	16	8	54		

3. The Third Class contains the Distances from the world's Pole of certain Fixed stars from Hipparchus's Observation, with the correction of Joseph Scaliger and Dionysius Petavius made from the more recent Tychonic Tables in [Petavius] *Uranologion* lib. 3, Dissert. cap. 8. The pole of the world, however, from which the stars listed below were distant in Hipparchus's time, was Northern — except for the last two of Scorpio, for which the Pole was Southern, as it was also for Sirius.

Table III. Distance from the world's pole in the time of Hipparchus.
[TABVLA III. Dist. à Mundi Polo tempore Hipparchi.]

Heading of the year column: "In the year before Christ 128" [Anno ante Chr. 128].
Row labels: the fixed stars [Fixæ]. Value columns: by Hipparchus [Hipparcho]; by Scaliger [Scaligero]; by Petavius [Petavio]. Each in degrees (G.) and minutes (M.).

Fixed star	Hipparcho G.	Hipparc ho M.	Scaliger o G.	Scaliger o M.	Petavi o G.	Petavi o M.
Arcturus	59	0	59	0	59	41
Bright star in the flank of Perseus [Persei lucida in	50	0	50	0	49	44

Fixed star	Hipparcho G.	Hipparc ho M.	Scaliger o G.	Scaliger o M.	Petavi o G.	Petavi o M.
latere]						
The southern of the 3 in the right [hand] of Andromeda [Australis 3. in dextra Androm.]	58	0	58	0	58	8
Aries' foot [Arietis pes]	90 nearly [ferè]		90	0	89	42
Middle of the Pleiades [Pleiadum media]	74	30	74	30	74	8
Palilicium, Aldebaran [Palilicium Aldebara]	80	30	80	30	80	50
Orion's left shoulder [Orionis humer. sinist.]	88	12	88	12	87	54
Orion's right shoulder [Orion. humerus dextr.]	85	40	85	40	85	24
A. Sirius, the Great Dog [Sirius Canis maior]	74	0	74	0	74	24
Spica Virginis	89	24	89	24	89	26
A. Antares, heart of Scorpio [Antares cor Scorpij]	71	0	71	0	70	40
Bright star of Aquila [Aquilæ lucida]	84	12	84	12	84	29
Ursa Major, last of	29	15	29	31	29	40

Fixed star	Hipparcho G.	Hipparc ho M.	Scaliger o G.	Scaliger o M.	Petavi o G.	Petavi o M.
the tail [Vrsæ maior caudæ vlt.]						
Middle of the tail [media caudæ]	23	30	23	26	23	19
Antepenultimate of the tail [antepenult. caudæ]	22	24	22	25	22	5
A. Southern Claw of Scorpio [Scorpij Chela australis]	84	24	84	24	84	34
Outermost of the wing of Pegasus [Pegasi alæ extrema]	87	0	87	0	86	51
The southernmost of the three in the left shoulder of Boötes [Australissima trium in sinist. humero Bootę]	63	0	64	0	62	11

4. The Fourth Class has the Distance from the world's Northern Pole of the last star in the tail of Ursa Minor, which is now called *Polaris* on account of its nearness to the Pole, but in Eudoxus's and Hipparchus's time was not *Polaris*. I say "the distance observed by various authors at various times," as below.

Table IV. Distance from the pole of the last star in the tail of Ursa Minor. [TABVLA IV. Distantiæ à Polo Stellæ vltimæ in cauda Vrsæ Minoris.]

Columns: the observer / source; the year [Anni ante Chr. or Anni Christi]; Distance from the Pole [Dist. à Polo] in degrees (G.), minutes (M.), and seconds (S.).

Observer / source	Year	G.	M.	S.
Eudoxus, in [Petavius] <i>Uranologion</i> lib. 3, Dissert.	368 BC	14	4	0

Observer / source	Year	G.	M.	S.
cap. 3				
Hipparchus, in Ptolemy <i>Geography</i> lib. 1, cap. 7	128 BC	12	24	0
Regiomontanus [Io. Regiomontanus], lib. 3 <i>de Triangulis</i> — whether from his own or another's observation is not clear [an aliorum observatione non liquet]	1470 AD	4	9	0
Petrus Nonius [Pedro Nunes], lib. 2 <i>de Observat.</i> cap. 7, from Naclerus [ex Nacleris]	1500	3	30	0
Gemma Frisius, from his own observation at Louvain, as reported in the <i>Astrolabium Catholicum</i> cap. 9 — for badly indeed has Gemma's son [given] it as gr. 3° 35' [malè enim Gemma eius filius habet gr. 3. 35']	1547	3	7	0
Paulus Hainzelius, in Tycho [Brahe] tom. 1 <i>Progymn.</i> pag. 361	1572	3	0	15
Tycho [Brahe], tom. 1 <i>Progym.</i> pag. 362	1577	2	58	50
the same, ibidem [idem ibidem]	1581	2	57	30
the same, ibidem [idem ibidem]	1585	2	56	10
Christoph Rothmann, in Willebrord Snellius [apud Villebrordum Snellium] in <i>obseru. Hassiacis</i>	1586	2	55	40
Tycho [Brahe], tom. 1 <i>Progy.</i> pag. 362	1589	2	54	50
Jacobus Kristmannus, lib. 1 <i>Solarium observat.</i> cap. 4	1596	2	51	50
Andreas Garzia Cespedius, in <i>Directorio Navigationis</i> , where he adds [a value] observed by Rodrigo Zamorano in the year 1584 [observatam à Roderico Zamorano An. 1584]	1598	2	59	30
Jacobus Kristmannus, in his Commentary on Alfraganus [in Comment. ad Alfraganum]	1618	2	44	30
Adriaan Metius [Adrianus Metius], in his book <i>On the Use of the Globe</i> [lib. de vsu Glob.]	1625	2	42	0
Pierre Gassendi [Petrus Gassendus], in his <i>Judgment concerning the 9 Stars near Jupiter</i> [in Iudicio de 9. Stellis circa Iouem]	1633	2	40	15

Observer / source	Year	G.	M.	S.
Pierre Hérigone [Petrus Herrigonius], tom. 4 of his <i>Cursus Mathematici</i>	1640	2	33	0
P. Stephanus Ostaul Minimus, in a letter given to me [Riccioli], though it ought according to the Tychonic [tables] to be 2° 36' 30" [in litteris ad me datis, at Tychonice debuit esse 2. 36'. 30"]	1643	3	6	20
Giovanni Domenico Cassini [D. Io. Dominicus Cassinus], who observed most subtly in the Malvasia residence at Bologna [in ædibus Maluaticis Bononiæ obseruauit subtilissimè]	1656	2	32	28
We [Riccioli], in the same year with Father Grimaldi [Patre Grimaldo], by means of a Gnomon [per Gnomonem]	1656	2	32	28

Note following Table IV: this observation [the 1656 Gnomon value] was made in the new Temple of S. Lucia, whose vault was not yet vaulted over [nondum tunc fornice obducto], to which one's feet stand higher by 74; for in either case [vtriq] one should rather stand [standum potiùs], than rely on minor instruments, as related in [the *Almagestum Novum*] lib. 6, *Almag. Novi* cap. 4. Nor indeed had Cassini seen our numbers [neq. verò Cassinus nostros numeros viderat], nor We Cassini's; but the very magnitude of the Gnomon (the use being indeed with a Gnomon high by 20 feet) and the diligence of observing produced a consensus so remarkable, and scarcely credible. [vsus est enim Gnomonis (vsus est enim Gnomone alto pedes 20.) & diligentia obseruandi, consensum fecit adeò mirum, & vix suspiciosus credibilem.]

5. The Fifth Class comprises the Declination of Spica, Regulus, Arcturus, the southern Pan [Lancis austrinæ — the southern Scale-pan of Libra], Fomalhaut, Rigel, and Sirius, observed by the authors listed below, but needing peculiar discussion.

[Margin: Spica observed by Werner. (Spica observata à Verno.)] Johann Werner of Nuremberg [Ioannes Vernerus Norimbergensis], as Daniel Santbech reports in *de Observationibus Phænomenorum*, Prop. 20, in the year 1514, December 16, observed at Nuremberg the meridian altitude of Spica as gr. 32° 7'; whence, supposing the altitude of the Pole to be gr. 49° 23' 30", he derived the southern Declination as gr. 8° 29' 30"; whence, supposing the obliquity of the Ecliptic to be

gr. $23^{\circ} 30'$, and the Latitude as gr. 2° (which is as handed down to [from] Ptolemy [à Ptolemæo tradita]), he derived the Longitude as ϱ [Libra] gr. $16^{\circ} 53' 20''$.

[Margin: And Regulus. (Et Regulus.)] Observing Regulus likewise the same year and place, he found the Meridian Altitude, and from it the Declination, as gr. $14^{\circ} 7' 30''$; its Longitude finally [Longit.] in ϱ [Leo].

[Margin: And the southern Pan [of Libra]. (Et Lancis Austr.)] The southern [pan], observed there at that time, [he found] in Auster [southern] gr. $13^{\circ} 38' 30''$; and from it the Longitude in $\mathfrak{M}$ [Scorpio] gr. $8^{\circ} 14'$ — as Tycho also reports, tom. 1 *Progymn.* pag. 221, and before all others Werner himself in the *Opusculum de Motu octavæ sphæræ*. Moreover, Petrus Nonius [Pedro Nunes], lib. 2 *de Observatione* cap. 4, notes a great Disagreement [Magnum Dissidium] among these observations of Werner's, and Copernicus's, and Cardanus's [Cardano]; of which below. Tycho, however, suspects there [ibidem], and presses him [perstringit eum], that Werner did not so much from his own observation as from his own judgment accommodate these declinations to the Ptolemaic latitude, and to the difference of longitude, which is between Spica gr. $54^{\circ} 10'$, between Spica and the [southern] Pan [Lancem] gr. $21^{\circ} 20'$ — although the truer [value] for Tycho [verior sit Tythoni illa] is gr. $53^{\circ} 59'$; this one [is] gr. $21^{\circ} 14'$. [Margin: Werner's deceptions / errors. (Vuernerī fallacia.)] As for the Pole too, the Altitude at Nuremberg is for Tycho gr. $49^{\circ} 26'$; and so, if the true Meridian Altitude was as above, the northern Declination of Regulus would have been gr. $14^{\circ} 10'$, but the southern of Spica gr. $8^{\circ} 27'$, and of the Pan [Lancis] austrina gr. $13^{\circ} 36'$ — from which, assuming for Tycho his own Latitudes, and the obliquity of the Ecliptic gr. $23^{\circ} 30'$, he gathers Trigonometrically a Longitude greatly dissonant from that which is owed to these stars from the Tyconic observations applied to the year 1515, as is clear from the appended Tyconic Table [Tabella Tyconica].

Tyconic Table [Tabella Tyconica] — for the year 1515.

Column heading: "At the beginning of the year of Christ 1515" [An. 1515. Chr. ineunte]. Sub-headings: Names of the Stars [Nomina Stellarum]; Werner's calculation from his own Declination [Calculus Vuerner. ex sua Declinat.] — Latitude per Ptolemy [La. Ptol.] and Longitude [Longitudo]; Tyconic calculation from the declination corrected from his own Tables [Calculus Tychon. ex Vuernerī Decl. corrects ex suis Tab.] — Longitude [Longit.], Tyconic Latitude [Lat. Tych.], and Longitude [Longit.].

Star	La. Ptol. G. M. (B/A)	Werner Longitudo (sign) G. M.	Tychon. Longit. G. M.	Lat. Tych. G. M.	Longit. G. M.
Regulus	0° 10' B	♌ 22 42	23 27	0° 26½'	23 4
Spica	2° 0' A	♌ 16 53½	16 47	1° 59'	17 3
Southern Pan [Lanx Austr.]	0° 40' B	♌ 8 14	7 19	0° 25½'	8 18

Therefore, from so doubtful a Declination of Werner's, nothing certain can be gathered for the true place of these Fixed stars. [Ergo ex tam dubia Declinat. Vueneriana nihil certi pro verò harum Fixarum loco licet colligere.]

6. [Margin: Spica observed by Copernicus. (Spica observata à Copernico.)] Nicolaus Copernicus, lib. 3 *Revolutionum* cap. 2, says that from the meridian altitude of Spica observed by himself at Frauenburg in Prussia in the year of Christ 1525, very nearly 27 partium [parts], and thence supposing the latitude of Frauenburg [Fruemburgica], he gathers its southern Declination as gr. 8° 40'; whence, assuming the Ptolemaic latitude gr. 2°, he deduces the Longitude in ♌ [Libra] very nearly gr. 17° 21'. He adds, moreover, that a decade before — that is, in the year 1515 — Spica was found by him [at] Declination gr. 8° 36' and Longitude ♌ gr. 17° 14'.

[Margin: The disagreement of Werner, Copernicus, and Cardanus on Spica. (Dissidium Vueneri, Copernici, & Cardani in Spica.)] For here indeed Petrus Nonius [Pedro Nunes], lib. 2 *de Observat.* cap. 4, is astonished at the great disagreement between Werner and Copernicus, since in the same year 1515 the one [places it] in Libra at gr. 16° 54', the other [Copernicus] here at gr. 17° 14' — as he points out [deprehendisse affirmat]; while Cardanus [Cardano], after 22 years — that is, in the year of Christ 1537 — brings back [retrahat] the same to eleven [gr.] of [the] observations [eandem observationibus vndecim ad gradum] 16° 18' in ♌.

Tycho, moreover, tom. 1 *Progymn.* pag. 220, when he had previously had the Pole-altitude of Frauenburg [Fruemburgicam] explored as gr. 54° 22' 15", corrects the Spica Declination of the year 1515, making [it] partium [of parts] 8° 33' 15"; and thence, assuming his own latitude gr. 1° 59', and the Obliquity of the Ecliptic gr. 23° 31' 30", he gathers the Longitude of Spica ♌ gr. 17° 3' 30". So for the year 1525, using the corrected Declination gr. 8° 37' 15", he obtains the Longitude in ♌ gr. 17° 14'; and limiting both [vtramq; limitans] he gathers for the year 1520 [the Longitude] in ♌ gr. 17° 8' 30".

[Margin: Lansbergen's deceptions. (Lansbergij fallacia.)] But Philippus Lansbergius, in his *Thesaurus observationum Fixarum*, as he reckons in his own tables, computes [Spica] for the year 1525 in Libra at gr. $17^{\circ} 35' 20''$; he confirms from Copernicus's observation two errors admitted by the Astronomer [duo peccata admittit Astronomica], one of omission, the other of commission, in correcting the Pole-altitude of Frauenburg [Fruemburgicam] by introducing a Refraction at his own discretion [arbitrato suo]. For he says that against a true altitude of gr. $26^{\circ} 57'$ there was [taken] a Refraction of altitude gr. $2^{\circ} 30'$; and, the altitude of the Equator being placed at gr. $35^{\circ} 41'$, [Spica] being observed by Copernicus at a declination of gr. $8^{\circ} 44'$ — from which, and from the latitude of Spica gr. $1^{\circ} 58'$ and the obliquity of the Ecliptic gr. $23^{\circ} 30'$, he extends [extends] the Longitude in $\simeq$ gr. $17^{\circ} 35'$.

7. [Margin: Stadius's observations of Spica. (Stadij observ. Spica.)] Johann Stadius [Io. Stadius], in his Commentary *de Fixis* cap. 1, relates the Equatorial Altitude observed by himself at Brussels [Bruxellis] as gr. $38^{\circ} 40'$, and in the year 1559, on the Nones of July, the Meridian [Altitude] of Spica gr. $29^{\circ} 52'$; and so the Declination gr. $8^{\circ} 48'$, with which, and the latitude gr. 2° , he gathers the Longitude of Spica $\simeq$ gr. $17^{\circ} 40'$; whence he refutes the Alphonsine Calculation, which for that year requires Spica in $\simeq$ gr. $16^{\circ} 50'$; and Cardanus's [Cardani], of which above. He further relates, cap. 2, [Margin: And Arcturus, Sirius. (Et Arcturi, Sirij.)] [that] there [ibidem] in the year 1559, observed on the day before the Ides of April, the Meridian Altitude of Arcturus [was] gr. $73^{\circ} 20'$; and thence the Declination gr. 69° ; and in the year 1598, on the Nones of March, the Meridian Altitude of Sirius [was] gr. $22^{\circ} 45'$; and so its southern Declination gr. $15^{\circ} 55'$; [Margin: Fomalhaut. (Fomahat.)] and the Meridian Altitude of Fomalhaut gr. $5^{\circ} 6'$; and its Declination gr. $33^{\circ} 33'$. Finally [Margin: Rigel. (Rigel.)] the Meridian Altitude of the left foot of Orion, Rigel, [was] gr. $29^{\circ} 28'$; and the southern Declination gr. $9^{\circ} 12'$; and from these the longitude of Fomalhaut in $\approx$ [Aquarius] gr. 28° , and Rigel in $\amalg$ [Gemini] gr. $10^{\circ} 10'$. [Margin: Stadius's errors. (Stadij errores.)] But in our *Geographia Reformata*, from the observations of Langren [Langreni] and of Wendelin [Vuendelini], I have shown the Pole-altitude at Brussels [Bruxellis] to be gr. $50^{\circ} 48'$, and the Equator to be gr. $39^{\circ} 12'$; and so, supposing the meridian altitude of Stadius, his Declinations are to be corrected, as below — which nevertheless do not cohere with the required Tychonic Table. [quæ tamen non cohærent, cum requisitis à Tychonica Tab.]

Comparison table of Stadius's declinations.

Heading: Declination & Observation of Johann Stadius [Declin. & Observ. Io. Stadij]. Columns: Year [Anno]; star; False [value] of Stadius [Falsa Stadij] in G. and M.; Corrected by Stadius [Correcto Stadio] in G. and M. (with B/A); Tychonic [value] [Tychonica] in G., M., S.

A n n o	Star	Falsa Stadij G. M.	Correcto Stadio G. M. (B/A)	Tychonica G. M. S.
1 5 5 9	Arcturus [Arcturi]	22 0	22 32 B	21 32 30
1 5 5 9	Sirius [Sirij]	15 55	16 27 A	16 9 22
1 5 5 9	Fomalhaut [Fomahant]	33 33	34 6 A	30 56 36
1 5 5 9	Rigel	9 12	9 44 A	9 21 6
1 5 5 9	Spica [Spicæ]	8 48	9 20 A	8 47 40

It is therefore clear that, from declinations so false, the places of the said Stars derived by Stadius are likewise false — including even Regulus, which he affirms in Caput 2 of his *Commentary de Fixis* to have been found by himself in the year 1555 in ♌ [Leo] gr. 23° 30'. [Patet igitur ex tam falsis Declinationibus, quam falsa sint loca dictarum Stellarum à Stadio inuecta, atq; adeò etiam Reguli, quem Capite 2. Commentarij de Fixis affirmat à se Anno 1555. in ♌ gr. 23. 30'. repertum.]

CAPUT IV.

The Longitudes and Latitudes of the Fixed stars selected from observations down to the time of Claudius Ptolemy exclusively, with a critical assessment of them.

[Fixarum Longitudines, ac Latitudines selectæ ex observationibus vsq; ad Claudij Ptolemæi tempus exclusivè, cum censura de illis.]

Besides the twofold method of Observing the Longitudes of the Fixed stars — namely, by the Ecliptic distance between them, and from the Moon captured by the naked eye, or by Astrolabes, and likewise the Ecliptic distance of the Moon from the Sun, which we indicated in chapter 1 — Later Astronomers down to Tycho have used also a third mode: namely, assuming their latitude as found from Ptolemy, as being unchangeable, with which, and with the obliquity of the Ecliptic, they investigated the longitudes of those stars observed by Declination at that time, through the analysis of Triangles [per Triangulorum analysim]. We shall therefore set forth the longitudes acquired in one or other of these modes by the Ancients down to Ptolemy, then those of Ptolemy himself, selected, and of his successors down to the time of Wilhelm, Landgrave of Hesse [Vilhelmi Lantgrauj Hassiæ], and of Tycho Brahe — noting in each what we shall judge worth knowing.

By way of foundation, however, we must first set down [Præmittendum tamen fundamenti loco] from our *Chronologia Reformata* the best Chronographies: the year 1 of the vulgar Epoch of Christ falls on the 23rd of August, Julian Calendar [die 23. Augusti Iuliani Kalendarij], beginning at the Nabonassar year 749; whence, the years from Nabonassar being determined from Ptolemy, we shall easily gather the years before or after Christ — these things being established.

1. [Margin: Spica observed 1st by Timocharis. (Spica 1. observatio Timocharidis.)] Timocharis of Alexandria, as Ptolemy reports lib. 7 *Almagest* cap. 2, observed Spica to be distant in advance of [in præcedentia à] the point of the Autumnal Equinox gr. 8° very nearly, that is, in ♍ [Virgo] gr. 22° very nearly; but he does not express the Year as it is now [sed Annum non exprimit sicut neq; cap. 3]: when [Ptolemy] relates that Timocharis observed the northern declination of Spica gr. 24° — below the same chapter he notes the first year, which for Timocharis he says to have been Nabonassar 454, that is, before Christ 295 [idest ante Christum 295]; on which account this Year for either observation is not improbably accepted by Bullialdus [Boulliau], lib. 5 *Astronomiæ Philolaicæ* c. 3, where, about the Nabonassar year 455, from the foresaid Declination and latitude of Spica, he gathers its place in ♍ gr. 21° 59'.

2. [Margin: Spica observed 2nd by Timocharis. (Spica 2. observ. Timoch.)]
Timocharis likewise at Alexandria, as Ptolemy has lib. 7 *Almag.* cap. 3, in the year 36 of the first Calippic Period, lasting 76 years [Constantis annis 76], on day 15 of Elaphebolion, that is, in the Nabonassar year 454, before Christ 294, on day 6 of the Egyptian month Tybi [die Tybi Mensis 5. (recte: see below)] — at the beginning of the third hour, that is, four hours before midnight, both temporal and equinoctial [tertia hora incipiente, idest quarta ante mediam noctem hora, tam temporali, quam æquinoctiali] — saw the Moon reach Spica with its Eastern limb, and so cross it [transgredi], such that Spica had exactly separated [diseparauerit] a third part of the Lunar diameter toward the North; whence Ptolemy, from his own Lunar tables, gathers the Longitude of Spica in $\text{M}\text{gr. } 22^{\circ} 20'$, and the southern Latitude very nearly $\text{gr. } 2^{\circ}$. Copernicus uses this observation, lib. 3. [Vtuntur hac observatione Copernicus lib. 3.]

(*De Revolutionibus* I.2 and Tycho, *Progymnasmata* I) — and he rightly adds that, from this observation to the one Spica made in the year of Christ 1585, 1879 years had elapsed. But Timocharis does not correctly say that the observation was completed in that year, because Ptolemy deduces it from his own calculation, not from Timocharis's observation, which placed Spica in $22^{\circ}10'$ of Virgo [in $\text{M}\text{gr. } 22. 10'$]. Ptolemy indeed deduces it from his own calculation, as we shall say; and he placed it very nearly at 22° . Lansbergen, however, in his *Thesaurus* of observations records it as fixed (see *Thesaurus* p. 146), and gathers from his Lunar Tables the position at $22^{\circ}4'58''$ of Virgo [in $\text{M}\text{gr. } 22. 4. 58'$], and the true latitude at 2° south. Here Lansbergen errs enormously, yet sins only in this, that in setting out the history of the observation he plainly relates a contradiction with Ptolemy: he gives a third of the diameter of the Moon as left over [*Trientem diametri Lunaris relictum*] toward the north from Spica, and at the end of the calculation it comes out at $4^{\circ}45'$. This is a third of the semidiameter, not of the diameter.

[Margin: Lansbergii error.]

3. Timocharis likewise at Alexandria, as Ptolemy relates (*Almagest* VII, cap. 3), in the 47th year of the first Calippic period, on the morning of the 8th of Pyanepsion, which had passed into the 9th of Thoth, in the 10th hour and a half, saw Spica exactly touching the northern part of the Moon, while the horizon was then rising. This is computed to have been the year 466 of Nabonassar, that is, before Christ 283, and at one and a half temporal hours past midnight; he concludes the true place of Spica very nearly at $22^{\circ}30'$ of Virgo [in $\text{M}\text{gr. } 22. 30'$], with a southern latitude of about 2° . Among the readings of this observation, "promoted"

[*promotam*] stands for "12" between the earlier reading and this observation, and for the sake of one degree of difference, with the Greeks reading "Spica promoted." The codex has 5, that is, the sigma with an acute accent, which signifies not "ten" but "six," with the Latin interpreter rendering it.

Longomontanus, however, in the *Astronomia Danica* (lib. 2, Theor., cap. 1, in the Commentary *De Stellis Fixis*), from his Lunar hypotheses places Spica at 22°30' of Virgo [in ♍ gr. 22. 30'], at the equal hour 15h 54' past midnight at Alexandria, in the year 466 of Nabonassar — but 1884, not 1600, before Christ now current. But Lansbergen in his *Thesaurus* of observations (p. 146) places the hour as equal at Alexandria at 2°30' [gr. 2. 30'] past midnight, and Spica from his tables at 22°12'21" of Virgo [in ♍ gr. 22. 12. 21].

[Margin: Spicæ observatio. Timoch.]

4. Timocharis from Ptolemy (*Almagest* VII, cap. 3): at Alexandria, in the 47th year of the first Calippic period, at Nabonassar 465, or before Christ 284, on the 29th day of the month Athir, in the 3rd hour of the night, that is at 3h 20' of equal time past midnight, he carefully noted the Moon's middle southern part applied to the middle of the Pleiades, or to the third following in succession, whence Ptolemy concludes the Fixed Star here to be in 29°30' of Aries [in ♈ gr. 29. 30'], with a northern latitude of 3°40' very nearly. Longomontanus, however, places it (as above) in 29°32' of Aries [in ♈ gr. 29. 32'] past midnight.

[Margin: Pleias Lucida observat. à Timoch.]

5. Timocharis, finally, in Ptolemy (*Almagest* VII, cap. 3): at Alexandria, in the first year of the first Calippic period, and at Nabonassar 454, on the 25th day of Poseideon, or the 7th of Phaophi, in the 16th hour incipient, that is at 4h 10' past midnight (but at equal time 3h 10'), he observes the Moon by its northern extremity touching the boreal extremity of the three in the front of the Scorpion, where Ptolemy deduces it to have been in the Scorpion at 1° [in ♏ gr. 1.] with a southern latitude of 1°20'. But Longomontanus (as above) places it at 15°30' [gr. 15. 30'] past midnight; the place of the star with the Moon in the Scorpion at 1°58' [gr. 1. 58']. Lansbergen in his *Thesaurus* (p. 148) asserts that Ptolemy was here deceived by a faulty longitude of the star, for he gives Spica's place at 1°26'29" [gr. 1. 26. 29] with a southern latitude of 1°15'; and so he supposes the conjunction of the Moon and the Fixed Star to have been seen on the horizon, at 2°30' [gr. 2. 30'] of equal time past midnight, and the true place of the Moon in the Scorpion at 0°50'32" [gr. 0. 50. 32]; and the true latitude north 1°16'49" [gr. 1. 16. 49].

[Margin: Scorpij frons.]

6. Hipparchus, as Ptolemy relates (*Almagest* VII, cap. 2), from his own time, that is from a following observation, gathers that in the year 3 of the third Calippic period — this is 128 years before Christ — he saw Spica distant in the preceding autumnal section by 6° [gr. 6.], but at it being in degree 24 of Virgo [in $\mathfrak{M}$ gr. 24.]. Bullialdus (*Astronomia Philolaica*, cap. 3) gives the latitude of Spica, gathering its place in 23°59' of Virgo [in $\mathfrak{M}$ gr. 23. 59']. Longomontanus, however, with respect to the true Equinox, where above, locates it in 24°25' of Virgo [in $\mathfrak{M}$ gr. 24. 25'].

[Margin: Spicæ observ. ab Hipparch.]

7. Hipparchus likewise, with Ptolemy reporting (*Almagest* VII, cap. 2)... the Sun was to be [*Solem... fuiſſe*]

he observed in the year 50 of the third Calippic period that Stella, which is in the Heart of the Lion [in Corde Leonis] in Cancer [in Cancrī], at 29°50' [gr. 29. 50']. Tycho gives the place from here for tome 1, *Progymnasmata* (p. 253), and reckons — but not rightly — it as completed, flowing from the years 1713 and 8. With Copernicus (lib. 3, cap. 2), having flowed around to the year 196 from the death of Alexander the Great [à morte Alexandri M.]. Bullialdus, however, in the place mentioned, gives the year of Nabonassar 621, since indeed Ptolemy reckons the years 265 between his own observations and Tycho's, whom (a little before this) he had said to have observed in the year of Antoninus the Emperor, hence the year of Nabonassar at 886. But Lansbergen in his *Thesaurus* (p. 153) reckons from his tables the place of Regulus in Cancer at 29°49'4" [in Cancrī gr. 29. 49. 4'], from that year up to which he reckons 6 solid Nabonassar years, 618. The Egyptian year is 365, with the sum 366. The first year of the Calippic period was the year of Nabonassar 454, begun, and at the end of the Calippic period 50 years; the third year of the Calippic period likewise ran with Nabonassar 620, increasing now to 621.

[Margin: Regulus observat. ab Hipp.]

[Margin: Chronologiæ diffidium Bullialdi, & Lansbergij.]

8. Agrippa, as Ptolemy writes (*Almagest* VII, cap. 4), in Bithynia, in the year 12 of the reign of Domitian the Emperor [Domitiani Imperat. & 840 Nabonassari], on the 7th of Metroi, and the 2nd of Tybi at the beginning of night, in the third hour past midnight, that is at 2 temporal hours, observed the southern part of the Moon applied to the middle of the Pleiades. Ptolemy adds that it was the Alexandrian hour of that equinoctial at 2°41' [gr. 2. 41'] past midnight. Hence

from his Lunar tables he deduces the place of the Pleiades in Taurus at $3^{\circ}5'$ [in Tauri gr. 3. 5'], with a northern latitude of $3^{\circ}40'$. It was then the year of Christ 92.

[Margin: Pleias obf. ab Agrippa.]

9. Menelaus at Rome, in the first year of Trajan the Emperor [Anno primo Traiani Imperat.], as he holds (*Almagest* VII, cap. 3), and at 845 of Nabonassar, on the 15th of Mechir, the sequence at the 16th hour temporal at $4^{\circ}5'$ [gr. 4. 5'] past midnight, observed the southern part of the Moon to the southern Spica; and after the middle of the night, Spica was to have appeared distant from the center of the Moon in the preceding hour by one diameter of the Moon, equal and remote from the Lunar horns; whence Ptolemy concludes that, before that same time, at the Alexandrian hour of $6^{\circ}15'$ [gr. 6. 15'] past the middle of the night, Spica was to be in Virgo at $25^{\circ}45'$ [in ♍ gr. 25. 45']. Lansbergen in the *Thesaurus* (p. 147) gives the place to have been at Rome at the equal hour $4^{\circ}57'$ [gr. 4. 57'] at the middle of the night, and at the year of Christ completed 97. Therefore Spica appears in $26^{\circ}1'$ of Virgo [in ♍ gr. 26. 1']; but as Copernicus (lib. 3) revolved, it was in the year of Christ 99, but the latter [reckoning] by 2' [gr. 2'], according to Copernicus (lib. 3). It is revolved at the year of Christ 99, but at the latter being 2' from the years of Nabonassar.

[Margin: Spica observata à Menelao.]

10. Menelaus again in the same year 1 of Trajan, from Ptolemy above (*Almagest* VII, cap. 3, sentence 18), Mechir the sequence at the 19th hour, the 11th: at Rome he saw the southern horn of the Moon in a straight line with the middle, and with the southern horn touching the heart of the Scorpion [centrum austrum Scorpij], the center not standing off from the straight line, indeed differing in the middle of those same things, which both [points were] as northern in the front of the Scorpion. Ptolemy concludes it was at the Alexandrian hour of $7^{\circ}10'$ [gr. 7. 10'] past the middle of the night, and from his tables concludes the boreal front of the Scorpion in the Scorpion at $5^{\circ}10'$ [in Scorpij gr. 5. 10'] with a northern latitude of $1^{\circ}10'$ [gr. 1. 10']. Lansbergen in his *Thesaurus* (p. 149) gives the hour at the middle of the night to be $6^{\circ}12'$ [gr. 6. 12'], equal to Rome, and the star to have been in the Scorpion at $5^{\circ}24'36''$ [in Scorpij gr. 5. 24. 36'], with a northern latitude of $1^{\circ}15'$ [gr. 1. 15'].

[Margin: Scorpij frons à Menelao.]

11. Ptolemy himself (*Almagest* VII, cap. 3): the declination of Spica at 0° [gr. 0.] he observed to be distant in the southern part, and as he had said in the year 2 of Antoninus the Emperor, on the 9th of Pharmuthi, hour past midnight at $5^{\circ}30'$ [gr.

5. 30'], with the Astrolabe he observed; thus to be at the third degree, and at 0°20' [gr. 0. 20'] past midnight in the place of the Lion [in Leonis loco] following the Ecliptic in succession; whence he gathers the place of Regulus in the Lion at 2°30' of the Lion [in Leonis gr. 2. 30'] to have been. Copernicus (lib. 3, Revol. cap. 2) affirms the place [located] at the year 462 from the death of Alexander the Great. Longomontanus, in the said Commentary *De Stellis Fixis*, from this gathers Regulus to have been in the Lion at 3°55' [in Leonis gr. 3. 55'], with refractions computed thence, the western [observations] both diminishing the longitude of the Sun, and diminishing the longitude of the Moon. Now that was the year of Christ 138 and 261; afterwards Hipparchus's observation is recounted, that the lesser Longitude of Ptolemy is numbered in the observation at 1600, the year of Christ being numbered 1454, until at last 1461 is completed. Lansbergen in his *Thesaurus* (p. 153) places the year of Christ 138. Regulus, in the Lion at 3°30'4" [in Leonis gr. 3. 30. 4'], with nothing about the curve of Refraction of the Sun, which doubtless represents a lesser one [than] he represented to Ptolemy, the longitude of the Moon, with the Sun being said to be...

[Margin: Spica & Regulus observ. à Ptolem.]

[Margin: Lansbergij inconstans.]

to have been close to setting, and yet otherwise, as Lansbergen [says], as we have seen, he did not neglect Refraction. Let us now compare in one view the places of the Fixed Stars stated above.

I. TABULA.

Observationū Ordo	Stellæ observatores, & Anni	Calculatores ex observatis	Loca Fixarum deducta — G.	I
1	Spica Timocharis à Chr. 296.	Timochar. / Bullialdus	♊ 22 22	pro xim è 59
2	Spica Timocharis ante Chrif. 296.	Ptolemæus Latit. / Lāsbergius Latit.	♊ 22 A 2 ♊ 22	20 pro xim. 4

Obfervationū Ordo	Stellæ obfervatores, & Anni	Calculatores ex obfervatis	Loca Fixarum deducta — G.	I
			2	0
3	Spica Timocharis ante Chrif. 283.	Ptolemæus Latit. / Longomōt. Lāsbergius	♄ 22	30
			A 2	pro xim.
			♄ 22	30
			22	12
4	Luci· Pleiad· Timocharis ante Ch. 284.	Ptolemæus Latit. / Longomōt.	♄ 29	30
			B 3	40
			♄ 29	32
5	Boreal· frōtis Scorpij Timocharis ante Chrif. 295.	Ptolemæus Latit. / Longomōt. Lansbergen· Latit.	♄ 2	0
			B 1	20
			♄ 1	58
			♄ 1	26
			B 1	15
6	Spica Hipparchus ante Ch. 129.	Hipparch· / Longomōt· / Bullialdus	♄ 24	0
			24	25
			23	59
7	Regulus Hipparchus ante Ch. 129.	Ptolemæus / Lansbergen·	♄ 29	50
			29	49
8	Pleiad· lucid· Agrip· Ch. 92.	Ptolemæus / Latit.	♄ 3	5

Obfervationū Ordo	Stellæ obfervatores, & Anni	Calculatores ex obfervatis	Loca Fixarum deducta — G.	I
			B 3	40
9	Spica Menelaus Chrifti 98.	Ptolemæus / Latit. / Lansbergen·	℞ 25	45
			A 2	0
			℞ 26	1
10	Boreal· frōtis Scorp· Menelaus Chrifti 98.	Ptolemæus / Latit. / Lansbergen· / Latit.	℞ 5	20
			B 1	20
			℞ 5	24
			B 1	15
11	Regulus Ptolemæus Chrifti 138.	Ptolemæus / Longomōt· / Lansbergen·	♂ 2	30
			3	53
			2	30

12. Since we have now arrived at Ptolemy, it would seem fitting to subjoin here the Ptolemaic Catalogue of the Fixed Stars, which we have collated with the Greek Basel text, with the Translation of George of Trebizond [Georgij Trapezuntij], revised by Andreas his son and by Luca Gaurico [Luca Gaurico]; and likewise with the abacus of Alphonsine, Prutenic, Copernican, Clavian, and Piserian [tables]. But why burden Typographers and Readers with so great a mass of false Longitudes and Latitudes? For, excepting a few Fixed Stars whose places can be compared, the Ptolemaic [places] with those of recent learning of the astronomical art, the rest are useless, since they labor under manifest or suspect falsity — a fault, whether from the rudeness of the observations, or from Refractions omitted in the capturing of distances of the Sun from the Moon (through which the places of the Fixed Stars are sought, as Ptolemy himself testifies, *Almagest* VII, cap. 4), or from the fallacious place of the Sun itself and of the Moon, from an excessive Parallax, and from the false and fallacious obliquity of the Ecliptic. It will therefore be enough to select Stars of the first and second

magnitude, and a very few more notable third [magnitude]. The places of the rest, up to Ptolemy's time, are better gathered from our Universal Catalogue, from the annual motion of the Fixed Stars, or from the difference of Longitude among them — these which we here give.

[Margin: Ptolemaici Catalogi imperfectio.]

II. TABULA.

Fixarum selectarum ex Catalogo Ptolemaico, cum Varia Lectione Longitudinis, aut Latitudinis vbi opus est. [Of selected Fixed Stars from the Ptolemaic Catalogue, with a variant reading of the longitude or latitude where needed.]

Ad initium Antonini Imperatoris, seu Annum Chrifiti 137. & 138. [For the beginning of Antoninus the Emperor, that is, the year of Christ 137 and 138.]

Ordo Ptolemaic us	Conftellationes, feu Aftra, & Fixa inter eas felecta	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
VRSA MINOR.									
1	Caudæ extrema, <i>tunc non Polaris</i>	II	0	10	66	0	B	3	♂ ♀
4	Auftralis in præcedenti latere ☐	II	29	40	75	40	B	4	
	— Copernico		29	40	75	20	B		
	— Prutenicis		29	40	75	50	B		
6	Auftralis in fequenti latere ☐	☿	17	10	72	50	B	2	
	— Græcus codex		17	20	72	50	B		
7	Borealis fequentis lateris ☐	☿	26	10	74	50	B	2	
VRSA MAIOR.									
16	Quæ in dorfo, & in quadri latero	☿	17	40	49	0	B	2	♂
17	Quæ in lateræ	☿	22	10	44	30	B	2	

Ordo Ptolemaicus	Constellationes, feu Altra, & Fixa inter eas selecta	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
	in quadri latero								
18	Quæ in radice Caudæ	♏	3	10	51	0	B	3	
19	Quæ in posteriori finiftra coxa	♏	4	0	46	30	B	2	☉ ♀
25	Prima Caudæ — Græcus codex	♏	12	10	53	30	B	2	
		♏	12	10	57	30	B	2	
26	Media Caudæ	♏	18	0	55	40	B	2	
27	Extrema Caudæ	♏	20	50	54	0	B	2	

(Tabula II continued)

Ordo Ptolem.	Constellationes, & Stella	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
	DRACO.								
2	Quæ in ore	♏	11	50	78	30	B	4	♏ ♏
3	Quæ supra oculum est	♏	13	10	75	40	B	3	
5	Quæ supra caput — Copernico	♏	29	40	75	30	B	3	
			29	10	75	30	B	3	
16	Sequens in fequenti flexu Δ	♏	26	10	80	15	B	3	
20	Sequens in parte Occident. Δ	♏	28	40	87	30	B	6	
	— Prutenicis	♏	26	40	87	30	B	6	
30	Proxima extremæ caudæ	♏	19	10	61	15	B	6	
	— Alphonfinis	♏	19	10	67	35	B	3	
31	Extrema caudæ	♏	13	10	56	15	B	3	

Ordo Ptolem.	Constellationes, & Stella	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
	— Prutenicis	♄	12	10	56	15	B	3	
	CEPHEI	✠	16	40	69	0	B	3	
	humerum tangens								
	BOOTES, feu ARCTOPHYLAX.								
5	Quæ in humero finiftro	♏	19	40	49	0	B	3	
16	Quæ in crure dextro ad cingulum	♏	0	0	44	0	B	3	
	— Alphonfo, & Copernico	♏	0	0	40	15	B		
19	Quæ in dextro calcaneo	♏	5	20	28	0	B	3	
20	Borealis trium in tibia finiftra	♏	21	20	28	0	B	3	
	Informis inter crura, feu Arcturus	♏	27	0	31	30	B	1	♂
	— Græcus Codex	♏	27	0	31	10	B	1	
	CORONÆ	♏	14	40	44	30	B	2	
	Borealis lucida								
	— Prutenicis	♏	14	40	44	36	B	2	
	ENGONASI, feu HERCVLES.								
1	Quæ eft in capite	♐	17	40	37	30	B	3	
3	Quæ in brachio dextro	♐	1	40	40	10	B	3	
5	Quæ in humero finiftro	♐	16	40	48	0	B	2½	
11	Quæ in dextro	♐	16	50	56	40	B	3	

Ordo Ptolem.	Constellationes, & Stella	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
	latere								
	— Græcus Codex	♊	6	50	56	20	B	3	
	— Alphonfinis, ac Prutenicis	♊	6	50	56	10	B	3	
25	Quæ in genu dextro	♊	15	40	65	30	B	3	
	LYRA, feu VVLTVR CADENS.								
1	Lyræ lucidiffima	♊	17	20	62	0	B	1	♀ ♊
3	Australis duarum lucidæ vicinarum	♊	20	20	61	0	B	3½	
9	Borealior duarum fequentium in iugo	♊	24	10	55	20	B	3	
	CYGNVS, feu GALLINA.								
1	Quæ in ore, feu roftro	♊	4	30	49	20	B	3	♀
4	Quæ in pectore	♊	28	30	57	20	B	3	
	— Alphonfinis, ac Prutenicis	♊	28	30	56	20	B	3	
5	Lucida caudæ	♊	9	10	60	0	B	2	♀
6	Quæ in ancone alæ dextræ	♊	19	40	64	40	B	3	
	— Prutenicis	♊	19	20	64	40	B	3	
10	Quæ in ancone alæ finiftræ	♊	0	50	49	30	B	3	
12	In extremo pectoris alæ	♊	6	40	44	0	B	3	

Ordo Ptolem.	Conftellationes, & Stella	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
	finiftræ								
	— Prutenicis		6	40	74	0	B	3	
	CASSIEPEA.								
1	Quæ in capite	Υ	7	50	45	20	B	3½	♀ ħ
2	Quæ in pectore Schedir	Υ	10	50	46	45	B	3	
4	Quæ in cruribus	Υ	16	40	49	0	B	2½	
5	Quæ in genibus	Υ	20	20	45	30	B	3	
	— Prutenicis	Υ	20	20	45	30	B	3	
13	Quæ in medio Cathedræ	Υ	7	50	51	40	B	3	
	PERSEVS.								
1	Nebulofa in extrema manu dextr.	Υ	26	40	40	30	B	Neb ulofa	ħ 𐌶
	— Græcus Codex	Υ	26	40	47	30	B	Neb ulofa	
7	Lucida in dextro latere	Υ	4	50	30	0	B	2	
10	Sequens trium poſt lucidam lateris	ΥΥ	7	40	27	20	B	3	
	— Alphonfinis	ΥΥ	7	40	27	30	B	3	
12	Fulgida in Gorgonis capite	Υ	29	40	23	0	B	2	ħ 𐌶
26	Quæ in genu finiftro	ΥΥ	8	40	19	15	B	3	
	— Alphonfinis, ac Prutenicis	ΥΥ	8	40	19	50	B	3	
28	Quæ in finiftro calcaneo	ΥΥ	4	10	12	0	B	3½	

Ordo Ptolem.	Constellationes, & Stella	Long. Sig.	Lon g. G.	Lon g. M.	Lat . G.	Lat . M.	(Lat. A/B)	Mag nitu do	Nat ura
29	Extrema pedis finiftri	♏♏	6	20	11	0	B	2½	

The selected Ptolemaic catalogue (Tabula II, AD 137–138) continues. Each constellation is given as a rubric, followed by its stars in Ptolemaic order (the *Ordo Ptolemæus* column). Longitude is given as zodiacal Sign / Degrees / Minutes; latitude as Degrees / Minutes with **B** = *Borealis* (north) and **A** = *Australis* (south). The **Magnitudo** column gives stellar magnitude; the **Natura** column gives the planetary nature (Ptolemy's astrological assignment), shown by planetary glyphs. Variant readings drawn from other sources — the *Græcus Codex* (Greek manuscript), the *Alphonsinis* (Alphonsine Tables), the *Prutenicis* (Prutenic Tables), *Copernico* (Copernicus), and *Clavio* (Clavius) — are entered as their own sub-rows beneath the star they qualify, with the longitude/latitude they record.

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AVRIGA, seu HENIOCHVS [Auriga, or the Charioteer]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . . G.	Lat. M.	B / A	Magnit udo	Natu ra
3	The bright Capella, on the left shoulder [Capella fulgens in humero sinistro] <i>Græcus Codex</i>	♏	2 0 22 5	30	B	1	♂ ♀
4	The one shining on the right shoulder [Quæ lucet in humero dextro]	♐	2 5 20 0	0	B	2	
8	The following one of the Kids [Sequens Hædorum]	♏	2 1 18 2 0	0	B	3½	
9	The preceding one of the Kids [Præcedens	♏	2 0 18 2	0	B	4	

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	Hædorum]					
	<i>Prutenicis</i>	♄	2 4 18 2 0	0	B 4	
10	The one on the left fetlock [Quæ in sinistro talo]	♄	1 5 10 9 0	10	B 3½	
11	On the right fetlock, or the northern horn of Taurus [In dextro talo, seu cornu Tauri boreal.]	♄	2 4 5 5 0	0	B 2½	

OPHIVCHS, seu SERPENTARIVS [Ophiuchus, or the Serpent-bearer]

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
1	The one on the head [Quæ in capite]	♌	2 5 36 4 0	0	B 2½	♂ ♀
2	The preceding of the two on the right shoulder [Præcedens duarum in humero dextro]	♌	2 0 27 8	15	B 3½	
7	The preceding of the two in the left hand [Præcedens duarum in manu sinistra]	♌	5 0 17	0	B 3	
8	The following of the two in the left hand [Sequens duarum in manu sinistra]	♌	6 0 17	30	B 3	
	<i>Alphonsinis</i>	[♌]	6 0 17	30	B 3	
	<i>Prutenicis</i>	[♌	6 0 12	30	B 3	

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
		]				
12	The one on the right knee [Quæ in genu dextro]	ℳ	2 1 7 1 0	30	B 3	
13	The one on the right shin [Quæ in tibia dextra]	ℳ	2 4 2 6 0	15	B 3	

SERPENS [The Serpent]

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Nat ura
3	The one shining on the temples [Quæ in temporibus lucet]	♌	2 2 36 4 0	0	B 3	
	<i>Alphonsinis, & Prutenicis</i>	[♌]	2 2 35 4 0	0	B 3	
4	The one at the root of the neck [Quæ in radice Colli]	♌	2 0 31 2	15	B 3	
	<i>Græcus Codex</i>	[♌]	2 0 34 2	15	B 3	
	<i>Alphonsinis, ac Prutenicis</i>	[♌]	2 0 34 2	15	B 3	
7	The one after the first bend of the neck [Quæ post primum flexum colli]	♌	2 4 29 1 1	15	B 3	
17	The penultimate in the tail [Penultima in cauda]	♏	8 4 21 0	10	B 3½	

SAGITTÆ [The Arrow]

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / A	Magnit udo	Natu ra
1	Standing alone in the iron (arrowhead) [solitaria in Ferro] <i>Alphonsinis, & Prutenicis</i>	♄	1 1 39 0 0	40	B	4	♀ ♂
		♄	1 1 39 0 0	20	B	4	

AQVILA, seu VVLTVR VOLANS [Aquila, or the Flying Vulture]

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / A	Magnit udo	Natu ra
2	The one shining on the neck [Quæ lucet in collo]	♄	4 5 27 0	10	B	3	
3	The bright one on the back of the head toward the shoulder- blades [Lucida in Occipite ad Scapulas]	♄	3 5 29 0	10	B	2½	♂ ♀
5	The preceding of the two on the left shoulder [Præcedens duarum in humero sinistro]	♄	3 1 31 0	10	B	3	
9	Beneath the tail, in contact with the Milky Way [Sub cauda, in contactu Galaxiæ] <i>Prutenicis</i>	♄	2 1 36 2 0	20	B	3	
		[♄]	2 1 26 2 0	30	B	3	

ANTINOVS, seu informes circa Aquilam [Antinous, or the unformed stars around Aquila]

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Nat ura
1	The preceding of the two in the head [Præcedens duarum in capite]	♄	3 4 0	21	40	B	3	
2	The one following that [Quæ istam sequitur]	♄	8 5 0	19	10	B	3	
	<i>Prutenicis</i>	[♄]	8 5 0	29	10	B	3	
6	The one preceding all of them [Quæ cunctas præcedit]	♄	2 1 1 0	18	10	B	3	
	<i>Græcus Codex</i>	♄	2 3 1 0	18	10	B	3	
	<i>Copernico</i>	♄	2 1 1 0	18	20	B	3	

DELPHIN [The Dolphin]

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Natu ra
1	The preceding of the three in the tail [Præcedens trium in cauda]	♄	1 4 7 0	29	10	B	3½	♂
	<i>Alphonsinis</i>	[♄]	1 4 7 0	29	29	B	3	
	<i>Copernico</i>	[♄]	1 4 7 0	20	10	B	3½	
4	The southern one on the preceding side of the rhombus [Australis]	♄	8 3 0	32	0	B	3½	

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	in Rhombi præcedenti latere]					
5	The northern one of the said side [Borealis dicti lateris]	♄	2 0 33 6	50	B 3½	
	<i>Græcus Codex</i>	♄	2 0 33 6	20	B 3½	
	<i>Copernico</i>	♄	2 1 33 6 0	50	B 3½	
6	The southern one on the following side of the rhombus [Australis in Rhombi latere sequenti]	♄	2 2 33 1 0	10	B 3½	
7	The northern one of the said side [Borealis dicti lateris]	♄	2 1 32 3 0	10	B 3	
	<i>Alphonsinis</i>	[♄]	2 1 32 3 0	10	B 3	

EQVVS ALATVS, seu PEGASVS [The Winged Horse, or Pegasus]

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natura
1	The navel of the horse, or the head of Andromeda [Vmbilicus equi, seu caput Andromedæ]	♄	1 5 26 7 0	0	B 2½	♀ ☿
2	The wing-tip at the loins [Ala extrema in lumbis]	♄	1 1 12 2 0	30	B 2½	♂ ☿ ♃
3	On the right shoulder, and the root of the	♄	2 1 31 0	0	B 2½	

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G.	Lat. M.	B / Magnit A udo	Natura
	foot [In humero dextro, & radice pedis]						
4	The one on the shoulder near the wing, close to the back of the head [Quæ in humero alæ prope occiput]	≈	2 4 19 6 0	40	B 2½		
7	The more northern of the two on the right knee [Borealior duarum in genu dextr.]	≈	2 0 35 9	0	B 3		
11	The preceding of the two neighbouring stars in the neck [Præcedens duarum vicinarum in collo]	≈	1 5 18 8 0	0	B 3		
15	The more northern of the two neighbouring stars in the head [Borealior duarum vicinarum in capite]	≈	9 1 16 0	50	B 3		
	<i>Prutenicis</i>	≈	9 0 16	50	B 3		
17	The one that is in the open mouth [Quæ est in rictu]	≈	5 2 22 0	30	B 3		
	<i>Alphonsinis, ac Prutenicis</i>	[≈]	5 2 21 0	30	B 3		
18	The one on the right fetlock [Quæ in dextro talo]	≈	2 4 41 3 0	10	B 3½		
19	The one on the left	≈	1 4 34	15	B 3½		

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / A	Magnit udo	Natura
	knee [Quæ in genu sinistro]		7 0				
20	The one on the left fetlock [Quæ in talo sinistro]	≈	1 4 36 2 0	50	B	3½	
	<i>Alphonsinis</i>	[≈]]	1 2 36 2 0	30	B	3½	

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ANDROMEDA

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / A	Magnit udo	Natura
1	The one shining on the back of the head [Quæ lucet in Occipite]	✠	2 2 24 5 0	30	B	3	♀ ☿
12	The southern one above the belt [Australis supra cingulum]	Υ	3 5 26 0	20	B	3	
	<i>Prutenicis</i>	[Υ]]	3 5 25 0	20	B	3	
15	The one above the left foot [Quæ supra pedem sinistrum]	Υ	1 5 28 6 0	0	B	3	
	<i>Alphonsinis, & Prutenicis</i>	[Υ]]	1 5 23 6 0	0	B	3	
16	The one on the right foot [Quæ in pede dextro]	Υ	1 1 37 7 0	20	B	3½	
17	The more southern of those [Quæ australior illa]	Υ	1 1 35 5 0	40	B	3½	

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Natu ra
	<i>Prutenicis</i>	[Υ]	1 1 5 0	35	20	B	3½	

TRIANGVLVM [The Triangle]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Nat ura
1	The one at the apex of the Triangle [Quæ in vertice Trianguli]	Υ	1 0 1	16	30	B	3	
2	The preceding of the three in the base [Præcedens trium in basi]	Υ	1 0 6	20	40	B	3	
4	The following of the three in the base [Sequens trium in basi]	Υ	1 5 6 0	19	0	B	3	

ZODIACI PARS BOREALIS [The Northern Part of the Zodiac]

ARIES [The Ram]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Natu ra
1	The preceding of the two in the horn [Præcedens duarum in cornu]	Υ	6 4 0	7	20	B	3½	♈ ♉
2	The following of the same [Sequens ipsarum]	Υ	7 4 0	8	20	B	3	♈ ♉
13	The one at the tip of the hind foot [Quæ in extremo pedis poster.]	Υ	1 0 5	5	0	A	3½	

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	<i>Græcus Codex, Alphons. & Pruten.</i>	Υ	1 0 5 5	15	A 3½	
	<i>Copernico</i>	Υ	1 5 5 4 5	0	A 3½	

Informes circa Arietem [The unformed stars around Aries]

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
1	The bright one above the head, which Hipparchus placed in the neck [Lucida supra caput, quam Hipparchus in collo posuit]	Υ	1 4 10 0 0	30	B 2½	♂ ♂
	<i>Alphonsinis, & Prutenicis</i>	Υ	1 2 10 0 5	0	B 2½	
	<i>Copernico, & Clavio</i>	Υ	1 4 10 0 0	0	B 2½	

TAVRVS [The Bull]

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Nat ura
6	The one on the breast [Quæ in pectore]	♄	3 4 8 0	0	A 3	
11	The one of the Hyades in the ears [Succularum quæ in auribus]	♄	9 0 5	15	A 3½	
	<i>Græcus Codex, & Alphons.</i>	♄	9 0 5	45	A 3½	
	<i>Prutenicis</i>	♄	9 4 5 0	45	A 3½	

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Nat ura
12	The Hyad between the ear and the northern eye [Succula inter aurem, & bor. oculum]	♄	1 2 4 0 0	15	A 3½	
	<i>Alphonsinis</i>	♄	1 2 4 0 0	45	A 3½	
13	The Hyad between this one and the southern eye [Succula inter hanc, & oculum austr.]	♄	1 5 5 0 0	50	A 3	
14	The bright Hyad in the southern eye [Lucida succula in oculo Austr.]	♄	1 4 5 2 0	10	A 1	♂
	<i>Græcus Codex</i>	♄	1 2 5 2 0	10	A 1	
15	The Hyad in the northern eye [Succula in oculo Boreali]	♄	1 5 3 1 0	0	A 3½	
19	The tip in the southern horn [Extrema in Cornu Australi]	♄	2 4 2 7 0	30	A 3	
	<i>Prutenicis</i>	♄	2 1 2 7 0	30	A 3	
21	The tip in the northern horn, or on the right foot of Auriga [Extrema in cornu Boreali, seu in pede dextro Aurigæ]	♄	2 4 5 5 0	0	B 2½	

GEMINI [The Twins]

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
1	The one on the	♊	2 2 9	30	B 2	♀ ♀

Ordo Ptolem.	Constellations & Stars	Sig .	G M Lat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	preceding head of the Twins [Quæ in capite præcedenti Geminorum]		3 0			
2	<i>Alphonsinis</i>	[II]	2 2 9 3 0	40	B 2	
	The one on the following head of the Twins [Quæ in capite sequenti Geminorum]	II	2 4 6 6 0	15	B 2	♂
	<i>Alphonsinis</i>	[II]	2 4 6 6 0	19	B 2	
	<i>Copernico, Prutenicis, Clavio</i>	II	2 3 6 6 0	15	B 2	
10	The one on the left knee preceding [Quæ in sinistro genu præced.]	II	1 0 1 3	30	B 3	
	<i>Prutenicis</i>	II	1 1 1 3 0	30	B 3	
11	The one on the left knee following the Twin [Quæ in sinistro genu sequenti Gemin.]	II	1 1 2 8 5	30	A 3	
	<i>Alphonsinis</i>	[II]	1 1 5 8 5	30	A 3	
	<i>Prutenicis</i>	[II]	1 2 2 8 0	30	A 3	
12	The one on the left armpit following the Twin [Quæ in sinistra axilla sequenti Gemin.]	II	2 4 0 1 0	30	A 3	
13	The one above the	II	2 4 0	30	A 3	

Ordo Ptolem.	Constellations & Stars	Sig .	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	right ham of the same [Quæ supra dextrum poplitem eiusdem]		1 0			
	<i>Græcus Codex</i>	II	2 4 0 1 0	40	A 3	
	<i>Prutenicis</i>	II	2 2 0 1 0	40	A 3	
14	The one on the tip of the preceding foot of the Twins [In extremo pede præcedentis Gemin.]	II	6 3 1 0	30	A 3½	
	<i>Copernico</i>	II	6 4 1 0	30	A 3½	
15	The one following this on the same foot [Sequens hanc in eodem pede]	II	8 3 1 0	15	A 3½	
	<i>Prutenicis</i>	II	8 1 1 0	15	A 3½	
16	The one on the tip of the right preceding foot of the Twins [In extremo ped. dextr. præced. Gemin.]	II	1 0 3 6	30	A 3½	
	<i>Prutenicis</i>	II	1 1 3 6 0	30	A 3½	
17	The one on the tip of the left following foot of the Twins [In extremo ped. sinist. sequ. Gemin.]	II	1 0 7 2	30	A 3	
1	The unformed star preceding the	II	4 1 0	40	A 4	

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G. M.	B / A	Magnit udo	Natu ra
	preceding foot of the Twins [Informium præcedens pedem Gemin. præc.]		0				
2	The unformed star preceding the preceding knee of the Twins [Informium præcedens genu præc. Gemin.]	II	6 3 5 0	50	B	3½	

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CANCER [The Crab]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . .	Lat. G. M.	B / A	Magnit udo	Nat ura
1	The nebulous Manger on the breast [Præsepe nebulosa in pectore]	☾	1 2 0 0 0	20	B	Nebul.	
	<i>Alphonsinis, & Prutenicis</i>	☾	1 2 0 0 0	40	B	Nebul.	
4	The Northern Donkey [Asellus Borealis]	☾	1 0 2 3	40	B	3½	
5	The Southern Donkey [Asellus Australis]	☾	1 2 0 1 0	10	A	3½	
	<i>Copernico</i> , printed at Basel [Basileæ impresso]	☾	1 2 0 1 0	40	A	3½	
9	The one on the southern hind foot [Quæ in posteriori pede Austral.]	☾	7 1 7 0	30	A	3½	

LEO [The Lion]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . . G.	Lat. M.	B / Magni A tudo	Natura
3	The more northern of the two in the head [Boreali duarum in capite]	♄	2 2 12 4 0	0	B 3	
4	The more southern of the same [Australior eatundem]	♄	2 1 9 4 0	30	B 2½	
5	The northern one [Borealis]	♂	0 1 11 0	30	B 3	♂ ♂
6	The bright middle one of the three in the neck [Media trium in collo lucida]	♂	2 1 8 0	30	B 2	
	<i>Prutenicis</i>	♂	2 5 8 0	30	B 2	
7	The southern of the three in the neck [Australis trium in collo]	♂	0 4 4 0	30	B 3	♂ ♀
8	The one in the heart, Basiliscus (Regulus) [Quæ in corde Basiliscus]	♂	2 3 0 0	10	B 1	
	In the Ptolemaic codex of al-Battānī [In Codice Ptolemaico Albategnij]	♂	2 1 0 0	10	B 1	♂ ♂ ♀ ♀
11	The one on the right knee [Quæ in genu dextro]	♄	2 2 0 7 0	0	B 5 + A	♂ ♀ ♀

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magni A tudo	Natura
19	The following of the two in the loins [Sequens duarum in lumbis]	♌	1 1 13 4 0	40	B 2½	
22	The more southern of the two in the vertebræ [Australior duarum in vertebris]	♌	1 2 9 6 0	40	B 3	♀ ☿
23	The one on the hind legs [Quæ in cruribus posterioribus]	♌	2 2 5 0 0	50	B 3	♀ ☿
27	The tip of the tail [Caudæ extrema]	♌	2 3 11 4 0	50	B 1½	♄ ♀ ☿
	<i>Græcus Codex</i>	♌	2 1 11 4 0	50	B 1½	
3	The unformed star of the three under the northern side [Informis trium sub latere Boreal.]	♌	1 3 1 7 0	10	B 3½	

VIRGO [The Virgin]

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A tudo	Natu ra
5	The tip of the southern left wing [Extrema alæ sinistræ Australis]	♌	2 0 0 9	10	B 3	
6	The preceding of the four of the left wing [Præcedens de quatuor alæ sinistræ]	♌	8 1 1 5	10	B 3	
10	The one under the belt	♍	1 2 8	30	B 3	

Ordo Ptolem.	Constellations & Stars	Sig. g.	G M Lat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	on the right side [Quæ sub cingulo in latere dext.]		4 0			
13	Protrygetrix (Vindemiatrix) [Protrigetrix]	♎	1 1 20 2 0	10	B 3	
14	Spica, the Ear of Virgo [Spica Virginis]	♎	2 4 2 6 0	0	A 1	♀ ☿
	<i>Alphons. & Græcus Codex melius</i>	♎	2 4 2 6 0	0	A 1	
15	The one under the belt by the right vertebra [Sub cingulo ad vertebram dextram]	♎	2 5 8 4 0	40	B 3	♀ ♂
26	The northern tip of the right foot [Extrema borealis pedis dextri]	♎	1 4 0 2 0	50	B 3	
	<i>Græcus Codex</i>	♎	1 4 0 2 0	50	B 3	

LIBRA [The Scales]

Ordo Ptolem.	Constellations & Stars	Sig. .	G M Lat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
1	The bright one at the tip of the southern claw [Fulgens in extremo forcipis Austral.]	♎	1 0 0 8	40	B 2	♋ ☿
3	The bright one at the tip of the northern claw [Fulgens in extremo forcipis Boreal.]	♎	2 1 8 2 0	50	B 2	

Ordo Ptolem.	Constellations & Stars	Sig .	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Natu ra
	<i>Alphonsinis, & Prutenicis</i>	[$\underline{\alpha}$]	2 1 2 0	8	30	B	2	

SCORPIVS [The Scorpion]

Ordo Ptolem.	Constellations & Stars	Si g.	G M . .	Lat. G.	Lat. M.	B / A	Magnit udo	Natu ra
1	The more northern of the three in the forehead [Boreali- trium in fronte]	$\mathfrak{M}$	6 2 0	1	20	B	3	
2	The middle of the forehead [Media frontis]	$\mathfrak{M}$	5 4 0	1	40	A	3	
3	The more southern of the three in the forehead [Australi- trium in fronte]	$\mathfrak{M}$	5 4 0	5	0	A	3	
4	The still more southern, on the other of the feet [Australi- adhuc in altero pedum]	$\mathfrak{M}$	6 0 7		50	A	3	
7	The preceding of the three in the body [Præcedens trium in Corpore]	$\mathfrak{M}$	1 4 0 0	3	45	A	3	
8	The Heart of the Scorpion, <i>Antares</i> [Cor Scorpij]	$\mathfrak{M}$	1 4 2 0	4	0	A	2	♂ ♀
9	The following of the three in the body [Sequens trium in Corpore]	$\mathfrak{M}$	1 3 4 0	5	30	A	3	
12	The one in the first	$\mathfrak{M}$	1 3 11		0	A	3	

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
	vertebra [Quæ in primo Spondylo]		8 0			
	<i>Prutenicis</i>	♄	1 2 11 8 0	0	A 3	
13	The one after this in the second vertebra [Quæ post hanc in secundo Spondylo]	♄	1 5 15 8 0	0	A 3	
16	The one in the fourth vertebra [Quæ in quarto Spondylo]	♄	2 1 19 3 0	30	A 3	
17	In the fifth vertebra [In quinto Spondylo]	♄	2 1 18 8 0	50	A 3	
18	In the sixth vertebra [In sexto Spondylo]	♄	0 3 16 0	40	A 3	
19	In the seventh vertebra next to the sting [In septimo Spondylo iuxta aculeum]	♄	2 0 15 9	10	A 3	
20	The following of the two in the sting [Sequens duarum in aculeo]	♄	2 3 13 7 0	20	A 3	

SAGITTARIUS [The Archer]

Ordo Ptolem.	Constellations & Stars	Si g.	G MLat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
1	The one on the iron (head) of the arrow [Quæ in ferro sagittæ]	♄	9 3 6 0	20	A 3	
	<i>Alphonsinis, & Prutenicis</i>	♄	9 3 6 0	30	A 3	

Ordo Ptolem.	Constellations & Stars	Si g.	G M Lat. . . G.	Lat. M.	B / Magnit A udo	Natu ra
2	The one on the hilt of the left hand [Quæ in capulo manûs sinistra]	↗	7 4 6 0	30	A 3	
3	The one on the southern part of the bow [Quæ in parte Australi arcûs]	↗	8 0 10	50	A 3	
4	The more southern on the northern part of the bow [Australior in parte Boreali arcûs]	↗	9 0 1	30	A 3	
6	The one on the left shoulder [Quæ in humero sinistro]	↗	1 2 3 5 0	10	A 3	
	<i>Alphonsinis</i>	↗	1 2 3 5 0	50	A 3	
8	The double and nebulous one in the eye [Gemina, & Nebulosa in oculo]	↗	1 1 0 5 0	45	B 4	
22	The one as if under the armpit [Quæ quasi sub axilla]	↗	1 2 6 6 0	45	A 3	
23	The one on the front left fetlock [Quæ in anteriori sinistro talo]	↗	1 4 23 7 0	0	A 2	𐌲 𐌿
24	The one on the knee of the front left foot [Quæ in genu pedis anter. sinistri]	↗	1 0 18 7	0	A 2½	
25	The one on the front rear (right) fetlock [Quæ in anteriori dietro talo]	↗	6 1 13 4	0	A 3	

Ordo		Si	G	M	Lat.	B	Magnit	Natu
Ptolem.	Constellations & Stars	g.	.	G.	M.	/	udo	ra
	<i>Prutenicis</i>	♄	6	4	13	0	A	3
				0				

The Ptolemaic star catalogue (Tabula II) continues. Columns: **Ordo Ptolem.** (Ptolemy's ordinal number) | **Constellationes, & Stellæ** (constellations and stars) | **Longitudo** (longitude: Sig. = zodiac sign, G. = degrees, M. = minutes) | **Latitudo** (latitude: G. = degrees, M. = minutes; A = north [Australis here used as boreal/austral marker — printed "A"], B = south) | **Magnitudo** (magnitude) | **Natura** (nature: the planetary character). The italic sub-rows (*Prutenicis*, *Alphonsinis*, *Græcus Codex*, *Copernico*, *Clavio*, etc.) give variant longitude/latitude values from those authorities for the star on the line immediately above.

Sagittarius (continued)

Or		Si	Lon.	Lon.	Lat.	Lat.	A	Ma	Natu
do	Star / variant	g.	G	M	G	M	/	B	gn. ra
26	In the left shin [Quæ in crure sinistro]	♄	27	20	13	30	A	3	
27	In the rear right forearm [Quæ in posteriori dextro cubito]	♄	23	50	26	0	A	3	
	<i>Alphonsine and Prutenic</i>	♄	23	40	20	10	A	3	

CAPRICORNUS [Capricorn]

Or		Si	Lon.	Lon.	Lat.	Lat.	A	Ma	Natu
do	Star / variant	g.	G	M	G	M	/	B	gn. ra
1	Northern of three in the following horn [Borealis trium in cornu sequenti]	♄	7	20	7	20	B	3	
	<i>Prutenic</i>	♄	7	20	7	30	B	3	
3	Southern of three in the said horn [Australis trium in dicto cornu]	♄	7	20	5	0	B	3	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
24	Preceding the two in the springing of the tail [Præcedens duas in eductione caudæ]	♄	21	50	0	10	A	3	
	<i>Prutenic</i>	♄	21	20	2	10	A	3	
25	Following those same [Sequens ipsas]	♄	26	20	2	0	A	3	

AQUARIUS [Aquarius]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
2	The Lucida of the two in the right shoulder [Lucida duarum in humero dextro]	♊	6	20	11	0	B	3	
4	In the left shoulder [Quæ in humero sinistro]	♄	26	30	8	50	B	3	
	<i>Prutenic</i>		26	40	8	50	B	3	
9	In the right elbow [Quæ in cubito dextro]	♊	9	30	8	45	B	3	
18	Northern of three at the top of the right [Borealis trium in summo dextræ]	♊	11	40	10	45	B	3	
18	Southern of two in the right shin [Australis duarum in tibia dextra]	♊	11	40	7	30	A	3	
42	The last in the pouring- out of the water, the mouth of the Fish [Ultima in effusione aquæ, os Piscis]	♊	0	0	20	20	A	1	♀ ☿
	<i>Greek codex</i> [Græcus	♊	7	0	23	0	A	1	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
	Codex]								
	<i>Copernicus, Prutenic, Clavius</i>	≈	7	0	23	0	A	1	

PISCES [Pisces]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	In the mouth of the preceding Fish [Quæ in ore Piscis præcedentis]	≈	21	40	9	15	B	3½	
19	In the knot of the one cord, toward the other [Quæ in Nodo lini unius ad alterum]	Υ	2	30	8	30	A	3	
	<i>Copernicus</i>	Υ	2	40	8	30	A	3	
34	In the spine, following toward the Tail [Quæ in Spina sequenti ad Caudam]	Υ	0	0	11	45	B	4	

CONSTELLATIONES AUSTRALES [The Southern Constellations]

CETE [Cetus, the Whale]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
2	Following of three at the tip of the Jaw [Sequens trium in Maxilla extrema]	Υ	17	40	12	20	A	3	
	<i>Prutenic</i>		17	40	11	20	A	3	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
3	Middle of those same, in the mouth [Media ipsarum in ore]	Υ	12	40	11	30	A	3	
4	Preceding the said ones, in the chin [Præcedens dictarum in mente]	Υ	10	30	14	0	A	3	
11	Southern in the following side [Australis in sequenti latere]	Υ	7	0	27	30	A	3	
12	Middle of three in the body [Media trium in corpore]	⋈	22	0	25	20	A	3	
14	Northern of three in the body [Borealis trium in corpore]	⋈	25	0	20	0	A	3	
15	Following of the two next to the Tail [Sequens duarum iuxta Caudam]	⋈	19	40	15	40	A	3	
	<i>Alphonsine and Prutenic</i>	⋈	19	40	15	20	A	3	
16	Preceding of the two next to the tail [Præcedens duarum iuxta caudam]	⋈	15	0	15	40	A	3	
21	Northern of the tail-tip [Borealis caudulæ extrema]	⋈	4	40	9	40	A	3½	
	<i>Prutenic</i>		3	20	9	30	A	3½	
22	Southern of the tail-tip [Australis caudulæ extrema]	⋈	5	40	20	2	A	3	

ORION [Orion]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
1	Nebulous one in the head [Nebulosa in capite] <i>Alphonsine</i>	♄	27	0	16	30	A	Ne b.	
			27	0	18	50	A	Ne b.	
2	Bright one of the right shoulder [Splendida humerali dextri]	♂	2	0	17	0	A	1½	♂ ♀
3	Lucida of the left shoulder [Lucida humerali sinistri]	♄	20	20	17	30	A	2	
26	Preceding of three in the Belt [Præcedens trium in Cingulo]	♄	25	20	24	10	A	2	
27	Middle of the Belt [Media Cinguli]	♄	27	20	24	50	A	2	♂ ♀
28	Last of the Belt [Ultima Cinguli] <i>Alphonsine</i>	♄	28	10	25	40	A	2	
	<i>Prutenic, and Clavius</i>	♄	28	20	25	30	A	2	
29	In the hilt of the sword [Quæ in ensis capulo]	♄	23	50	25	50	A	3	
33	Southern at the tip of the sword [Australis in extremo ensis]	♄	27	0	29	50	A	3	
36	Bright one at the tip of the foot, in the water [Splendida in extremo pedis in aqua] <i>Alphonsine and Prutenic</i>	♄	19	10	31	30	A	1	♂ ♀
39	Under the right, and at the following knee [Quæ	♂	0	10	33	30	A	2½	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
	sub dextro, & sequenti genu]								

FLUVIUS ERIDANUS [the River Eridanus]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
1	The one after the tip of Orion's Foot [Quæ post extremam Pedis Orionis]	♄	18	20	31	50	A	3½	
10	Following, the nearest of four [Sequens de quatuor vicinissima]	♄	27	0	32	50	A	3	
13	Preceding the four other neighboring ones [Quatuor aliarum vicinarum præced.]	♄	22	0	28	0	A	3	
	<i>Prutenic</i>	♄	22	10	28	0	A	3	
14	Following the said four [Sequens dictarum quatuor]	♄	17	10	25	30	A	3	
34	Bright one, and last of the River [Splendida, & ultima Fluvij]	♄	0	10	53	30	A	1	♀ ♄

LEPUS [Lepus, the Hare]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
7	The one in the middle of the body [Quæ in medio corpore]	♄	25	50	41	30	A	2	
	<i>Prutenic</i>	♄	25	30	41	30	A	2	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
8	The one under the belly [Quæ sub ventre]	♄	24	50	44	20	A	3	
	<i>Greek codex</i> [Græcus Codex]	♄	24	50	43	15	A	3	
13	Tip of the Tail [Extrema Caudæ]	♂	11	40	38	10	A	3½	

CANIS MAIOR [Canis Major, the Greater Dog]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
1	Bright one in the mouth, <i>Sirius</i> [Splendida in ore Sirius]	♂	17	40	39	10	A	1	♂ ♂
9	Tip of the front foot [Extrema pedis anterioris]	♂	11	0	41	20	A	3	
15	The one under the belly, between the legs [Quæ sub ventre inter crura]	♂	23	40	51	30	A	3	
	<i>Clavius</i> [Clavio]	♂	23	40	51	20	A	3	
17	Tip of the right foot [Extrema pedis dextri]	♂	9	40	53	45'	A	3	
	<i>Prutenic</i>	♂	9	40	55	40	A		
18	The one in the Tail [Quæ in Cauda]	♄	2	10	50	40	A	3½	
	<i>Prutenic</i>		2	10	50	30	A		
9	<i>Unformed</i> , bright one following under the feet [Informium sub pedibus sequens splendida]	♄	29	0	59	40	A	2	♄
10	<i>Unformed</i> , bright one preceding under the feet	♄	26	0	57	40	A	2	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
	[Informium sub pedibus splendida præced.]								

ANTECANIS PROCYON [Canis Minor, Procyon]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	The one shining in the neck [Quæ in collo lucet]	II	25	0	14	0	A	4	
2	Bright one in the hinder parts [Splendida in posterioribus]	II	29	30	16	10	A	1	
	<i>Alphonso, Prutenic, Clavius</i>	II	29	10	16	10	A	1	

ARGONAVIS [Argo Navis, the Ship Argo]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
2	Following of the two at the end of the ship [Sequens duarum in extremo navis]	♄	14	20	43	20	A	3	
6	Bright one in the middle of the little Shield [Splendida in medio Scutulo]	♄	6	20	47	15	A	3	
13	More southern of the two in the Keel [Australior duarum in Carina]	♄	4	0	58	40	A	3½	
	<i>Prutenic</i>		4	0	58	30	A	3	
32	Third one following the little Shield [Tertia sequens Scutulum]	♄	15	10	51	30	A	2	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
	<i>Alphonso, & Prutenic</i>		15	10	54	30	A	2	
36	Bright one following under the hearth [Splendida sequens sub focis]	♌	0	0	63	50	A	2	
37	Bright one toward the south in the lower Keel [Splendida ad Meridiem in inferiori Carina]	♌	8	30	69	40	A	2	
40	Following of three following ones [Trium sequentium sequens]	♌	26	0	67	20	A	2	
	<i>Alphonsine</i>		26	0	67	28	A	2	
	<i>Prutenic</i>		26	0	65	50	A	2	
45	<i>Canopus</i> in the rudder [Canopus in gubernaculo]	♏	17	10	75	0	A	1	
	<i>Alphonsine</i>	♏	17	10	69	0	A	1	

HYDRUS [Hydra]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
12	The Lucida in the Heart [Lucida in Corde]	♏	0	0	20	30	A	2	♂ ♀
	<i>Prutenic</i>	♏	0	0	20	20	A	2	
16	Preceding three in a straight line [Trium in recta linea præcedens]	♏	18	0	24	40	A	3	
	<i>Prutenic</i>		18	0	24	30	A	3	
23	Following of three in the triangle $\triangle$ [Sequens trium in $\triangle$]	♏	16	10	31	20	A	3	
	<i>Alphonsine, & Prutenic</i>		16	10	31	40	A	3	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
1	<i>Unformed</i> , south of the Head [Informis à Meridie Capitis]	☿	12	30	23	15	A	3	
2	<i>Unformed</i> , near the Neck [Informis prope Collum]	♂	11	0	16	0	A	3	
	<i>Prutenic</i>		11	0	26	0	A	3	

CRATERIS [Crater, the Cup]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
4	CRATER, in the southern bend of the rim [Crateris in australi arcu oris]	♂	7	0	18	30	A	3½	

CORVUS [Corvus, the Crow]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	In the Beak, common with Hydra [In Rostro communis cum Hydra]	♂	15	20	21	40	A	3	
	<i>Prutenic</i>		15	20	21	30	A	3	
2	The one in the neck, toward the head [Quæ in collo ad caput]	♂	14	20	19	40	A	3	
4	The one in the preceding wing, toward the right [Quæ in ala præcedenti ad dextram]	♂	13	30	14	50	A	3	
5	Preceding of the two in the following wing [Præcedens duarum in ala sequenti]	♂	16	40	12	30	A	3	

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
7	Tip of the foot, common with Hydra [Extrema pedis, communis cum hydra]	♄	20	30	18	10	A	3	

CENTAURUS [Centaurus]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
5	The one in the left shoulder, and preceding [Quæ in humero sinistro, & præcedenti]	♌	6	10	25	40	A	3	
	<i>Copernicus</i> [Copernico]		6	10	25	30	A	3	
6	The one in the right shoulder [Quæ in humero dextro]	♌	15	40	22	30	A	2	♂ ♀
16	The one in the right elbow [Quæ in dextro cubito]	♌	22	50	25	15	A	3	
18	Bright one at the joining of the human body [Splendida in coniunctione humani corporis]	♌	18	0	23	30	A	2½	
	<i>Alphonsine & Prutenic</i>		18	0	33	30	A	2½	
29	Preceding of the two under the belly [Duarum sub ventre præcedens]	♌	16	20	43	0	A	2	☉ ♃
	<i>Prutenic</i>		16	30	43	0	A	2	
31	The one in the bend of the right foot [Quæ in poplite pedis dextri]	♌	10	0	51	10	A	2	☉ ♃

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
32	The one in the ankle of the right foot [Quæ in talo pedis dextri]	♌	15	20	51	40	A	2	

Centaurus (continued)

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natur a
34	The one in the calf of the left foot [Quæ in sura pedis sinistri]	♌	11	10	55	20	A	2	
	<i>Prutenic</i>		11	10	55	40	A	2	
35	Tip of the right foot, the front one [Extrema dextri pedis anterioris]	♌	8	20	41	10	A	1	♂ ♀
	<i>Another codex</i> [Alius Codex]	♌	8	20	44	10	A	1	
36	The one in the knee of the left foot [Quæ in genu sinistri pedis]	♌	24	10	45	20	A	2	

FERA, seu LUPUS [the Beast, or Wolf]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	The one in the tip of the hinder foot [Quæ in extremo posteriori pede]	♌	28	0	24	50	A	3	
	<i>Alphonsine</i>		28	0	24	10	A	3	
2	The one in the bend of the same [Quæ in poplite eiusdem]	♌	25	50	29	10	A	3	
	<i>Alphonsine</i>		25	50	29	6	A	3	

THURIBULUM [the Censer / Ara, the Altar]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
3	The one in the middle of the Altar [Quæ est in medio Aræ]	♌	26	20	26	30	A	3½	
	<i>Prutenic</i>		26	10	26	30	A	3½	
5	More southern of three in the hearth [Trium in foco australior]	♌	25	10	34	10	A	3½	

CORONA AUSTRALIS [the Southern Crown]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	Preceding, outside the southern bow [Præcedens extra arcum australem]	♐	9	10	21	30	A	4	
	<i>Another reading</i> [Alia lectio]		9	10	24	30	A	4	

PISCIS AUSTRALIS [the Southern Fish]

Or do	Star / variant	Si g.	Lon. G	Lon. M	Lat. G	Lat. M	A / B	Ma gn.	Natu ra
1	The one in the mouth, at the beginning of the water [Quæ in ore in principio aquæ]	♐	7	0	23	0	A	1	
	<i>Alphonsine</i>		7	0	20	28	A	1	
1	<i>Unformed</i> , preceding three before the Fish [Informium trium præcedens ante Piscem]	♐	8	0	22	20	A	3½	

[End of the Ptolemaic catalogue, Tabula II.]

CAPUT V

The longitudes and latitudes of the fixed stars as observed and arranged, from Ptolemy's time exclusive, down to the observations of Hesse [Hassiacas] and Tycho, exclusive.

[Margin: Albategnius's observation of the fixed stars [Albategnius Fixarum observator].]

For 1740 whole years, between Ptolemy and al-Battānī [Albategnius], there was a remarkable silence concerning the fixed stars. At last al-Battānī, the foremost of the Arabs in Syria — and at that time easily the most learned in the science of the stars — observed in the year 1627 of Nabonassar [years of Nabonassar], that is, AD 879 now completed, beginning 880. He observed Regulus in 14° of Leo, as he himself reports in chapter 51 of his *Science of the Stars*, adding that Ptolemy had observed and recorded Regulus in 2° [?] of Leo and the sixth part of a degree [grad. 2. & sexta gradus parte] — that is, 10 minutes — in the year 836 of Nabonassar. Reckoning, then, that the fixed stars had advanced $11^{\circ}50'$ over all the Ptolemaic figures, he added $11^{\circ}50'$ to the longitude, while retaining the Ptolemaic latitude.

Add, then — and you, reader, to the longitude of the fixed stars handed down just now in the preceding chapter, in the last Table — and you will have the positions of the fixed stars at al-Battānī's epoch, according to his opinion. For the rest, Ptolemy's codex has Regulus in $2^{\circ}30'$ of Leo,

[Margin: To be corrected in al-Battānī [Corrigenda in Albategnio].]

and so does the manuscript codex of Clavius, and the Greek codex of Basel, and the version of Trapezuntius [George of Trebizond]; and therefore only $11^{\circ}30'$ would have to be added. Moreover, al-Battānī retrogressed from the year 845 of Nabonassar, in which Menelaus [Menelaus of Alexandria] had observed the fixed stars, and therefore, distributing those $11^{\circ}50'$ of his over 782 years, he said that the fixed stars complete one degree in 66 solar years. But if the interval were taken between his own epoch and the Ptolemaic time — namely 741 years — they would have advanced only 63 years to a single degree, or $62\frac{1}{3}$ [?]; indeed, if Ptolemy's place [$2^{\circ}30'$] were used, the years would be $64\frac{1}{6}$ [?]. — [The example: Regulus in Leo.]

[Margin: Ebenesophim restored the position of Regulus among the fixed stars, AD 936 [Ebenesophim Fixarum restitutor Reguli locus Ann. 936].]

2. After al-Battānī, by 57 years, Ebenesophim [Ibn Yūnus?][?] the philosopher — in the year of the Arabs, or of the Hijra, 325, that is AD 936 — verified the positions of the fixed stars to the day of that year, the 18th of November, on the 7th feria [Friday]; and he wrote a book on the places of the fixed stars, which Boulliau [Bullialdus] (*Astronomia Philolaica*, book 5) asserts he himself saw in manuscript by the favor of Pierre Gassendi [Petri Gassendi], and of Forcalquier, the magistrate [proprætor] of his town in Provence. And Gassendi himself, in his second *Epistle* — written on the Ides of July 1636 to Wendelen [Wendelinus] — mentions that codex of Arnaldus[?]; in which the place of the Heart of the Lion [Cor Leonis, Regulus] is noted in 15°12' of Leo.

[Margin: The Persian Table of the fixed stars, AD 1115 [Persica Tabula Fixarum Anni 1115].]

3. After 180 years, the Persian Mathematicians [Mathematici Persæ], from their own observations, established the positions of the fixed stars; and Boulliau, in the appendix to his *Astronomia Philolaica*, brings out their Tables — from the Royal Library of Paris, and from the manuscript of M. Georgios Chrysokokkes. The Table was constructed in the year of the Arabs 509, that is AD 1115, on May 27, the 5th feria [Thursday], with which that year of the Arabs began; and from it the positions of 25 fixed stars are taken, with the Latin Name added, according to Boulliau's opinion — which rests upon the ecliptic distance between these fixed stars and the Heart of the Lion [Regulus], which is found in Ptolemy.

Caput V (continued) — Observed Longitudes and Latitudes of the Fixed Stars from the Time of Ptolemy down to the Hessian and Tyconic Observations

Persian Table for the Year of Christ 1115

The names are given first in their Latinized Persian form, then in the form used by [Ismaël] Bullialdus [Boulliau]. Longitudes are given by sign [Sig.], degree [G.], and minute [M.]; latitudes by degree [G.] and minute [M.]; with the magnitude [Magnit.]. The letters **A** and **B** in the latitude column mark whether the latitude is north or south (Boreal / Austral).

Latinized Persian name	Name (after Boulliau)	Long. Sig.	G MLat. . . G.	N M/ . S	Ma gn.
Sulcus	Ultima Eridani (last star of Eridanus)	♈ Aries	1 1 13 5 0	2 A 0	1
Manus tincta	Lucida Cath. Cassiop. (the bright star of the Chair of Cassiopeia)	♈ Aries	2 5 51 2 0	4 B 0	3
Caput Equi	<i>interpretation lacking</i> [deest interpr.]	♉ Taurus	1 4 45 4 0	0 B	2
Latus Persei	Latus dextrum Persei (right side of Perseus)	♉ Taurus	1 5 30 9 0	0 B	2
Oculus Bovis	Oculus Tauri austr. (southern eye of Taurus)	♉ Taurus	2 0 5 7	0 A	1
Pes Didymorum	Pes Orionis sinistr. (left foot of Orion)	♊ Gemini	4 5 31 0	3 A 0	1
Capra	Capella	♊ Gemini	1 0 22 0	3 B 0	1
Humerus Didymorum	Orionis humerus dext. (right shoulder of Orion)	♊ Gemini	1 0 17 7	0 A	1
Soail Iamanè	Canobus (Canopus)	♊ Gemini	2 1 75 0	0 A	1
Siair Iamanè	Sirius Canis mai. (Sirius, of Canis Major)	♋ Cancer	2 4 39 0	1 A 0	1
Siair Siami	Procyon Canis min. (Procyon, of Canis Minor)	♋ Cancer	1 1 16 4 0	1 A 0	1
Cor Leonis	Cor Leonis (heart of Leo / Regulus)	♌ Leo	1 3 0 7 0	1 B 0	1
Parvus Kontaratus	Spica Virginis (Spica)	♎ Libra	1 4 2 1 0	0 B	1
Kontaratus	Arcturus	♎ Libra	1 0 31 2	1 B	1

Latinized Persian name	Name (after Boulliau)	Long. Sig.	G MLat. . . G.	N M/ . S	Ma gn.
Pes Centauri	Pes Centauri ante dext. (right forefoot of Centaurus)	♎ Libra	2 2 41 3 0	1 A 0	1
Discus parvus fractus	Lucida Coronæ Bor. (bright star of the Northern Crown)	♎ Libra	2 4 44 9 0	3 B 0	2
Cor Scorpij	Cor Scorpij (heart of Scorpius / Antares)	♏ Scorpius	2 4 4 7 0	0 A	2
Vultur Volans	Lucida Aquilæ (bright star of Aquila / Altair)	♐ Capricorn	1 5 29 8 0	1 A 0	2
Os Piscis Notij	Fomahant (Fomalhaut)	♑ Aquarius	2 0 23 2	0 B	1
Cauda Avij	Cauda Cygni (tail of Cygnus / Deneb)	♑ Aquarius	2 1 60 4 0	0 B	2
Umbilicus Equi	Mækab Pegasi (Markab of Pegasus)	♐ Pisces	1 4 19 1 0	4 B 0	2
Ceti Cauda	Ceti Cauda (tail of Cetus)	♐ Pisces	1 2 19 9 0	4 B 0	2
Pegasus	Ultima alæ Pegasi (last star of the wing of Pegasus)	♐ Pisces	2 1 12 7 0	3 B 0	2
Humerus Equi	Pegasi humerus in eductione cruris (shoulder of Pegasus at the spring of the leg)	♐ Pisces	1 1 31 7 0	0 B	2

The compilers of the Alphonsine Tables, in the year of Christ 1252, had followed the opinion concerning the trembling [trepidation] of the eighth sphere and the anomaly of the motion of the fixed stars. Afterward, however, in the year 1256, by command of King Alphonso [Alfonso X], having seen the codex of al-Battānī [Albategnius], they chose his view of the uniformity of this motion, and—reckoning by 66 years to a single degree, with the necessary computations—placed Spica in Libra at 13° 48', where Ptolemy had set it in Virgo at 26° 40', in the

year of Christ 138. Al-Battānī, however, [had placed it] in Libra at 8° 30', in the year of Christ 879. The difference between the Ptolemaic and Alphonsine position is 17° 8'. Between the position of al-Battānī and that of the Alphonsines it is 5° 18'.

If you add this 17° 8' to the position derived from the table of the preceding chapter, you will have the positions of the fixed stars corrected according to the mind of Alphonso for the year of Christ 1256. But if, taking the years 1118 that fell between al-Battānī and the Alphonsine correction, you divide by 66, there result 17 38/66 degrees, that is, 34 minutes; and so, following Ptolemy's position, they ought to have placed Spica in Libra at 14° 14'. Dividing instead the 377 years that fell between al-Battānī and the Alphonsine correction by 66, there remain 5 47/66 degrees, that is, very nearly 43 minutes; and adding these to the Battanian position, Spica was to be placed in Libra at 14° 13'.

[Margin: *Alphonsine Table of the fixed stars.*] [Margin: *The defect of the Alphonsine [tables].*]

[5.] Rabbi Levi [Levi ben Gerson / Gersonides], as he himself relates in Book 5 of his *Wars of the Lord* [*Defensionum Dei*], chapter 62, and Augustinus Riccius in his treatise *On the Motion of the Eighth Sphere*, in the year of Christ 1336, observed Spica and several other affixed stars to have advanced from al-Battānī's time by 6° 58', and so to differ from the Ptolemaic time by 18° 48'. For he followed al-Battānī's opinion most closely, of one year for [one] degree out of 66.

[Margin: *Positions of the fixed stars for the year 1336, after Rabbi Levi.*]

6. In the year of Christ 1364, the positions of certain fixed stars were verified by some astronomer or other, whose table Petrus Gassendus [Pierre Gassendi] produced from the Arnaldine Codex in his letter to Wendelin [Vendelinus], which stands at the end of Tome 4 of Gassendi's works; and it runs thus, with the longitude reduced to its signs:

For the Year of Christ 1364

Name	Long. Sig.	G M			M N		Mag
		. .	Lat. G.		. /S	n.	
Extrema alæ Pegasi	♈ Aries	1 1	12		3 B	2	
		5 8			1		
Venter Ceti	♈ Aries	1 1	20		0 A	2	
		3 0					
Cauda Ceti	♈ Aries	8 0	15		2 A	2	

Name	Long. Sig.	G M . . Lat. G.	M N . /S	Mag n.
			0	
Postrema Fluminis	♈ Aries	1 2 53 8 0	0 A	1
Caput Algol	♉ Taurus	1 4 23 7 5	0 B	2
Aurigæ Capella	♊ Gemini	1 1 22 3 0	3 B 0	1
Spathula Alaioth	♊ Gemini	2 0 20 1	0 B	2
Aldebaram	♊ Gemini	1 0 5	1 B 0	1
Orionis humerus dext.	♊ Gemini	1 1 17 8 0	0 A	2
Pes lucidus Orionis	♊ Gemini	8 0 31	0 A	1
Caput Geminorum	♋ Cancer	1 2 9 1 8	4 B 0	2
Sinistrum brachium Gemini antec. (left arm of the leading Twin)	♋ Cancer	1 5 6 4 0	1 B 5	2
Halabor	♋ Cancer	6 0 39	1 A 0	1
Algomeisa	♋ Cancer	1 2 16 7 0	1 A 0	1
Canopus	♋ Cancer	5 3 29 8	0 A	1
In latere Ursæ maioris	♌ Leo	5 1 72 9	5 B 0	2
Sequens illam	♌ Leo	1 1 79 4 9	5 B 0	2
In dorso Ursæ maioris	♌ Leo	1 4 40 0 9	0 B	2
Equus seu Dubhe	♌ Leo	1 1 44 9 9	0 B	2

Name	Long. Sig.	G .	M .	Lat. G.	M .	N /S	Mag n.
Coxa sinistra Ursæ mai.	♌ Leo	2 1	1 9	46	3 0	B	2
Pectus Leonis	♌ Leo	2 0	2 0	7	3 0	B	2
Cor Leonis	♌ Leo	2 0	4 0	0	1 0	B	1
Alcore	♍ Virgo	0	1	53 8	3 0	B	2
Benenax	♍ Virgo	1 8	0	54	0	B	2
Dorsum Leonis	♍ Virgo	2 0	2	13	4 0	B	2
Cauda Leonis	♍ Virgo	1 2	4 5	12	5 0	A	1
Alramech	♎ Libra	1 4	1 0	31	3 0	B	1
Spica Virginis	♎ Libra	1 5	0	2	0	B	1
Pes dexter Centauri	♎ Libra	2 8	1 0	51	1 0	A	2
Calcaneus pedis sin. Cent. (heel of the left foot of Centaurus)	♎ Libra	2 9	2 0	55	2 0	A	1
Extremum pedis anter. Cent. (tip of the forefoot of Centaurus)	♎ Libra	2 6	3 0	41	1 0	A	1
Elphera	♏ Scorpius	2 0	5	44	3 0	B	2
Caput stateræ Meridional. (head of the southern Balance)	♏ Scorpius	6 0	1	0	4 0	B	2
Caput stateræ Septentrion. (head of the northern Balance)	♏ Scorpius	9 0	2	8	3 0	B	2
Calcaneus pedis Centauri	♏ Scorpius	3	3	51	4	A	2

Name	Long. Sig.	G .	M .	Lat. G.	M N ./S	Mag n.
		0			0	
Alcantub. cor Scorpij	♏ Sagittarius	2	0	4	0 A	2
Vultur cadens	♐ Capricorn	5	3	62	0 B	1
		0				
Caudæ Gallinæ	♐ Capricorn	2	1	60	0 B	2
		7	8			
Alchayr	♐ Capricorn	2	0	29	1 B	2
		2			0	
Cauilla sinistra Sagittarij (left ankle of Sagittarius)	♐ Capricorn	6	0	23	0 A	2
Spathula sinistra Sagittarij	♐ Capricorn	1	0	13	3 A	1
		6			0	
Genu sinistri Sagittarij (knee of the left [leg] of Sagittarius)	♐ Capricorn	5	0	18	0 B	2
Spathula sinistra Aquarij	♒ Aquarius	1	5	8	5 B	2
		4	0		0	
Os Piscis Australis	♒ Aquarius	1	0	2	0 A	1
		5				
Spathula equi maior	♓ Pisces	1	5	19	4 B	2
		4	0		0	
Humerus dexter mai. equi (right shoulder of the greater horse)	♓ Pisces	2	2	31	0 B	2
		0	0			

At the foot of the table these words of a more recent author were to be read: *Note that the motion of the eighth sphere, from the time of Alphonso down to 1406, was 1° 44' 30".*

7. At the end of the *Works of Cardinal Nicholas of Cusa* [Nicolaus Cusanus] there stands a certain table of the fixed stars constructed from the observations of Cusa himself and of Cardinal [Nicholas] of Nicaea and of [Pierre d'Ailly, the] Alliensis, as is there asserted, and reduced to the year of Christ 1440. In it I do not doubt there is an error of one and a half degrees, and sometimes more, if it be compared with the Tychonic hypothesis of the fixed stars, as is plain from the stars of first magnitude written below, which I have selected from Cusa's table:

Table of Cardinal Cusa

Name	Anno 1440 — Long. Sig.	G M . . Lat. G.	M N . /S
Orionis humerus dext.	♊ Gemini	2 0 17 3	0 A
Capella	♊ Gemini	1 0 22 6	3 B 0
Sirius	♋ Cancer	8 4 39 0	5 A 0
Procyon	♋ Cancer	2 1 16 0 0	0 A
Regulus	♌ Leo	2 3 0 3 0	1 B 0
Leonis Cauda	♍ Virgo	1 3 11 5 0	5 B 0
Spica	♎ Libra	1 4 2 7 0	0 A
Arcturus	♎ Libra	1 0 31 8	3 B 0
Cor Scorpij	♏ Sagittarius	3 4 4 0	0 A

8. In the year of the Lord 1474, Abraham Zacutus [Abraham Zacuto] observed Spica in Libra at 17° 10', as his disciple Augustinus Riccius reports in his treatise *On the Motion of the Eighth Sphere*; and comparing this position with the one determined by the Alphonsines for al-Battānī, he concluded—to the mind of al-Battānī—that the fixed stars complete one degree in 66 years. Yet if you compare this position, carried back to this same year by the Tychonic [reckoning], you will see it exceed [the truth] by half a degree and more, and accommodated rather to the Battanian opinion, which the Arabs strove to support, than derived from exact observation.

[Margin: *Spica observed by Zacuto.*]

9. Bernardus Vualtherus [Bernhard Walther], as we have in his own observations, observed the longitudes of the fixed stars written below by means of armillae rectified through the position of Venus—yet these are inconsistent with themselves in the case of Sirius, whether on account of refractions or some

defect of the armillae. He says, moreover, that the observation of Aldebaran was most diligent, and that of Orion most certain; but the position of Aldebaran falls short of the Tychonic by 5'—unless the minutes are written faultily in both, 18' for 48'. And that of Orion differs by 32'.

[Margin: *Walther's method.*]

Year	Star	Sig.	G	M
			.	.
1489, March 6	Sirius	☾ Cancer	7	0
	Regulus	♌ Leo	2	0
			3	
1503, Dec. 12	Aldebara[n]	♊ Gemini	2	4
				5
1504, Jan. 5	Sirius	☾ Cancer	7	3
				3
	Canicula	☾ Cancer	1	3
			8	8
	Orionis hum. dext.	♊ Gemini	2	1
			1	8
1504, Jan. 20	Sirius	☾ Cancer	6	4
				0
	Canicula	☾ Cancer	1	3
			8	8
	Orion. hum. dext.	♊ Gemini	2	1
			1	8

10. How much trust the positions of the fixed stars of Johannes Werner [Io. Vuernerus], Copernicus, Cardanus [Girolamo Cardano], and Johannes Stadius [Io. Stadij] deserve, or how much correction they require, we have shown well enough, on the occasion of the declinations, in chapter 3, from number 5 to the end.

11. Petrus Appianus [Peter Apian], in the *Astronomicum Caesareum*, places Regulus—taking the beginning [of the year] as the year of the Lord 1500—in Leo at 22° 8'; that is, 19° 38' beyond the Ptolemaic position. But afterwards, in the Catalogue of the year 1532, which Clavius records in his *Sphaera*, page 182 (in my copy), he places Regulus and the remaining fixed stars 19° 58' beyond the Ptolemaic position.

Therefore, by adding the aforesaid degrees and minutes to the Ptolemaic positions from Chapter 4 (the last table of those selected), you will have the positions of the fixed stars to the mind of Apian for the year 1532.

[Margin: *Apian's Catalogue.*]

12. Clavius himself, who had not seen Tycho's Catalogue, exhibits in his *Sphaera* a Catalogue of the fixed stars in which he supposes Spica and the rest of the fixed stars to be advanced from Ptolemy by $21^{\circ} 7'$ to the year of Christ 1575. If, then, these are added to the Ptolemaic positions of the fixed stars, you will have the Clavian Catalogue, that is, the positions of the fixed stars for the year 1575 according to the opinion of Clavius, by which he also constructed a Globe, as he there asserts. For example, Spica, which in Ptolemy stands in Virgo at $26^{\circ} 40'$, is in Clavius—in the use he makes of his Table—in Libra at $17^{\circ} 47'$. In the year 1575, therefore, it had advanced, as I said, $21^{\circ} 7'$. But because in this very Table he imitated Copernicus in placing the elongations of the fixed stars from the first star of Aries, and made it elongated [from there] by 170° , he therefore supposes the first star of Aries to be in longitude $27^{\circ} 47'$ from the vernal equinox.

Hence, if you wish to elicit the Ptolemaic positions of the fixed stars from Clavius's Catalogue (according to the manuscript codex by which Clavius attests he used it), add to the elongations of Clavius $27^{\circ} 47'$; and you will have the Clavian longitudes for the year 1575 from the vernal equinox. From these in turn subtract $21^{\circ} 7'$, and you will have the Ptolemaic positions for Ptolemy's time. But since Clavius for the most part followed Copernicus, it is no wonder if, together with him, he departed from the goal of the true positions of the fixed stars; as appears from Spica itself, which by Tycho ought, in the year 1575, to have been in Libra at $17^{\circ} 54' 45''$. Clavius therefore falls short by about $8'$. Which is no error, nor enormous; rather one ought to congratulate astronomy that it has so far advanced, and approached so near the Hessian [Lantgravian] observations—indeed, that the Tychonic observations differed from it by within ten minutes of error.

[Margin: *Clavius's Catalogue.*] [Margin: *Clavius corrected.*]

CAPUT VI

On the Positions of the Fixed Stars Observed by Wilhelm, Landgrave of Hesse, and his Astronomers

1. Tycho [Brahe] testifies, in the dedicatory epistle of his *Letters* addressed to Prince Maurice and Landgrave of Hesse, that Wilhelm [Gulielmus], father of

Maurice, held the foremost place among the astronomers of his age—indeed of all Germany—through exquisitely wrought instruments and instruments of every kind; and that, well furnished with craftsmen skilled in this science, he himself applied himself to nightly observations for the reform of astronomy, so far that he duly set in order four hundred stars to within five minutes of certainty. Then, in the Argument of the Epistles of Tome 1, [Tycho] asserts a difference of five minutes between the Tychonic and the Lantgravian longitudes of the fixed stars, referred by Christoph Rothmann to azimuth, and the altitudes carelessly taken by quadrants.

[Margin: *Praises of Wilhelm of Hesse.*]

I should like, however, to draw from Tycho (page 49 of the Epistles) the longitudes and latitudes of certain stars, which Tycho computed from the Canon of Sines, [working] from the data provided by the Lantgravian observations, and from the assumed Right Ascension of Aldebaran of $63^{\circ} 10'$ to the beginning of the year 1587; and with the obliquity of the ecliptic at $23^{\circ} 30'$, and the altitude of the Pole at Cassel $51^{\circ} 20'$ —which, however, Tycho confessed (page 39) to be $51^{\circ} 19'$.

CAPUT VII

On the Observations of Tycho Brahe, especially concerning the Fixed Stars, their Certainty, their Order, and the Method of reforming them

[The following table opens Caput VI's material but is printed at the head of page 218 under Caput VI; the running structure resumes with Caput VII's prose below.]

From the Observations of the Landgrave of Hesse, and the Computation of Tycho

Star [Anno 1586. Compl.]	Long. Sig.	G M S				N	
		.	.	.	Lat. G.	'	"/S
Prima Arietis	♈ Aries	2	3	0	7	8	3 B
		7	0				0
Andromedæ Caput	♈ Aries	8	3	3	25	4	3 B
			9	0		1	0
Tertia Arietis Lucida	♉ Taurus	1	5	3	9	5	0 B
			8	0		7	
Oculus Tauri	♊ Gemini	4	6	0	5	2	0 A
						8	

Star [Anno 1586. Compl.]	Long. Sig.	G M S				N	
		.	.	.	Lat. G.	'	"/S
Orionis pes sinister	♊ Gemini	1	1	0	31	9	0 A
		1	2				
Orionis humer. dext.	♊ Gemini	2	5	0	16	3	3 A
		3				0	
Canis maior	♋ Cancer	8	2	0	39	2	0 A
		8				8	
Castoris caput	♋ Cancer	1	3	3	10	6	3 B
		4	3	9		0	
Pollucis caput	♋ Cancer	1	3	0	6	4	0 B
		7	5			2	
Canis minor	♋ Cancer	2	1	0	15	5	3 A
		0	1			2	0
Præsepe Cancrī	♌ Leo	1	3	0	1	1	0 B
		7				6	
Lucida Hydræ	♌ Leo	2	3	0	22	2	0 A
		1	8			0	
Ceruix Leonis	♌ Leo	2	4	0	8	5	0 B
		3	5			4	
Cor Leonis	♌ Leo	2	1	0	0	3	0 B
		4	1			2	
Dorsum Leonis	♍ Virgo	5	3	3	14	2	0 B
		6	0			5	
Cauda Leonis	♍ Virgo	1	0	0	12	2	3 B
		6				4	0
Spica Virginis	♎ Libra	1	9	0	1	5	4 A
		8				5	5
Arcturus	♎ Libra	1	3	3	31	7	3 B
		8	5	0		0	
Lanx Borealis	♏ Scorpius	1	4	0	8	3	3 B
		3	1			8	0
Cor Scorpj	♐ Sagittarius	4	5	0	4	2	0 A
						5	
Caput Ophiuchi	♐ Sagittarius	1	4	0	36	0	0 B

Star [Anno 1586. Compl.]	Long. Sig.	G M S			Lat. G.	'	"	N /S
		.	.	.				
		6	6					
Aquilæ Lucida	♑ Capricorn	2	3	0	29	2	0	B
		6				1		
Cauda Cygni	♒ Aquarius	2	4	0	59	5	0	B
		9	6			4		
Scapula Pegasi	♐ Pisces	1	5	0	19	2	3	B
		7	1			4	0	

The prose of Caput VII (on Tycho's observations of the fixed stars) follows the ornamental band; the right column of page 218 continues the discussion begun under Caput VI:

[2.] ...and perhaps of two minutes. For in Book 1 of the Theorics, in the *Astronomia Danica*, chapter 4, [Longomontanus] says: *I afterwards, from the year 1590, for a five-year stretch, was not only present at this business of restoring the fixed stars to the heavens and carrying it out, but indeed presided over it; so that I may affirm in good faith—so far as can ever be expected from human industry—that to the restoring of these [stars] according to longitude and latitude, [a certainty] accommodated by us, and every doubt, by reciprocal [checks] on both sides, often repeated where there was need, was [removed], so that they did not stand at the same minutes as nearly as possible [from one another]. Although, on account of the longitude of the Sun being diminished by us by half a minute beyond a minute, just so much, star by star, of the longitudes of the stars did we subtract from Tycho's Canon.* Hence the longitude of the fixed stars in the Danish Tables is less by a whole minute than in the Tychonic and Rudolphine [tables]; and it is plain that Longomontanus labored at it, and that he observed the declinations, [and] the distances of the fixed stars—not all, but most nearly in the same [stars]—to be consistent. Let us now hear that other Tycho, so to speak, or his very eye-pupil, or his very hand, namely Kepler.

[Margin: *Longomontanus's testimony.*]

3. Johannes Kepler, in his work *On Mars* [the *Astronomia Nova*], chapter 10, speaking of the Tychonic observations made on the island of Hven, says: *In use it often happens, even in the observations on the island, that Right Ascensions deduced from two stars differ by three scruples [thirds]. When I consulted Christian [Longomontanus] about this, whether it should be ascribed to a defect of observations, or to a weakness of sight, he answered that it was not unusual.* He

speaks of Christian Longomontanus; and in the explanation of the foundation of his *Ephemerides*, page 15, he says: *The motion of the Sun differs from the fixed stars by six minutes—Tycho's [datum] wavering, and Brahe's [observation] undecided; here testimony fails me.* He goes on: there he indicates many suspicions of errors, which, joined together as it were from heaps of snow, a great [one], and the error of some minutes, could effect. Briefly, concerning Brahe's observations, he says (page 14): *Nothing in this matter rests on any authority but that of a most diligent Artificer, on whom I rely; with whose observations relying, may I become, through a comparison of many others, guilty of some minutes [of error].* He adds, however (page 15): *Yet it is easy [for me] to think the quadrant of one degree's observers visible.*

[Margin: *Kepler's testimony.*]

4. If we compare the Tychonic observations among themselves, and these with those which Paulus Hainzelius—most commended by Tycho himself—acquired by a quadrant of 14 cubits, we shall detect a disagreement of some minutes, not only once, in the Tables of Distances and Declinations to be exhibited a little below. As for the Distances also, deduced trigonometrically from longitude and latitude, if we compare them with the distance [given] by Tycho through sextants, that same disagreement is rarely repeated. Gassendus too noted this in his *Commentaries on Celestial Matters*, page 96. For the distance between the Scales of Libra is, by Tycho in the *Epistles*, $9^{\circ} 8' 20''$; and from the solution of the triangles through longitude and latitude the same Tychonic [distance] comes out, according to Gassendi, at $9^{\circ} 11'$.

5. As for Tycho's Method in reforming the positions of the affixed stars: First, he inquired through the circumpolar stars, especially the one that shines in the tail of Ursa Minor and from its nearness to the Pole of the World is called *Polaris*, the altitude of the Pole at Uraniborg; and he obtained it as once $55^{\circ} 54' 30''$, but afterwards more accurately as $54^{\circ} 40''$, and sometimes $55^{\circ} 54' 40''$ —as is plain from the very *Epistles*, page 40, and from Tome 1 of the *Progymnasmata*, page 28. Secondly, he caught the distances of most of the fixed stars among themselves not with the astronomical radius, which he found deceptive, but with great sextants, and sometimes with a hemicycle. Thirdly, he investigated the meridian altitudes of the fixed stars with various quadrants and with the trigonic sextant. Fourthly, he hunted out the Right Ascension of the bright star of Aries—not, as Werner and the ancients did, but from Venus seen in the morning and evening, [tracing] its rising exponent until [it came] to the right ascensions [of the stars]. Fifthly, from the Right Ascension of the bright star of Aries and of the other nearer fixed stars,

and by completing the declinations with the help of trigonometry, he investigated the right ascension, and by the same method obtained the right ascensions of the other fixed stars. Sixthly, from the Right Ascension and Declination themselves—as [from] the Poles of the Equator and Ecliptic—which he nevertheless falsely set at $23^{\circ} 31' 30''$, through the triangle...

he investigated their longitude and latitude, reducing all of this to the year 1585.

Seventh, comparing the longitude of Spica and of Regulus for the year 1585 with what the ancients had observed, he derived the motion of the fixed stars in longitude over the intervening centuries as 51 [seconds]. **Eighth**, so that the work would not require so many resolutions of triangles for so many stars, he constructed a table from which the longitude and latitude could at once be found from a given declination and right ascension; and on this he based his Canon of a Thousand Fixed Stars, complete for the year of our Lord 1600, with their longitudes and latitudes given individually to the second. **Ninth**, for the same completed year 1600 he determined the right ascensions and declinations of a hundred select principal stars; and to these he added the increase of longitude over a hundred years (since this is constant) and the distance of the latitude from the pole; he investigated the right ascension and declination of those same hundred stars for the year 1700; and he interposed the difference of right ascension and the difference of declination between the years 1600 and 1700, so that from these the proportional part could be derived for other years, the intermediate ones from the earlier. Yet he omitted the bright star in the right shoulder of the Lesser Bear [Ursa Minor], though it is of the second magnitude, because, since the Tychonic followers saw its right ascension decreasing while its longitude increased, they thought that the longitude ought likewise to increase together with the right ascension, and they were unable to resolve this knot. **Tenth**, he at last proceeded to the tables of the advance [progressus] and retreat [regressus] of the fixed stars in longitude over a span of years, with a table of refractions appended.

6. In nearly the same order we shall report Tycho's observations, and the places derived from them, reserving nonetheless for the end of this book a universal Catalogue, should we have found anywhere that it needs correction.

Beginning therefore with the distances of the fixed stars among themselves — since these are perpetually unchangeable — we shall set down those of our own [Nobis], taken with three medium-sized sextants and with the larger triple sextants, together with those that Petrus Gassendus [Pierre Gassendi] took with

his radius corrected for that purpose, set out in his *Commentaries on Celestial Matters* [*Commentarii Rerum Caelestium*], book 4, work 6 of the same. We shall add, besides, distances measured trigonometrically by means of our [instruments], by Dionysius Petavius [Denis Pétau], or by Adrian Metius, or by Herigonius [Pierre Hérigone], or by others, as found in Pétau's *Uranologion*, or in Metius's *On the Use of the Globe* [*De Usu Globi*]; and finally, any taken by Naclerus's nautical radius in the southern hemisphere. Next we shall give the declinations observed by Tycho, or by Paulus Hainzelius [Paul Hainzel] under examination by them. Afterward we shall set out the right ascensions, and the longitudes and latitudes derived from them.

CAPUT VIII.

On the Great Table of Distances, by which the Fixed Stars are distant among themselves; its Order, and its Use.

1. The order we follow is the alphabetical order of the constellations, so that the distances of the fixed stars may be found more readily. But because the distance is often between two stars of different constellations, the distance is to be sought under that constellation which precedes the other in alphabetical order. For example, if you seek the distance between the bright star of Aries [Lucida Arietis] and the southern eye of Taurus [Oculus Australis Tauri], look for it under the constellation Aries. And because within the same constellation too we keep the alphabetical order, in the constellation Andromeda we first place *Caput* (Head), then *Cingulum* (Girdle), and last *Pedem* (Foot); and so for the rest.

Distances taken by Tycho and by his assistants, and recorded in the *Epistolae* at pages 50 and 51, we mark with this note *Epist.* Those he transmitted in *Progymnasmata* [*Progymnasmatum*] tome 1 or 2, from page 195 to 232 and from page 284 to 294, and at page 344, we mark with this note *Prog. p.*, adding the page number as it appears in the Frankfurt edition of the year 1610. Those, finally, which our Father Albertus Curtius [Albert Curtz] of our Society — concealing his own name in the anagram *Lucius Barrettus* — by command of the Emperor Ferdinand had published at Vienna from the types of David Haut, inscribing them *Sylloge Ferdinanda*, we distinguish by this note *Syll. Ferd.*; and although hitherto we have for these no observations except those of the year 1582, we shall nonetheless distinguish our own corrections, which are in book 6 of the *Almagestum Novum*, by this pronoun *Nobis*, those taken by ourselves [per Radium], from those by Bernardo Vualtero [Bernhard Walther], or by Gassendi, or by Adrian Metius, or by Naclerus, under their own names. As for the

[distances] which Dionysius Petavius gives in *Uranologion* book 3, *Dissertatio* chapter 6, derived from Tychonic longitude or latitude — that is, given by Tycho — and so on, that is, those derived from data given by Tycho, which cannot be accurate, because Tycho in deriving longitude and latitude used a false distance of the poles — these distances, then, we deduce from the Tychonic declination and difference of right ascension, as being not entangled with the deception of the obliquity of the ecliptic; which we have done so that the reader may know, whenever we say *ex Tych. da.* (from Tychonic data), that he should understand under the note *da.* not data given, of whatever kind, but rather a difference of declination and of right ascension. We indicate these by those marks; but when we put *ex Tych. LL.*, a distance derived from Tychonic longitude and latitude is meant.

Great Table of Distances between the Fixed Stars in alphabetical order of the constellations [Magna Tabula Distantiarum inter Fixas ordine Alphabetico Constellationum]

ANDROMEDA

Pairing	Observers	G	M	S
Caput, & Cingulum Androm. (Head & Girdle of Andromeda)	Nobis saepe	1	2	5
		4	6	0
	ex Tych. da.	1	2	0
		4	6	
Caput, & pes Australis Andr. (Head & southern Foot of Andr.)	Nobis saepe	2	4	0
		6	2	
	ex Tych. da.	2	4	3
		6	2	0
Caput, & Arietis lucida (Head & bright star of Aries)	Tych. Epist.	2	7	3
		7		0
	Nobis semel	2	8	0
		7		
	saepius	2	8	3
		7		0
	ex Tych. da.	2	7	4
		7		0
Caput, & Cassiopeae genu (Head & knee of Cassiopeia)	Tych. Epist.	3	4	0
		3	1	

Pairing	Observers	G	M	S
	Tych. Syllog. F.	3	4	0
		3	1	
	&	3	4	0
		3	0	
	&	3	4	0
		3	2	
	ex Tych. da.	3	4	4
		3	1	0
Caput, & Cassiopeae Flexura (Head & bend of Cassiopeia)	Gassendo	3	2	1
		2	4	0
Caput, & Cassiopeae Schedir (Head & Schedir of Cassiopeia)	Gassendo	2	0	2
		8		0
	&	2	2	0
		8		
Caput, & Cygni Cauda (Head & Tail of Cygnus)	ex Tych. da.	4	2	0
		3	4	
Caput, & Pegasi Algenib. (Head & Algenib of Pegasus)	ex Tych. da.	1	5	5
		3	6	
Caput, & Pegasi genu (Head & knee of Pegasus)	Tych. Epist.	1	2	0
		8	8	
	Tych. Syllog. F.	1	2	3
		8	9	0
	&	1	2	3
		8	7	0
Caput, & Pegasi Markab. (Head & Markab of Pegasus)	Nobis	2	1	0
		0	2	
	&	2	1	4
		0	2	0
	Gassendo	2	1	0
		0	4	
	&	2	1	0
		0	2	
	ex Tych. da.	2	1	2
		0	1	4

Pairing	Observers	G	M	S
Caput, & Pegasi Scheat (Head & Scheat of Pegasus)	ex Tych. da.	1 3	4 1	4 0
Caput, & Persei latus luc. (Head & bright side of Perseus)	ex Tych. da.	4 2	1 5	3 0
Cingulum, & Pes Austr. Andr. (Girdle & southern Foot of Andr.)	Nobis	1 2	2 8	3 0
	ex Tych. da.	1 2	2 8	2 2
Cingulum, & lucida γ (Girdle & bright star of Aries)	Tycho	1 7	2 7	1 5
	Nobis	1 7	2 7	4 0
	ex Tycho da.	1 7	2 7	3 0
Cingulum, & Capella (Girdle & Capella)	Nobis	4 7	2 0	0
	ex Tycho da.	4 7	1 9	3 0
Cingulum, & Cygni cauda (Girdle & Tail of Cygnus)	ex Tycho da.	5 0	2 1	1 0
Cingulum, & Caput Medusae (Girdle & Head of Medusa)	Nobis	2 3	4 6	0
	ex Tycho da.	2 3	4 6	4 0
Cingulum, & Pegasi Algenib. (Girdle & Algenib of Pegasus)	ex Tych. da.	2 4	0	4
Cingulum, & Pegasi Markab. (Girdle & Markab of Pegasus)	Nobis	3 4	3 3	0
	ex Tycho da.	3 4	3 1	0
Cingulum, & Pegasi Scheat (Girdle & Scheat of Pegasus)	ex Tycho da.	2 7	3 5	3 0

ANDROMEDA (continued)

Pairing	Observers	G	M	S
Cingulum, & Persei Latus (Girdle & Side of Perseus)	Nobis	2 8	8 0	3 0
	ex Tycho da.	2 8	1 0	3 0
Cingulum, & Aldebara (Girdle & Aldebaran)	ex Tycho da.	4 9	3 1	5 0
Australior in manu Andr. & Pegasi genu (the more southern in the hand of Andr. & knee of Pegasus)	Tycho in Syllog.	1 7	6 0	0 0
	& bis	1 7	0 0	3 0
	& quinquies	1 6	5 8	0 0
Pes Austr. Andromedae, & Lucida γ (southern Foot of Andromeda & bright star of Aries)	Tycho	1 8	4 8	0 0
	Nobis	1 8	4 8	3 0
	ex Tych. da.	1 8	5 1	4 0
Pes au. & Aurigae hum. seq. (south. Foot & following shoulder of Auriga)	ex Tych. da.	4 1	5 0	2 0
Pes, & Capella (Foot & Capella)	ex Tych. da.	3 4	2 2	4 0
Pes, & Ceti Mandibula (Foot & Jaw of Cetus)	ex Tych. da.	4 0	2 4	4 0
Pes, & Cygni Cauda (Foot & Tail of Cygnus)	ex Tych. da.	5 5	4 1	1 0
Pes, & Pegasi Algenib (Foot & Algenib of Pegasus)	ex Tych. da.	3 6	2 0	1 0
Pes, & Pegasi Markab (Foot & Markab of Pegasus)	ex Tych. da.	4 6	5 3	3 0
Pes, & Pegasi Scheat (Foot & Scheat of	ex Tych. da.	4	3	5

Pairing	Observers	G	M	S
Pegasus)		4	8	5
Pes, & Persei latus luc. (Foot & bright side of Perseus)	Nobis	1	4	1
		5	5	0
	ex Tych. da.	1	4	0
		5	6	
Pes, & Aldebara (Foot & Aldebaran)	Nobis	4	2	0
		1	5	
	ex Tych. da.	4	2	5
		1	5	0
Pes, & Tauri Cornu bor. (Foot & northern Horn of Taurus)	ex Tych. da.	4	4	2
		2	3	5

ANTINOVS [Antinous]

Pairing	Observers	Gr.	I	II
Manus praeced. & Aquilae lucida (preceding Hand & bright star of Aquila)	Tycho	10	5	0
			6	
	Nobis	10	5	0
			7	
Manus praeced. & os Pegasi (preceding Hand & mouth of Pegasus)	Tych. Epist.	20	4	0
			1	
Manus alt. & os Pegasi (other Hand & mouth of Pegasus)	Tych. Syllog.	25	2	0
			7	
	&	25	2	3
			6	0

AQVARIVS [Aquarius]

Pairing	Observers	Gr.	I	II
Fomahant, & Lucida Υ (Fomalhaut & bright star of Aries)	Nobis	69	5	4
			5	0
	ex Tych. da.	69	5	4
			7	0
Fomahant, & cornu Υ praec. (Fomalhaut & preceding Horn of Capricorn)	ex Tych. da.	40	3	4
			5	0
Fomahant, & cornu Υ seq. (Fomalhaut	ex Tych. da.	39	3	5

Pairing	Observers	Gr.	I	II
& following Horn of Capricorn)			1	
Fomahant, & ceti Cauda austr. (Fomalhaut & southern Tail of Cetus)	Nobis	26	4	0
			8	
	ex Tych. da.	26	4	2
			8	0
Fomahant, & prima Eridani (Fomalhaut & first star of Eridanus)	Naucleris	39	4	0
			5	
Humerus praecedens seu sin. & Humerus sequens (preceding or left Shoulder & following Shoulder)	Tych. Epist.	10	1	0
	Nobis	10	0	3
				0
Hum. praec. & Lucida Aquilae (prec. Shoulder & bright star of Aquila)	Tych. prog. 230.	29	0	3
				0
	Nobis	29	5	3
			8	5
Hum. praec. & γ Cornu bor. Nobis 19. 21'. (prec. Shoulder & northern Horn of Capricorn)	Tycho Epist.	19	2	0
			5	
		19	2	0
			1	
Hum. praec. & Pegasi Algenib. (prec. Shoulder & Algenib of Pegasus)	ex Tych. da.	45	3	3
				6
Hum. praec. Pegasi Markab. (prec. Shoulder & Markab of Pegasus)	Tych. prog. 230.	31	3	1
				5
	Nobis	31	2	1
				0
	Metio	31	1	0
Hum. praec. & γ Cornu austr. (prec. Shoulder & southern Horn of Capricorn)	Tych. Epist.	19	3	0
			7	
Humer. sequens seu dextr. & Aquarii manus luc. (following or right Shoulder & bright Hand of Aquarius)	Tych. Epist.	21	2	3
			7	0

Pairing	Observers	Gr.	I	II
	ex Tych. da.	21	2 7	0
Hum. seq. & Aquilae lucida (foll. Shoulder & bright star of Aquila)	Tych. Epist.	34	5 3	3 0
	Nobis	34	5 4	0
	ex Tych. da.	34	5 4	3 0
Hum. seq. & Pegasi Algenib (foll. Shoulder & Algenib of Pegasus)	Nobis	35	7	5 0
Hum. seq. & Pegasi Markab. (foll. Shoulder & Markab of Pegasus)	Nobis	21	1 8	0
	ex Tych. da.	21	1 7	0
Hum. seq. & media Capitis ≈ (foll. Shoulder & middle of the Water- stream)	Tych. prog. 230.	48	5 9	2 0

AQVILA, seu VVLTVR VOLANS [Aquila, or the Flying Vulture]

Pairing	Observers	Gr.	I	II
Lucida, & Guttur Aquilae (bright star & throat of Aquila)	Nobis	2	3 3	0
Lucida, & Ala bor. Aquilae (bright star & northern wing of Aquila)	Nobis	12	7	0
Lucida, & Cauda Aquilae (bright star & Tail of Aquila)	Tych. Syllog.	8	2 8	3 0
	&	8	2 8	1 5

LVCIDA AQVILAE, & infrascriptae Stellae [the bright star of Aquila, and the stars listed below]

Pairing	Observers	Gr.	I	II
Antares cor Scorp. (Antares, the heart of Scorpius)	D. Valesio	60	9	0

ANTINOVS [Antinous] (continued — Manus / Hand pairings)

Pairing	Observers	Gr		I	
		.	I	I	
Antinoi Manus (Hand of Antinous)	Nobis	66	1	0	
			0		
	ex Tych. da.	60	9	1	
				5	
	Tych. Syllog.	10	5	0	
			1		
	&	10	5	0	
			2		
	&	10	5	0	
			3		
Arietis Lucida (bright star of Aries)	Tych. prog. 195.	96	1	0	
			5		
Capricorni Cornu super. (upper Horn of Capricorn)	Tych. Epist.	22	2	0	
			5		
	Nobis	22	2	1	
			5	0	
	ex Tych. da.	22	2	1	
			4	0	
Capricorni Cornu infer. (lower Horn of Capricorn)	Tych. Epist.	24	4	0	
			5		
Coronae austr. Lucida (bright star of southern Corona)	Naucleris	50	4	0	
			5		
Cygni Cauda (Tail of Cygnus)	Tych. Epist.	38	4	3	
				0	
	Tych. Syllog.	38	4	3	
				0	
	Nobis	38	4	2	
				0	
	ex Tych. da.	38	3	0	
Cygni Pectus (Breast of Cygnus)	Tych. Syllog.	32	1	0	
			2		
	Nobis	32	1	1	

Pairing	Observers	Gr	I	
		.	I	I
			2	5
Cygni Rostrum (Beak of Cygnus)	Tych. Epist.	19	4	0
			0	
	Tych. Syllog.	19	4	0
			0	
	&	19	3	4
			9	0
	ex Tych. da.	19	3	5
			9	0
Cygni ancor. alae seq. (anterior of the following wing of Cygnus)	Nobis	28	8	3
				5
Cygni media alae bor. (middle of the northern wing of Cygnus)	Tych. Syllog.	43	4	0
Herculis caput (Head of Hercules)	Tych. Syllog.	38	3	0
			0	
	&	38	3	0
			1	
	&	38	3	0
			2	
	Tych. Epist.	38	3	0
			2	
Herculis hum. sinist. (left Shoulder of Hercules)	Tych. Syllog.	48	4	3
			3	0
Lyrae lucida (bright star of Lyra)	Tych. Syllog.	34	9	0
	&	34	8	0
	&	34	8	2
			0	
	&	34	8	4
			0	
	&	34	9	3
			0	
	&	34	1	0
			0	

Pairing	Observers	Gr	I	
		.	I	I
[Lyrae lucida, cont.]	Nobis saepe	34	9	0
Ophiuchi manus sin. (left Hand of Ophiuchus)	Tych. Syllog.	42	4	0
			0	
	&	42	3	3
			8	0
	&	42	3	0
			9	
Ophiuchi caput (Head of Ophiuchus)	Tych. Syllog.	33	3	0
			0	
	Nobis	33	3	4
			0	0
	ex Tych. da.	33	3	4
			1	0
Ophiuchi manus lucidior (brighter Hand of Ophiuchus)	Tych. Epist.	55	1	1
			7	0
	Tych. prog. 200.	55	1	2
			7	0
Pegasi Markab. (Markab of Pegasus)	Tych. prog. 198.	47	4	4
			9	0
	& pr. 199.	47	4	0
			9	
	Nobis	47	4	2
			9	0
Pegasi os (mouth of Pegasus)	ex Tych. da.	28	3	4
			0	
Pegasi Scheat (Scheat of Pegasus)	ex Tych. da.	48	1	1
			7	5
Piscis australis os (mouth of the Southern Fish)	Tych. Epist.	48	1	3
			6	0
Piscis praeced. dorsum (back of the preceding Fish)	Tych. Epist.	53	5	0
			5	
Piscis australis caput (head of the Southern Fish)	Tych. Epist.	51	3	0
			2	

Pairing	Observers	Gr	I	I
Sagittarii hum. sin. (left Shoulder of Sagittarius)	D. Valesio	37	3	0
			2	
Spica Virginis (Spica of Virgo)	Tych. prog. p. 195. & 199.	97	5	0
			0	

ARGONAVIS [Argo Navis]

Pairing	Observers	Gr.	I	II
Canopus, & Hydrae lucida (Canopus & bright star of Hydra)	Nacleris	57	5	0
			2	
Canopus, & Sirius (Canopus & Sirius)	Nacleris	36	5	0
			0	

ARIES

Pairing	Observers	Gr.	I	II
Prima Υ , & Pegasi Markab (first star of Aries & Markab of Pegasus)	Tych. prog. 229.	40	2	3
			3	0
Prima Υ , & Aldebara (first star of Aries & Aldebaran)	Tych. Epist.	38	3	0
			6	
	Tych. prog. 229.	38	3	0
			9	
	Tych. Syllog.	38	3	3
			9	0
	&	38	3	3
			7	0
	&	38	3	0
			8	
Secunda Υ , & Aldebara (second star of Aries & Aldebaran)	Tych. Epist.	38	2	4
			1	0
Secunda Υ , & Cinguli Andr. (second star of Aries & Girdle of Andromeda)	Nobis	17	4	0

LVCIDA, seu 3. Arietis, & infrascriptae [the bright, or 3rd, star of Aries, and those listed below]

Pairing	Observers	Gr.	I	II
2. Arietis ipsius (the 2nd star of Aries itself)	Gassendo	3	5	2

Pairing	Observers	Gr.	I	II
			3	4
Aurigae hum. sinist. (left Shoulder of Auriga)	ex Tych. da.	43	4	5
			8	2

AVRIGA, seu ERICHTONIVS [Auriga, or Erichthonius] (and Cassiopeia pairings)

Pairing	Observers	G	I	II
Aurigae hum. dextr. (right Shoulder of Auriga)	ex Tych. da.	5	2	4
		1	5	3
Aurigae Capella (Capella of Auriga)	Tycho	4	6	3
		4		5
	Nobis	4	5	5
		4		0
	Metio	4	6	0
		4		
1 Cassiopeae in capite (1, in the head of Cassiopeia)	Tych. prog. 283.	3	4	3
		4	7	0
2 Cassiopeae Schedir	pag. 284.	3	3	2
		6	8	0
	in Epist.	3	3	4
		6	8	5
3 Cassiop. in Cingulo (in the girdle)	Tych. prog. 285.	3	1	0
		7	2	
4 Cassiop. in Flexura (in the bend)	Tych. prog. 285.	3	1	4
		9	0	5
	in Epist.	3	1	3
		9	0	0
	in Syllog.	3	1	3
		9	0	0
	&	3	1	0
		9	0	
5 Cassiop. in Genu (in the knee)	Tych. prog. 286.	3	2	0
		7	7	
	in Epist.	3	2	0
		7	7	

Pairing	Observers	G	I	II
	in Syllog.	3	2	3
		7	7	0
6 Cassiop. in Crure (in the leg)	Tych. prog. 286.	4	1	4
		0	3	0
7 Cassiop. pedis extrema (the outermost of the foot)	p. 287.	4	2	3
		4		0
8 Cassiop. in dextro cubito (in the right elbow)	p. 287.	3	5	3
		9	6	0
9 Cassiop. in pede Cathed. (in the foot of the throne)	p. 288.	4	2	0
		2	9	
10 Cassiop. lucida Cathed. (the bright star of the throne)	p. 288.	4	2	4
		1	0	5
	in Epist.	4	1	3
		1	9	0
11 Cassiop. extrema Cathed. (the outermost of the throne)	Tych. prog. 289.	4	3	0
		1	2	
12 Cassiop. in Scabello (on the footstool)	p. 289.	4	1	3
		5	0	0
13 Cassiop. praec. genua (preceding the knees)	p. 290.	4	4	0
		5	7	
15 Cassiop. stellula ad crines (the little star at the hair)	p. 291.	3	4	0
		5	6	
16 Cassiop. ultima virgae (the last of the rod)	p. 291.	2	5	3
		8	4	0
17 Cassiop. in brachio sin. (in the left arm)	p. 292.	3	2	0
		3	1	
18 Cassiop. in cubito sin. (in the left elbow)	p. 292.	3	3	0
		3	8	
19 Cassiop. apud extra sellae (near, outside the seat)	p. 292.	4	2	0
		3		
20 Cassiop. inter 11. & 12. (between 11 and 12)	p. 292.	4	5	3
		5		0
21 Cassiop. extrema sellae (the outermost of the seat)	p. 293.	4	5	0
		8	4	

Pairing	Observers	G	I	II
22 Cassiop. media Scabelli (the middle of the footstool)	p. 293.	4 7	2 3	0
23 Cassiop. sequens genu (following the knee)	p. 293.	3 6	1 4	3 0
24 Cassiop. in virga praec. (in the rod, preceding)	p. 293.	3 1	4 1	0
25 Cassiop. in virga sequens (in the rod, following)	p. 294.	3 1	2 3	0
26 Cassiop. virgae penult. (the next-to-last of the rod)	p. 294.	2 9	4 0	0

LVCIDA Arietis, & infrascripta [the bright star of Aries, and those listed below]

Pairing	Observers	G .	I	II
Ceti cauda austral. (southern Tail of Cetus)	Nobis	4 6	1 2	0
Ceti cauda boreal. (northern Tail of Cetus)	Tycho	4 1	3 7	0
	Nobis	4 1	3 7	4 0
Draconis Stella sub polo (star of Draco below the pole)	Tych. prog. 212.	8 4	2 0	3 0
Geminor. Calx pedis (heel of the foot of Gemini)	Tych. prog. 199.	5 8	2 2	0
Gemini Pollucis caput (head of Pollux of Gemini)	Tych. prog. 195.	7 4	4 5	3 0
Geminorum pes lucidus (bright foot of Gemini)	ex Tych. da.	6 3	2 4	5 0
Medusae caput (Head of Medusa)	Nobis	2 1	3 9	2 0
	ex Tycho da.	2 1	3 9	2 5
	Gassendo	2 1	4 0	5 0
	&	2	3	3

Pairing	Observers	G		
		.	I	II
		1	5	0
Orionis 1. Balthei (1st of the Belt of Orion)	Tych. Epist.	5	7	4
		5		0
	ex Tych. da.	5	8	1
		5		0
Orionis hum. sinistr. (left Shoulder of Orion)	Tych. Epist.	5	3	2
		0	1	0
	ex Tych. da.	5	3	0
		0	2	
Orionis pes lucid. sin. (bright left foot of Orion)	Nobis	5	4	0
		5	1	
	ex Tych. da.	5	4	5
		5	0	2
Pegasi Algenib.	Nobis	2	2	5
		8		
	ex Tych. da.	2	0	5
		8		5
Pegasi Markab.	Tych. prog. 199.	4	3	1
		3	7	5
	Nobis	4	3	1
		3	7	0
Pegasi Scheat	Tych. Epist.	4	1	3
		1	6	0
	in Syllog.	4	1	0
		1	6	
	&	4	1	4
		1	6	5
Persei latus lucidum (bright side of Perseus)	Nobis	3	1	4
		0	7	0
Pleiadum lucida (bright star of the Pleiades)	Tycho Epist.	2	5	3
		2	6	0
	Nobis	2	5	4
		2	7	0

Pairing	Observers	G		
		.	I	II
Tauri Cornu boreum (northern Horn of Taurus)	Gassendo	2	5	4
		2	5	6
	Nobis	4	4	5
		4	1	0
Tauri ocul. austr. Aldeb. (southern eye of Taurus, Aldebaran)	ex Tycho da.	4	4	0
		4	2	
	Tych. prog. 229.	3	8	3
		3		0
Tauri ocul. austr. Aldeb. (southern eye of Taurus, Aldebaran)	Metio	3	8	0
		3		
	Tych. Epist.	3	3	0
		5	2	
Tauri ocul. austr. Aldeb. (southern eye of Taurus, Aldebaran)	in Syllog.	3	3	0
		5	2	
	& ibi	3	3	2
		5	2	0
Tauri ocul. austr. Aldeb. (southern eye of Taurus, Aldebaran)	Progymn. 200.	3	3	1
		5	2	0
	Nobis saepe	3	3	0
		5	2	

Pairing	Observers	Gr.	I	II
Quae supra Caudam ♉, & Aldebara (those above the Tail of Aries, & Aldebaran)	Tycho Epist.	26	4	0
			5	

AVRIGA, seu ERICHTONIVS [Auriga, or Erichthonius]

Pairing	Observers	Gr.	I	II
Capella, & infrascriptae (Capella, & those listed below)	Gassendo	7	3	3
			8	0
Aurigae hum. dextr. (right Shoulder of Auriga)	Nobis	7	4	0
			0	
	ex Tych. da.	7	4	0
			3	

Pairing	Observers	Gr.	I	II
Aurigae Hoedor. pes (foot of the Kids of Auriga)	Nobis	3	6	0
Cancri praesepe bor. (northern Manger of Cancer)	ex Tych. da.	48	5 7	1 0
Canis maior Sirius (Sirius of Canis Major)	ex Tych. da.	64	5 1	2 0
Canis minor Procyon (Procyon of Canis Minor)	Nobis	51	7	0
	ex Tycho da.	51	7	3 5
1 Cassiopeae caput (head)	Tych. prog. 284.	43	4 4	3 0
2 Cassiop. Schedir	ex Tych. da.	42	4 8	3 0
3 Cassiop. in cingulo (in the girdle)	Tych. prog. 285.	41	7	4 5
6 Cassiop. in crure (in the leg)	pro 286.	32	4 6	3 0
7 Cassiop. pedis extrema (outermost of the foot)	p. 287.	30	1 8	3 0
8 Cassiop. in cubito dext. (in the right elbow)	p. 287.	48	9	3 0
9 Cassiop. in pede cathed. (in the foot of the throne)	p. 288.	41	5 3	3 0
11 Cassiop. cathed. extr. (outermost of the throne)	p. 289.	48	3	0
12 Cassiop. scabell. ad plant. (footstool, at the sole)	p. 289.	34	4 4	0
13 Cassiop. praec. genua (preceding the knees)	p. 290.	36	5 5	0
15 Cassiop. stellula crinium (the little star of the hair)	p. 291.	44	1 5	3 0
16 Cassiop. ultim. virgae (the last of the rod)	p. 291.	45	2 5	0

Pairing	Observers	Gr.	I	II
17 Cassiop. in brach. sin. (in the left arm)	p. 292.	38	4 2	0
18 Cassiop. in cub. sin. (in the left elbow)	p. 292.	39	2 9	0
19 Cassiop. ad extrem. sellae (at the outermost of the seat)	p. 292.	48	3 1	0
20 Cassiop. inter 11. & 12. (between 11 and 12)	p. 292.	36	1 4	3 0
21 Cassiop. scabelli extrem. (outermost of the footstool)	p. 293.	37	4 2	3 0
22 Cassiop. scabelli media (middle of the footstool)	p. 293.	36	1 5	0
23 Cassiop. quae sequit. gen. (which follows the knee)	p. 293.	34	5 9	3 0
24 Cassiop. in virga praeced. (in the rod, preceding)	p. 293.	44	1 5	0
25 Cassiop. in virg. sequens (in the rod, following)	p. 294.	43	3 0	0
26 Cassiop. penult. virgae (next-to-last of the rod)	p. 294.	44	4 3	0

CAPELLA item, & infrascriptae [Capella, also, and those listed below]

Pairing	Observers	Gr.	I	II
Geminorum calx pedis (heel of the foot of Gemini)	Metio	27	1	0
Gemin. Castoris caput (head of Castor of Gemini)	Nobis	29	5 9	5 0
Gemini Pollucis caput (head of Pollux of Gemini)	Tych. Epist.	34	1 8	3 0
	ex Tych. da.	34	1 8	4 0
Geminorum pes lucidus (bright foot of Gemini)	ex Tych. da.	33	2 0	4 0
Medusae caput (Head of Medusa)	Nobis	23	3 7	0

Pairing	Observers	Gr.	I	II
	ex Tych. da.	23	3 6	3 0
Orionis humerus lucid. (bright Shoulder of Orion)	Nobis	39	3 0	0
	ex Tycho da.	39	3 2	0
Orionis pes lucidus (bright foot of Orion)	ex Tych. LL.	54	1 8	5
Persei lucidum latus (bright side of Perseus)	Nobis	19	1 1	5
Pleiadum Lucida (bright star of the Pleiades)	Nobis	28	2 1	0
	ex Tych. da.	28	1 9	4 0
Regulus cor ♀ (Regulus, the heart of Leo)	ex Tych. da.	69	3 7	3 0
Tauri cornu boreal. (northern Horn of Taurus)	Tycho	17	3 1	0
	Nobis	17	3 1	2 0
Tauri oculus austral. (southern eye of Taurus)	Gassendo	30	4 5	0
Tauri oculus austr. Aldeb. (southern eye of Taurus, Aldebaran) [Nostris Oenipont. observatoribus / by our observers at Innsbruck]	Nobis	30	4 2	3 0
	&	30	4 3	3 0
	ex Tych. da.	30	4 3	2
	ex Tych. LL.	30	4 3	3 4
Ursae Minoris ult. caudae (last of the tail of Ursa Minor)	ex Tych. da.	44	2 4	2 0

Pairing	Observers	Gr.	I	II
Ursae Maior humerus lucid. (bright Shoulder of Ursa Major)	ex Tych. da.	50	6	0
Ursae Maioris Ilia (flank of Ursa Major)	ex Tych. da.	52	4	1 0
Ursae Maioris Co. luc. (bright [star] of Ursa Major)	ex Tych. da.	59	4 8	2 0
Ursae Maioris tergus (back of Ursa Major)	ex Tych. da.	60	1 7	1 5
Aurigae humerus dexter, & Persei latus lucidum (right Shoulder of Auriga & bright side of Perseus)	Nobis	26	3 3	0
	Tychoni	26	3 4	3 0
Aurigae pes borealis, & Orionis hum. lucid. (northern foot of Auriga & bright Shoulder of Orion)	Nobis	29	6	0
Pes idem, & Pollucis Caput (the same foot & head of Pollux)	Tych. Epist.	36	2 3	3 0
Pes idem, & Procyon (the same foot & Procyon)	Nobis	46	4 8	0
Pes idem, & Aldebara (the same foot & Aldebaran)	Tych. Epist.	33	3	3 0
Pes lucid. Aurigae Pollucis Cap. (bright foot of Auriga & head of Pollux)	Tych. Epist.	30	3 3	4 5
Pedes Hoedorum, & luc. pes II (feet of the Kids & bright foot of Gemini)	Nobis	34	9	0
Hoedi inter se se (the Kids between themselves)	Gassendo	0	4 4	4 0

[The Great Table of distances by which the fixed stars are separated from one another continues, alphabetically by constellation. Each row pairs two stars (or names a single star reckoned from the constellation's principal star, under the "& infrascriptæ" rubrics) and gives their angular distance in degrees (Gr.), minutes ('), and seconds ("), together with the observer or source: *Nobis* ("by us"), *Gassendo* (Gassendi), *Nauccleris* (Schiller/Bayer's *Nauccler*), *Tycho* / *ex Tych. da.* (from Tycho's data) / *ex Tych. LL.* / *Tych. Epist.* (Tycho's letters) / *Tych. prog.*

(Tycho's *Progymnasmata*, with page) / in *Sylog.* / *Tych. ibidem*, and *Petavius* (Petau). The astronomical symbol ♂ (in the observer column) marks an alternative or mean value for the same pair.]

BOOTES, or ARCTOPHYLAX

ARCTURUS, and those listed below

Stars compared	Observer	Gr.	'	"
The bright star in the leg of Bootes [Tibia Bootis lucida]	Gassendo	5	1 0	3 0
	ex Tych. da.	5	1 2	0
The bright star of the northern Crown [Coronæ bor. lucida]	Nobis	19	3 3	2 0
	ex Tych. da.	19	3 4	5 0
	Gassendo	19	3 2	0
	♂	19	3 5	0
Head of Hercules [Herculis Caput]	ex Tych. da.	42	4 9	5 0
Northern Balance [Lanx Borealis]	ex Tych. da.	32	2 6	1 0
Southern Balance [Lanx Australis]	ex Tych. da.	36	2 6	1 0
Tail of Leo [Leonis Cauda]	Nobis	35	2 4	4 0
Heart of Leo [Leonis Cor]	Nobis	59	4 9	0
	ex Tych. da.	59	4 8	1 0
The bright star of Lyra [Lyræ lucida]	Nobis	58	5 2	0
	ex Tych. da.	58	5 0	3 5

Stars compared	Observer	Gr.	'	"
	ex Tych. LL.	58	5	4
			0	0
Heart of Scorpio, Antares [Scorpij Cor Antares]	Nobis	56	4	1
				0
	ex Tych. da.	56	4	2
				0
The more northern star of the front of Scorpio [Scorpij borealior frontis]	ex Tych. da.	49	2	2
			7	5
The bright star of the neck of Serpens [Serpentis lucida colli]	ex Tych. da.	25	1	4
			6	0
Spica of Virgo [Spica Virginis]	Gassendo	33	2	0
	Nobis	33	2	1
				0
	♂	33	1	5
				0
	ex Tych. da.	33	1	1
				5
	ex Tych. LL.	33	2	0
Vindemiatrix	Gassendo	19	3	0
			6	
	ex Tych. da.	19	4	4
			1	0
The bright star in the shoulder of Ursa Minor [Vrsæ Minoris hum. lucid.]	Nobis	55	2	4
				0
The bright shoulder of Ursa Maior [Vrsæ Maioris humerus lucid.]	Nobis	53	4	0
			7	
	ex Tych. da.	53	4	2
			6	0
The flank of Ursa Maior [Vrsæ Maioris Ilia]	Nobis	51	3	2
			3	0
	ex Tych. da.	51	3	0
			5	
The bright star in the hip of Ursa Maior [Vrsæ Maioris lucida Coxæ]	Nobis	43	5	4
			1	0

Stars compared	Observer	Gr.	'	"
	ex Tych. da.	43	5 0	3 0
The back of Ursa Maior [Vrsæ Maioris tergus]	Nobis	43	4 5	0
	ex Tych. da.	43	4 5	3 0
The 1st star in the tail of Ursa Maior [Vrsæ Maioris 1. Caudæ]	Nobis	39	4 3	2 5
The 2nd star in the tail of Ursa Maior [Vrsæ Maioris 2. Caudæ]	Nobis	36	5 5	1 5
The last star in the tail of Ursa Maior [Vrsæ Maioris vlt. Caudæ], perhaps 30. 31. [forte 30. 31.]	Nobis	30	3 1	3 0
	Gassendo	30	2 1	0
	ex Tych. da.	30	2 9	5 0
Arcturus, and the bright star in the hip of Bootes [Arcturus, & lucida Coxę Boot.]	Nobis	10	1 3	0
Arcturus, and the unformed star beneath it of the 2nd magnitude [Arcturus, & Informis sub ipso 2. Magnit.]	Nobis	9	5 7	0
The same unformed star, and the bright star of the Crown [Eadē inform. & Coronę lucida]	Nobis	11	0	0

CANCER

Stars compared	Observer	Gr.	'	"
The northern Ass, and Regulus [Asellus boreus, & Regulus]	Tych. prog. 229.	22	2 9	3 0
The northern Ass, and the bright star in the foot of Gemini [Asell. boreus, & lucidus pes II]	Tych. prog. 229.	30	4	3 0
	ex Tych. da.	30	4	1

Stars compared	Observer	Gr.	'	"
				0

CANIS MAIOR

SIRIUS, and those listed below

Stars compared	Observer	Gr.	'	"
Procyon of Canis Minor [Canis Minor Procyon]	Tych. Epist.	25	4	3
			1	0
	Gassendo	25	4	0
			0	
	♂	25	4	0
			2	
	Nobis	25	4	4
			1	0
	♂	25	4	0
			2	
	ex Tych. da.	25	4	5
			1	0
	ex Tych. LL.	25	4	3
			0	0
The star of Eridanus near the foot of Orion [Eridani quæ ad ped. Orion]	Nobis	26	2	0
			4	
The first of the Hyades, in Taurus [Hyadum ♂ prima]	Nobis	46	5	0
			6	
The middle of the Hyades [Hyadum media]	Nobis	49	2	0
The outermost of the Hyades, at the Nostrils [Hyadum extrema Natium]	Nobis	48	1	0
			4	
	ex Tych. da.	48	1	1
			5	8
Heart of Hydra [Hydræ Cor]	Nobis	40	1	0
			9	
Heart of Leo [Leonis Cor]	Nobis	57	4	3
			3	0
	ex Tych. da.	57	4	4

Stars compared	Observer	Gr.	'	"
			3	5
	ex Tych. LL.	57	4	3
			3	2
The bright star of the back of Lepus [Leporis lucida Dorsi]	Nobis	17	2	0
			7	
The 1st star of the Belt of Orion [Orionis 1. balthai]	Nobis	22	5	0
			7	
	ex Tych. da.	22	5	5
			5	0
The 2nd star of the Belt of Orion [Orionis 2. balthai]	Nobis	22	5	0
			6	
The 3rd star of the Belt of Orion [Orionis 3. balthai]	Nobis	21	3	0
			7	
	ex Tych. da.	21	3	0
			6	
The bright star of the sword of Orion [Orionis lucida ensis]	Nobis	20	1	0
			0	
The right knee of Orion [Orionis genu dext.]	Nobis	15	4	0
			2	
The bright shoulder of Orion [Orionis hum. lucid.]	Gassendo	26	5	0
			7	
	♂	26	5	0
			8	
	♂	26	5	0
			9	
	ex Tych. da.	26	5	0
			8	
	ex Tych. LL.	26	5	5
			8	0
The left shoulder of Orion [Orionis hum. sinistr.]	Gassendo	30	6	0
	♂	30	6	5
				0
The bright star in the foot of Orion, Rigel	Tych. Epist.	23	4	4

Stars compared	Observer	Gr.	'	"
[Orionis pes lucid. Rigel]			1	0
	Nobis	23	4	0
			0	
	♂	23	4	2
			0	0
	Gassendo	23	4	0
			2	
	ex Tych. da.	23	4	3
			0	0
The southern eye of Taurus [Tauri oculus austral.]	Nobis	45	5	5
			8	0
	Tych. Epist.	45	5	3
			7	0
	ex Tych. da.	45	5	4
			7	0
	ex Tych. LL.	45	5	2
			8	0
The Root of the Tail of Canis, and the Heart of Hydra [Radix Caudæ Canis, & Cor Hydræ]				
	Nobis	37	2	0
			8	

CANIS MINOR, CANICULA

PROCYON, and those listed below

Stars compared	Observer	Gr	.	'	"
Algomisa					
	Bern. Vualtero [Bernhard Walther]	4	1	0	
				2	
	♂	4	1	0	
				4	
Head of Gemini, Castor [Gemini Castoris Caput]	Nobis	26	3	0	
				5	
	ex Tych. da.	26	3	1	
				5	0
Head of Gemini, Pollux [Gemini	Nobis	22	4	5	

Stars compared	Observer	Gr		
		.	'	"
Pollucis Caput]			4	0
	Gassendo	22	4	0
			3	
	ex Tych. da.	22	4	0
			5	
The bright star in the foot of Gemini [Geminorum Pes lucidus]	Tycho	18	4	0
			8	
	Nobis	18	4	0
			9	
The heel of Gemini, Castor [Geminorum Calx Castoris]	Nobis	25	1	0
			5	
The nearer star of Gemini [Geminorum Propus]	Nobis	18	4	0
			9	
Heart of Hydra [Hydræ Cor]	Tych. Epist.	30	2	0
			0	
	Nobis	30	1	0
			9	
	Gassendo	30	1	0
			9	
Heart of Leo [Leonis Cor]	Tych. Epist.	37	1	3
			9	0
	Nobis	37	2	0
			0	
	ex Tych. da.	37	1	4
			9	0
The 1st star of the Belt of Orion [Orionis 1. balthei]	ex Tych. da.	32	1	2
			9	0
The 2nd star of the Belt [2. balthei]	Nobis	31	2	0
			9	
	ex Tych. da.	31	2	0
			9	
The 3rd star of the Belt [3. balthei]	Nobis	30	3	0
			5	

Stars compared	Observer	Gr		
		.	'	"
	ex Tych. da.	30	3	5
			4	0
The bright shoulder of Orion [Orionis humerus lucid.]	Nobis	26	2	5
				0
	Gassendo	26	2	0
The left shoulder of Orion [Orionis hum. sinist.]	Nobis	33	2	2
			8	0
	ex Tych. da.	33	2	3
			7	0
The bright star in the foot of Orion [Orionis pes lucidus]	Tycho Epist.	38	3	3
			7	0
	Nobis	38	3	3
			7	0
	♂ olim [formerly]	38	3	0
			8	
	ex Tycho da.	38	3	5
			7	1
The southern horn of Taurus [Tauri Cornu austr.]	ex Tycho da.	33	3	4
			3	0
The northern horn of Taurus [Tauri Cornu boreale]	Nobis	39	1	0
			4	
The southern eye of Taurus [Tauri Oculus austr.]	Tych. Epist.	46	2	0
			2	
	Nobis	46	2	0
			2	
	ex Tych. da.	46	2	5
			1	0
The bright star of the Neck of Canicula, and the bright star of the foot of Gemini [Lucida Colli Caniculæ, & lucida pedis II]	Nobis	14	3	0
			0	

CAPRICORNUS

Stars compared	Observer	Gr.	'	"
The preceding star of the Tail, and the horn above [Caudæ præced. & cornu super]	Tych. prog. 230.	20	1 5	4 5
The following star of the Tail, and Aquila [Caudæ sequens, & Aquila]	Tycho	38	5	0
The preceding star of the Tail, and Markab [Caudæ præc. & Markab]	Tych. prog. 230.	38	3	3 0

The rest see under AQUARIUS, and under AQUILA.

CASSIOPEA

Stars compared	Observer	Gr.	'	"
The head of Cassiopea, and the bright star of the Chair [Caput Cassiop. et Cathed. lucid.]	Tych. prog. 345.	6	3 3	3 0
The head, and the girdle of Cassiopea [Caput, & cingulum Cass.]	p. 346.	4	1 7	0
The head, and the leg of Cassiopea [Caput, & crus Cass.]	p. 346.	13	5 3	0
The head, and the knee of Cassiopea [Caput, & poples Cass.]	p. 346.	9	6	0
The head, and Schedir of Cassiopea [Caput, & schedir Cass.]	p. 345.	2	4 1	0
The head, and the outermost star of the foot of Cassiopea [Caput, & pedis extrem. Cass.]	p. 346.	18	5 4	0
The head, and the flank of Cassiopea [Caput, & Ilia Cass.]	p. 345.	7	2 0	0
The girdle, and the knee of Cassiopea [Cingulum, & poples Cassiop.]	Tych. prog. 346.	5	1 9	3 0
The girdle, and the leg of Cassiopea [Cingulum, & crus Cass.]	p. 346.	9	5 3	0
The girdle, and the outermost star of the foot of Cassiopea [Cingulum, &	p. 346.	14	4	0

Stars compared	Observer	Gr.	'	"
pedis extr. Cass.]			5	
The girdle, and the upright of the Chair of Cassiopea [Cingulū, & sellæ erectio Cass.]	p. 345.	5	2 3	0
The girdle, and the knee of Cassiopea [Cingulum, & genu Cass.]	in Epist.	5	1 9	0
The girdle, and the flank of Cassiopea [Cingulum, & Ilia Cass.]	p. 345.	3	3	0
The leg, and the outermost star of the foot of Cassiopea [Crus, & extr. ped. Cassiop.]	Tych. prog. 346.	5	9	0
The leg, and the flank of Cassiopea [Crus, & Ilia Cass.]	pag. 345.	7	1 9	0
The left knee, and Aldebaran [Genu sinistrum, & Aldebara]	Tych. Epist.	55	2 3	3 0
	in Syllog.	55	2 3	3 0
	♂	55	2 3	0
The knee, and the bend of Cassiopea [Genu, & flexura Cass.]	Tych. Epist.	3	3 5	3 0
The knee of Cassiopea, and Scheat of Pegasus [Genu Cass. & Pegasi Scheat]	ex Tych. da.	40	2	0
The bright star of the Chair, and the tail of Cygnus [Cathed. lucida, & Cygni cauda]	Nobis	33	3 2	2 0
The bright star of the Chair, and the girdle of Cassiopea [Cath. luc. & cingul. Cass.]	Tych. Epist.	5	1 7	3 0
	prog. 345.	5	1 9	0
The bright star of the Chair, and the outermost star of the Chair [Cath. luc. & extrema Cath.]	Tych. Epist.	4	4 5	0
The bright star of the Chair, and the leg	Tych. Epist.	13	1	0

Stars compared	Observer	Gr.	'	"
of Cassiopea [Cath. luc. & Crus Cass.]			8	
	prog. 345.	13	1 7	3 0
The bright star of the Chair, and the flank of Cassiopea [Cath. luc. & Ilia Cass.]	Tych. prog. 345.	6	1 2	3 0
The bright star of the Chair, and the outermost star of the foot of Cassiopea [Cath. luc. & pedis extr. Cass.]	Tych. prog. 345.	17	2 6	0
The bright star of the Chair, and the knee, or the bend [Cath. lucid. & Poples, seu genu]	Tych. prog. 345.	9	4 2	0
	in Epist.	9	4 1	0
The bright star of the Chair, and Schedir [Cathed. luc. & Schedir]	Tych. prog. 345.	4	5 9	0
	in Epist.	4	5 7	3 0
The bright star of the Chair, and the bend of Cassiopea [Cath. luc. Flexura Cass.]	Tych. Epist.	6	1 0	3 0
The bright star of the Chair, and the Pole Star [Cath. luc. & Stella Polaris]	Tych. prog. 346.	30	1 3	3 0
	♂ Nobis	30	1 3	3 0
The bright star of the Chair, and the head of Pollux [Cath. luc. & Pollucis caput]	Tych. prog. 288.	77	2 5	0
	Nobis	77	2 5	2 0
The bright star of the Chair, and Markab of Pegasus [Cath. luc. & Pegasi Markab.]	Nobis	45	3 2	0
	ex Tych. da.	45	3 1	3 5

Stars compared	Observer	Gr.	'	"
The bright star of the Chair, and Scheat of Pegasus [Cath. luc. & Pegasi Scheat]	Nobis	33	4	0
	ex Tych. da.	33	3	0
The bend of Cassiopea, and Schedir [Flexura Cassiop. & Schedir]	Tych. prog. 345.	4	4	0
			0	
The bend of Cassiopea, and the head of Pollux [Flexura Cass. & Pollucis Cap.]	Tych. prog. 285.	71	2	0
			5	
The flank of Cassiopea, and the outermost star of the foot [Ilia Cass. & pedis extrema]	Tych. prog. 345.	11	5	3
			6	0
The flank, and the leg of Cassiopea [Ilia, & Poples Cass.]	Tych. prog. 345.	3	3	0
			5	
The flank, and the Pole Star [Ilia, & Polaris Stella]	Tych. prog. 346.	28	3	0
			6	
The knee of Cassiopea, and the leg [Poples Cassiop. & Crus]	Tych. prog. 346.	4	5	0
			0	
The knee, and the outermost star of the foot of Cassiopea [Poples, & ped. extr. Cass.]	p. 346.	9	5	0
			6	
The knee, and the upright of the Chair of Cassiopea [Poples, & Sellæ erectio Cass.]	p. 345.	6	4	3
			8	0
The knee, and Schedir [Poples, & Schedir]	p. 345.	6	5	0
			6	
Schedir, and the girdle of Cassiopea [Schedir, & cingul. Cassiop.]	Tycho Epist.	1	4	0
			0	
	prog. 345.	1	4	0
			2	
Schedir, and the leg of Cassiopea [Schedir, & crus Cass.]	prog. 345.	11	3	0
			3	
Schedir, and the outermost star of the foot of Cassiopea [Schedir, & pedis extr. Cass.]	prog. 345.	16	2	0
			8	

Stars compared	Observer	Gr.	'	"
Schedir, and the upright of the Chair [Schedir, & Sellæ erectio]	prog. 345.	6	2	0
			7	
Schedir, and the tail of Cygnus [Schedir, & cauda Cygni]	Nobis	37	5	3
			8	0
Schedir, and Markab of Pegasus [Schedir, & Markab. Pegasi]	ex Tych. da.	45	3	3
			1	5
Schedir, and Scheat of Pegasus [Schedir, & Pegasi Scheat]	Nobis	33	1	2
			4	0
	ex Tycho da.	33	1	2
			5	0
Schedir, and the Pole Star [Schedir, & Polaris Stella]	Tych. Epist.	32	4	4
			7	5
	prog. 346.	32	4	3
			8	0
	Nobis	32	4	4
			7	0
Schedir, and the head of Pollux [Schedir, & Pollucis Caput]	Tych. prog. 284.	75	1	1
			1	5
	Nobis	75	1	1
			0	0
The upright of the Chair, and the bright star of the Chair [Sellæ erectio, & luc. Cath.]	Tych. prog. 345.	4	4	0
			4	
The upright of the Chair, and the head of Cassiopea [Sellæ erect. & Caput Cass.]	pr. 345.	9	3	0
The upright of the Chair, and the leg of Cassiopea [Sellæ erec. & Crus Cass.]	pr. 345.	9	9	3
				0
The upright of the Chair, and the outermost star of the foot of Cassiopea [Sellæ erec. & ped. extr. Cass.]	pr. 345.	12	4	0
			9	
The upright of the Chair, and the flank of Cassiopea [Sellæ erec. & Ilia Cass.]	pr. 345.	3	3	0
			5	
The upright of the Chair, and the Pole Star [Sellæ erec. & Polaris Stella]	Tych. prog. 346.	26	2	6
			6	

Stars compared	Observer	Gr.	'	"
	Sylog.	26	2	0
			5	
	♂	26	2	3
			4	0
The outermost star of the Chair of Cassiopea, and the Pole [Extrema Cath. Cass. & Polaris]	Tych. Epist.	26	4	3
			2	0
The navel of Cassiopea, and the foot of the Chair [Vmbilicus Cass. & pes Cath.]	Tych. prog. 290.	4	4	3
			2	0
The navel of Cassiopea, and the bright star of the Chair [Vmbilicus Cass. & lucid. Cath.]	Tych. ibidem	6	2	0

The rest look up under ANDROMEDA, ARIES, and AURIGA.

CENTAURUS

Stars compared	Observer	G	'	"
		.		
The apex of the Cross, and Antares [Crucis apex, & Antares]	Naucleris	5	2	0
		1	5	
The apex of the Cross, and Spica [Crucis apex, & Spica]	Naucleris	4	2	0
		8	0	
The foot of the Cross, and Antares [Crucis pes, & Antares]	Naucleris	5	1	0
		3	5	
The foot of the Cross, and Spica [Crucis pes, & Spica]	Naucleris	5	5	0
		2	0	
The arms of the Cross between themselves [Crucis brachia inter se]	Naucleris	3	5	0
			5	
The preceding arm of the Cross, and the foot of the Cross [Crucis brach. præc. & pes ♄]	Naucleris	4	2	0
			5	
The following arm of the Cross, and the foot of the Cross [Crucis brach. seq. & pes crucis]	Naucleris	4	5	0
			4	

Stars compared	Observer	G		
		.	'	"
The left knee, and Antares [Genu sinistrum, & Antares]	Naucleris	4 4	0	0
The left knee, and Spica [Genu sinistr. & Spica]	Naucleris	4 9	3 0	0
The hip, and the bright star of Hydra [Coxa, & Lucida Hydræ]	Naucleris	5 4	2 6	0
The hip, and Spica [Coxa, & Spica]	Naucleris	4 4	4 0	0
The bright star of the right foot, and Antares [Pedis dextri lucida, & Antares]	Naucleris	3 8	2 0	0
The bright star of the right foot, and Spica [Pedis dextr. lucida, & Spica]	Naucleris	5 2	1 0	0
The following shoulder, and Antares [Humerus sequens, & Antares]	Nobis circiter [approximately]	3 1	4 1	0

CEPHEUS

Stars compared	Observer	Gr.		
			'	"
The preceding shoulder, and the tail of Cygnus [Humerus preced. Cygni cauda]	Gassendo	18	7	4 8
	Nobis	18	8	0
	♂	18	8	3 0
The preceding shoulder, and the bright star of Lyra [Humer. præced. & Lyrę lucidæ]	Nobis	33	5 9	0
	♂	34	0	0
The bright star of the girdle, and the tail of Cygnus [Cinguli lucida, & Cygni cauda]	Nobis	25	5 6	3 0
The same, and the bright star of Lyra [Eadem, & Lyræ lucida]	Nobis	38	4 4	0
	ex Tych. da.	38	4	2

Stars compared	Observer	Gr.	'	"
			2	0

CETE [CETUS]

Stars compared	Observer	Gr.	'	"
The bright star of the Jaw, and Aldebaran [Mandibula lucida, & Aldebara]	Nobis	26	6	4 5
The bright star of the Jaw, and the southern star of the tail of Cetus [Mādib. luc. & Ceti cauda austr.]	Nobis	26	4	2 0
	ex Tycho da.	40	4 3	4 0
The bright star of the Jaw, and the bright shoulder of Orion [Mandib. luc. & Orion. hum. luc.]	Tych. Epist.	40	4 4	1 0
	in Syllog.	43	8	0
	♂	43	7	3 0
	Nobis ♂	43	8	0
	Nobis	43	6	1 0
The bright star of the Jaw, and Rigel of Orion [Mandib. luc. & Orionis Rigel]	ex Tycho da.	35	1 4	5 0
The bright star of the Jaw, and Algenib of Pegasus [Mādib. luc. & Pegasi Algenib.]	Nobis	34	0	0
The two stars in the Jaw of Cetus [Ceti duæ in Mandibula]	Tych. Syllog.	4	4 2	0
The northern belly of Cetus, and Aldebaran [Ceti venter bor. & Aldebara]	ex Tych. da.	48	4 0	1 5
The northern belly of Cetus, and the southern star of the tail [Ceti venter bor. & Caud. austr.]	Gassendo	18	1 3	3 0

The tail of Cetus, look up under AQUARIUS, and ARIES.

CORONA AUSTRALIS

Stars compared	Observer	Gr.	'	"
The bright star of the Crown, and Antares [Lucida Coronæ, & Antares]	Naucleris	36	1 0	0
The bright star of the Crown, and Aquila [Lucida Coronæ, & Aquilæ]	Naucleris	50	4 5	0

CORONA BOREALIS

Stars compared	Observer	Gr.	'	"
The bright star of the Crown, and the Tail of Leo [Lucida Coronæ, & Cauda ♌]	ex Tych. da.	53	3 9	2 0
	ex Tych. LL.	53	4 1	0
The bright star of the Crown, and the bright star of Lyra [Lucida Coron. & Lucida Lyræ]	Nobis	49	3	1 5
The bright star of the Crown, and Spica of Virgo [Lucida Coronæ, & Spica ♍]	Nobis	49	4	0
	ex Tycho da.	49	3	5 0
The bright star of the Crown, and the head of Ophiuchus [Luc. Coron. & Ophiuchi Cap.]	ex Tych. da.	31	3 0	1 5
The bright star of the Crown, and the bright star of the Coil of Serpens [Luc. Cor. & luc. Coll. Serpentis]	Nobis	20	2 4	0
	ex Tych. da.	20	2 5	0
The bright star of the Crown, and Ursa Maior [Luc. Coronæ, & Vrsæ mai.]	Nobis	30	3 4	0
The bright star of the Crown, and the last star of the Tail of Ursa Maior [Luc. Coronæ, & Vrsæ mai. vltima Caudæ]	ex Tych. da.	30	3 2	0
The bright star of the Crown, and the middle star of the Tail of Ursa Maior [Luc. Coronæ, & Vrsæ mai. media Caudæ]	Nobis	36	5 1	0
	ex Tych. da.	36	4	1

Stars compared	Observer	Gr.	'	"
			9	5

CORVUS

Stars compared	Observer	Gr.	'	"
The left wing, and Spica [Ala sinistra, & Spica]	Gassendo	18	0	0
	♂	17	5	4
			5	5
	ex Tych. LL.	17	5	0
			6	

CRATER

Stars compared	Observer	Gr.	'	"
The bright star at the base of Crater, and the bright star of Hydra [Crateris lucida in basi & Hydræ lucida]	Gassendo	21	2	0
			1	

CYGNUS

Stars compared	Observer	Gr.	'	"
The tail, and the eastern wing [Cauda, & ala orientalis]	Nobis	11	2	0
			1	
The tail, and the bright star of Lyra [Cauda, & Lyræ lucida]	Tycho	23	5	0
			2	
	Nobis	23	5	5
			2	0
	Gassendo	23	4	0
			9	
	it ought to have been [ait debuisse]	23	5	0
			2	
The tail, and Algenib of Pegasus [Cauda, & Pegasi Algenib.]	ex Tycho da.	53	2	5
			9	0
The tail, and Scheat of Pegasus [Cauda, & Pegasi Scheat]	ex Tycho da.	32	5	1
			6	5

Stars compared	Observer	Gr		
		.	'	"
	Nobis	32	5	1
			7	0
The tail, and the Pole Star [Cauda, & Polaris Stella]	Tych. Epist.	44	3	3
			9	0
	ex Tycho da.	44	4	2
			1	0
The tail, and the Beak [Cauda, & Rostrum]	Nobis	22	2	3
			1	0
The breast of Cygnus, and the bright star of Lyra [Pectus Cygni, & Lyræ lucida]	Tych. Syllog.	20	1	3
			7	0
	♂	20	1	0
			5	
	ex Tych. da.	20	2	1
			0	0
The breast of Cygnus, and the head of Ophiuchus [Pectus Cygni, & Ophiuc. Cap.]	Tych. Syllog.	45	5	3
			2	0
	♂	45	5	0
			3	
	♂	45	5	3
			3	0
The breast of Cygnus, and Scheat of Pegasus [Pectus Cygni, & Pegasi Scheat]	Tych. Epist.	35	1	3
			2	0
	ex Tych. da.	35	1	3
			0	0
The breast, and the Beak of Cygnus [Pectus, & Rostrum Cygni]	Tych. Syllog.	16	1	3
			2	0
The Beak, and the right shoulder of Ophiuchus [Rostrū, & Ophiuch. hum. dext.]	Tych. Syllog.	34	3	3
			5	0
	♂	34	3	0
			7	

Stars compared	Observer	Gr		
		.	'	"
The Beak, and Scheat of Pegasus [Rostrum, & Pegasi Scheat]	Tych. Epist.	46	3	4 6 0
The middle star of the northern wing, and Scheat of Pegasus [Media alæ Bor. Pegasi Scheat]	Tych. Epist.	46	1	3 0

The rest look up under ANDROMEDA, AQUILA, and CASSIOPEA.

DRACO

Stars compared	Observer	Gr		
		.	'	"
The star of Draco nearest the ecliptic pole, and the heel of the foot of Gemini [Draconis Stella polo Eclipticæ proxima, & Calx pedis II]	Tych. prog. 212.	90	3	0 7
The same, and the Heart of Leo [Eadem, & Cor ♀]	prog. 212.	85	9	0
The same, and the head of Pollux [Eadem, & Caput Pollucis]	prog. 212.	81	3	5 1 0
The same, and Spica of Virgo [Eadem, & Spica ♍]	prog. 212.	87	6	3 0
The bright star in the preceding part of the head, and the bright star of Lyra [Lucida in capite præcedens & Lyræ lucida]	Nobis	14	3	5 3 0
	ex Tych. LL.	14	3	0 5
The penultimate star of the Tail of Draco, and the star listed below; and the left shoulder of Bootes [Caudæ Draconis penultima, & infrascriptæ Stellæ; Bootæ humerus sinistr.]	Petavius ex Tychonis datis Lib. 3. Vranol. cap. 6. [Petau, from Tycho's data, <i>Uranologion</i> Book 3, ch. 6]	35	4	0 8
The southern Ass of Cancer		61	5	0

Stars compared	Observer	Gr	'	"
[Cancri Asellus australis]				3

[The following block on the right of folio 224 is a single-anchor list: each row names one star whose distance is reckoned from a common reference (continuing the Draco/Cancer comparison-stars above), with only the distance column filled. Observer column blank as printed.]

Star	Gr.	'	"
The northern Ass of Cancer [Cancri Asellus borealis]	58	46	0
The northern preceding star of Cancer, in the square [Cancri bor. præc. in □]	60	2	0
The southern star of Cancer, in the square [Cancri austr. in □]	62	49	0
The 3rd southern star in the right arm of Andromeda [3. Austr. in brach. dextr. Andr.]	73	24	0
The lowest star of the left wing of Aquila [Infima alæ sin. Aquilæ]	90	39	0
The southernmost star of the right arm of Andromeda [Australiss. brach. dextr. Andr.]	67	27	0
The kidneys of Aries [Arietis renes]	85	30	0
The foot of Cassiopea [Cassiopeæ pes]	45	47	0
The breast of Cepheus [Cephei pectus]	43	21	0
The northern star of the rim of Crater [Crateris borea peripheriæ]	81	18	0
The northern handle of Crater [Crateris ansa borealis]	84	2	0
The following star of the wing of Corvus [Corui ala sequens]	86	12	0
The neck of Cygnus [Cygni collum]	64	5	0
The beak of Cygnus [Cygni rostrum]	68	47	0
The upper Crown [Corona superior]	49	58	0
The right wing of Cygnus [Cygni ala dextra]	43	5	0
The outermost star of the left wing of Cygnus [Cygni alæ sin. extrema]	73	47	0
The elbow of the left wing of Cygnus [Cygni ancon. alæ sin.]	68	37	0

Star	Gr.	'	"
The head of Draco [Draconis caput]	39	53	0
The head of Gemini, Castor [Geminorum caput Castoris]	56	49	0
The head of Gemini, Pollux [Geminorum caput Pollucis]	57	28	0
The right foot of Auriga [Aurigæ pes dexter]	64	49	0
The left foot of Auriga [Aurigæ pes sinister]	66	37	0
The elbow of the right arm of Hercules [Herculis dextræ ancon.]	61	4	0
The Heart of Hydra [Hydræ Cor]	83	27	0
The northern Balance [Lanx borea]	83	26	0
The left knee of Ophiuchus [Ophiuch. genu sin.]	90	30	0
The right knee of Ophiuchus [Ophiuch. genu dext.]	97	57	0
The right shoulder of Ophiuchus [Ophiuch. hum. dextr.]	81	35	0
The left shoulder of Ophiuchus [Ophiuch. hum. sinist.]	73	13	0
The Heart of Leo [Leonis cor]	62	2	0
The head of Ophiuchus [Ophiuchi caput]	73	8	0
The middle star of the Belt of Orion [Orionis media balthai]	95	52	0
The mouth of Pegasus [Pegasi os]	95	21	0
The left Leg of Perseus [Persei Tibia sinistra]	67	58	0
The left shoulder of Perseus [Persei hum. sinist.]	58	35	0
The bright star of the Coil of Serpens [Serpentis lucida colli]	61	9	0
The right knee of Taurus [Tauri genu dextr.]	92	33	0
The southern star of Ursa Maior, of the right foot [Vrsæ mai. austral. pedis dextri]	34	5	0
The more northern star of the same foot [eiusdem borealior]	33	41	0

GEMINI

CASTOR'S Head, and those listed below

Stars compared	Observer	Gr		
		.	'	"
Head of Pollux [Caput Pollucis]		4	3	0
			2	
	Bern. Vualther [Bernhard]	4	2	0

Stars compared	Observer	Gr		
		.	'	"
	Walther]		9	
	Nobis ♂	4	3	0
			2	
	Gassendo	4	3	0
			2	
	it ought to have been [debet ait]	4	3	0
			2	
Heart of Hydra [Hydræ cor]	ex Tych. LL.	48	4	5
			1	8
	ex Tych. da.	48	4	4
			5	0
Heart of Leo [Leonis cor]	Tych. Epist.	40	3	0
			2	
	Nobis	40	3	5
			2	5
The bright star in the foot of Orion [Orionis pes lucidus]	Nobis	52	9	1
				5
	ex Tych. da.	52	9	1
				0
The preceding shoulder of Orion [Orionis hum. præc.]	Nobis	39	2	0
			9	
	ex Tych. da.	39	2	4
			8	0
The bright shoulder of Orion [Orionis humer. lucid.]	Tycho	33	3	1
			8	0
	Nobis	33	3	1
			8	0
	ex Tych. da.	33	3	3
			7	0
The 1st star of the Belt of Orion [Orionis balthei 1.]	Nobis	43	2	0
			5	
The 2nd star of the Belt [balthei 2.]	Nobis	43	2	0
			1	

Stars compared	Observer	Gr		
		.	'	"
The 3rd star of the Belt [balthei 3.]	Nobis	43	1	0
			7	
The southern eye of Taurus [Tauri oculus austral.]	Tych. Epist.	43	1	3
			2	0
The bright shoulder of Ursa Maior [Vrsæ mai. luc. humer.]	Nobis	44	4	3
			1	0
	ex Tych. da.	44	4	3
			3	0
The flank of Ursa Maior [Vrsæ maior. Ilia]	Nobis	42	5	3
			3	0

POLLUX'S HEAD, and those listed below

Stars compared	Observer	Gr.		
		.	'	"
The left heel of Gemini [Calx sinister II]	Tych. Epist.	19	2	0
			8	
	in Syllog.	19	2	0
			8	
	♂	19	2	3
			8	0
The outermost star of the foot of Gemini [Extrema pedis II]	Nobis	19	2	0
			8	
	♂	19	2	4
			7	0
	Tych. Epist.	21	1	0
			4	
	♂ syllog.	21	1	0
			4	

This page continues the **Great Table of Distances** (*Magna Tabula Distantiarum*) — inter-star distances arranged alphabetically by constellation — begun in Caput VIII. Each row gives a pair of stars, the observer or source for the measured distance, and the distance in degrees (Gr.), minutes ('), and seconds ("). The column of pairs at the foot of the left column here continues the GEMINI

("Twins") entries from the preceding page; the right column opens new constellation rubrics.

Left column (continuation)

The first entries continue under GEMINI (the Twins), carried over from the previous page.

Star pair	Observer	G r.	'	"
Bright foot of Gemini [Lucidus pes II]	Gassendo [Gassendi]	19	32	12
	Nobis [by us]	19	32	10
Heart of Hydra [Hydrae cor]	Nobis	44	11	10
Tail of Leo [Leonis cauda]	ex Tych. da. [from Tycho, "given"]	57	43	0
Bright star of the neck of Leo [Leonis lucida colli]	Tych. Syllog. [Tycho, <i>Syllogus</i>]	36	3	0
	prog. 229. [<i>Progymnasmata</i> 229]	35	59	0
	Adriano Metio [Adriaan Metius]	36	0	0
Heart of Leo [Leonis cor — Regulus]	Tych. Epist. [Tycho, <i>Epistolae</i>]	36	59	40
	prog. 200.	36	59	30
	in Syllog. [in the <i>Syllogus</i>]	37	0	0
	♂ [conjunction/comparison]	37	1	0
	♂	37	1	20
	♂	37	2	0
Bright foot of Orion [Orionis pes lucidus]	Nobis	36	59	30
	Nobis	51	25	30
	ex Tych. da.	51	25	33
Preceding shoulder of Orion [Orionis humer. praeced.]	Nobis	39	41	30
Following shoulder of Orion [Orionis humer. sequens]	Tych. Epist.	33	16	0
	Nobis	33	15	30

Star pair	Observer	G r.	'	"
	ex Tych. da.	33	15	10
1st of the belt of Orion [Orionis 1. balthai]	Nobis	42	45	50
2nd of the belt [2. balthai]	Nobis	42	38	50
3rd of the belt [3. balthai]	Nobis	42	34	0
Spica Virginis [Spica]	Tych. prog. 195.	90	46	20
Southern eye of Taurus [Tauri oculus austr.]	Tych. prog. 200.	45	5	0
	♂ Sylloge [conj. <i>Syllogus</i>]	45	4	15
	♂	45	7	0
	Nobis	45	4	10
Northern horn of Taurus [Tauri cornu Boreum]	Tych. Syllog.	30	32	30
	Ibidem [same place]	30	33	0
	Nobis	30	32	45
Bright star of the shoulder of the Greater Bear [Ursae mai. humer. lucid.]	Nobis	46	48	0
	ex Tych. da.	46	46	40

PES LUCID. II & infrascr. — i.e. distances of "the Bright Foot of Gemini and the stars listed below":

Star pair	Observer	G r.	'	"
Head of Castor [Caput Castoris]	Gassendo	20	12	20
	Nobis	20	12	30
Northern Ass of Cancer [Cancri Asellus boreus]	Tych. prog. 229.	30	4	30
Heart of Leo [Leonis Cor — Regulus]	Tych. prog. 229.	51	11	0
	Nobis	51	7	30
Bright shoulder of Orion	Gassendo	13	42	45

Star pair	Observer	G r.	'	"
[Orionis humer. lucid.]				
	Nobis quoque [also by us]	13	42	45
Southern eye of Taurus [Tauri oculus austr.]	Tycho Epist.	29	9	0
	♂ prog. 229.	29	9	0
	Nobis	29	9	0
Northern horn of Taurus [Tauri cornu boreal.]	ex Tych. da.	29	9	10
	Nobis	20	27	20
Northern eye of Taurus [Tauri oculus bor.]	ex Tycho da.	20	29	0
	Tych. prog. 229.	30	48	0
Heel of Castor, & the Heart of Leo [Calx sin. Castoris, & Cor ♂]	Tych. prog. 198.	54	33	45
	in Epist. [in the <i>Epistolae</i>]	54	35	0
	in Sylloge.	54	35	30
	♂	54	36	0
Heel of Castor, & Aldebaran, or the eye of Taurus [Calx sin. Castoris, & Aldebara, seu oculus ♂]	Tych. Epist.	25	53	0
	in Sylloge.	25	53	0
	♂ bis [conj., twice]	25	53	30
	♂	25	54	0
(à Nobis 25.53.10. [by us 25°53'10"])	♂	25	54	15
	♂	25	54	30
Propus, & Aldebaran [Propus, & Aldebara]	addit fide huic [adds, on the faith of this]			
	Tych. Epist.	24	3	0
	in Sylloge.	24	4	0
Extremity of the foot of Pollux,	Tych. Epist.	56	26	30

Star pair	Observer	G r.	'	"
& the Heart of Leo [Extrem. ped. Pollucis, & cor ♀]				

Seek the remaining distances under ARIES, AURIGA, CANIS MINOR, CANCER, CASSIOPEIA, DRACO, and TAURUS. [*Reliquas quaere sub Ariete, Auriga, Cane Minori, Cancro, Cassiopea, Dracone, & Tauro.*]

GRUS [the Crane]

Star pair	Observer	G r.	'	"
Head of Grus, & the eye of Pavo [Gruis caput, & oculus Pauonis]	Nacleris [Nacler / the Dutch navigators]	24	20	0
Head of Grus, & the bright foot of Pavo [Gruis caput, & pes lucid. ♀(?)]	Nacleris	29	55	0
Breast of Grus, & the eye of Pavo [Gruis pectus, & ocul. Pauonis]	Nacleris	23	18	0
Breast of Grus, & the bright foot of Pavo [Gruis pectus, & lucid. pes ♀(?)]	Nacleris	34	50	0
Northern wing of Grus, the eye of Pavo [Gruis ala bor. oculusq; Pauon.]	Nacleris	18	15	0
Northern wing of Grus, the bright foot [Gruis ala bor. pesq; lucid. ♀(?)]	Nacleris	29	5	0

Right column

HERCULES

Star pair	Observatores [Observers]	G r.	'	"
Head, & the bright star of Lyra [Caput, & Lyrae lucida — Vega]	Nobis	30	23	0
	ex Tycho da.	30	22	25

Seek the rest under AQUILA, BOOTES, & DRACO. [*Reliquas quaere sub Aquila, Boote, & Dracone.*]

HYDRA

Star pair	Observer	G r.	'	"
Heart of Hydra, & the Heart of Leo [Cor Hydrae, & cor ♀ — Alphard & Regulus]	Nobis	22	59	0
	Gassendo	23	1	0
	♂	22	58	30
Heart of Hydra, & the tail of Leo [Cor Hydrae, & cauda ♀]	Nobis	42	5	16
	ex Tych. LL. [from Tycho, <i>Libri Litterarii</i> (?)]	42	4	55
Heart of Hydra, & the bright shoulder of Orion [Cor Hydrae, & Orion hum. luc.]	ex Tych. da.	55	18	40
	ex Tych. LL.	55	19	0
Heart of Hydra, & the bright foot of Orion [Cor Hydrae, & Orion pes luc.]	ex Tych. da.	62	32	5
Heart of Hydra, & Spica [Cor Hydrae, & Spica ♀]	Nobis	58	27	40
	ex Tycho da.	58	27	20

Seek the rest under CANIS MAIOR, & MINOR, or under ARGO NAVIS, CENTAURUS, GEMINI. [*Reliquas quaere sub Cane Maiore, & Minore, aut sub Argonauti, Centauro, Geminis.*]

LEO

Star pair	Observatores	G r.	'	"
Regulus, & the more southern of the head [Regulus, & australior capitis]	Bern. Vualthero [Bernhard Walther]	15	55	0
Regulus, & the tail of Leo	Tych. Epist.	24	39	45

Star pair	Observatores	G r.	'	"
[Regulus, & cauda ♏]				
	in Syllog.	24	39	45
	♂	24	39	30
	♂	24	39	0
	Nobis	24	40	0
	Gassendo	24	39	20
Regulus, & the 3rd of the southern wing [Regulus, & 3. alae australis ♏(?)]	Tych. prog. pag. 229.	40	22	0
Regulus, & Spica (pag. 38.) [Regulus, & Spica ♏ pag. 38.]	Lätgrau Hassia [the Landgrave of Hesse]	54	2	0
	Tych. Epist.	54	1	50
	in prog. 198.	54	2	0
	199. 200.	54	2	0
	in Sylloge.	54	1	40
	♂ bis	54	2	0
	♂ bis	54	2	30
	♂ bis	54	2	15
	♂	54	3	0
	Nobis	54	1	45
	♂	54	1	30
Regulus, & the neck of Leo [Regulus, & Ceruix ♏]	Gassendo	8	21	0
Tail of Leo, & the Heart of Scorpius [Cauda ♏, & cor Scorpij]	Gassendo	24	38	15
	debut ait [he says it ought to be]	24	39	45
Tail of Leo, & the bright star of the neck of Serpens [Cauda ♏, & serpentis luc. colli]	Nobis	58	12	30
Tail of Leo, & Spica [Cauda ♏, &	Tych. Epist.	35	1	45

Star pair	Observatores	G r.	'	"
Spica ♀]				
	in Sylloge.	35	3	0
	♂	35	3	30
	Gassendo	35	2	45
	Nobis	35	2	0
	♂	35	2	10
Tail of Leo, & the bright shoulder of the Greater Bear [Cauda ♀, & Ursae ma. hum. luc.]	ex Tych. da.	47	51	48
	ex Tych. LL.	47	52	10
Tail of Leo, & the Greater Bear, the last of the tail [Cauda ♀, & Ursae mai. Caudae ultima]	ex Tych. da.	42	18	10
	ex Tych. LL.	42	18	50
Bright star of the loins, & the Heart of Leo [Lumborum lucida, & cor ♀]	Vualthero	17	55	0
	Nobis	17	54	40
Bright star of the loins, & the tail of Leo [Lumborum lucid. & cauda ♀]	Vualthero	10	22	0
	Nobis	10	17	40
Bright star of the loins, & the bright star of the mane [Lumbor. luc. & Iubae lucid.]	Tycho	12	44	0
	Vualthero	12	41	0
	Nobis	12	44	30
Bright star of the loins, & Spica [Lumbor. luc. & Spica ♀]	Nobis	48	12	50
	ex Tych. da.	45	11	5

Page 226 — Left column (continuation of LEO)

The left column continues the LEO entries, carried over from the foot of the preceding page.

Star pair	Observer	Gr.	'	"
Bright star of the neck, & the underwritten, the Heart of Leo [Colli, seu lucida, & infrascriptae Cor ♀]	Vualthero	8	29	0
	♂	8	28	0
	Gassendo	8	28	0
Bright star of the neck, & the tail of Leo [Colli lucida, & cauda ♀]	Nobis	21	59	10
Bright star of the neck, & Spica [Colli lucida, & Spica ♀]	Tych. Epist.	55	12	0
	Nobis	55	10	55
	Tych. Syllog.	55	12	0
Bright star of the neck, & Vindemiatrix [Colli luc. & Vindemiatrix ♀]	Tych. prog. 229.	40	3	10
Bright star of the neck, & the more southern of the head [Colli luc. & australior capitis]	Vualthero	8	43	0
	♂	8	45	0
Hip of Leo, & the Heart of Leo [Coxa ♀, & cor ♀]	Tych. Epist.	17	51	0
Hip of Leo, & the neck of Leo [Coxa ♀, & ceruix ♀]	Tych. Epist.	8	31	0
Hip of Leo, & the thigh of Leo [Coxa ♀, & femur ♀]	Tych. Epist.	12	44	0

Seek the rest under BOOTES, CANCER, CANIS, CANICULA, CORONA, CORVUS, DRACO, GEMINI, HYDRA. [*Reliquas quaere sub Boote, Cancro, Cane, Canicula, Corona, Coruo, Dracone, Geminis, Hydra.*]

LEPUS [the Hare]

Star pair	Observer	Gr.	'	"
Bright star in the back of Lepus, & Sirius [Leporis Lucida in Dorso, & Sirius]	Nobis	17	27	0

LIBRA [the Scales]

Star pair	Observatores	G r.	'	"
The Scale-pans, one from the other [Lances inter se se]	Tycho Epist.	9	8	20
	D. Valesio [D. Valois(?)]	9	10	0
	Gassendo	9	12	0
	Nobis	9	10	40
	(Gassendo) ex Tych. LL.	9	12	0
Northern Scale, & the head of Ophiuchus [Lanx boreal. & cap. Ophiuch.]	Nobis, ♂	40	39	30
	Melius [better]	40	39	40
Northern Scale, & the knee of Ophiuchus [Lanx bor. & genu Ophiuch.]	Nobis	19	45	40
	ex Tych. da.	19	44	50
Northern Scale, & the Heart of Scorpius [Lanx bor. & cor Scorpij]	Tych. prog. 230.	24	10	30
	Nobis	24	9	0
	Adr. Metio [Adriaan Metius]	24	10	40
	ex Tych. da.	24	10	40
Northern Scale, & Spica [Lanx boreal. & Spica ♍]	Tych. prog. 230.	27	34	0
	Nobis melius	27	33	40
	Metio	27	34	0
Southern Scale, & the Heart of Scorpius [Lanx austr. & cor	Nobis	25	9	40

Star pair	Observatores	G r.	'	"
Scorpij]				
	ex Tych. da.	25	8	10
Southern Scale, & the middle of the three in the forehead of Scorpius [Lanx austr. & media 3. in fronte Scorpij]	Gassendo	17	42	0
	debuit ait	17	37	0
Southern Scale, & the northern in the forehead of Scorpius [Lanx austr. & bor. in fronte Scorpij]	ex Tych. da.	18	5	40
	Gassendo	18	9	50
Southern Scale, & the head of Ophiuchus [Lanx austr. & cap. Oph.]	ex Tych. da.	49	35	20
Southern Scale, & the following knee of Ophiuchus [Lanx austr. & Oph. genu seq.]	Nobis	33	25	10
	ex Tych. LL.	33	26	25
Southern Scale, & Spica [Lanx austr. & Spica ♀]	Gassendo	21	25	0
	♂	21	26	0
	Nobis	21	24	20
	ex Tych. da.	21	22	30

Seek the remaining distances of the Scales under AQUILA & BOOTES.

[*Reliquas distantias Lancium, quaere sub Aquila, & Boote.*]

LYRA, or VULTUR CADENS [the Lyre, or the Falling Vulture]

Star pair	Observatores	G r.	'	"
Bright star of Lyra, & the preceding star of the hand of Ophiuchus [Lucida Lyrae, Oph.	Tych. Syllog.	53	42	30

Star pair	Observatores	G r.	'	"
man. praec.]				
	Nobis	29	33	40
Bright star of Lyra, the head of Ophiuchus [Luc. Lyr. Ophiuchi caput]	ex Tych. da.	29	34	0
Bright star of Lyra, & Scheat Pegasi [Lyr. luc. & Scheat Pegasi]	Tych. Epist.	55	30	40
	Longomontan. [Longomontanus]	55	31	0
	ex Tych. da.	55	29	50
Bright star of Lyra, & the bright star of the neck of Serpens [Lyrae luc. serp. lucida Colli]	Nobis	50	30	0
	ex Tych. da.	50	31	20
Bright star of Lyra, & the Pole Star [Lyrae luc. & Polaris Stella]	Tych. Epist.	51	34	40
	Nobis	51	36	30
	ex Tych. da.	51	35	20
Bright star of Lyra, & the left shoulder of Hercules [Lyrae luc. & hum. sin. Hercul.]	Tych. Syllog.	32	5	0

Seek the rest under AQUILA, BOOTES, CEPHEUS, CORONA, CYGNUS, HERCULES. [*Reliquas quaere sub Aquila, Boote, Cepheo, Corona, Cygno, Hercule.*]

Page 226 — Right column

OPHIUCHUS

Star pair	Observatores	Gr.	'	"
Head, & the northern hand [Caput, & manus boreal.]	Tych. Epist.	25	46	0
	Sylloge.	25	46	30
	♂	25	46	15
	♂	25	45	40

Star pair	Observatores	Gr.	'	"
	♂	25	45	0
Head, & Spica [Caput, & Spica ♀]	Tych. Syllog.	36	14	0
	♂	36	15	0
Head, & the northern Claw of Scorpius [Caput, & Chela bor. Scorp.]	Tych. Epist.	40	41	30
	in Sylloge.	40	41	30
Head, & the bright star of the neck of Serpens [Caput, & Serpentis lucida colli]	Nobis	27	44	30
Left hand, the brighter, or northern, & Spica [Manus sin. lucidior, seu bor. & Spica]	Tycho Epist.	42	33	0
	Prog. 200.	42	33	30
	in Sylloge.	42	32	15
	♂	42	33	0
	♂	42	34	0
	♂	42	34	30
	Nobis	42	33	30
Left shoulder, & the highest hand [Humer. sin. & manus suprema]	Tych. Syllog.	16	57	0

Seek the rest under AQUILA, BOOTES, CORONA, CYGNUS, LIBRA, & LYRA.
[Reliquas quaere sub Aquila, Boote, Corona, Cygno, Libra, & Lyra.]

ORION

Star pair	Observatores	G r.	'	"
Bright shoulder, or the right one, & the bright foot, RIGEL [Lucidus humerus, seu dexter, & lucidus pes, RIGEL]	♂ sequens [following conjunction]			
	Nobis	8	35	50
	ex Tych. LL.	8	35	30
Bright shoulder, & 1st of the belt [Lucid. humer. & Balthei 1.]	Nobis	9	45	0

Star pair	Observatores	G r.	'	"
Bright shoulder, & 2nd of the belt [Lucid. humer. & Balth. 2.]	Nobis	9	50	30
Bright shoulder, & 3rd of the belt [Lucid. humer. & Balth. 3.]	Nobis	9	52	0
	Gassendo	9	54	40
Bright shoulder, & the bright star of the Pleiades [Lucid. hum. & Pleiadu lucida]	ex Tych. da.	34	44	10
Bright shoulder, & Aldebaran [Lucida hum. & Aldebara]	Tych. Epist.	21	23	0
	Nobis item [likewise by us]	21	23	0
	Gassendo	22	23	0
	ex Tych. da.	21	26	10
	Tych. Syllog.	21	23	0
Preceding-left shoulder, & the following [Humerus praeced.- sinist. & seq.]	Tych. Epist.	7	30	40
	Gassendo	7	29	36
	♂	7	28	0
Preceding shoulder, Rigel [Humer. praeced. Rigel]	Nobis	7	29	20
	Gassendo	18	33	10
	♂	18	35	0
Preceding shoulder, & Aldebaran [Humer. praeced. & Aldebaram]	debut inquit [he says it ought to be]	18	35	0
	Nobis	15	48	0
	♂	15	47	35
	ex Tych. da.	15	48	10
Bright star of the Sword, & Aldebaran [Lucida Ensis, & Aldebara]	Nobis	26	46	40

Star pair	Observatores	G r.	'	"
1st of the belt, & Aldebaran [Balthei 1. & Aldebara]	Tych. Epist.	21	49	30
	Nobis	21	50	0
	ex Tych. da.	21	48	10
2nd of the belt, & Aldebaran [Balthei 2. & Aldebara]	Nobis	23	9	40
	ex Tych. da.	23	8	40
3rd of the belt, & Aldebaran [Balthei 3. & Aldebara]	Nobis	24	24	0
	ex Tych. da.	24	26	0
Highest of the belt, & the 2nd [Balthei suprema, & 2.]	(continuation)	1	23	0
	Gassendo	1	22	0
	♂	1	25	30
Middle of the belt, & the lowest [Balthei media, & infima]	Gassendo	1	19	30
	♂	1	20	30
	♂	1	21	0
	♂	1	22	30
Highest of the belt, & the lowest [Balthei suprema, & infima]	Gassendo	2	42	30
	♂	2	43	0
	♂	2	43	24
Bright foot, & the 2nd of the belt [Pes lucidus, & Balthei 2.]	Nobis	8	49	50
	ex Tych. da.	8	54	30
Bright foot, & Aldebaran [Pes lucidus, & Aldebar.]	Tycho	26	32	0
	ex Tych. da.	26	31	20
<i>Did Tycho's refraction obstruct it? [An Refractio Tychoni obfuit?]</i>	Nobis	26	35	0
	Gassendo	26	33	0

Page 227 — Left column (continuation of ORION)

Star pair	Observer	Gr.	'	"
Bright foot, & the northern horn of Taurus [Pes lucidus, & ♂ cornu bor.]	ex Tych. da.	16	36	45
Right knee, & Aldebaran [Genu dextrum, & Aldebara]	Nobis	11	36	0

Seek the remaining distances of Orion under ARIES, CANIS, CANICULA, CETUS, GEMINI, HYDRA. [*Reliquas Orionis distantias quaere sub Ariete, Cane, Canicula, Cete, Geminis, Hydra.*]

PAVO [the Peacock]

Star pair	Observer	Gr.	'	"
Eye of Pavo, & Antares [Pavonis Ocul. & Antares]	Nauclerus	51	45	0

Seek the rest under CENTAURUS, ERIDANUS, GRUS. [*Reliquas quaere sub Centauro, Eridano, Grue.*]

PEGASUS

Star pair	Observatores	Gr.	'	"
Algenib, or the extremity of the wing, & Markab [Algenib. seu alae extrema & Markab]	Nobis	16	29	0
	♂	16	30	20
	Gassendo	16	30	0
	ex Tycho da.	16	33	0
Algenib, & Scheat Pegasi [Algenib. & Scheat Pegasi]	Tych. Syllog.	20	37	15
	ex Tych. da.	20	38	10
	Nobis	20	36	0
Algenib, & the bright side of Perseus [Algenib. & Persei latus luc.]	ex Tych. da.	51	45	10
Markab of Pegasus, & the Knot [of Pisces] [Pegasi Markab. & Nodus ♄]	Tych. prog. 230.	43	23	0
Mouth of Pegasus, & the Jaw of Pisces	Tycho	20	41	0

Star pair	Observatores	Gr.	'	"
[Os Pegasi, & Piscis Mandib.]				
Mouth of Pegasus, & Scheat Pegasi [Os Pegasi, & Scheat Pegasi]	Nobis	26	6	0
	ex Tych. da.	26	6	0
Mouth, & the preceding knee of Pegasus [Os, & genu praec. Pegasi]	Nobis	24	31	0

Seek the rest under ANDROMEDA, AQUARIUS, AQUILA, ARIES, CASSIOPEIA, CETUS, CYGNUS, LYRA. [*Reliquas quaere sub Andromeda, Aquario, Aquila, Ariete, Cassiop. Cete, Cygno, Lyra.*]

PERSEUS

Star pair	Observer	G r.	'	"
Bright side, & Aldebaran [Latus lucidum, & Aldebara]	Tycho	36	20	40
Bright side, & the Pole Star [Latus luc. & Polaris Stella]	Nobis	39	26	30
	ex Tych. da.	39	26	10
Bright side, & the northern horn of Taurus [Latus lucid. & cornu bor. ♂]	ex Tych. da.	31	28	10
Bright side, & Medusa [Latus lucid. & Medusa]	Gassendo	9	23	10
Head of Medusa, & Aldebaran [Medusae caput, & Aldebara]	Tych. & Nos [Tycho & us]	30	54	0
Head of Medusa, & the Pole Star [Medusae cap. & Polaris Stella]	Nobis	48	16	40
	♂	48	17	0
Bright foot, & Aldebaran [Pes lucidus, & Aldebara]	Nobis	30	53	0

Seek the rest under ANDROMEDA, ARIES, & AURIGA. [*Reliquas quaere sub Andromeda, Ariete, & Auriga.*]

PISCES

Star pair	Observer	Gr.	'	"
Bright star of the Knot, & Aldebaran [Nodi lucida, & Aldebara]	Tych. prog. 230.	40	13	45
	Nobis	40	13	40

Seek the rest under AQUILA, & PEGASUS. [*Reliquas quaere sub Aquila, & Pegaso.*]

SAGITTARIUS

Star pair	Observat.	G	.	'	"
Bright star of the head, & Antares [Capitis lucida, & Antares]	Tych. prog. 230.	3	37	30	
		5			
Bright star of the head, & the right shoulder [Capit. luc. & hum. dext. ★(?)]	Tycho	4	59	20	
		8			
Bright shoulder, & Antares [Humerus lucid. & Antares]	Nobis	3	33	0	
		2			
	D. Valesio	3	34	0	
		2			
Bright star of the hand, & Antares [Manus luc. & Antares]	Nobis	3	24	0	
		2			
1st of the arrow, & Antares [1. Sagittae, & Antares]	Nobis	2	28	0	
		1			
Middle of the bow, & Antares [Media arcus, & Antares]	Nobis	2	41	30	
		4			
The more southern of the bow, & Antares [Australior arcus, & Antares]	Nobis	2	50	0	
		5			
The more northern of the bow, & Antares [Borealiior arcus, & Antares]	Nobis	2	40	0	
		6			
Bright star of the arm, & Antares [Brachij lucida, & Antares]	Nobis	3	19	30	
		0			
Bright star of the shoulder, & the northern frontal star [Humer. luc. & Boreal. frons ★(?)]	Nobis	3	6	27	
		9			

Seek the rest under AQUILA, & OPHIUCHUS. [*Reliquas quaere sub Aquila, & Ophiuco.*]

SCORPIUS

Star pair	Observer	G r.	'	"
Heart of Scorpius, & Spica, or Antares [Cor Scorpj, & Spica ♏, seu Antares]	Tych. Epist.	45	51	30
	in Syllog.	45	52	30
	Nobis saepe [often by us]	45	52	0

Page 227 — Right column (continuation of SCORPIUS into the frontal stars)

The right column continues with further SCORPIUS pairings (the stars of the forehead / "frons"), carried over from the foot of the preceding page.

Star pair	Observer	Gr.	'	"
Heart of Scorpius, & the middle of the forehead [Cor, & media frontis]	Gassendo	9	39	10
Southern Claw, & Spica [Chela austr. & Spica]	Tych. Epist.	21	22	0
	♂ in Syllog.	21	22	0
Northern Claw, & Spica [Chela bor. & Spica]	Tych. Epist.	27	34	0
The northern of the forehead, & the Heart [Boreal. Frontis, & Cor]	Gassendo	8	39	30
	Nobis	8	40	10
The northern of the forehead, & Spica [Boreal. Frontis, & Spica]	Tych. Epist.	39	26	30
	in Sylloge.	39	26	30
The middle of the forehead, & Spica [Media Frontis, & Spica]	Tych. Epist.	38	40	0
	Nobis	38	39	30
	♂	38	41	10

Star pair	Observer	Gr.	'	"
The southern of the forehead, & Spica [Australis Frontis, & Spica]	Tych. Epist.	39	6	30
	Nobis	39	6	35
Heart, & the sting of the Tail [Cor, & aculeus Caudae]	Gassendo	17	9	45
The Precordium, & the southern Scale [Praecordium, & Lanx austr.]	Nobis	23	12	0
Bend of the tail, & the Cusp of Sagittarius [Caudae flexus, & Cuspis ✕]	Nobis	16	18	0
Bend of the tail, & the lowest of Sagittarius [Caudae flexus, & Infima ✕]	Nobis	19	17	0

Seek the rest under AQUILA, BOOTES, CENTAURUS, CORONA AUSTRALIS, LIBRA, LEO, OPHIUCHUS, PAVO. [*Reliquas vide sub Aquila, Boote, Centauro, Corona Austr. Libra, Leone, Ophiuco, Pauone.*]

SERPENS

Star pair	Observator	Gr.	'	"
Bright star of the neck, & Spica [Lucida Colli, & Spica]	Nobis	38	47	50
The same, & the head of Ophiuchus [Eadem, & Caput Ophiuchi]	Nobis	27	44	30
Bright star of the temples, & Aquila [Temporum lucida, & Aquila]	Nobis	55	10	0

Seek the rest under BOOTES, CORONA, LEO, & LYRA. [*Reliquas quaere sub Boote, Corona, Leone, & Lyra.*]

TAURUS

Star pair	Observer	G r.	'	"
Aldebaran, or the southern eye, & the Head of Castor [Aldebara, seu oculus ✕ austr. & Caput Castoris]	Tycho	4 3	1 2	39(?)
	Nobis	4	1	0

Star pair	Observer	G r.	'	"
		3	2	
Aldebaran, & the northern horn [Aldebara, & Cornu bor.]	Nobis olim [by us, formerly]	1	4	0
		6	5	
	postea [afterwards]	1	4	30
		6	5	
	Vualthero	1	5	0
		6	0	
	ex Tych. da.	1	4	20
		6	5	
Aldebaran, & the southern horn [Aldebara, & Cornu austr. ♂]	Nobis	1	1	0
		5	8	
	ex Tych. da.	1	1	50
		5	7	
Aldebaran, & the northern eye [Aldebara, & Oculus bor. ♂]	Tycho	3	1	0
			9	
	Nobis	3	1	0
			8	
	ex Tych. da.	3	1	0
			7	
	ex Tych. da.	3	1	0
			9	
Aldebaran, & the extreme horns of the Hyades, between themselves [Aldebara, & Hyadu extrema Cornua ♂ inter se]	Vualthero	8	1	0
			1	
Bright star of the Pleiades, & Aldebaran, and so the rest [Pleiadum lucida, & Aldebara, & sic ex]	Nobis	1	3	10
		3	7	
	Muñ. Elui(?)	1	3	40
		3	6	
	ex Tych. da.	1	3	40

Star pair	Observer	G r.	'	"
		3	8	
	Gassendo	1	3	0
		3	7	

Seek the rest of Taurus under ANDROMEDA, ARIES, AURIGA, CANIS, GEMINI, ORION, & PERSEUS; I shall give the distances of the Pleiades among themselves below in Caput XIII, num. 6. [*Reliquas Tauri, quaere sub Andromeda, Ariete, Auriga, Canibus, Geminis, Orione, & Perseo; Pleiadum distantias inter se dabo infra Capit. XIII. num. 6.*]

VIRGO

Star pair	Observatores	G r.	'	"
Spica, & the latter star of the right side [Spica, & Crus dext. posterius]	Vualthero	10	45	0
Spica, & the right side under the girdle [Spica, & sub cingulo later. dext.]	Vualthero	9	28	0
Spica, & the 3rd of the southern wing [Spica, & 3. alae austral.]	Tych. Epist.	14	29	0
	Progymn. [<i>Progymnasmata</i>] (229)	14	29	15
Spica, & Vindemiatrix [Spica, & Vindemiatrix]	Gassendo	11	49	0

Seek very many others under AQUILA, BOOTES, CORONA, CENTAURUS, GEMINI, HYDRA, LEO, LIBRA, OPHIUCHUS, & SCORPIUS. [*Plurimas alias, quaere sub Aquila, Boote, Corona, Centauro, Geminis, Hydra, Leone, Libra, Ophiucho, & Scorpio.*]

URSA MAIOR [the Greater Bear]

Star pair	Observer	Gr.	'	"
Dubhe of the shoulders, & the bright star of the hip [Humeri dubhe, & coxa lucida]	Nobis	10	23	0

Star pair	Observer	Gr.	'	"
	ex Tych. LL.	10	22	46
Dubhe, & the 1st of the Tail [Dubhe, & 1. Caudae]	Gassendo	19	12	0

Caput VIII — De Magna Tabula Distantiarum (*conclusion*)

URSA MAIOR (*distance table, continued*)

The Great Table of inter-star distances concludes with the remaining pairs in Ursa Maior. Columns: pair of stars | observer/source | degrees | minutes | seconds.

Pair of stars	Source	Gr.	'	"
Dubhe, & lucida Cynosurae (Dubhe and the lucida of Cynosura)	Gassendo	23	13	0
	Nobis	23	19	0
Prima Caudae, & media Caudae (1st of the Tail and the middle of the Tail)	Nobis	4	22	10
	ex Tych. da.	4	21	50
1. Caudae, & Polaris (1st of the Tail and Polaris)	Nobis	34	40	0
1. Caudae, & vltima Caudae (1st of the Tail and the last of the Tail)	Nobis	10	29	20
	Nobis	10	31	0
	ex Tycho da.	10	28	50
1. Caudae, & Cynosura (1st of the Tail and Cynosura)	Gassendo	21	25	0
	Nobis	21	35	20
2. Caudae, & vltima Caudae (2nd of the Tail and the last of the Tail)	Gassendo	6	43	0
	Nobis	6	40	50
	ex Tycho da.	6	40	45
Caudae vlt. & Dubhe (last of the Tail and Dubhe)	Nobis	25	40	0
	Gassendo	25	40	0

Pair of stars	Source	Gr.	'	"
	ex Tycho da.	25	39	10
Caudae vltimae, & Polaris (the last of the Tail and Polaris)	Nobis	41	22	0
	ex Tych. da.	41	21	50
	ex Tych. LL.	41	20	50
Caudae vlt. & Cynosura (the last of the Tail and Cynosura)	Gassendo	25	45	0
	Nobis	25	44	50

For the remaining distances, look under BOOTES, CORONA, GEMINI, & LEO.

Pair of stars	Source	Gr.	'	"
Vrsae Minoris lucida humeri, & Polaris (the lucida of the Lesser Bear's shoulder, and Polaris)	Nobis	16	30	0

URSA MINOR (distances from Polaris)

This subtable lists the distance of each named star from Polaris. The observers are given as: "Ex Datis Tyconicis per Petauium l. 6. Vranolog. cap. 6." — From the Tyconic data, by way of [Denis Pétau], *Uranologion* book 6, chapter 6.

Star	Observers	G r.	'	"
HVMERI Lucida, quae saeculo Eudoxi fuit Polaris, & infrascriptae Stellae (The lucida of the Shoulder, which in the age of [Eudoxus] was the pole-star, and the stars listed below)	Ex Datis Tyconicis per Petauium l. 6. Vranolog. cap. 6.			
Andromedae 3. brac. dext. aust. (Andromeda, 3rd of the right arm, southern)		66	8	0
Eiusdem brachij australissima (of the same arm, the most southern)		66	8	0
Aquilae infima alae sinist. (Aquila, the lowest of the left		80	3	0

Star	Observers	G r.	'	"
wing)				
Arietis Renes (the Loins of Aries)		83	46	0
Bootae humerus sinister (the left shoulder of Bootes)		36	18	0
Cancri Asellus austral. (Cancer, the southern Ass)		72	58	0
Cancri Asellus boreal. (Cancer, the northern Ass)		69	47	0
Cancri bor. praec. in □ (Cancer, the northern preceding [star] in the square)		71	29	0
Cancri seq. austr. in □ (Cancer, the following southern [star] in the square)		73	46	0
Cassiopeae pes (the foot of Cassiopea)		41	47	0
Cephei pectus (the breast of Cepheus)		33	50	0
Crateris ansa boreal. (Crater, the northern handle)		92	5	0
Crateris periph. boreal. (Crater, the northern rim)		90	47	0
Coronae borea. superiora (Corona Borealis, the upper [stars])		45	58	0
Corui ala sequens (Corvus, the following wing)		93	23	0
Cygni ala dextra super. (Cygnus, the upper right wing)		33	18	0
Cygni extrema alae sinistr. (Cygnus, the tip of the left wing)		63	42	0

Star	Observers	G r.	'	"
Cygni ancon. alae sin. (Cygnus, the elbow of the left wing)		57	16	0
Cygni collum (the neck of Cygnus)		52	30	0
Cygni rostrum (the beak of Cygnus)		57	51	0
Draconis caput (the head of Draco)		29	37	0
Geminorum cap. Castoris (Gemini, the head of Castor)		65	14	0
Geminor. caput Pollucis (Gemini, the head of Pollux)		67	16	0
Heniochi pes dexter (Auriga, the right foot)		70	10	0
Heniochi pes sinister (Auriga, the left foot)		70	32	0
Herculis dextr. Ancon. (Hercules, the right elbow)		57	31	0
Hydrae cor (the heart of Hydra)		93	45	0
Lanx borealis (the northern Scale)		83	14	0
Leonis cor (the Heart of the Lion [Regulus])		73	11	0
Leonis in collo austr. (Leo, on the southern part of the neck)		68	33	0
Lyrae superiora (Lyra, the upper [stars])		43	44	0
Ophiuchi humer. dextr. (Ophiuchus, the right shoulder)		74	9	0
Ophiuchi humer. sinist. (Ophiuchus, the left shoulder)		67	25	0
Ophiuchi genu sinist. (Ophiuchus, the left knee)		92	41	0

Star	Observers	G r.	'	"
Ophiuchi caput (the head of Ophiuchus)		86	26	0
Orionis media balthei (Orion, the middle of the belt)		10 2	52	0
Pegasi os (the mouth of Pegasus)		84	11	0
Pegasi lucida colli (the lucida of the neck of Pegasus)		84	24	0
Pegasi lumbi (the loins of Pegasus)		87	31	0
Persei hum. sin. (Perseus, the left shoulder)		56	32	0
Persei Tibia sinistra (Perseus, the left shin)		69	21	0
Piscis bor. media in spina austr. (the northern Fish, the middle [star] in the southern spine)		83	21	0
Serpentis lucida colli (Serpens, the lucida of the neck)		69	20	0

Right column — concluding distance entries

[The right column at the top of the page completes a set of distance entries whose star-pair labels run into the gutter; the readable labels and the three distance values (degrees, minutes, seconds) are:]

Entry	Gr.	'	"
Tauri genu dextrum (the right knee of Taurus)	95	45	0
Vrsae maior australior in pede dextro anteced. (the more southern [star] of Ursa Maior in the right forefoot)	44	33	0
Borealior eiusdem pedis (the more northern of the same foot)	43	39	0
Vltima Caudae nunc Polaris — Gassendo (the last of the Tail, now Polaris — Gassendi)	16	28	0

For the remaining distances — especially that of the star which is now the Pole Star — look under BOOTES, AURIGA, CASSIOPEA, CORONA, CYGNUS, LYRA, PERSEUS, & URSA MAIOR.

CONCLVSIO (*Conclusion*)

From what has been said, then, it is established that the Tychonic distances themselves disagree among one another by something on the order of the first two minutes.

CAPVT IX.

We bring back the declinations of the fixed stars, reckoned by Tycho, into four classes. The first class is of those declinations which, in the year 1572 completed and at the beginning of 1573, either Tycho alone, or Tycho together with [Paul Hainzel] at Göggingen near Augsburg, had already observed — the place where the altitude of the pole is, for Tycho, 48°22'. Tycho sets these out in *Progymnasmata*, volume 1, pages 361 to 369, where he also gives, for other [stars], the distances of the pole-star from the pole over 4 years of observation.

Class I — Paulus Hainzelius, Anno 1573 ineunte (*maximum and minimum meridian altitudes, with declinations*)

[The table gives, for each star, its maximum and minimum meridian altitude (Altitudo Merid.) and its declination (Declinatio), each in degrees, minutes, seconds.]

Paulus Hainzelius,
Anno 1573 ineunte (at
the beginning of the
year 1573)

		Altitudo Merid. Gr.	'	"	Declinatio Gr.	'	"
Vrsae minoris Polaris (Polaris of the Lesser Bear)	Max	51	2	1	86	5	4
	ima		2	5		9	5
	Min	45	2	4	86	5	4
	ima		2	5		9	5
Cephei humerus dexter (the right shoulder of Cepheus)	Max	77	3	4	60	5	2
	im.		1	0		0	0
	Min	19	1	4	60	5	4

Paulus Hainzelius,
Anno 1573 ineunte (at
the beginning of the
year 1573)

		Altitudo Merid. Gr.			Declinatio		
					Gr.	'	"
	im.					0	0
Precedens in latere	Max	62			75	5	4
Vrsae minoris (the	im.					4	5
preceding [star] on the							
side of the Lesser Bear)							
	Min	34			75	5	0
	im.					5	
In latere dextro Cephei	Max	69			68	4	3
(on the right side of	im.					3	0
Cepheus)							
	Min	27			68	4	0
	im.					3	
Vrsae maioris 1. Caudae	Max	78			59	2	3
(Ursa Maior, the 1st of	im.					6	0
the Tail)							
	Min	17			59	2	3
	im.					6	0
Vrsae maioris 2. Caudae	Max	81			57	1	0
(Ursa Maior, the 2nd of	im.					3	
the Tail)							
	Min	15			57	1	0
	im.					4	
Vrsae maioris humerus	Max	74			64	4	0
luc. (Ursa Maior, the	im.						
bright shoulder)							
	Min	22			64	4	0
	im.						
Vrsae maioris Crus	Max	82			56	5	3
sinistrum (Ursa Maior,	im.						0
the left leg)							
	Min	14			56	6	3
	im.						0

Paulus Hainzelius,
Anno 1573 ineunte (at
the beginning of the
year 1573)

			Declinatio		
	Altitudo Merid.	Gr.	'	"	Gr.
Vrsae maioris Ilia (Ursa	Max	79	4	0	58
Maior, the flank)	im.		1		
	Min	17	2	3	58
	im.			0	
Cassiopeae Genu (the	Max	82	2	3	57
knee of Cassiopea)	im.		2	0	
	Min	16	2	3	58
	im.		2	0	

Class I (*continued*) — Anno Christi 1572 Completo: Hainzelius / Tycho declinations

This subtable, headed "Anno Christi 1572. Completo" (in the year of Christ 1572, completed), gives for each star the declination according to [Paul Hainzel] (Hainzelius) and according to [Tycho Brahe], in degrees, minutes, seconds.

Stella	Hainzelius Decl.	Gr.	'	"	Tycho Decl.	Gr.	'	"
Prima ♈ (the first [star] of Aries)	17		1	0	17		1	3
			1				0	0
Oculus ♉ (the Eye [of Taurus], Aldebaran)	15		3	0	15		3	3
			5				4	0
Castoris Caput (the head of Castor)	32		4	4	32		4	4
			3	5			3	0
Pollucis Caput (the head of Pollux)	28		5	0	28		5	1
			9				9	0
Cor Leonis (the Heart of the Lion [Regulus])	14		1	3	14		1	3
				0				0
Spica ♍ (Spica of Virgo)	8		5	A	8		5	1
			2				2	5

Anno 1572 Completo — Cassiopea: Tycho declinations

1572. Completo — Cassiopea — Stella	Tycho Decl.	Gr.	'	"
Caput (the head)	51		32	30
Schedir	54		11	30

1572. Completo — Cassiopea — Stella	Tycho Decl. Gr.	'	"
Cingulum (the girdle)	55	31	30
Flexura (the bend)	58	24	0
Genu (the knee)	57	58	0
Crus (the leg)	61	30	20
Pedis extrem. (the tip of the foot)	65	23	0
In erect. sedis (on the upright of the seat)	60	34	0
Lucida Cathed. (the lucida of the Throne)	56	48	30

Polaris — distance from the pole over the Tyconic years

Polaris, Stella Tycho — Annis (years)	Dist. à Polo Gr.	'	"	Decl. Gr.	'	"
1577	2	5	5	87	1	1
		8	0			0
1581	2	5	3	87	2	3
		7	0			0
1585	2	5	1	87	5	5
		6	0			0
1589	2	5	5	87	5	1
		4	0			0

Class II — Lucius Barettus (Albert Curtz), Anno 1582

The second class is of those which, at the command of the Emperor Ferdinand, Father [Albert Curtz] of the Society of Jesus — under the pen-name *Lucius Barettus*, by anagram — saw to publishing, from the press of David Hautt of Vienna, in the year 1582. There he sets the meridian observations as made at Uraniburg, whose altitude of the pole, chosen by Tycho, is 55°54'40"; from this, accordingly, the declination is derived.

Class III — Ex Sylloge Ferdinandea Observationum Tychonis, Anno 1582 (*Sextant, or the Greater or Lesser Quadrant*)

This table, headed "Ex Sylloge Ferdinandea Observationum Tychonis Anno 1582. Sextante, aut Quadrante Maiore, vel Minore" (From the Ferdinandean collection of Tycho's observations, in the year 1582, with the sextant, or with the greater or lesser quadrant), gives the names of the stars, the months and days of

observation, the meridian altitude (Altit. Merid.), and the declination — each in degrees, minutes, seconds.

[The left-hand column of folio 229 carries the opening of this large table; the right-hand column continues it, and it runs across all of folio 230.]

Nomina

Stellarum

(Names of the stars)	Mensium Dies (Month / day)	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
Lucida Υ (the lucida of Aries)	Ianuar. 10	55	3 30 1	21	2 2 6 0
	12	55	3 30 0	21	2 2 5 0
Tauri Oculus (the Eye of Taurus)	Ian. 11	49	4 30 2	15	3 1 7 0
	Sext. 21	49	4 45 1	15	3 1 6 5
	Q.	49	4 0 2	15	3 4 6 0
	Sext. — Ian. 22	49	4 ferè 3 (nearly)	15	3 4 7 0
	Q.	49	4 0 2	15	3 4 6 0
Castoris pes dext. (the right foot of Castor)	Ian. 19	54	3 0 0	20	2 4 4 0
Castoris Calx pedis (the heel of Castor's foot)	20	56	4 15 4	22	3 5 8 5
	21	56	4 30 3	22	3 1 8 0
II Extrema pedis (Gemini, the end of the foot)	Ian. 20	56	3 0 9	22	3 4 3 0
	21	56	3 0 9		

Nomina Stellarum (Names of the stars)	Mensium Dies (Month / day)	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
	22	56	3 0 9		
II Propus (Gemini, Propus)	Ian. 20	57	2 30 8	23	2 1 3 0
Pollucis pes sinist. (the left foot of Pollux)	Ian. 19	50	4 0 6	16	4 4 0 0
Pollucis pes dext. (the right foot of Pollux)	19	47	2 0 3	13	1 4 7 0
Caput (the head [of Pollux])	21	63	4 0	28	5 4 8 0

Right column of folio 229 — Anno 1582 (continued)

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinatio Gr.	' "
Cancri Asell. austr. (Cancer, the southern Ass)	Ian. 19	53	4 3 3 0	19	3 1 8 0
Leonis Cor (the Heart of the Lion)	Ian. 3	48	4 0	13	5 4 8 0
	19	48	4 0		
	21	48	4 0		
	23	48	4 0		
	Febr. 24	48	4 0		
	25	48	4 3 0	13	5 1 9 0
	Mart. 5	48	3 3 0	13	5 1 8 0
	&	48	2 3 0	13	5 1 7 0
Leonis Ceruix (the	Ian. 13	56	0 0	21	5 4

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
neck of Leo)						4	0
	17	56	0	3	21	5	1
				0		5	0
	19	56	0	3			
				0			
	21	56	0	3			
				0			
	23	56	0	4	21	5	2
				0		5	0
	Febr. 24	56	1	0	21	5	4
						5	0
	Mart. 15	56	0	3			
				0			
	16	56	1	0			
Leonis Femur (the thigh of Leo)	Ian. 17	51	4	3	17	4	1
			7	0		2	0
	23	51	4	0	17	4	4
			9			3	0
Leonis Coxa (the haunch of Leo)	Ian. 17	56	5	3	22	4	1
			3	0		8	0
	21	56	5	0	22	4	4
			4			8	0
	23	56	5	4	22	4	2
			3	0		8	0
Leonis media Ceruix (Leo, the middle of the neck)	Mart. 20	56	1	0	22	4	4
			2			6	0
	Febr. 25	51	1	0	16	5	4
						5	0
Leonis venter (the belly of Leo)	Mart. 14	51	0	3	16	5	1
				0		5	0
Leonis Crus poster. (Leo, the hind leg)	Mart. 29	45	3	3	11	2	1
			0	0		5	0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
Leonis Cauda (the tail of Leo)	Mart. 29	46	5	3	12	5	1
			5	0		0	0
	Ian. 17	51	0	2	16	5	0
				0		5	
	20	51	0	3	16	5	1
				0		5	0
	21	51	0	3			
				0			
	23	51	0	2			
				0			
	Febr. 18	51	0	3			
				0			
	22	51	0	0	16	5	4
						4	0
	Mart. 26	51	0	0			
Spica ♍ (Spica of Virgo)	29	51	1	0	16	5	4
						5	0
	Q. M. April. 13	51	0	0			
	Q. M. 13	51	0	3			
				0			
	Ian. 17	25	1	1	8	5	5
			0	5		5	A
	21	25	1	0	8	5	2
			0			5	0
	23	25	1	0			
			0				
	Febr. 18	25	1	0			
			0				
	22	25	1	0			
			0				
	Q. 24	25	1	3	8	5	5
			0	0		4	0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
	Sext. 24	25	9	4	8	5	3
				5		5	5
	25	25	1	0			
			0				
	Mart. 5	25	1	5	8	5	1
			0			5	5
	21	25	1	0			
			0				
	Q. M. Mart. 30	25	9	4			
				5			
	Q. M. 30	25	1	0	8	5	2
			1			4	0
	Q. M. April. 13	25	1	1	8	5	5
			0	5		5	
	Q. M. 13	25	9	0	8	5	2
						6	0
♍ alae media (Virgo, the middle of the wing)	Ian. 17	34	5	0	0	5	4
			9			3	0
	23	35	0	0	0	5	4
						4	0
	Febr. 24	34	5	0			
			9				
	April. 13	34	5	4	0	5	2
			7	5		2	5
	&	34	5	0	0	5	4
			8			4	0
♍ 2. alae austr. (Virgo, the 2nd of the southern wing)	Ian. 23	35	4	2	1	4	0
			6	0		1	
	Febr. 26	35	4	0	1	4	4
			6			0	0
♍ in Syrmate (Virgo, in the train)	Mart. 30	25	4	3	8	1	5
			9	0		5	0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
							A
3. Austrā'ior (the 3rd, the more southern)							
Borealiō earum (the more northern of them)	Mart. 30	33	4	4 0		1 4	
			7	0		7 0	A
Lanx Austral. (the southern Scale)	Febr. 24	19	5	0 14		1 2	
			4			1 0	A
	Mart. 20	19	5	0 14		1 2	
			3			2 0	
	21	19	5	1 14		1 5	
			3	5		2	
	29	19	5	1			
			3	5			
Lanx Borealis (the northern Scale)	Febr. 24	26	2	3 7		4 5	
			0	0		4 0	A
	25	26	2	0 7		4 2	
			1			4 0	
	Mart. 20	26	2	0 7		4 2	
			0			5 0	
	29	26	2	0			
			0				
	30	26	2	0			
			0				

Anno 1582 (continued across folio 230, both columns)

Left column of folio 230

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
Scorpij Chela austr. (Scorpius, the southern	Febr. 24	9	2	30	24	4 5	
			2			2 0	A

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
Claw)					
	25	9	2 0 2	24	4 2 3 0
	28	9	2 30 3	24	4 5 1 0
Scorpij Media Frontis (Scorpius, the middle of the forehead)	Febr. 24	12	4 30 8	21	1 5 6 0 A
	25	12	4 0 8	21	1 2 7 0
	Mart. 20	12	4 10 8	21	1 1 7 0
	Mart. 30	12	4 40 8	21	1 4 6 0
Scorp. Chela bor. (Scorpius, the northern Claw)	Mart. 20	15	3 45 3	18	3 3 1 5 A
	29	15	3 30 3	18	3 5 1 0
	30	15	3 30 3		
Canis Maior (the Great Dog)	Febr. 22	17	5 0 7	16	8 2 0 A
	Mart. 5	17	5 30 5	16	9 5 0
Canis Minor (the Lesser Dog)	Mart. 9	40	2 30 0	6	1 1 5 0 B
Cete media Mandib. (Cetus, the middle of the jaw)	12	35	3 0 1	1	2 4 5 0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
Cete Lucida	12	36	3 30	2	2 1
Mandib. (Cetus, the lucida of the jaw)			0		5 0
	13	36	3 30 0		
Cephei Lucida brachij (Cepheus, the lucida of the arm)	Febr. 9	26	4 20 6	60	5 4 1 0
	&	26	4 30 7	60	5 5 2 0
Cephei genu sin. (Cepheus, the left knee)	Febr. 17	41	1 30 3	75	1 5 8 0
	18	41	1 0 3	75	1 2 8 0
Cephei cub. sin. (Cepheus, the left elbow)	18	29	5 35 6	64	1 5 5
Cigni cauda (the tail of Cygnus)	Febr. 9	9	4 6 8	43	5 2 3 0
	&	9	5 0 0	43	5 2 5 0
Cassiopeae caput (the head of Cassiopea)	Ian. 13	22	4 20 7	56	5 4 2 0
	17	42	4 0 8	56	5 2 3 0
	20	22	4 0 8		
	Febr. 5	22	4 30 6	56	5 5 1 0
	Q. M.	22	4 15	56	5 3

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
			7		2 5
	Sext. — Febr.	22	4 0	56	5 2
	18		7		2 0
	Q. M.	22	4 20		
			7		
Cassiopeae flexura (Cassiopea, the bend)	Ian. 13	24	2 50	58	2 1
			3		9 0
	17	24	2 30	58	2 5
			3		8 0
	20	24	2 ferè	58	2 2
			4 (nearly)		9 0
Cassiop. pectus (the breast of Cassiopea)	Ian. 23	20	1 45	54	1 5
			0		6
Cassiopeae genu (the knee of Cassiopea)	Ian. 31	24	0 0	58	5 2
					0
	17	23	5 30	58	4 5
			9		0
	23	24	0 ferè		
			(nearly)		
	Q. M. Febr.	23	5 30	58	3 5
	18		8		0
	Sext.	23	5 40	58	4 0
			8		
Cassiopeae pes (the foot of Cassiopea)	Ian. 13	27	3 50	61	3 1
			0		6 0
	17	27	3 15	61	3 3
			1		6 5
	20	27	3 0	61	3 2
			1		6 0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
	21	27	3 40 1	61	3 4 6 0
	23	27	3 0 1		
	Febr. 15	27	3 0 0	61	3 2 5 0
	&	27	3 0 1		
	Q. M. 18	27	3 0 0		
Draconis lucida lateris praec. (Draco, the lucida of the preceding side)	Febr. 5	32	5 30 1	66	5 5 6 0
		32	5 0 3	66	5 2 8 0
Hydrae lucida (the lucida of Hydra)	Ian. 17	27	1 30 3	6	5 5 1 0 A
	Febr. 22	27	1 0 4	6	5 2 1 0
	24	27	1 30 3		
	25	27	1 0 4		
Hydrae 1. in educatione colli (Hydra, the 1st in the rising of the neck)	Febr. 22	21	3 0 6	7	3 4 0 0
Herculis hum. dextr. (Hercules, the right	Mart. 5	56	3 15 2	22	2 5 6 5

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinati o Gr.	' "
shoulder)					
	25	56	3 15 3	22	2 4 6 0
	26	56	3 0 3	22	2 1 6 0
	29	56	3 30 2	22	2 1 6 0
Herculis Cap. (the head of Hercules)	Mart. 26	49	1 30	14	5 1 6 0
	30	49	3 0	14	5 4 6 0
	April. 3	49	2 0	14	5 4 6 0
Ophiuchi Manus lucid. (Ophiuchus, the lucida of the hand)	Febr. 24	31	3 0 4	2	3 2 1 0 A
	25	31	3 30 4	2	3 0 1
	28	31	3 0 5	2	3 5 0 0
Manus sup. (the upper hand)	Mart. 20	31	3 40 3	2	3 4 1 0
	26	31	3 30 3	2	3 5 1 0
	30	31	3 20 3	2	3 0 2

Right column of folio 230 — Anno 1582 (continued)

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	' "	Declinatio Gr.	' "
Ophiuchi humerus sin. (Ophiuchus, the left shoulder)	Mart. 26	44	1 0 1	10	5 4 0

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
	30	44	1	0	10	6	2
			1				0
	April. 3	44	1	4	10	6	2
			1	0			0
	11	44	1	3	10	6	1
			1	0			0
Orionis humerus lucidus (Orion, the bright shoulder)	Ian. 12	41	2	3	7	1	1
			1	0		6	0
	22	41	2	4	7	1	2
			1	0		6	0
Orion. hum. sin. (Orion, the left shoulder)	Ian. 19	40	0	0	5	5	4
						9	0
	&	40	0	3	6	0	1
				0			0
Orion. pes dexter (Orion, the right foot)	Ian. 19	24	1	0	9	5	2
			4			1	0
	&	24	1	2	9	5	0
			5	0		0	
	22	22	1	3	9	4	5
			6	0		9	0
Orionis pes lucid. (Orion, the bright foot [Rigel])	Ian. 19	25	2	0	8	4	2
			2			3	0
							A
	Q. M. 22	25	2	0			
			2				
	Sext. &	25	2	3	8	4	5
			2	0		2	0
Orionis 1. balthei (Orion, the 1st of the belt)	Ian. 19	33	2	0	0	4	2
			5			1	0
							A
	& Q. M.	33	2	2	0	4	0
			5	0		1	

Nomina Stellarum	Mensium Dies	Altit. Merid. Gr.	'	"	Declinatio Gr.	'	"
Orionis 2. balthei (Orion, the 2nd of the belt)	Sext. 21	33	2	3	0	4	5
			4	0		1	0
	Q. M. 21	33	2	0			
			5				
	Sext. 22	33	2	4	0	4	4
			4	0		1	0
	Q. M. 22	33	2	0			
			5				
	Ian. 19	32	3	3	1	3	5
			3	0		1	0
							A
	Q. M. 19	32	3	0	1	3	2
Orion. balthei 3. (Orion, the 3rd of the belt)			3			2	0
	21	32	3	0	1	3	2
			2			3	0
	Sext. 22	32	3	3	1	3	5
			2	0		2	0
	Q. M. 22	32	3	0			
			3				
	Ian. 19	31	5	4	2	1	4
			3	0		1	0
							A
	21	31	5	0	2	1	2
			4			1	0
Pegasi in pect. praec. (Pegasus, the preceding [star] in the breast)	22	31	5	0			
			4				
	Nou. 23	55	2	0	21	2	4
			6			0	0
Sequens earundem (the following of the	24	55	3	0	21	2	4
			0			4	0
	Nou. 23	56	3	3	22	2	1
			0	0		5	0

Nomina Stellarum	Mensium Dies	Altitud. Merid. Gr.	'	"	Declinatio Gr.	'	"
same)							
	24	56	3	0	22	2	4
			0			4	0
Vrsae Minoris lucid. in rota poster. (the lucida of the Lesser Bear in the hind wheel)	Ian. 10	41	4	1	75	5	3
			6	0		1	0
	11	41	4	0			
			6				
	12	41	4	1			
			6	0			
	23	41	4	0	75	5	2
			6			1	0
Vrsae Min. Polaris alt. minima (Polaris of the Lesser Bear, the minimum altitude)	Ian. 11	52	5	4	87	2	5
			6	5			
	vel (or)	52	5	5	87	2	1
			6	0			0
	17	52	5	3	87	2	5
			7	0			0
	20	52	5	0			
			7				
	21	52	5	1	87	2	3
			7	5			5
	23	52	5	4	87	3	5
			7	5			
	Sext. 23	52	5	3	87	2	5
			7	5			5
	Febr. 5	52	5	4	87	3	0
			7	0			
	Q. M. 9	52	5	3			
			7	0			

Nomina Stellarum	Mensium	Altit. Merid. Gr.			Declinatio Gr.		
	Dies		'	"		'	"
	Q. M. 9	52	5	0	87	4	2
			9				0
	Sext. 9	52	5	3			
			7	0			
	Q. M. 18	52	5	0	87	2	2
			7				0
	Sext. 18	52	5	3			
			7	0			

Class IV (*closing note + Tycho 1584/1585 reduction table*)

The fourth class is of those fixed stars whose meridian altitudes, captured in the years toward the end of 1584 and during 1585 — or, about the end of 1586 and the beginning of 1587, at Uraniburg — Tycho displays in the *Epistles*, page 53; where he there says (also in volume 1 of the *Progymnasmata*, page 28) that the altitude of the pole is 55°54'40". From this, accordingly, we shall easily infer their declinations.

Tycho Anno 1584.

exeunte, & 1585.

labente (Tycho, at the

end of 1584 and during 1585)

	Altitudo Meridiana Gr.			Ergo Declinatio Gr.		
		'	"		'	"
Prima Υ (the first of Aries)	51	1	0	17	1	4
		9			3	0
Secunda Υ (the second of Aries)	52	5	0	18	4	2
		0			4	0
Informis supra caudam Υ (the unformed [star] above the tail of Aries)	59	3	0	25	3	4
		6			0	0
Pleiadum penultima (the second-to-last of the Pleiades)	56	5	3	22	4	1
		0	0		6	0
Cancri Chelar. australis (Cancer, the southern of the Claws)	47	3	0	13	2	4
		0			4	0

Tycho Anno 1584.

exeunte, & 1585.

labente (Tycho, at the

end of 1584 and during
1585)

	Altitudo Meridiana Gr.	'	"	Ergo Declinatio Gr.	'	"
Leonis in pede sinistro (Leo, on the left foot)	45	5	0	11	4	4
		0			4	0
Leonis inferior in capite (Leo, the lower [star] in the head)	59	4	0	25	3	4
		4			8	0

Liber IV — De Stellis Fixis (continued)

Caput IX (continued): Tycho's fixed-star declinations by class

The tables below continue the declinations of the fixed stars derived from Tycho Brahe's [Tycho Brahe] observations. Each star is given with the meridian altitude [altitudo meridiana] observed at Uraniborg and the declination [declinatio] that follows from it. The marker **A** denotes a southern (australis) declination; **B** denotes a northern (borealis) declination. Where neither letter is printed, the original gives none.

Third class — observations of 1584/1585 (meridian altitude and resulting declination)

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Leonis in ventre	45	3	0	11	2	4	
		0			4	0	
Leonis coxae superior	56	5	3	22	4	1	
		2	0		7	0	
Leonis genu	46	5	4	12	4	2	
		4	0		9	0	
Leonis femur	51	4	0	17	4	4	
		7			1	0	
Leonis cauda	50	5	0	16	5	4	
		9			3	0	

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Scorpij Frontis — Infima	9	2	0	24	4	2	A
		1			4	0	
Scorpij Frontis — Media	12	4	2	21	1	0	A
		7	0		8		
Scorpij Frontis — Suprema	15	3	0	18	3	2	A
		3			2	0	
Scorpij Cor	8	4	0	25	2	2	A
		5			0	0	
Capricorni — Cornu superius	20	2	3	13	4	5	A
		3	0		1	0	
Capricorni — Cornu inferius	18	7	2	15	5	0	A
			0		8		
Capricorni — Praecedens in Cauda	15	4	4	18	2	3	A
		0	5		4	5	
Capricorni — Sequens in Cauda	16	1	3	17	5	5	A
		1	0		3	0	
Aquarij — Humerus sinister	26	4	4	7	1	3	A
		6	5		8	5	
Aquarij — Humerus dexter	31	4	0	2	1	2	A
		9			6	0	
Aquarij — Media Urnae	32	0	0	2	5	2	A
						0	
Piscis Austral. Mandibula	35	7	4	1	2	2	B
			0			0	
Ceti Mandib. inferior	36	3	0	2	2	4	
		1			5	0	
Persei — Caput Algol	73	2	3	39	1	1	
		2	0		7	0	
Persei — Praeced. in ant. planta	65	0	0	30	5	4	
					4	0	
Persei — Sequens in ant. planta	64	4	0	32	3	4	
		9			4	0	

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Aurigae pes sinister	66	3 0	0	32	2 4	4 0	
Bootis pes dexter	49	3 9	3 0	15	3 4	1 0	
Bootis lucida in Clava	68	5 9	3 0	34	5 4	1 0	
Canis Minor praecedens	43	8	0	9	2	4 0	
Hydrae lucida	27	1 2	0	6	5 3	2 0	A
Herculis — Humerus dexter	56	3 2	4 0	22	2 7	2 0	
Herculis — Humerus sinist.	59	3 0	0	25	2 4	4 0	
Herculis — Caput	49	2	0	14	5 6	4 0	
Ophiuchi — sinistra manus	30	3 0	0	3	3 5	2 0	A
Ophiuchi — hum. sinistr.	44	1 1	0	10	5	4 0	B
Ophiuchi — Genu dextr.	19	0	3 0	15	4	5 0	A
Ophiuchi — Caput	47	2	0	12	5 6	4 0	
Aquilae lucida	41	5 6	3 0	7	5 1	1 0	
Aquilae scapula	43	4 6	4 5	9	4 1	1 5	
Antinoi sinistra manus	32	7	4 0	1	5 7	4 0	A
Pegasi os	42	7	0	8	1	4 0	

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Pegasi schein	59	5	3	25	5	1	
		7	0		2	0	
Pegasi scapula	47	5	3	13	0	1	
			0			0	
Pegasi lucida in pectore	56	3	3	22	2	1	
		3	0		8	0	
Pegasi alae extrema	46	5	3	12	5	1	
		8	0		3	0	

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Virginis — Media australe	34	5	0	0	5	4	
		6			0	0	
Virginis — Cingulum	39	4	0	5	3	4	
		5			9	0	
Virginis — Vindemiator	47	1	4	13	1	1	
		7	5		2	5	
Virginis — Extrem. infer. alae	30	4	0	3	1	2	A
		7			8	0	
Virginis — Spica	25	8	0	8	5	2	A
					7	0	
Virginis — Pes Borealis	30	1	2	3	4	5	A
		8	0		6	0	
Lanx Australis	19	5	3	14	1	5	A
		1	0		3	0	
Lanx Borealis	26	1	3	7	4	5	A
		9	0		5	0	
Androm. cinguli lucida	67	3	0	33	2	4	
		0			4	0	
Androm. Caput	60	5	0	26	4	4	
		5			9	0	

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Persei Algenib.	82	2 4	0	48	1 8	4 0	
Capella	79	3 4	0	45	2 8	4 0	
Hoedorum sequens	74	3 9	0	40	3 3	4 0	
Eridani extrema	28	2 4	0	8	4 1	2 0	A
Orionis — Pes sin. lucid.	25	2 1	0	8	4 4	2 0	A
Orionis — Hum. sin.	40	5 9	5 0	6	5 4	3 0	
Orionis — 1. Balthei	33	2 5	3 0	0	3 9	5 0	A
Orionis — 2. Balthei	32	3 3	0	1	3 2	2 0	A
Orionis — 3. Balthei	31	5 1	4 0	2	1 3	4 0	A
Orionis — Capitis Lucidior	43	4 0	3 0	9	3 5	1 0	B
Orionis — Ensis infima	27	5 1	0	6	1 4	2 0	A
Orionis — Pes dexter	24	1 3	0	9	5 2	2 0	A
Orionis — Humerus dext. luc.	41	2 0	3 0	7	1 0	1 0	B
Canis maior pes anter.	16	1 8	0	17	4 7	2 0	A
Canis maior	17	5 4	0	16	1 1	2 0	A
Canis minor	40	1 8	4 5	6	1 3	1 5	B

Star	Alt. merid. Gr.	'	"	Declination Gr.	'	"	A / B
Bootis sura	54	3	0	20	3	4	
		6			0	0	
Arcturus	55	2	0	21	2	4	
		8			2	0	
Coronae Gnosiae praeced.	64	4	0	30	3	4	
		0			4	0	
Coronae lucida	62	1	0	28	9	4	
		5				0	

Fourth class — declinations Tycho recorded in *Progymnasmata* I (pp. 159–232), for various years

The fourth and last class consists of those fixed stars whose declinations Tycho compiled from his own observations and recorded in *Progymnasmata*, volume 1, from page 159 to page 232, for various years. [marginal numeral "4" beside this paragraph]

Nomina Stellarum	Anni Christi	Decl. Gr.	'	"	A / B	I. Progymn. Pagina
Aquarij hum. sinistr.	1585. Compl.	7	1	1	A	232
			8	5		
Aquilae lucida	1585. Compl.	7	5	2		200
			1	0		
Arietis prima	1585. Compl.	17	1	0		232
			4			
Arietis lucida	1585. Compl.	21	2	3		200
			8	0		
&c.	1587. Ian. 14	21	2	3		181
			8	0		
Cancri Asellus bor.	1585. Compl.	22	5	3		232
			2	0		
Capric. Caudae praec.	1585. Compl.	18	2	3	A	232
			4	0		

Nomina Stellarum	Anni Christi	Decl. Gr.	'	"	A / B	I. Progymn. Pagina
Geminorū Calx praec.	1582. Mart.	22	3	3		161
			8	0		
Geminorum pes lucid.	1585. Compl.	16	4	2		232
			0	0		
&c.	1588. April.	16	4	3		191
			0	0		
Castoris Caput	1587. Aug.	32	4	1		183
			2	0		
&c.	&c.	32	4	1		186
			2	5		
Pollucis Caput	1582. April.	28	5	0		163
			7			
&c.	1585. Sept.	28	5	0		166
			7			
&c.	1585. Compl.	28	5	0		200
			7			
&c.	1585. Compl.	28	5	4		204
			7	5		
&c.	1588. April.	28	5	4		184
			6	0		
Leonis lucida Colli	1585. Compl.	21	5	3		232
			4	0		
Leonis Cor	1585. Compl.	13	5	0		200
			8			
&c.	1585. Compl.	13	5	4		204
			7	5		
&c.	1588. Octob.	13	5	2		182
			7	0		
Librae lanx boreal.	1585. Compl.	7	4	4	A	232
			5	5		
Ophiuchi borealior	1585. Compl.	2	3	1	A	200
			3	5		

Nomina Stellarum	Anni Christi	Decl. Gr.	'	"	A / B	I. Progymn. Pagina
Manus sinistrae	Eodem	2	3	1	A	232
			3	5		
Pegasi 1. Alae	1585. Compl.	13	0	4		200
				0		
Piscium lucida in nexu	1585. Compl.	0	4	3		232
			4	0		

Nomina Stellarum	Anni Christi	Decl. Gr.	'	"	A / B	I. Progymn. pagina
Sagittarij media Capit.	1585. Compl.	22	1	0	A	232
			3			
Scorpij Cor	1585. Compl.	25	2	0	A	232
			3			
Tauri oculus boreal.	1585. Compl.	18	1	0		232
			2			
Tauri oculus austr.	1582. Febr.	15	3	0		159
			6			
	1582. Mart.	15	3	0		168
			6			
	1585. Compl.	15	3	1		200
			6	5		
	1588. Martij	15	3	4		189
	28		6	5		
Virginis 3. alae austr.	1585. Compl.	0	5	1		232
			1	5		
Virginis Spica	1585. Compl.	8	5	2	A	200
			6	0		
	1588. Dec.	8	5	1	A	175
			7	5		

[The lower part of this table — printed under the heading "Tom. 2." — gives declinations from *Progymnasmata*, volume 2, with page references prefixed "p.".]

Nomina Stellarum	Anni Christi	Decl. Gr.	'	"	A / B	Pagina (Tom. 2)
Aquilae lucida	1577	7	5	0		p. 15
			2			
Antinoi lux man. sin.	1577	1	5	0	A	19
			7			
Aquarij hum. sin.	1577	7	2	0	A	20
			0			
Aquarij hum. dextr.	1577	2	1	0	A	20
			6			
Pegasi os	1577	15	1	0		21
			7			
Capricorni cornu inf.	1577	15	5	0	A	19
			8			
Prima alae Pegasi	1577	12	5	0		22
			7			
Lucid. duarum in collo	1577	8	4	0		22
			3			
Scheat Pegasi — Pegasi	1577	25	5	0		22
			0			
Genu dextr. Pegasi	1577	28	2	0		24
Boreal. in pect. Pegasi	1577	22	2	0		27
			6			
Lyrae lucida	1577	38	2	0		29
			6			

The Conclusions drawn from the four classes

From the four classes set out above I likewise draw the following observations, or Conclusions.

1. First Conclusion. Some of Tycho's declinations are not so certain that one may not suspect an error of one or two minutes — as will be plain to anyone who works through the first, second, and fourth classes.

2. Second Conclusion. The altitude of the Pole at Uraniborg is subject to an uncertainty of about 15 seconds. For Tycho, in his *Letters* (p. 40), writes thus to

Landgrave [Wilhelm] of Hesse: "The elevation of the equator in our higher-latitude observations of the stars must be taken at $34^{\circ} 5' \frac{1}{3}$; for from frequent experiments which the middle of the island of Hven has yielded — that famous Hven in the celebrated Danish strait, with its parts in the fourth scruple, attolli &c."; and on p. 53 he repeats: "Uraniborg, where the Pole is elevated $55^{\circ} 54' \frac{2}{3}$." But in *Progymnasmata* volume 1, p. 28, speaking of the year 1583, he says: "Inasmuch as at that time the elevation of this place, when it had earlier been increased by some amount in preceding years, was $55^{\circ} 54' \frac{2}{3}$, the seconds being neglected," and a little more exactly in the same volume, p. 218, he says: "Since the altitude of the Pole and the circumpolar stars — especially the truly polar one — is here most diligently determined, as has often been indicated, P. $55^{\circ} 54' 45''$." It follows that the altitude of the meridian of Spica at the beginning of the year 1586 was found to be $34^{\circ} 5' 55''$; subtracting the parts $34^{\circ} 5' 15''$, he concludes the southern declination of Spica to be $8^{\circ} 36' 20''$ partium [?]. Either, then, through some oversight, the altitude of the Pole was elsewhere stated otherwise than indicated above — as five seconds, or as something to be added by later observations, as he reckoned. — Finally, at the close of the second class, when we considered the meridian altitudes of the polar star, observed at the beginning of the year, we shall find them somewhat variously taken, at about $52^{\circ} 57' 45''$; and, neglecting the seconds, it was found to be $52^{\circ} 59'$. Thus the meridian altitude of the bright star of the Lesser Bear [Humeri lucidi Ursae minoris] is least, $39^{\circ} 14'$; and greatest, $72^{\circ} 35' 30''$, or $72^{\circ} 35' 30''$. From these the altitude of the Pole comes out as either $55^{\circ} 54' 30''$ — which seems to have been the case — or, in determining the altitude of the Pole, as $55^{\circ} 54' 45''$. Since indeed he obtained the very least altitude of the polar star in the same year, at about $52^{\circ} 56' 45''$, or $52^{\circ} 57' 45''$ — it is credible that he chose a mean between these. [marginal note: *Poli Altit. Uranib. expensa* — "the altitude of the Uraniborg Pole weighed"]

So in the first class we see that in the year 1581 he settled the distance of the polar star from the Pole at $2^{\circ} 57' 30''$, and thus chose another value as nearly intermediate between the extremes [extimam]; for that he was not anxious about a part smaller than a sixth of a minute is plain from his own words in *Progymnasmata* volume 1, p. 69, where, prescribing about the altitude of the Pole from the circumpolar star, he says: "Known on this ground not only to within a minute, but even to a sixth, or a third, or at least a sixth part of a scruple of the Pole (for so great a precision is here required), is not unknown to us in the complete and quadrant elevation." Nevertheless, we have chosen the inclination between the extremes, $55^{\circ} 54' 40''$ — both because Tycho selected it in three places as intermediate between the extremes, and because it agrees best when collated with the solar observations made there, and with those carried out by

our Gnomon at Bologna, as I have said in the *Book on the Sun*. [marginal note: *Poli Altit. Uranib.*]

3. Third Conclusion. Tycho's fixed-star declinations, even granting the same meridian altitude, are exposed to an uncertainty of seconds of 15", however little they may be liable to error otherwise. The altitude of the Uraniborg Pole, as said in the preceding Conclusion, is exposed to error. Therefore the declinations which we have here derived from the meridian altitude observed at Uraniborg are probable, to within five seconds, or even fewer, and must not be excluded as evidently mistaken, granted that we have used that intermediate altitude of the Pole, 55° 54' 40".

4. Fourth Conclusion. Among certain of Tycho's fixed-star declinations a discrepancy appears, arising from a source other than the diversity of observation. In the fourth class, for instance, the bright star of Aries is assigned the same declination, both for the year 1585 complete (as on *Progymnasmata* pages 195, 198, 200, 202, 232) and again for the year 1587 at its beginning (as on page 178 and on page 181). And yet for the year fully complete, according to Tycho's own tables, this star increases its declination by 18"; and at one second per month, it follows that for January of the year 1587 it was found to be 21° 28' 30", whereas it ought to have been, at the close of the year 1585, 21° 28' 10". But from the observations of the second class, in the year 1582 at its beginning, it was 21° 26' 20"; and consequently, for the year 1585 complete, it would have been 21° 27' 32"; or, at gr. 21° 26' 32", if a minute increases at the rate of one, the median is reckoned greater... [the prose here packs several alternative reckonings of the same value]. And so it is most certain — and this is confirmed precisely by our observations, namely 21° 27' 0" — and from this most of all, since it agrees with our observations as established in Chapter XVI, no. 2: namely that the declination of this Tychonic star, taken across these two centuries [duobus saeculis] by half-increments, has been greater than the true declination. For from the latitude of this same Tychonic star, with the longitude adduced, the distance of the Poles being 23° 30' 20", it ought, for the year 1660 complete, to have a declination of 21° 51'; and yet from our observations, as adduced in the said Chapter, it will be established, this very value being then only 21° 49' 30".

Likewise, in the class of Pollux's Head [Caput Pollucis] the declination is recorded as 28° 57', both for the year 1582 in April and for the year 1585 (as found on *Progymnasmata* pages 163, 195, and 200); and yet for the year 1585 complete it is put at 204, and at 232 it is placed at 28° 57' 45"; and in the class for the year 1586 complete it is set at 28° 56' 40", not otherwise than in the class for the year 1588.

The declinations of this star can in no way agree with what could decrease through the years of this century according to Tycho's reckoning, namely 12". If, then, for the year 1586 complete it was observed at 28° 56' 40", it ought for the year 1588 to be set at 38° 56' 47", and for the year 1582 at 38° 56' 33"; whereas in April of the year 1582 it is 28° 57' 15". [marginal note: *Pollucis Declinatio*]

In the class of the Heart of Leo [Cor Leonis], the declination is double for the same year 1585 complete: one value 13° 58'; in the third class another, 13° 57' 45"; and for the year 1586 fully complete it is observed at 13° 57' 40". Now it decreases, according to Tycho, by this much per century, namely 8"; and therefore, for the year 1585 complete, it ought to have been 13° 57' 52"; and so the more correct value is 13° 58'. [marginal note: *Reguli Declinatio*]

The declination of Aquila in the fourth class, for the year 1577, is put at 7° 52'; and for the year 1585 (since this increases by 7" 48" from Tycho's centenary table for individual years) it ought to be, for the year 1585 complete, 7° 52' 0"; or if for the said year it was 7° 51' 20", it ought, for the year 1577, to have been...

only 7° 50' 18"; but because in the third class it is set down as observed for the year 1585 at its course, at 7° 51' 10", therefore for the same year fully complete it could scarcely have been 7° 51' 18"; thus it stands in many other cases as well.

6. Spica of Virgo [Spica Virginis], according to Tycho, increases by twenty seconds per century in declination. Therefore, if for the year 1587 at its beginning, as it is in the third class, it was 8° 57' 20", it ought for the year 1585 complete to have been 8° 57'; and yet it is in the fourth class, for the year 1585 complete, at 8° 56' 20" (Tycho gives it as 8° 56' 20" in *Progymnasmata* volume 1, p. 195, 200, 204, and 232). What if this declination were taken from those, which in most cases are gathered from class-2 observations? For there we have, in six places, the meridian altitude of Spica at 25° 10'; and so the declination 8° 55' 20", in that same year 1582 at its beginning, and at its course, therefore for the year 1585 complete ought to have been 8° 56' 40"; or at least 8° 56'. From this it can in no way be reconciled with the observation of the year 1587, made by the Great Quadrant [Quadrante Maximo].

7. Among these and similar diversities, since Tycho, for the year 1585 complete, laid the foundations of the other fixed stars from the right ascension of the bright star of Aries [lucida Arietis], it seemed best to reduce the Tychonic declinations to the end of the same year by this method. First, we selected the declinations of the third class — both because they are derived immediately from their own sources, namely from the meridian altitude of the fixed stars and from the altitude of the

Pole (which Tycho preferred), and because at that time he was furnished with greater skill and larger instruments; and next, because we have used, in part, the proportional increment or decrement of the declination, which Tycho's table supplies in *Progymnasmata* volume 1, p. 278. Yet, so that, when the discrepancy lies in two or three seconds, we may retain round numbers of decads — since within this subtlety we are not certain of the altitude of the Uraniborg Pole, as said in the second Conclusion above — secondly, for the stars that are not in the third class, we have used declinations of the first, second, or fourth class, reducing them to the end of the year 1585 by the aforesaid proportional part.

Reduced declinations to the end of the year 1585

Star	Decl. correcta Gr.	'	"	A/ B
Antinoi manus sinistra	1	57	50	A
Andromedae — Caput	26	49	10	
Andromedae — Cinguli lucida	33	26	0	
Andromedae — Pes australis	40	18	30	
Aquarij — Humerus dexter	2	16	12	A
Aquarij — Humerus sinister	7	18	20	A
Aquarij — Urnae media	2	5	15	A
Aquarij — Fomahant	31	43	40	A
Aquilae lucida	7	51	15	
Aquilae scapula	9	41	20	
Arietis — prima in cornu	17	12	30	
Arietis — secunda	18	43	10	
Arietis — 3. seu lucida supra Caput	21	27	0	
Aurigae — Capella in hum. sinist.	25	28	40	
Aurigae — Humerus dexter	44	49	30	
Aurigae — Pes sinister	32	24	40	
Aurigae — Hoedorum sequens	40	33	40	
Bootis — In fimbria Arcturus	21	23	0	
Bootis — Humerus sinister	40	7	0	
Bootis — Pes dexter	15	34	0	
Bootis — Sura	20	31	0	

Star	Decl. correcta Gr.	'	"	A/ B
Bootis — Lucida Clavae	34	54	0	
Cancri — Asellus Borealis	22	52	30	
Cancri — Asellus Australis	19	37	20	
Cancri — Chela Australis	13	24	35	
Cancri — Praesepe	21	4	50	
Canis Maior Sirius	16	11	20	A
Canis Maioris pes praecedens	17	47	20	A
Canis Minor procyon	6	13	20	
Canis Minor praecedens	9	2	35	
Capricorni — Cornu superius	13	42	20	A
Capricorni — Cornu inferius	15	57	55	A
Capricorni — Caudae praecedens	18	24	30	A
Capricorni — Caudae sequens	17	53	45	A
Cassiopeae — Caput	51	36	50	
Cassiopeae — Pectus Schedir	54	15	50	
Cassiopeae — Cingulum	55	35	50	
Cassiopeae — Genu	58	2	15	
Cassiopeae — Flexura	58	28	20	
Cassiopeae — Crus	61	34	40	
Cassiopeae — Pes	61	37	40	
Cassiopeae — Pedis extrema	65	27	20	
Cassiopeae — In erectione sedis	60	38	20	
Cassiopeae — Lucida Cathedrae	56	52	50	
Cephei — Lucida brachij	60	53	50	
Cephei — Latus sub cingulo	68	46	30	
Cephei — Cubitus sinister	64	2	40	
Cephei — Genu sinistrum	75	19	20	
Cete — Lucida Mandibulae	2	25	45	
Cete — Ventor	12	20	40	A
Cete — Cauda Borealis	11	6	0	A

Star	Decl. correcta Gr.	'	"	A/ B
Cete — Cauda Australis	20	17	5	A
Coronae boreae lucida	28	9	50	
Coronae boreae praecedens	30	34	50	
Cygni — Rostrum	27	8	20	
Cygni — Pectus	38	58	20	
Cygni — Cauda	43	50	30	
Cygni — Ala superior	44	9	55	
Cygni — Ala inferior	32	26	50	
Draconis lucida capitis	51	37	15	
Draconis lucida lateris praec.	66	57	30	
Geminorum — Caput Castoris	32	42	45	
Geminorum — Caput Pollucis	28	56	50	
Geminorum — Calx Castoris	22	38	38	
Geminorum — Propus	23	23	15	
Geminorum — Planta pedis	22	32	40	
Herculis — Humerus dexter	22	27	15	
Herculis — Humerus sinister	25	24	40	
Herculis — Caput	14	56	40	
Hydrae lucida, seu Cor	6	53	30	A
Leonis — Cor Regulus	13	58	20	
Leonis — Cauda	16	53	30	
Leonis — Media cervicis	21	54	0	
Leonis — Lucida lumborum	22	47	30	
Leonis — Colli suprema	25	27	0	
Leonis — Colli infima	18	45	0	
Leonis — In capite inferior	25	38	35	
Leonis — In ventre	11	24	30	
Leonis — Genu	12	49	10	
Leonis — Femur	17	41	30	
Leonis — Pes sinister	11	44	35	

Star	Decl. correcta Gr.	'	"	A/ B
Leporis femur	21	7	0	A
Librae lanx borealis	7	45	35	A
Librae lanx australis	14	13	35	A
Lyrae lucida	38	27	25	
Navis lucida in puppi	23	8	45	A
Ophiuchi — Caput	12	56	50	
Ophiuchi — Manus sinistrae lucida	2	33	15	A
Ophiuchi — Humerus dexter	4	49	45	
Ophiuchi — Humerus sinister	10	5	40	
Ophiuchi — Genus dextrum	15	4	50	A
Ophiuchi — Genu sinistrum	9	36	45	A
Orionis — Humerus dexter	7	15	10	
Orionis — Humerus sinister	6	54	25	
Orionis — Suprema Capitis	9	35	5	
Orionis — Balthei 1.	0	39	55	A
Orionis — Balthei 2.	1	32	25	A
Orionis — Balthei 3.	2	13	45	A
Orionis — Ensis infima	6	14	23	A
Orionis — Pes lucidus sinister	8	44	25	A
Orionis — Pes dexter	9	52	25	A

(Caput IX, continued) — Corrected-declination master table, reduced to the completed year 1585

The table of corrected declinations continues and concludes here. The left column gives the star (grouped by constellation); the right gives the corrected declination [*declinatio correcta*] in degrees (Gr.), minutes ('), and seconds ("). Entries marked **A** are austral/southern [*australis*]; the remainder, where no marker is given, are northern [*borealis*].

From Tycho's observations, for the completed year 1585.

Star	Gr.	'	"	A/B
Pegasi — Markab	13	0	10	
Algenib	12	53	20	
Scheat	25	52	20	
Os	8	1	50	
Lucidior pectoris [the brighter star of the breast]	22	28	20	
Persei lucidum latus [the bright flank of Perseus]	48	18	40	
Persei caput Medusæ [the head of Medusa]	39	17	20	
Persei plantæ anterioris præcedens [the preceding star of the forward sole]	30	54	45	
sequens eiusdem [the following star of the same]	32	34	45	
Piscium Occiput, seu mandib. austr. [the back of the head of Pisces, or the southern jaw]	1	2	30	
Piscium lucida in nexu [the bright star in the knot of Pisces]	0	44	30	
Sagittarii media capitis [the middle of the head]	22	13	0	A
orientalis capitis [the eastern star of the head]	21	36	10	A
Scorpii Cor, Antares	25	20	25	A
Scorpii borealis frontis chela [the northern claw of the forehead]	18	32	25	A
Scorpii media frontis [the middle of the forehead]	21	18	5	A
Scorpii chela australis [the southern claw]	24	44	25	A
Serpentis lucida colli [the bright star of the neck]	7	49	10	A
Tauri — Oculus austr. Aldebaran [the southern eye, Aldebaran]	15	36	30	
Oculus Borealis [the northern eye]	18	11	5	
Cornu Boreales [the northern horn]	28	10	40	
Cornu Australes [the southern horn]	20	49	10	
Hyadum 1 [first of the Hyades]	14	34	10	
Hyadum 2 [second of the Hyades]	16	29	35	
Hyadum 4 [fourth of the Hyades]	14	55	55	
Pectus [the breast]	11	15	35	
Pleiadum lucida [the bright star of the Pleiades]	22	46	20	

Star	Gr.	'	"	A/B
Virginis — Spica	8	57	0	A
Media alæ austr. [the middle of the southern wing]	0	51	0	
Cinguli lucida [the bright star of the girdle]	5	40	0	
Vindemiator	13	12	35	
Extrema alæ inferioris [the tip of the lower wing]	3	18	0	A
Pes borealis [the northern foot]	3	46	40	A
Syrmatis borealior [the more northerly star of the train]	0	19	0	A
Syrmatis australior [the more southerly star of the train]	8	17	0	A
Vrsæ minoris Polaris, vlt. caudæ [Polaris, the last star of the tail]	87	3	50	
Humerus lucidus [the bright shoulder]	75	50	0	
Vrsæ maioris Luc. humer. Pubhe [the bright shoulder-star, Dubhe]	64	0	0	
Ilia [the flank]	58	36	40	
Coxendix posterior [the hinder hip]	56	2	0	
Tergoris lucida [the bright star of the back]	59	20	0	
Radix Caudæ [the root of the tail]	58	14	50	
1. Caudæ [first of the tail]	59	22	10	
2. Caudæ [second of the tail]	57	9	10	
Vlt. seu 3. Caudæ [the last, or third, of the tail]	51	26	30	
Crus sinistrum [the left leg]	56	4	0	

CAPVT X.

The right ascension of the bright star of Aries [lucida Arietis], examined precisely by Tycho up to the completed year 1585, and corrected.

1. [Margin: *Priscorum methodus* — The method of the ancients.] The ancients — Hipparchus, Ptolemy [Ptolemæus], and al-Battānī [Albategnius] — investigated the positions of the fixed stars from the Sun by way of the Moon, as I showed in

Book 6, chapter 1 (*Almagestum Novum*). By the great art of construction, in chapters 2 and 4, they took the zodiacal distances in the evening. For at dusk they would take the zodiacal distances of the Moon from the Sun, a little after sunset, and from these, computed through parallaxes, they would gather the place of the Moon in the zodiac. Then on the following night, with the same instrument, they would take the distance of the Moon from one of the fixed stars; and by adding to the Moon's earlier place however much the time elapsed between the first and second observations required, they would infer the place of the fixed star in the zodiac — yet with this much danger of error, however much the instrument's defect introduced (whether from too coarse a graduation), arising from neglect of the parallaxes and refractions of the Sun.

2. [Margin: *Tychonis methodus* — Tycho's method.] To avoid the troublesome business of the Moon's parallaxes, Tycho [Tycho Brahe] substituted Venus, observed in the evening when very high, in three observations which he reports in *Progymnasmata* vol. 1, pages 157 to 165. At one and the same moment he took the altitudes of the Sun and of Venus and their mutual distance, and through the equatorial armillae [*armillæ æquatoriæ*] he found the declination — for he learned the Sun's declination from the Sun's place in the ecliptic at that moment, the moment of time being reckoned out, since that moment was known to him from a verified clock. Then, having the ratio of the Sun and of Venus, he derived trigonometrically the difference of right ascension [*differentia ascensionis rectæ*] from their distance and from the complements of their declinations; and converting this into a true one, and adding it to the right ascension of the Sun found from his own tables, he obtained the true right ascension of Venus for that moment of time. Then, on the following night, conveniently and at a sure moment, he observed the distance of Venus from one of the fixed stars — namely Aldebaran, in the first observation, and the Heel of the Gemini [Calce Geminorum] in the second, together with the altitude and the declination of Venus, whose right ascension required only the time elapsed between the preceding and the immediately following observation. In other observations, moreover, he observed the declinations of the said fixed stars, and through them and the mutual distances he obtained the difference of right ascension between them and the bright star of Aries [lucida Arietis]. Thus, then, inquiring into the right ascensions of those fixed stars and of Venus, and trigonometrically tracing out the difference of right ascension between them, he acquired the right ascension of the said stars; and by means of this he reduced the right ascension of the bright star of Aries to the motion of the fixed stars, and so up to the completed year of Christ 1585. We shall give an example below. With these three reported

observations he found the right ascension of the bright star of Aries, as in the following short table.

Anno 1585. Compl. Asc. Recta Lucidæ γ [Right ascension of the bright star of Aries, for the completed year 1585]	Gr.	'	"
Obs. I	26	0	44
Obs. II	26	0	32
Obs. III	26	0	30

3. [Margin: 2. *Tych. method.* — Tycho's second method.] But lest the implication of the Solar parallaxes, the Sun, and Venus, and of the refractions, leave any scruple, by a fuller and more thorough investigation he compared many observations of this kind of Venus with the Sun, and then evening observations of Venus with the fixed stars against morning ones — keeping the Sun and Venus at the same altitude, and obtaining the distance from the earth and the declination in the morning as nearly as possible to what they had had in the evening observation. For thus the variations of refraction and of parallax compensate and counterbalance each other. For the refraction of the setting Sun, raising its image toward the evening Venus, diminishes both their distance optically and likewise the difference of right ascension; and so it then exhibits the right ascension, both of Venus and of the fixed star derived from it, smaller than is just. By contrast, the refraction of the rising Sun, raising its image toward the morning Venus, diminishes that same distance and the difference of right ascension, but this is to be subtracted from the right ascension of the Sun, so that it then exhibits the right ascension of the morning Venus, and the right ascension both of Venus and of the fixed star derived from it, greater than is just. Therefore, said Tycho, if in the evening and morning observations the Sun, Venus, and the rest stand equally high, the parallaxes will also be equal, and the parallaxes and refractions, once the parallaxes are removed, are purified — and however much the evening ones diminish, that much the morning ones increase the right ascension.

(Caput X, continued)

the right ascension; and the mean, therefore, between these as chosen will be the truest right ascension. From several further observations, accordingly, of both evening and morning ones, and of the right ascensions of the bright star above the Head of Aries, he selected twelve down to the end of the year 1585, reduced; and, the mean having been taken in the last little column between the extremes, I have made a compendium of them from Tycho's vol. 1, *Progymnasmata*, from page 165 to 194. It will help, before going further, to subjoin these to the eyes,

adding in explanation what afterward the letter **M** marks for the Morning observations and **V** for the Evening ones.

The observations:

Tempus Observationum				Asc. Recta luc. Υ	Repug nantia
O r d o	Tychonis [Time of Tycho's observations] (Anno. M. D.)	Altitudo $\odot$ (Gr.)	Altitudo $\oslash$ (Gr.)	An. 1585. compl. (Gr. ' ")	
I	1582 Febr. 27 V	10	45	26 4 16	R
	1582 Sept. 21 M	10		25 56 23	R
	Media Asc. R.			26 0 20	
I I	1582 Mart. 5 V	5½	44	25 56 33	
	1585 Sept. 14 M	5½	38	26 4 43	
	Media Asc. R.			26 0 38	
I I I	1582 Mart. 5 V	8	46	25 59 15	
	1585 Sept. 15 M	8	41	26 1 21	
	Media Asc. R.			26 0 18	
I V	1582 Mart. 9 V	6	43	25 59 49	
	1585 Sept. 15 M	6	40½	26 1 16	
	Media Asc. R.			26 0 32	
V	1586 Dec. 26 V	3	23	25 54 51	
	1588 Dec. 15 M	3	20	26 6 32	
	Media Asc. R.			26 0 42	
V I	1586 Dec. 27 V	3½	23	25 52 22	
	1588 Nou. 29 M	3½	24½	26 8 52	
	Media Asc. R.			26 0 37	
V I	1587 Ian. 9 V	8	28	26 2 5	R

	Tempus Observationum				
O r d o	Tychonis [Time of Tycho's observations] (Anno. M. D.)	Altitudo ☉ (Gr.)	Altitudo ♀ (Gr.)	Asc. Recta luc. ♀ An. 1585. compl. (Gr. ' ")	Repug nantia
I	1588 Dec. 6 M	8	19½	25 58 49	R
	Media Asc. R.			26 0 27	
V	1587 Ian. 24 V	17½	30	26 6 44	R
I					
I					
I	1588 Oct. 26 M	17½	25	25 54 13	R
	Media Asc. R.			26 0 29	
I	1587 Aug. 17 M	2⅝	25½	26 5 40	
X	1588 April. 16 V	2⅝	27½	25 54 48	
	Media Asc. R.			26 0 14	
X	1587 Aug. 17 M	5	28½	26 1 1	
	1588 April. 16 V	5	28	25 59 6	
	Media Asc. R.			26 0 4	
X	1587 Aug. 18 M	10	33	25 54 35	R
I	1588 Mart. 28 V	10	32	26 6 20	R
	Media Asc. R.			26 0 28	
X	1587 Aug. 17 M	8	31	25 54 49	R
I					
I	1588 April. 16 V	8	32	26 6 30	
	Media Asc. R.			26 0 39	

4. Let not the reader be surprised that observations of the same day of the same year are reported here, when in fact they were made in different years and at different hours; nor suppose this to be set down by a typographical error in

Tycho's narrative — read in the place of A.M. (Morning) P.M., and so the Morning observations have been wrongly transposed by us with the Evening ones, as a careful reader of Tycho's whole discourse, and of the circumstances by which the Morning ones are certainly distinguished from the Evening, would gather; the characteristic mark M, and the Evening ones with V — you would rather be surprised at the discrepancy between the twelve mean right ascensions, which exceeds gr. 26. 0'. 4", and gr. 26. 0'. 42", that he should not have chosen a mean middle of gr. 26. 0'. 23", but takes gr. 26. 0'. 30", as he has on page 194.

[On the right column of this page, paragraphs 5 and 6 continue Tycho's argument:]

5. [Margin: 1. *Contra Tychonem obiectio* — First objection against Tycho.] Perhaps he did so because in the third observation, taken in isolation, of which the number is 1, he had obtained gr. 26. 0'. 30"; this, therefore, on page 194 he selected, not only as the foundation of all the fixed stars' right ascensions, but he also called the bright star of Aries the *Angular cornerstone of the remaining affixed stars* [*Angularem lapidem reliquarum Affixarum Stellarum*]. We, however — saving the man's regard, and with regard for the great merit of so distinguished an astronomer — find many causes why this right ascension of his is revoked into doubt.

The **first** is the Solar hypothesis, which Tycho used in gathering its right ascension and declination — false in the middle motion of the Sun, in the eccentricity, and in the prosthaphæresis [*prosthaphæresis*], and greatest in the declination of the Sun, which springs from the supposed but not demonstrated excessive Solar parallax — as is plain from what has been said of these severally in Book 1, on the Sun.

The **second** [Margin: 2. *Obiectio*] is the error in the declination of the bright star of Aries: for he found its declination to be gr. 21. 28'. 30" at the beginning of the year 1587, but it had more truly been gr. 21. 28'. 40"; he uses this same value also for the year 1585, *Progymnasmata* pages 178, 181, 195, 198, 200, 204, 232 — yet if it had remained unchanged throughout, he ought nevertheless to set it for the year 1585 as compl. gr. 21. 28'. 20", indeed gr. 21. 27', as we shall show in chapter 9, conclusion 4. Likewise from what is there said he erred in choosing the declinations of certain of the fixed stars.

The **third** [Margin: 3. *Obiectio*] is the fallacy in the second of Tycho's methods, namely the method above at number 3: for as regards compensating the defect of refraction from the evening observations by the excess of the morning ones,

unless Venus, and the same stars, shall have been at the same distance from the centre of the Earth, the same temperaments of the air bring about the same quantity of refraction. For it has been observed by us that the refractions are usually greater in winter, at the equinoxes, and in summer, and these greater for the Morning than the Evening ones. For in the morning the air is colder and denser than at other times alike, because of the preceding absence of the Sun; in the evening it is warmer and rarer, as being thoroughly baked by the daytime heat of the Sun. See what we said in Book 1, *Almagestum [Novum]*, chapter 30, Scholium 3, on the prolixity of the evening twilight, arisen from the foregoing heat of the Sun; and Book 10, on Refraction.

The **fourth** [Margin: 4. *Obiectio*] is a twofold discrepancy in Tycho's reduction of the observations. For if at the end of the year 1585 the true right ascension of the bright star of Aries was gr. 26. 0'. 30", then the excess of right ascension in the morning observations, and the defect in the evening ones, ought to be greater, the Sun being lower, than higher above the horizon on account of the greater refraction. And yet in some observations the opposite appears, running through the table at the end, number 3. As, for example, in observation VIII the Sun stands higher by gr. 17½. Right ascension recedes by gr. 16. 0'. 30" per minute 6½. But in observation X the Sun stands lower only by gr. 5; right ascension recedes by a single minute only. Moreover, in the year 1585 the true right ascension of the bright star of Aries was gr. 26. 0'. 30". Therefore all the right ascensions derived from the evening observations ought to have been smaller than the said right ascension; and conversely those derived from the morning ones ought to have been greater — yet the opposite happens in observations I, VII, VIII, XI, and XII. Therefore in the last column he subjoined the characteristic mark of the discrepancy, **R**. This double discrepancy is an indication that there is either inconstancy of refraction, or a defect of altitude, or faulty observations.

6. Those twelve Morning observations, then, and as many Evening ones, in which the Sun was wrapped in sensible refractions, set aside, I observe that evening refraction which Tycho reports in vol. 1, *Progymnasmata*, page 160, when the Sun stood at gr. 31, and Venus modulated by gr. 57, modulated by 23½, and the Heel of the Gemini [Calx Geminorum] by the said refraction at the end of Book 1, chapter 1, on the Sun. For a single observation of so well-purified an evening refraction prevails over many of doubtful ones, which we have above held suspect. Because indeed it is not noted by us, as is said, it is certain that, in the Solar hypothesis, Tycho strayed in the prosthaphaeresis, not in the ellipse bisecting the eccentricity, but in a circle, exactly investigating the integral eccentricity, and in too great a Venus parallax; therefore we shall use our own Solar hypothesis.

(Caput X, continued)

7. Moreover, since from these same observations of Tycho, brought to bear in chapter 9, I set down for the completed year 1585 the declination of the bright star of Aries as gr. 21. 27'. 0", and the declination of the Heel of the Gemini [Calcis Π] as gr. 22. 38'. 38", if we use the proportional part which Tycho sets down on page 276, it follows that for the year 1582, March 20, the declination of the bright star of Aries had been gr. 21. 27'. 10", and that of the Heel of the Gemini gr. 22. 38'. 30". These, therefore, we shall use.

I have now prefixed the figure adjoined here, in which **A** is the angle [*angulus*] at the vertex [*vertex*], made by the two vertical circles AB and AC and BC; **BC** is the portion of the horizon intercepted by them; and **S** is the true place of the Sun, but its apparent place by force of parallax is **K**; thus the true place of Venus is **V**, but its apparent place is **G**, and so the true distance of these is **VS**; but the apparent one **GK**. When, however, **A** is the angle at the Pole of the world [*Mundi Polum*], and BC the portion of the equator intercepted between the quadrants of the declination circles, then, with two stars placed, one at **S**, the other at **V**, the complements of the declinations are **AS** and **AV**. These things premised, let this be the following epilogism [recapitulation]:

Diagram. A spherical-triangle construction at the head of the left column. Vertex **A** sits at the top; two arcs descend from it to a base arc running between **B** (lower left) and **C** (lower right). Intermediate points along the descending right arc are labelled, from top to bottom, **V**, **S**, **K**, **C**; the point **G** lies on the left descending arc. The figure illustrates the vertical circles AB, AC and the equator/horizon arc BC, with S (true Sun) and K (apparent Sun), V (true Venus) and G (apparent Venus).

- A (apex): the angle at the vertex (or at the Pole of the world)
- B (lower left): endpoint of the horizon/equator arc BC
- C (lower right): endpoint of the horizon/equator arc BC
- V (upper, on a descending arc): true place of Venus
- G (left arc, below V): apparent place of Venus
- S (mid-right arc): true place of the Sun
- K (lower right arc): apparent place of the Sun

Computation I.

I — Ex Tych. pag. 160. Anno 1582. Martij 20. hor. 2. 25'.
p.m. [From Tycho, page 160, year 1582, March 20, hour 2,
25' p.m.]

	Gr.	'	"
☉ Altitudo visa CK [apparent altitude of the Sun, CK]	31	0	0
☉ Parallaxis nostra KS [our parallax, KS]	0	0	17
☉ Visa distantia à vertice AK [apparent distance from the vertex, AK]	59	0	0
☉ Vera distantia à vertice AS [true distance from the vertex, AS]	58	59	43
♀ Altitudo visa BG [apparent altitude of Venus, BG]	57	0	0
♀ Parallaxis nostra GV [our parallax, GV]	0	0	27
♀ Distantia visa à vertice AG [apparent distance from the vertex, AG]	33	0	0
♀ Distantia vera à vertice AV [true distance from the vertex, AV]	32	59	33
☉ & ♀ Distantia observata GK [observed distance of Sun and Venus, GK]	43	50	0
Ergo Angulus A [therefore the angle A]	51	41	20
Et vera ☉ ac ♀ Distantia VS [and the true distance of Sun and Venus, VS]	43	49	50
☉ Locus noster [our place of the Sun]	9	29	56
Eiusq; Ascensio Recta [and its right ascension]	8	43	25
Eiusdemq; Declinatio Bor. [and its northern declination]	3	46	23
♀ Declinatio observata Bor. [observed northern declination of Venus]	23	2	0
sed vera per nos [but the true one, by us]	23	2	20
Igitur in Triangulo ASV [therefore, in the triangle ASV:]			
AS, Complementum Declinationis ☉ [complement of the Sun's declination]	86	13	37
AV, Complem. Declinat. ♀ [complement of Venus's declination]	66	57	40
VS, Vera eorum Distantia [their true distance]	43	49	50
Ergo A, diff. Ascens. Rectæ [therefore A, the difference of right ascension]	40	44	40

I — Ex Tych. pag. 160. Anno 1582. Martij 20. hor. 2. 25'.
p.m. [From Tycho, page 160, year 1582, March 20, hour 2,
25' p.m.]

	Gr.	'	"
Et ♀ Ascensio Recta [and the right ascension of Venus]	49	28	5

Computation II.

II — Nocte seq. hor. 8. 11'. p.m. fuit 2. Obsetuatio, idest
hora 5. 45'. post priorem observatio [On the following
night, hour 8, 11' p.m., was the second observation, that
is, hour 5, 45' after the prior observation]

	Gr.	'	"
Motus diurnus ♀ fuit [the diurnal motion of Venus was]	0	45	30
Ergo hor. 5. 45'. eius motus [therefore at hour 5, 45', its motion]	0	10	55
Et proinde Ascensio recta ♀ [and accordingly the right ascension of Venus]	49	39	0
Tunc autem ♀ altitudo observata [then the observed altitude of Venus]	23	30	0
♀ Parallaxis nobis [the parallax of Venus, by us]	0	0	46
Ergo visa ♀ distantia à vertice AG [therefore the apparent distance of Venus from the vertex, AG]	66	30	0
sed vera AV [but the true one, AV]	66	29	14
Tunc Calcis II dist. à vertice vera AS [then the true distance of the Heel of the Gemini from the vertex, AS]	45	0	0
Eiusq; distantia à ♀ visa GS [and its apparent distance from Venus, GS]	36	32	0
sed vera VS [but the true one, VS]	36	31	27
Declinatio ♀ tunc observata Bor. [northern declination of Venus then observed]	23	4	45
sed ex Parallaxi correcta fuit [but corrected for parallax it was]	23	5	20
Declinatio autem Calcis II CS, ex dictis num. 6. Borea. [the declination of the Heel of the Gemini, CS, from what was said in number 6, northern]	22	38	30
Datur ergo complementum AV [therefore the complement AV is given]	66	54	40

II — Nocte seq. hor. 8. 11'. p.m. fuit 2. Obsetuatio, idest hora 5. 45'. post priorem observatio [On the following night, hour 8, 11' p.m., was the second observation, that is, hour 5, 45' after the prior observation]

	Gr.	'	"
& complementum AS [and the complement AS]	67	21	30
Et distantia vera VS [and the true distance VS]	36	31	27
Ergo Angulus A, & Arcus BC [therefore the angle A, and the arc BC]	39	45	42
Et Ascensio Recta Calcis Π [and the right ascension of the Heel of the Gemini]	89	24	42

[The right column of this page continues with a third short table and the conclusion:]

III	Gr.	'	"
Complem. Declinationis Calcis Π [complement of the declination of the Heel of the Gemini]	67	21	30
Complem. Declinationis Lucidæ Υ [complement of the declination of the bright star of Aries]	68	33	0
Distantia harum Stellarum ex Tychone tom. 1. pag. 198. [distance of these stars, from Tycho vol. 1, page 198]	58	22	0
Ergo A, seu BC, Differ. Asc. Rectæ [therefore A, or BC, the difference of right ascension]	63	28	8
Ideoq; Ascensio Recta Lucidæ Υ [and so the right ascension of the bright star of Aries]	25	56	34
Sed Anno 1585. Completo [but for the completed year 1585]	25	59	47

For from Tycho, page 276, the right ascension of the bright star of Aries grows in this century by 51" each year. Therefore, in $3\frac{3}{4}$ years — which are from March 20 of the year 1582 to the end of the year 1585 — it grew by minutes 3'. 13"; so that, if on that day, March 20, it was gr. 25. 56'. 34", then at the end of the year 1585 it was gr. 25. 59'. 47". Granted that Tycho, in vol. 1, *Progymnasmata*, page 162, using his own Solar hypothesis, obtained from this observation gr. 26. 0'. 32", that is, greater by 45" — yet it ought to have been found so; and conversely, by our hypothesis, it had to come out smaller by about a minute. And since this happens, I am the more confirmed that this was Tycho's observation, and well usurped [taken up] by us.

Sit igitur Fundamenti loco Anno 1585.

Completo, [Let there be set, then, in
place of a foundation, for the
completed year 1585:]

Ascensio Recta [Right ascension]

Lucidæ γ [the bright star of Aries]

Gr. 25 59' 47"

Calcis II [the Heel of the Gemini]

Gr. 89 24' 50"

CAPVT XI.

The right ascensions of seven other fixed stars, corrected by Tycho, are themselves corrected; what is to be done about the rest; and on the omission of those fixed stars whose right ascension the Tychonics were ignorant to be decreasing.

1. Since Tycho, in vol. 1, *Progymnasmata*, from page 195 to 230, investigated the right ascensions of 23 other stars, the Heel of the Gemini [Calce II] having been computed, but chiefly of 7, through their declinations and mutual distances, and from these tracing out the differences of right ascension, and using the right ascension of the bright star of Aries [Lucidæ γ], he established their right ascensions in common — upon us a necessity falls, on a threefold ground, of correcting them: namely, on account of the diversity found in the right ascension of the bright star of Aries; and in the declinations of the fixed stars, which in chapter 9, from Tycho's own data, we have corrected and emended up to the completed year 1585; and finally, from the distances of the fixed stars, in chapter 8, by our own repeated observations, and in some matters differing somewhat from Tycho's. It is fitting, moreover, to begin the sum of the differences in right ascension from the bright star of Aries, and to come around to it, that it may be equal to the whole equator, that is, precisely 360 degrees. For which experiment we choose 8 stars from Tycho, page 200, elected; using the triangle CPD, in which P is the Pole of the equator [*Æquatoris Polus*], and the angle subtending the arc of the equator AB — that is, the difference of right ascension; the arcs PC and PD are the complements of the declination of the fixed stars, and CD their distance. When, moreover, one of the other fixed stars — such as Spica — has a southern declination, we use the triangle PCF, in which A is as above, and PC...

Diagram. A spherical-triangle construction in the lower-right column. Vertex **P** (the Pole of the equator) sits at the top; arcs descend from P to **C** (left) and **D** (right). A base arc runs from **A** (lower left) through to **B** (right), and a further arc

descends to F (bottom right, below B). The figure illustrates triangle CPD (and the auxiliary triangle PCF for a southern-declination star): PC and PD are the declination-complements of the fixed stars, CD their distance, and the angle at P subtends the equatorial arc AB (the difference of right ascension).

- P (apex): the Pole of the equator
- C (left, on a descending arc): one fixed star
- D (right, on a descending arc): another fixed star
- A (lower left): endpoint of the equatorial arc AB
- B (right): endpoint of the equatorial arc AB
- F (bottom, below B): the point used for the southern-declination triangle PCF

the complement of the star's declination, namely C and PF, [arising] from the quadrant PB, and from the declination BF and CF, the distance between the stars. From these elements we shall gather the difference of right ascension — that is, the angle P, which measures the arc AB. We do this not, indeed, by the troublesome and error-prone multiplication of tangent-sines and so forth, but by the addition of logarithms alone, for which we have Vlacq's [Adriaan Vlacq] Canon [of logarithms] extending to single decades of seconds — indeed, at the beginning of the quadrant, and at the end (by our own extension), to single seconds.

[Here follows the first table. Star names, distance from the preceding star (degrees/minutes/seconds), declination completed for 1585 (degrees/minutes/seconds), and difference of right ascension (degrees/minutes/seconds). The australis/borealis marker (A/B) follows the declination.]

Star names	Distance from preceding (Gr. ' ")	Declination 1585 compl. (Gr. ' ")	Difference of right ascension (Gr. ' ")
Lucida ♈ [Aries]		21 27 0 B	
Aldebara[n]	35 32 0	15 36 30 B	37 4 49
Pollucis Caput [Head of Pollux]	45 5 0	28 56 50 B	46 54 24
Regulus	36 59 30	13 58 20 B	36 35 8
Spica ♍ [Virgo]	54 2 0	8 57 0 A	49 19 3
Sin. manus Oph. [Left hand of]	42 33 30	2 33 15 A	42 19 16

Star names	Distance from preceding (Gr. ' ")	Declination 1585 compl. (Gr. ' ")	Difference of right ascension (Gr. ' ")
Ophiuchus]			
Aquilæ lucida [bright star of Aquila]	55 17 20	7 51 15 B	54 26 25
Markab Pegasi	47 49 20	13 0 10 B	48 24 44
Lucida ♈ [Aries]	43 37 10	21 29 47 B	44 57 40
Sum of differences of ascension			360 1 28

2. From this it is clear that the Tychonic declinations — or rather the distances of the fixed stars from one another — were not so exactly determined, [being off] by a second of arc. For the sum of the differences of right ascension ought to have been precisely 360 degrees. This same point we shall be able to recognize from our own observations later. Meanwhile, that stated sum exceeds the equator by that 88"; distributing this over the eight aforementioned differences, we subtract eleven seconds from each. On that basis we establish the right ascensions, as in the following table.

Star names	Differ. of right ascension (Gr. ' ")	Right ascension (Gr. ' ")
Lucida ♈ [Aries]		25 59 47
Aldebara[n]	37 43 38	63 3 25
Pollucis Caput	46 54 13	109 57 38
Regulus	36 34 57	146 32 35
Spica ♏	49 18 52	195 51 27
Lucida Oph. manus sin. [bright star, left hand of Ophiuchus]	42 18 53	238 10 20
Aquilæ lucida	54 26 14	292 36 34
Pegasi Markab	48 24 33	341 1 7
Lucida ♈	44 57 29	25 58 36
Calx pedis ♊ [Heel of the foot of Gemini]	Ex fine CX. [From the end of Cap. X]	89 24 50

3. To these stars we shall add the Heart of Scorpius [Cor Scorpionis, Antares], which Tycho likewise uses, so that we may afterward establish its Tychonic longitude by comparing the motion of the fixed stars with that observed by the ancients. We take its distance from Spica from Cap. VIII, and its declination from Cap. IX.

	Distance of stars (Gr. ' ")	Southern declination (Gr. ' ")	Differ. of right ascension (Gr. ' ")
Spica		8 57 0	
Antares	45 52 0	25 20 25	45 25 30

[Below the table:] Hence, since the right ascension of Spica at that time is $195^{\circ} 50' 21''$, that of Antares was $241^{\circ} 15' 51''$.

For the remaining 12 stars, whose right ascensions Tycho did not investigate as carefully as those of the others he took as fundamental, we have no need [to do so here]; for the right ascensions of these — and of many others — we shall investigate more clearly for the year of the Lord 1660.

From the distances [given] in Cap. VIII, [these] are established, and from the declinations diligently observed by us. If anyone should wish to correct the Tychonic right ascensions, let him use the distances of Cap. VIII and the declinations, by the method indicated above, and let him seek out the differences [of right ascension]; for from these, and from the right ascensions of the ten fixed stars established above, he will obtain the right ascensions of the rest, and he will recognize how great a correction the table requires which Tycho handed down (vol. 1, p. 276) for the year 1600 and 1700.

4. But in that table it may seem surprising that Tycho placed even stars of the third or fourth magnitude there, yet omitted the most brilliant star in the shoulder of Ursa Minor [Polaris], a most celebrated one — both because it is of the second magnitude, and because in Eudoxus's [Eudoxus] and Hipparchus's [Hipparchus] time, and nearly in Ptolemy's [Ptolemy], it was closest to the pole of the world, and hence was then most carefully observed as the Pole star and the Cynosure of mariners. To me it is nearly certain that Tycho and his assistants did not omit the right ascension of a star of this kind by oversight, but deliberately suppressed it, because they had run into an insoluble knot, given the opinion they held — namely, that the right ascensions of all the fixed stars must increase as their longitude increases; whereas they found that, as the longitude of this star [Polaris]

advanced from the year of Christ 1600 to the year 1700 — and likewise its latitude, and [given] the distance of the poles — they recovered for the same star a right ascension *smaller* than the right ascension of the year 1600. And reiterating the calculation, they always found this decrement; and not having applied their minds to the theory of this peculiar motion, overcome by weariness and entangled in this perplexity, they thought it safer to pass over this star [in silence] — which, however, they did place in the catalogue of longitudes and latitudes, because, as far as the increment of longitude is concerned, they experienced no such difficulty.

[Margin: Humerus Ursæ minoris dissimulatus à Tychone. — The shoulder of Ursa Minor concealed by Tycho.]

[Margin: Tychonis defectus. — A shortcoming of Tycho's.]

5. Let us now see how great the right ascension of this star [Polaris] ought to have been for the year 1600 and 1700, on the Tyconic hypothesis of [its] longitude, latitude, and the distance of the poles. But first, for the demonstration, let the following diagram be inspected, in which let ABC be the colure of the solstices, and so on.

Diagram. A celestial sphere drawn with the solstitial colure, the equator, the ecliptic, and circles of latitude and declination, used to derive the right ascension of Polaris (the Cynosure).

- A, Υ, Q (lower-left through center to right): the equator A Υ Q
- P (upper region): the pole [of the equator]
- E, C (left and lower-right): the ecliptic EC
- Z (upper region near P): the pole of the ecliptic; the Cynosure [Polaris] is at O
- O (just below P/B): the Cynosure (Polaris)
- B (top): point on the colure near P
- D (right of center): point on a circle through the sphere
- G (left of center, on the ecliptic): the place of the star on the ecliptic, the foot of the latitude-circle quadrant ZOG
- K, Υ, L, H (along the lower band, the ecliptic/equator crossing): intermediate points
- Q (right): equatorial point
- ♋ / 69 (left, on the ecliptic near E): zodiacal point (Cancer)
- C (bottom): point on the colure

The equator is $A \cap Q$, and of it the pole is P ; let the ecliptic be EC , of which [the pole] is Z ; let the Cynosure be at O , through which let a quadrant of the latitude-circle ZOG be drawn, since indeed its Tychonic place G [is] in the ecliptic for the year 1600 — namely Cancer $[♋]$ $7^{\circ} 16' 30''$, and the northern latitude GO $72^{\circ} 51' 30''$; and its complement OZ is $17^{\circ} 8' 30''$. And from the pole P , through the same star O , let a quadrant of the declination-circle POH be drawn; for in the right triangle POZ there are given the two sides PZ — the Tychonic distance of the poles, $23^{\circ} 31' 30''$ — and OZ , the complement of the latitude, $17^{\circ} 8' 30''$; and from the longitude of the star, which is $127^{\circ} 16' 30''$ [reckoned along the ecliptic from the colure], subtracting 90° , the angle PZO is given, $37^{\circ} 16' 30''$. Therefore, by the canons of triangles, the angle OPZ is given, $47^{\circ} 0' 30''$, which measures the equatorial arc HQ . Hence the arc AH is $132^{\circ} 59' 30''$; and if to this 90° be added, the right ascension of the Cynosure is obtained, $222^{\circ} 59' 30''$, for the year 1600.

6. Let the Cynosure now be advanced in longitude from O , in I , through the little circle $BOID$ parallel to the ecliptic [and described] about the pole Z — assuming the fixed stars proceed thus, the same latitude being retained throughout. Let a quadrant of the latitude-circle ZIK be drawn; for since the longitude of the Cynosure for the year 1700 is...

[p. 238, left column:]

[the longitude of the Cynosure is] to Tycho ϱ [Leo] $8^{\circ} 41' 20''$, the angle PZI will be $38^{\circ} 41' 20''$; with which, in the triangle PZI , and with the complement of the latitude IZ , $17^{\circ} 8' 30''$, and the distance of the poles PZ , $23^{\circ} 31' 30''$, by the canons of triangles the angle IPZ is found, $47^{\circ} 13' 36''$, measuring the arc LQ . Accordingly, as the longitude increases, the right ascension decreases; for the arc AL will be $132^{\circ} 46' 24''$, and joined to 90° it will give, for the year 1700, a right ascension of $222^{\circ} 46' 24''$. And thus, the quadrant of declination PIL falling short of the quadrant POH , [this] will always occur, until that time arrives when the quadrant of the declination-circle drawn through the Cynosure does not cut the parallel $BOID$ but precisely touches it; for from that point on, as the longitude increases, the right ascension will begin to increase. And it so happens, for all the fixed stars whose complement of latitude is less than the distance of the poles from the equator, and [less than] the distance from the ecliptic — as I taught more fully in *Almagestum Novum* (Book 6, Cap. 19), where I also reviewed other fixed stars of this condition. This it was worth the trouble to point out to the reader.

CAPVT XII.

De Longitudine, ac Latitudine Fixarum Tychonica emendanda; necnon Motu earum in Longitudinem.

[On the correcting of the Tychonic longitude and latitude of the fixed stars; and also on their motion in longitude.]

1. It is established that Tycho (vol. 1, *Progymnasmata*, from p. 203) derived the longitudes and latitudes of the fixed stars from given data — that is, from elements: namely, from the right ascension, the declination of the fixed stars, and the distance of the poles — partly by the solution of spherical triangles, partly by a table constructed for this purpose, on the supposition of the obliquity of the ecliptic at $23^{\circ} 31' 30''$. But equally, from what was said about the Sun (Book [1]) it is established that this obliquity, or the distance of the poles, does not exceed $23^{\circ} 30' 20''$; and from what was said in this book, Cap. IX and X, the declinations which Tycho used must very often be corrected; and the right ascensions [must] in all cases be corrected. Therefore, from these same three chapters it is established that the Tychonic longitudes and latitudes of the fixed stars are to be corrected. Let Longomontanus [Christian Longomontanus] in his *Astronomia Danica* (Book 1, *Theoricorum*, cap. 4) be [the example]: he held that the Tychonic longitudes alone should be diminished by about one minute, on account of the reduced mean longitude of the Sun. And so, both by way of example, and to investigate the motion of the fixed stars in longitude, we shall reduce to the ecliptic — by the aid of trigonometry, but using the truer distance of the poles, and the right ascensions and declinations established in [Cap. IX and the] preceding chapter — those Ten stars which we adduced in the preceding chapter.

[Below, the table:]

Distance of the poles assumed: $23^{\circ} 30' 20''$. [Positâ Polorum Distantia Grad. 23. 30'. 20".]

Year of Christ 1585 compl.	Right ascension (G. M. S.)	Declination (G. M. ")	Longitude (Sig. G. M. ")	Latitude (G. M. ")
Lucida Υ	25 59 47	21 27 0 B	ϑ [Taurus] 1 51 39	9 56 30 B
Aldebara[n]	63 3 25	15 36 30 B	Π [Gemini] 3	5 29 30 A

Year of Christ 1585 compl.	Right ascension (G. M. S.)	Declination (G. M. ")	Longitude (Sig. G. M. ")	Latitude (G. M. ")
			59 49	
Calx Π [Heel of Gemini]	89 24 50	22 38 30 B	Π [Gemini] 29 27 20	0 51 46 A
Poll. Caput [Head of Pollux]	109 57 38	28 56 50 B	$\mathbin{\complement}$ [Cancer] 17 31 28	6 38 59 B
Regulus	146 32 35	13 58 20 B	ϱ [Leo] 24 3 2	0 27 47 B
Spica $\mathfrak{M}$	195 51 27	8 57 0 A	$\mathbin{\lrcorner}$ [Libra] 18 2 41	2 0 23 A
Ophiuchi man. sin. [Ophiuchus, left hand]	238 10 20	2 33 15 A	$\mathfrak{M}$ [Scorpius] 26 30 20	17 19 3 B
Cor Scorp. [Antares]	241 16 57	25 20 25 A	$\mathbin{\rhd}$ [Sagittarius] 4 5 18	4 22 50 A
Aquilæ lucida	292 36 34	7 51 15 B	$\mathbin{\lrcorner}$ [Capricorn] 26 1 30	29 19 30 B
Pegasi Markab.	341 1 7	13 0 10 B	$\mathbin{\lrcorner}$ [Pisces] 17 42 20	19 25 56 B

[p. 238, right column:]

2. In the preceding calculation, having first sought, from the right ascension, the declination of the fixed star, and the distance of the poles, the latitude — and with this, and with the declination and distance of the poles, the longitude — this calculation, treated faithfully step by step, turned out so happily that the differences of longitude, taken together, complete exactly 360° of the ecliptic. Nor indeed, as I scrupulously testify, did I keep manipulating the calculations and the data until it came out right for me; rather, it came out [right] from three [data], used [each] once, taken once, and at a single application. And here, in the following little table, are the differences of longitude.

	Longitude (Sig. G. ' ")	Differ. of longitude (G. M. ")
Lucida Υ	$\mathbin{\lrcorner}$ 1 51 39	32 3 4

	Longitude (Sig. G. ' ")	Differ. of longitude (G. M. ")
Aldebara[n]	II 3 54 43	25 32 17
Calx II	II 29 27 20	18 10 58
Pollucis Caput	☿ 17 38 18	36 24 44
Regulus	♌ 24 3 2	53 59 39
Spica ♏	♏ 18 2 41	28 27 39
Ophiuchi manus	♏ 26 30 20	7 34 58
Cor Scorpj	♏ 4 5 18	51 56 12
Aquilæ lucida	♏ 26 1 30	51 40 50
Pegasi Markab	♏ 17 42 20	44 19 19
Sum		360 0 0

3. Now indeed Tycho (vol. 1, *Progymnasmata*, p. 253), using in the first place the place of Regulus observed by Hipparchus and by al-Battānī [Albategnius], and afterward [his own], deduces the annual motion of the fixed stars to be 51". But Hipparchus — on Ptolemy's testimony (book 7, cap. 2), in the year 50 of the third Callippic period, that is, before Christ 128 — observed Regulus in Cancer [☿] 29° 50'; yet from the declination, 20° 40', with which the same Ptolemy observed it at that time (cap. 3), and the latitude 0° 27' 47", and given the obliquity of the ecliptic, its place follows as Cancer [☿] 29° 57' 44". After [that, i.e.,] the year 1713, that is, of Christ 1585, Tycho — corrected by us — observed Regulus in Leo [♌] 24° 3' 2"; therefore the [accumulated] motion was 24° 5' 18", which divided gives an annual motion of 30" ¹⁰⁷/₁₇₁. But if al-Battānī, in the year of Christ 878 — that is, [year] 1627 of Nabonassar, as he himself reports (cap. 51 of his *De Scientia Stellarum*) — observed Regulus in Leo [♌] 14° [and] progressing, [and his place] is everywhere referred to Leo [♌] 14° 3' 2", [then over] 707 years, the annual motion is therefore 51 ¹³/₇₁", or in round numbers 51", which Tycho chose.
4. There are now in vol. 1 of the *Progymnasmata* two most celebrated tables of fixed stars. The *first* is of the longitudes and latitudes of the principal fixed stars completed for the year of Christ 1600, which is found there on p. 258. The *second*, which is found on p. 276, [gives them] with the right ascension and the declination [for] one hundred selected fixed stars, for the completed year 1600 and 1700, and their hundred-year difference. If anyone wishes to use those tables, let him consult Tycho — or, for the first

table, the Rudolphine [Tables] or the Philolaic Tables. But if anyone wishes them corrected, they can be corrected in two ways.

5. The *first* [way] is by investigating trigonometrically the difference of right ascension between the fixed stars, which is found in Cap. VIII — the distance — and Cap. IX — the declination — for the year 1585, as we did in Cap. XI for ten stars; and, by means of the right ascension of Lucida Υ [Aries], or of Calx Π [the Heel of Gemini], [finding] their right ascension, with which — together then with the declination, and the truer distance of the poles, $23^{\circ} 30' 20''$ — the latitude is to be sought, which is perpetual; and then the longitude, which can thereafter be advanced to whatever years you please by adding to the longitude of [the year] 1585, for each single year, $51''$. Furthermore, the longitude having thus been found for the year 1600 and 1700, [the latitude] can be inquired together with it by trigonometric labor, both the latitude and the distance of the poles, and likewise the declination, and then the right ascension for the year 1600 and 1700. This method, as it is of the most labor, so it is the most exact.
6. The *second* [way] is, though not so exact: if of all the stars of the same constellation — of which ten have been corrected by us in this and the preceding chapter — only so much is subtracted, or [so much] is added to the right ascension, declination, longitude, and latitude as Tycho [gives for] the years 1600...

[p. 239, left column:]

and 1700, as great as is the difference, whether in excess or in defect, between the uncorrected Tychonic [value] and the Tychonic [value] corrected in this and the preceding chapter. As for those fixed stars, the ten declinations will nonetheless be established more exactly, if to the declinations of Cap. IX, in the last table to be corrected, there be added or subtracted as much as the hundred-year proportion of the difference set down by Tycho (p. 276) requires — that is, the ratio of 15 years for the year 1600, and then of 100 years for that quantity, as the ratio of the 100 years requires.

7. But since later [astronomers] will wish to have the Tychonic...

[p. 239, right column:]

table as it stands — and perhaps some things in it [are] corrected by Longomontanus from later observations — we shall exhibit it entirely as it is in Tycho, except for the ten aforementioned stars, to which we shall append the

necessary correction at the interval of 15 years between the year 1585 and 1600. In the rest the reader will see whether, on account of a false distance of the poles assumed by Tycho, an error of about one minute, and sometimes more, may be suspected.

[Below, spanning the full page width, the large catalogue table:]

Centum Fixarum Tabula Tychonica ad Annos infra notatos.

[Table of one hundred fixed stars, Tyconic, for the years noted below.]

The table gives, for the completed year of Christ 1600 (longitude, latitude, right ascension, declination) and for the completed year 1700 (right ascension, declination), plus the right-ascension/declination [Asc. Decl.] and the difference of declination [Differ. Declin.]. The A/B markers in the latitude and declination columns are australis/borealis; the A/S markers in the final difference-of-declination column indicate whether the declination is increasing or decreasing. Headers as printed: *Anno CHRISTI MDC. Completo.* | *Anno M.DCC. Completo.*

Sub-column headers (1600): Longitudo (Sig. Gr. M.) | Latitudo (Gr. M.) | Ascensio Recta (Gr. M.) | Declinatio (Gr. M.). (1700): Ascensio Recta (Gr. M.) | Declinatio (Gr. M.) | Ascensio Recta (Gr. M.) | Differ. Declin. (M.).

` could not be resolved with confidence. Fractional minutes (e.g. 17½, 35½) are printed with superscript fractions and transcribed as shown.]

Star name	1600						1700						Diffe r. Decl n. M
	1600		1600		1600		1700		1700		AscR ecta Gr		
	Lon	Lat	A	De	A	De	A	De	A	De			
	g.	.	G	cl.	G	cl.	G	cl.	G	cl.			
	Sig	MGr	r	M	Gr	M	r	M	Gr	M			
Cassiopeæ pectus [breast of Cassiopeia]	♄	1 46 7 ½	4	3 54 6	2	5 54 1	5	5 54 8	5	5	1	2 34 2	
Polaris Stella [Pole]	♄	2 66 ½	5	4 87 7	9	9 ½	9	4 87 6	4	3	3	5 34 9	

Star name	160 0 Lon g. Sig	16 00 Lat . MGr	16 00 R A G r				17 00 R A G r				170 0 De cl. M Gr		1700 AscR ecta Gr	M	Diffe r. Decl n. M
			M	Gr	M		M	Gr	M						
Star]										$\frac{1}{2}$					
Cete Cauda austr. [Cetus, souther n tail]	✕	5 20 6	5	5 20 1	1	2	7	8 19	3 8	1	1	34 7			
Cassiop eæ flexura [bend of Cassiop eia]	✂	2 48 7 $\frac{1}{2}$	8	2 58 1	3	3	9	4 59 8	7	1	2 7	34			
Androm edæ cingulu m [girdle of Androm eda]	✂	4 25 9	11	5 33 0	3	2	13	1 34 3	5	1	2 3	33			
Cassiop eæ genu [knee of Cassiop eia]	✂	2 46 1	15	3 58	7		16	3 58 8	4 0	1	3 5	33			
Præced ens cornu [prece ding horn]	Υ	3 7 7	22	5 17 6	1 9		24	1 17 9	5 0	1	2 3	31			

Star name	160		16		00		160		00		170		1700		Diffe r. Decl n. M
	Lon g. Sig	Lat . MGr	A G r	M	De cl. Gr	M	A G r	M	De cl. Gr	M	AscR ecta Gr	M			
of Aries]															
Venter Cete [belly of Cetus]	♈	2 20 5	22	5 9	12	1 6	24	1 4	11	4 5	1	1 5	31		
Sequens cornu ♈ [followi ng horn of Aries]	♈	2 8 3	23	1 0	18	5 0	24	3 2	19	2 1	1	2 2	31		
Australi s pes Androm . [southe rn foot of Androm eda]	♏	3 27 9	24	5 5	40	2 3	26	2 4	40	5 3	1	2 9	30		
Nodus Li. ⋈ [knot of the thread of Pisces]	♏	3 2 6	25	2 2	0	5 0	26	4 0	1	2 0	1	1 8	30		
Lucida ♈ [Aries, the	♏	6 9	26	1 3	21	3 3	27	3 8	22	3	1	2 5	30		

Star name	1600 Long. Sig	1600 Lat. MGr	1600 Right Ascension Gr	1600 Declination M	1600 Magnitude	1700 Right Ascension Gr	1700 Declination M	1700 Magnitude	1700 Epoch	1700 Epoch	1700 Epoch	1700 Epoch	1700 Epoch
bright star]													
→ <i>sed</i>		4 9	26	1 21	3	27	3 22	1	1	2	30		
<i>corrigere</i>		$\frac{2}{5}$		2	2		7	$\frac{1}{2}$		5			
[but correct it]				$\frac{1}{2}$	$\frac{1}{2}$		$\frac{1}{2}$						
Lucida mandib. Cete [bright star, jaw of Cetus]	♊	4 12 7	40	2 5	2	2	41 4 2 0	5	1	1	25		
Caput Medusæ [Head of Medusa]	♊	3 22 7	40	3 8	39	2 2	42 1 39 5	4	1	3	25		
Persei lucidum [bright side of Perseus]	♊	1 30 7	44	2	48	2 2	45 3 48 0	4	1	2	21		
Lucida Pleiadum [bright star of]	♊	2 4 4	50	5 7	22	4 9	52 2 23 6	1	1	2	21		

Star name	160 0 Lon g. Sig	16 00 Lat . MGr	16 00 R A G r				17 00 R A G r				170 0 De cl. M	1700 AscR ecta Gr		Diffe r. Decl n. M
			M	Gr	M		M	Gr	M			M	Gr	
the Pleiades]														
Infima Hyadum [lowest of the Hyades]	II	1 5 2	59	1 14 6	3 7		60	4 14 1	5 4	1	2 17 5			
Boreus oculus ♄ [northe rn eye of Taurus]	II	5 2 3	61	2 18 1	1 4		62	4 18 5	3 1	1	2 17 4			
Aldebar a[n] ♄	II	1 5 2 ½	63	1 15 6 ½	5 8		64	4 15 3	5 3	1	2 15 6 ½			
														[?]
→ <i>sed corrigere</i>		1 5 2 ⅓	63	1 15 5 ⅞	3 8 ¾		64	4 15 3 ½	5 3 ¾	1	2 15 6 ½			
Capella Aurigæ [the She- Goat of Auriga]	II	1 22 6	71	4 45 9	3 0		73	3 45 8	4 0	1	4 10 9			

Star name	160		16		16		17		170		1700		Diffe r. Decli n. M
	Lon g. Sig	Lat . MGr	A G r	M	Gr	M	A G r	M	Gr	M	AscR ecta Gr	M	
Lucid. Pes Orionis [bright foot of Orion, Rigel]	II	3 31 7	73	5 1 ½	8	4 3	75	7 3 ½	8	3 3 ½	1	1 5 ½	9½
Boreale Cornu ♄ [northe rn horn of Taurus]	II	5 5 9 ½	75	1 6	28	1 2	76	5 3	28	2 0	1	3 7	8
Orionis humér. præced. [Orion, precedi ng shoulde r]	II	2 16 3	75	5 8	5	5 5	77	1 7	6	3 3	1	1 9 ½	8
Leporis femur [thigh of Lepus]	II	6 43 ½	77	4 8	21	6	78	5 5	20	5 9	1	7 7	7
Orionis Balthei præced. [Orion, precedi	II	5 23 0 ½	77	5 8	0	3 9	79	1 5	0	3 2	1	1 7	7

Star name	160 0 Lon g. Sig	16 00 Lat . MGr	16 00 R A G r				17 00 R A G r				170 0 De cl. M		1700 AscR ecta Gr		Diffe r. Decl n. M	
			M	Gr	M		M	Gr	M				M			
ng star of the belt]																
Orionis suprem a caput [Orion, topmost of the head]	II	1 13 1 ½	78	2 9 1	3		79	4 9 3	4	5		1		2 7 2		
Cornu Austral e ♂ [southe rn horn of Taurus]	II	1 2 2	78	2 20 6	5 1		79	5 21 7	1	[?]		1		3 7 1		
Orionis 2. Balthei [Orion, 2nd of the belt]	II	5 24 4	79	1 1	3 0		80	1 1 8	2	4		1		1 6 7		
Orionis infima Balthei [Orion, lowest of the belt]	II	6 25 ½	79	6 0	1 2		81	2 0 6	7			1		1 5 6		
Aurigæ humeru	II	5 21 2	82	4 44 0	5 0		84	3 44 5	5	4		1		5 4 5		

Star name	1600 Lon g. Sig	1600 Lat . MGr	1600 R A G r	1600 De cl. M	1600 Gr M	1700 R A G r	1700 De cl. M	Gr M	AscR Gr	1700 De cl. M	Difference Declination
Orionis humer. sequens [Orion, following shoulder]	II	1 16 2	83 2 6	7 6	1 6	84 4 8	7 2 0		1	2 4 2	
Lucidus pes II [bright foot of Gemini]	☿	3 6 1	93 3 8	16 4 0	4 0	95 6 8	16 3 8		1	2 2 8	
Canis maior Sirius [Sirius]	☿	3 39 5 ½	96 5 3	16 1 1	1 1	98 0 5	16 1 5		1	7 4	
Caput superius [upper head of Gemini, Castor]	☿	4 10 1	10 9 7	32 4 1	4 1	10 8 3	32 3 0		1	4 4 [?]	11
Canis minor Procyon [Procyon]	☿	1 15 8 ½	11 3 0	6 7	1 2	11 5 0	6 7 0		1	2 0	12

Star name	160 0 Lon g. Sig	16 00 Lat . MGr	16 00 R A G r				17 00 R A G r				170 0 De cl. M		1700 AscR ecta Gr		Diffe r. Decl n. M	
			M	Gr	M		M	Gr	M				M			
n]																
Caput II inferius [lower head of Gemini, Pollux]	♊	5 6 3	11 0	1 3	28	5 5	11 1	4 7	28	4 3	1	3 4	12			
→ <i>sed</i> <i>corrige</i>		5 6 4 ¼	11 0	1 1 ½	28	5 5 ⅓ 0	11 1	4 5 ¾	28	4 3 ⅓ 0	1	3 4	12			
Lucida in puppi Nauis [bright star in the stern of Argo]	♊	5 43 3 ½	11 7	3 9	23	1 1	11 8	4 3	23	2 6	1	4	15			
Præsep e ♊ [the Manger]	♊	4 1 6 ½	12 4	2 0	21	2	12 5	4 8	20	4 3	1	2 8	19			
Boreus Asellus ♊ [northe rn Ass- colt]	♊	5 3 7	12 4	5 8	22	5 1	12 6	2 8	22	3 1	1	3 0	20			
Australi s	♊	8 0	12 5	2 7	19	3 5	12 6	5 4	19	1 5	1	2 7	20			

Star name		160		16		16		17		170		1700		Diffe	
		Lon	g.	Lat	.	A	De	A	De	AscR	Gr	Gr	Gr	r.	Decli
		Sig		MGr		r	M	Gr	M	r	M	Gr	M	n.	M
Asellus ♄ [southe rn Ass- colt]															
Hydræ Cor [Heart of Hydra, Alphard]	♋	4 22 5 ½			13 1 6 7		5 7	13 1 7 8 6		2 2		1		1 25 5	
Infima Ceruicis ♋ [lowest of the neck of Leo]	♋	2 4 0			14 2 18 6 2		4 2	14 5 18 7 0		1 4		1		2 28 8	
Cor Basilisc us [Heart of Leo, Regulus]	♋	1 0 7			14 4 13 6 5 ½		5 3 ½	14 8 13 8		2 5		1		2 28½ 2 ½	
→ <i>sed corrige</i>		1 0 5 ¾			14 4 13 6 5 1/		5 4 ½	14 2 13 8 / 1		2 5 ¾		1		2 28½ 2 ½	
Suprem a	♋	5 11 7			14 3 25 8 3		2 3	15 1 24 0		5 4		1		2 29 8	

Star name	160		16		16		17		170		1700		Diffe	
	Lon	g.	Lat	.	A	De	A	De	AscR	ecta	Gr	M	n.	Decli
	Sig		MGr		r	M	Gr	M	r	M	Gr	M		M
Ceruicis ♌ [topmos t of the neck of Leo]			1/2											
Media Ceruicis ♌ [middle of the neck of Leo]	♌	5 8			14 9	2 5	21 1/2	5 0	15 0	5 1	21 1	2 1	2 5	29 1/2
Infer. præc. □ Vrsæ ma. [lower precedi ng [star] of the square of Ursa Major]	♌	3 49			15 9	1 2	58 1	3 1	16 0	4 9	57 9	5 9	1 7	3 32
Superio r □ Dubhe [upper [star] of the square,	♌	4 45			15 9	3 7	63 1	5 4	16 1	1 8	63 2	2 2	1 1	4 32

Star name	160	16	16	160	17	170				1700	Diffe
	0	00	R	0	00	R	0				r.
	Lon	Lat	A	De	A	De	AscR				Decli
	g.	.	G	cl.	G	cl.	ecta				Decli
	Sig	MGr	r	M	Gr	M	r	M	Gr	M	n. M
Dubhe]											

Centum Fixarum Tabula Tyconica (continued and concluded)

[The Hundred Fixed Stars, Tyconic Table — concluding stars 52–100. The page carries the heading rule "Anno CHRISTI MDC. Completo" (For the completed year of Christ 1600) over the longitude/latitude/right-ascension/declination columns, and "Anno MDCC. Completo" (For the completed year 1700) over the second pair of right-ascension and declination columns.]

This page completes the catalogue begun on the preceding folio. The columns are: the names of the fixed stars; longitude (sign, degrees, minutes) and latitude (degrees, minutes, with A = australis/southern or B = borealis/northern) for the completed year 1600; right ascension and declination for 1600; right ascension and declination for the completed year 1700; the annual change [differentia] in right ascension (degrees, minutes) and the change in declination (minutes, with A = increasing toward the north or S = toward the south, as printed). Each star's *sed corripge* ("but correct it to") sub-row gives Riccioli's corrected reading.

Star catalogue, completed stars 52–100.

Star name			RA		RA		RA	
	Long.	Lat.	1600	Decl.	1700	Decl.	diff.	Decl.
	(Sig	(Gr	(Gr	1600	(Gr	1700	(Gr	diff.
	Gr M)	M)	M)	(Gr M)	M)	(Gr M)	M)	(M)
Lucida	♊ 5 41	14	163	22 43	164	22 9	1 27	34
Lumbi ☾ [bright star of Leo's loins]		20	10		37			
Cauda ☾ [tail of]	♊ 16 3	12	172 9	16 49	173	16 15	1 19	34
		18			28			

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
Leo]								
Infer. seq.	♌ 25	51	173 3	55 57	174	55 23	1 23	34
☐ Vrsæ	25½	37			26			
mai.								
[lower following star of the square of Ursa Major]								
Superior	♌ 24	47	178	59 15	180	58 41	1 20	34
☐	45	6½	50		10			
sequent.								
[upper following star of the square]								
Cingulum	♌ 5 55	8	188	15 37	190	15 3	1 18	34
♌ [girdle of Virgo]		41	53		11			
Radix	♌ 3 10	54	189 1	58 10	190	57 37	1 9	33
Caudæ		18			10			
Vrsæ ma.								
[root of Ursa Major's tail]								
Vindemiati	♌ 4	16	190	13 8	191	12 35	1 17	33
rix ♌	23½	15	36		53			
		½						
Spica ♌	♌ 18	1	196 4	9 11	197	9 33½	1 19½	32½
[Spica]	16	59			23½			
sed	— 18	2	196	9 15	197	9 34⅓	1 19½	32½

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
<i>corrigē</i>	15½	0⅓	3⅓		22⅝			
Penult. Caudæ Vrsæ ma. [next-to- last of Ursa Major's tail]	⅞ 9 56½	56 22	196 54	57 3	197 57	56 31	1 3	32
Vltima Caudæ eiusdem [last of the same tail]	⅞ 21 12½	54 25	202 54	51 22	203 56	50 51	1 2	31
Arcturus	⅔ 18 39½	31 2½	209 23½	21 18½	210 34½	20 49	1 11	29½
Bootæ humer. sinist. [left shoulder of Boötes]	⅔ 13 5½	49 53 ½	214 2	40 3	215 4	39 36	1 2	27
Lanx Australis [southern scale-pan]	⅞ 9 31	0 26	217 14½	14 18	218 37½	14 45	1 23	27
Lanx Borealis [northern scale-pan]	⅞ 13 48	8 35	223 54½	7 50	225 16	8 14	1 21½	24
Coronæ lucida [bright star of the	⅞ 6 38½	44 23 ½	229 26	28 16	230 31	27 45	1 5	21

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
Crown]								
Serpentis colli lucida [bright star of the Serpent's neck]	♌ 16 30	25 35 ½	231 12	7 46	232 27	7 25	1 15	11
Scorpij frons borealis [northern of Scorpius' forehead]	♌ 27 36	1 5	235 54	18 38	237 2	18 57	1 28	19
manus sin. [left hand]	♌ 26 44½	17 19	238 25	2 47	239 48	2 55	1 23	18
<i>sed</i> <i>corrigere</i>	— 26 43½	17 19 ⅔	238 18½	2 36	239 45½	2 54	1 23	18
Cor Scorpij Antares [Antares, the Heart of Scorpius]	♏ 4 13	4 27	241 18	25 26	242 50	25 42	1 32	16
<i>corrigere</i>	— 4 5½	4 22	241 —	25 12⅓	243 2⅔	25 38¾	1 32½	16
Herculis humer. dextr.	♏ 25 27½	42 48	243 13	22 27	244 20	22 12	1 5	15

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
[right shoulder of Hercules]								
Ophiuchi genu sin. [left knee of Ophiuchu s]	♄ 3 39	11 30	243 49	9 39	245 12	9 54	1 23	15
Ophiuchi genu dext. [right knee of Ophiuchu s]	♄ 12 24	7 18	251 50	15 7	252 40	15 17	0 50	10
Herculis Caput [head of Hercules]	♄ 10 31	37 23	254 6	14 55	255 14	14 47	1 8	8
Herculis hum. sin. [left shoulder of Hercules]	♄ 9 10	47 47	254 40	25 22	255 32	25 14	0 52	8
Ophiuchi Caput [head of Ophiuchu s]	♄ 16 50	35 57	259 5	12 56	260 16	12 49	1 11	7
Ophiuchi hum.	♄ 21 5	16 11	260 56	4 49	262 9	4 44	1 13	5

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
dextr. [right shoulder of Ophiuchus]								
Draconis lucida Capitis [bright star of the Dragon's head]	♄ 6 19½	75 21	266 52	51 37	267 27	51 35	0 35	2
Lyræ lucida [Vega, bright star of the Lyre]	♄ 9 43	61 47 ½	275 52	38 28	276 42	38 32	0 50	4
Orientalis Capitis ♄ [more easterly of the head, Sagittarius]	♄ 19 8½	5 8	281 32	21 35	283 3	21 27	1 31	8
Cauda Vulturis [tail of the Vulture]	♄ 14 15½	36 16 ½	281 47	13 20	283 0	13 28	1 13	8
Cygni Rostrum [beak of the Swan]	♄ 25 44	49 2	288 40	27 10	289 41	27 21	1 17	11

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
Lucida Vulturis [Altair, bright star of the Vulture]	♊ 26 9	29 21 $\frac{1}{2}$	292 49	7 54	294 6	8 7	1 17	13
<i>sed</i> <i>corrige</i>	— 26 14 $\frac{1}{4}$	29 14 $\frac{1}{4}$	292 48 $\frac{1}{2}$	7 53 $\frac{1}{2}$	294 5 $\frac{1}{3}$	8 6 $\frac{1}{3}$	1 17	13
Cygni ala superior [upper wing of the Swan]	♊ 10 53	64 28	293 10	44 12	293 58	44 26	0 48	14
Capricor. Cornu super. [upper horn of Capricorn]	♊ 28 18	7 2 $\frac{1}{2}$	298 57	13 40	300 22	13 24	1 25	6
Eiusdem cornu infer. [lower horn of the same]	♊ 18 31	4 41	299 39	15 57	301 6	15 49	1 27	17
Cygni pectus [breast of the Swan]	♊ 19 25	57 9 $\frac{1}{2}$	302 1 $\frac{1}{2}$	39 1	302 55	39 19	0 53 $\frac{1}{2}$	18
Aquarij manus sin. [left	♊ 6 10	8 10	306 32	10 53	307 48	10 34	1 16	19

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
hand of Aquarius]								
Cygni cauda [tail of the Swan]	≈ 29 53½	56 ½	306 57½	43 53½	307 49	44 14	0 51½	20½
Cygni ala infer. [lower wing of the Swan]	≈ 22 9½	49 26	307 31	32 30	308 31	32 51	1 0	21
Aquarij humer. sin. [left shoulder of Aquarius]	≈ 17 51	8 42	317 37	7 15	318 58	6 49	1 21	26
Capricorni cauda præc. [preceding star of Capricorn' s tail]	≈ 16 14	2 26	319 28	18 21	320 54	17 55	1 26	26
Cephei cingulum [girdle of Cepheus]	∞ 0 13	71 7	320 46	68 50	321 8	69 16	0 22	26
Pegasi os [mouth of Pegasus]	≈ 26 22	22 7½	321 10	8 5	322 28	8 31	1 18	26
Capricorni cauda seq.	≈ 18 0	2 29	321 16	17 51	322 41	17 24	1 25	27

Star name	Long. (Sig Gr M)	Lat. (Gr M)	RA 1600 (Gr M)	Decl. 1600 (Gr M)	RA 1700 (Gr M)	Decl. 1700 (Gr M)	RA diff. (Gr M)	Decl. diff. (M)
[following star of Capricorn' s tail]								
Aquarij humer. dextr. [right shoulder of Aquarius]	≈ 27 9½	10 42	326 19	2 13	327 39	1 44	1 20	29
Aquarij Fomahant [Fomalha ut of Aquarius]	≈ 3 17	15 53	338 46	31 39	340 11	31 8	1 25	31
Pegasi Scheat	≈ 23 49½	31 7½	341 9	25 56	342 21	26 28	1 21	32
Pegasi Markab. <i>sed</i> <i>corrige</i>	≈ 17 56½ — 17 55⅞	19 26 19 25 ½	341 15 341 12⅓	13 5	342 30 342 27⅓	13 37	1 15	32
Occiput Pes Australis [back of head / southern foot]	≈ 15 50½	7 17 ½	344 9	1 7	345 26	1 40	1 17	33
Andromed æ Caput [head of	Υ 8 47	25 42	356 59	26 54	358 16	27 28	1 17	34

Star name	Long.	Lat.	RA		RA		RA	
	(Sig Gr M)	(Gr M)	1600 (Gr M)	Decl. 1600 (Gr M)	1700 (Gr M)	Decl. 1700 (Gr M)	diff. (Gr M)	Decl. diff. (M)
Andromed a]								
Cassiopeæ luc. Cathed. [bright star of Cassiopeia 's throne]	Υ 29 35½	51 14 ½	357 5	56 58	358 20	57 32	1 15	34
Pegasi alæ extrema [outermost of Pegasus' wing]	Υ 3 38½	12 35	358 14	12 58	359 30	13 32	1 16	34
Cete cauda Borealis [northern tail of Cetus]	⋈ 25 23	10 1	359 49	11 1	1 7	10 27	1 18	34

CAPVT XIII.

De Observationibus Fixarum post Tychonem, usque ad Nostras exclusivè.

(On observations of the fixed stars after Tycho, down to but not including our own.)

[Margin: *Lansbergij observ.* — Lansbergius' observations.]

1. Philippus Lansbergius [Philippe van Lansbergen], in his *Tables of the celestial motions* (p. 101), places the first star of Aries at Zodiac degree 354° 5' 29" for the epoch of Nabonassar; but for the epoch of Christ he puts it at degree 4° 43' 22", with respect to the mean motion. And yet on the following page (102), from his own observation, he sets out a catalogue of 25 stars, in

which — taking the beginning of the years of Christ as his reference — he places the first star of Aries, with respect to the true vernal equinox, at Υ 4° 25'. The catalogue runs as follows.

Catalogus XXV. Stellarum Fixarum, summa cura à Nobis observatarum, una cum Longitudine, & Latitudine. (*A catalogue of 25 fixed stars, observed with the greatest care by us, together with longitude and latitude.*)

Column heading: *Ad initium Ann. Christi* (at the beginning of the years of Christ) | Longitudo (Sig. G. Υ) | Latitudo (Gr. $\circ$, with B = borealis/northern, A = australis/southern).

Catalogue of 25 stars (Lansbergen), longitude and latitude.

Star name	Long. (Sig Gr $\circ$)	Lat. (Gr $\circ$)	A/ B
Prima Arietis [first star of Aries]	Υ 4 25	7 7	B
Occidentalior Pleiadum [more westerly of the Pleiades]	Υ 29 49	4 12	B
Borealissim. extra Pleiadas [northernmost outside the Pleiades]	♄ 0 38	4 36	B
Quæ iuxta hanc [the one next to it]	♄ 0 46	4 29	B
Australior Pleiadum [more southerly of the Pleiades]	♄ 0 39	3 55	B
Media, & lucida Pleiadum [middle and bright star of the Pleiades]	♄ 1 7	4 6	B
Orientalior Pleiadum [more easterly of the Pleiades]	♄ 1 44	4 2	B
Palilicium oculus ♄ [Aldebaran, the eye of Taurus]	♄ 11 0	5 44	A
In ventre Meridion. ♊ [in the southern belly, Gemini]	♊ 19 43	0 33	A
Caput ♊ præced. [preceding star of the head of Gemini]	♊ 21 28	9 40	B

Star name	Long. (Sig Gr ')	Lat. (Gr ')	A/ B
Caput ♊ sequens [following star of the head of Gemini]	♊ 24 33	6 16	B
Canis minor [Procyon, the Lesser Dog]	♊ 27 6	16 16	A
Asellus Austrinus [southern Ass]	♋ 9 55	0 12	A
Cor Leonis, Basiliscus [Regulus, the Heart of the Lion]	♌ 1 5	0 12	B
Præced. 4. Stell. in sin. ala ♍ [preceding of the 4 stars in Virgo's left wing]	♍ 6 4	1 21	B
Sequens sub austr. hum. ♍ [following star beneath Virgo's southern shoulder]	♍ 11 23	2 43	B
Spica Virginis [Spica]	♍ 25 2	2 0	B
Lanx Austrina [southern scale- pan]	♎ 16 25	0 32	B
Lanx Borea [northern scale- pan]	♎ 20 31	8 43	B
Suprema in fronte Scorpij [topmost on Scorpius' forehead]	♏ 4 26	1 16½	B
Media in fronte Scorpij [middle on Scorpius' forehead]	♏ 3 48	1 45	A
Australior trium frontis [more southerly of the three on the forehead]	♏ 4 13	5 10	A
Cor Scorpij [Antares, the Heart of Scorpius]	♏ 11 13	4 11½	A
Boreal. in Cornu præc. ♐ [northern in the preceding horn, Capricorn]	♐ 5 54	7 20	B
Australior earum [more southerly of them]	♐ 6 7	5 0	B

Then Riccioli's discussion continues beneath the catalogue:

Now since Lansbergen flourished near the beginning of our own century, and was able to reduce the positions of these fixed stars to the beginning of the years of Christ, he must necessarily have collated his own observations with those of his predecessors, so as from them — by reckoning the annual motion of the fixed stars — to draw those positions back to the beginning of the years of Christ.

2. Moreover, the same author, at the end of his *Thesaurus* of observations, sets down the observations of the fixed stars written out below, made by himself or by Hortensius [Maarten van den Hove] in Zealand, assuming the altitude of the equator at Goes to be $38^{\circ} 39'$ and at Middelburg $38^{\circ} 29'$, and the obliquity of the ecliptic to be $23^{\circ} 30'$ — let this be on page 42 of the same *Thesaurus*, which he says he himself discovered at his own time to be $23^{\circ} 30' 10''$. From these elements, by the Copernican method, together with the latitude, he gathers the longitude of the fixed stars, and compares it with the longitude computed from his own tables.

[The observations themselves are tabulated in the right-hand column. Each block names a year and epoch (*ineunte* = at the beginning, *completo* = completed, *desinente* = at the end, *incipiente* = beginning) and the place of observation (Goes, or Middelburg in Zealand). For each star are given the meridian altitude, northern or southern declination, its latitude, the obliquity of the ecliptic, the longitude of the star "therefore" deduced — and then "*sed ex Tabulis*" (but from the tables) the tabular value. The marginal labels identify which star each block concerns.]

Lansbergen / Hortensius observations of fixed stars. Columns: epoch and item observed | Sig. | Gr. | ' | ".

Year / item observed	Place	Si g.	G r	'	"	[Margin]
1589. ineunte	Goesæ					[<i>Observ. Aldebara. —</i> Aldebaran observed]
Palilicij alt. Meridiana [meridian altitude of Aldebaran]			5	6	4	
			4		0	
Declinatio Boreal. [northern declination]			1	3	4	
			5	7	0	
Latitudo eius A [its			5	3	0	

Year / item observed	Place	Si g.	G r ' "	[Margin]
latitude, southern]			0	
Obliquitas Eclipticæ			2 3 0	
[obliquity of the ecliptic]			3 0	
Ergo Longitudo Stellæ		II	4 1 4	
[therefore longitude of the star]			0 5	
ex Tabulis [from the tables]		II	4 1 3	
			0 4	
1601. ineunte	Goesæ			
Palilicij altit. Merid.			5 8 0	
[meridian altitude of Aldebaran]			4	
Bor. Declinatio			1 3 0	
[northern declination]			5 9	
Latitudo Austr.			5 3 0	
[southern latitude]			0	
Obliq. Ecl. vt supra, & Long. [obliquity of the ecliptic as above, and longitude]		II	4 1 0	
			8	
sed ex Tabulis [but from the tables]		II	4 1 4	
			7 3	
1588. completo	Goesæ			[<i>Canicula observ.</i> — Sirius/Procyon observed]
Canis minor altit.			4 4 4	
Merid. [meridian altitude of the Lesser Dog]			4 2 0	
Declinatio Boreal.			6 1 4	
[northern declination]			3 0	
Latitudo Austr.			1 5 0	
[southern latitude]			5 4	

Year / item observed	Place	Si g.	G r ' "	[Margin]
Obliq. Eclipt. [obliquity of the ecliptic]			2 3 0 3 0	
Ergo longitudo Stellæ [therefore longitude of the star]		☿	2 1 0 0 6	
sed ex Tabulis [but from the tables]		☿	2 1 3 0 6 4	
1599. ineunte	Goesæ			[<i>Reguli observ.</i> — Regulus observed]
Reguli altit. Merid. [meridian altitude of Regulus]			5 2 3 2 4 0	
Declinatio Boreal. [northern declination]			1 5 0 3 8	
Latitudo eius Bor. [its northern latitude]			0 3 0 1	
Obliq. Eclipticæ [obliquity of the ecliptic]			2 3 0 3 0	
Ergo Longitudo [therefore longitude]		♂	2 1 0 4 4	
sed ex Tabulis [but from the tables]		♂	2 1 0 4 4	
1630. ineunte	Middelburgi Zeland.			
Reguli altit. Merid. [meridian altitude of Regulus]			5 1 0 2 6	
Declinatio Boreal. [northern declination]			1 4 0 3 7	
Latitudo eius Bor. [its northern latitude]			0 3 0 1	
Obliquitas Eclipticæ			2 3 0	

Year / item observed	Place	Si g.	G r ' "	[Margin]
[obliquity of the ecliptic]			3 0	
Ergo Longitudo Reguli [therefore longitude of Regulus]		♌	2 4 0 4 7	
sed ex Tabulis [but from the tables]		♌	2 4 3 4 7 0	
1599. ineunte	Goesæ			[<i>Spicæ observ.</i> — Spica observed]
Spicæ altit. Meridiana [meridian altitude of Spica]			2 3 0 9 0	
Vera ob Refractionem [the true value, on account of refraction]			2 2 0 9 8	
Declinatio Australis [southern declination]			9 1 0	
Latitudo Australis [southern latitude]			1 5 0 8	
Obliquitas Eclipticæ [obliquity of the ecliptic]			2 3 0 3 0	
Ergo Spicæ Longitudo [therefore longitude of Spica]		♎	1 1 0 8 9	
sed ex Tabulis [but from the tables]		♎	1 1 2 8 9 8	
1630. ineunte	Middelburgi			
Spicæ altit. Merid. observ. [observed meridian altitude of Spica]			2 2 0 9 0	
Vera ob Refract. [the true value, on account			2 1 0 9 8	

Year / item observed	Place	Si g.	G r ' "	[Margin]
of refraction]				
Declinatio Austr.			9 1 0	
[southern declination]			1	
Latitudo Austr.			1 5 0	
[southern latitude]			8	
Obliq. vt supra ergo		♌	1 4 0	
Longit. [obliquity as above, therefore longitude]			8 5	
at ex Tabulis [but from the tables]		♌	1 4 3 8 5 0	
1601. incipiente	Goesæ			[<i>Scorpij Frons.</i> — Scorpius' forehead]
Supr. frontis Scorpij			1 5 0	
alt. Merid. [meridian altitude of the topmost on Scorpius' forehead]			9 4	
Vera ob Refract. [the true value, on account of refraction]			1 5 0 9 0	
Declinatio Austral.			1 3 0	
[southern declination]			8 9	
Latitudo Borealis			1 4 0	
[northern latitude]				
Obliquitas Eclipticæ			2 3 0	
[obliquity of the ecliptic]			3 0	
Ergo Stellæ Longitudo		♌	2 4 0	
[therefore longitude of the star]			7 4	
sed ex Tabulis [but from the tables]		♌	2 4 4 7 3 3	
1600. desinente	Goesæ			[<i>Cor Scorpij.</i> — Heart of Scorpius / Antares]

Year / item observed	Place	Si g.	G r ' "	[Margin]
Cordis Scorpj alt.			1 8 0	
Merid. visa [observed meridian altitude of the Heart of Scorpius]			3	
Vera ob Refract. [the true value, on account of refraction]			1 2 0 3	
Declinatio Austr. [southern declination]			2 2 0 5 7	
Latitudo eius Austr. [its southern latitude]			4 2 0 6	
Obliquit. Eclipt. [obliquity of the ecliptic]			2 3 0 3 0	
Ergo Stellæ Longitudo [therefore longitude of the star]		✎	4 3 0 0	
& ex Tabulis [and from the tables]		✎	4 3 4 0 3	

3. Against Lansbergen's summary arguments, however, *the first point* they make is that he assumed an excessive refraction for the fixed stars in Spica and Scorpius — something taken up rather than demonstrated, or merely probable. *Secondly*, the latitudes of the fixed stars he took from Ptolemy and Copernicus, and adjusted to suit the anomaly of the obliquity of the ecliptic; that those latitudes are false is plain from what was said above, and from comparing them with the Tyconic values. As for the obliquity of the ecliptic varying — as Ptolemy supposed — that is false, as is established from what was said in Book 1. *Thirdly*, if the positions of Aldebaran, Sirius/Procyon [Canicula], Regulus, Spica, and Scorpius assigned by Lansbergen in his first table for the beginning of the years of Christ be compared with the positions drawn out from the observation itself — as we too have done with our associates — then the annual motion of the fixed stars will come out as 52½", very nearly the value we shall show below not to be excessive.

De Iulio Schillero, & Io. Bayero.

(On Julius Schiller and Johann Bayer.)

4. Johann Bayer [Johann Bayer] published his *Uranometria* at Augsburg, drawing not so much on his own observations as chiefly on those of others; and, assisted by him and imitating him, Julius Schiller [Julius Schiller], likewise of Augsburg, in the year 1627 published the *Coelum Stellatum Christianum* [Christian Starry Heaven] — so called because, in place of the names drawn from astronomers ancient and pagan, he substituted new names, and sacred ones. In its second part, beginning at page 131, are given the longitude, latitude, declination, right ascension, and culmination [Medium Coeli] of 360 fixed stars, for the year of Christ 1625, computed by Jacob Bartsch [Jakob Bartsch] from the Tychonic determination and from Bayer's. Among these, however, are certain stars observed by various navigators [Naucleri], from whose observations Bayer — after the earlier *Uranometria* had been published — fixed their positions, and Bartsch thence computed them to the same year 1625. Kepler [Johannes Kepler], moreover, at the end of the *Rudolphine* tables, drew the same stars back, on the supposition of the Tychonic motion, to the year 1600. Leaving aside, then, the others that are in the Tychonic catalogue, we shall transcribe from Schiller only those fixed stars which were observed by the navigators across the Equator — concerning whose distances measured by the navigators with the cross-staff [Radius], see above, Chapter 8. Whatever may be the case with such observations, it is better to have them than none at all.

Tabula Iulij Schilleri Fixarum aliquot ex Observat. Nauclerorum, & Determinatione inde facta Io. Bayeri, ac supputatione Iacobi Bartschij ad Annum Christi 1625. (*A table of some of Julius Schiller's fixed stars, from the observations of the navigators and the determination made therefrom by Johann Bayer, and the computation of Jacob Bartsch, for the year of Christ 1625.*)

Columns: name of the stars | Longitudo (Sig. Gr. M.) | Latitudo Aust. [southern] (Gr. M.) | Ascensio Recta [right ascension] (Gr. M.) | Declinatio Austr. [southern declination] (Gr. M.) | Magnitudo.

Schiller / Bayer / Bartsch table of southern stars, year 1625.

Star name	Long. (Sig Gr M)	Lat. Aust. (Gr M)	RA (Gr M)	Decl. Aust. (Gr M)	M a g.
CENTAVRI suffrago pedis sinist. post. [hock of the left hind foot of Centaurus]	♄ 2 28	55 40	173 46	61 24	2
Sura pedis dextri posterioris [calf of the right hind foot]	♄ 1 20	51 15	178 36	57 41	2
Cauum pedis dextri posterioris [hollow of the right hind foot]	♄ 6 38	51 40	183 2	60 6	2
Pedis sinistri prioris genu [knee of the left fore foot]	♄ 15 20	45 20	199 26	58 24	2
Pedis dextri prioris vngula [hoof of the right fore foot]	♄ 29 30	41 10	221 0	59 36	1
Sub aluo duarum præcedens [preceding of the two beneath the belly]	♄ 7 38	43 0	193 20	53 28	2
ARGONAVIS Lucida in sectione instrati [bright star of Argo Navis in the section of the deck]	♂ 9 4	51 15	117 32	31 25	2
Sequens scutum ad transtra [following the shield, at the cross-benches]	♂ 6 29	54 39	114 37	34 4	2
In transtro Lucida sequens [following	♂ 12 28	58 10	117 2	38 44	2

Star name	Long. (Sig Gr M)	Lat. Aust. (Gr M)	RA (Gr M)	Decl. Aust. (Gr M)	M a g.
bright star at the cross-bench]					
Sequens Carinam puppis instrat. [following the keel, at the deck of the stern]	♌ 21 24	63 50	119 25	45 30	2
Intra Carinam ad austrum [within the keel, toward the south]	♌ 29 48	69 40	119 18	52 12	2
Supra Carinam proræ austral. [above the keel, on the southern side of the prow]	♍ 17 28	65 45	131 58	53 10	2
Canopus in temone [Canopus, at the rudder]	♋ 8 25	75 0	93 30	51 34	1
Lupi poples ped. dext. post. [ham of the right hind foot of the Wolf]	♍ 19 32	29 45	215 58	45 46	3
Lupi coxa, seu alui infer. [thigh of the Wolf, or lower belly]	♍ 22 30	27 40	220 26	44 55	3
Coronæ australis lucida [bright star of the Southern Crown]	♐ 8 18	18 0	280 31	41 12	2
GRVIS, seu Phœnicis lucida capit. [bright star of the head of	♑ 12 13	22 50	320 7	38 56	2

Star name	Long. (Sig Gr M)	Lat. Aust. (Gr M)	RA (Gr M)	Decl. Aust. (Gr M)	M a g.
the Crane, or Phoenix]					
Eiusdem alæ præcedens lucida [bright preceding star of its wing]	≈ 10 56	32 57	326 29	48 45	2
Eiusdem educio caudæ [the springing-out of its tail]	≈ 17 14	34 36	334 45	48 2	2
Eiusdem lucida colli [bright star of its neck]	✕ 9 32	40 10	1 1	44 17	2
INDI collum, vel caput [neck, or head, of the Indian]	♂ 27 57	32 30	310 11	52 12	4
PAVONIS lucida capitis [bright star of the head of the Peacock]	♂ 17 0	36 0	298 12	57 58	2
Eiusdem lucida dorsi [bright star of its back]	♂ 10 45	45 20	291 1	68 5	3
Eiusdem alæ dextræ lucida [bright star of its right wing]	♂ 15 35	46 32	300 9	68 25	3
Apodis, seu Aus Indicæ cauda austr. [southern tail of the Apus, or Bird of India]	↗ 8 25	59 20	206 3	77 56	4
Apis, seu Muscæ ala præced. [preceding	ℳ 15 50	56 25	184 38	67 15	4

Star name	Long. (Sig Gr M)	Lat. Aust. (Gr M)	RA (Gr M)	Decl. Aust. (Gr M)	M a g.
wing of the Bee, or Fly]					
Chamæleontis collum [neck of the Chameleon]	♁ 25 5	63 20	175 56	75 3	5
TIANGVLI Australis cuspis [point of the Southern Triangle]	♂ 4 27	41 0	228 4	60 51	3
Basis lucida præcedens [bright preceding star of the base]	♂ 3 17	48 30	244 47	70 21	3
Basis lucidarum sequens [following of the bright stars of the base]	♂ 13 17	46 20	237 58	68 0	3
Piscis volantis caput [head of the Flying Fish]	♁ 18 40	72 26	134 29	65 52	5
Informis circa eam [unformed star around it]	≈ 4 45	78 30	64 38	74 32	4
Doradi Piscis caput [head of the Dorado fish]	♁ 25 42	86 53	97 0	67 40	4
Eiusdem venter [its belly]	♂ 29 50	88 12	87 54	64 56	5
Toucan Rostrum [beak of the Toucan]	≈ 4 16	45 55	328 27	62 38	3
Caput eiusdem [its head]	≈ 15 12	48 15	344 19	60 36	3
Hydræ caput [head	♂ 4 20	64 5	25 14	64 12	3

Star name	Long. (Sig Gr M)	Lat. Aust. (Gr M)	RA (Gr M)	Decl. Aust. (Gr M)	M a g.
of the Hydra]					
Nubecula maior in medio [the Greater Cloud, in the middle]	0 0	84 0	78 0	71 25	—
Nubeculæ minoris medium [the middle of the Lesser Cloud]	5 0	67 0	17 58	76 20 23 [?]	—

Petri Gassendi Observationes [The Observations of Pierre Gassendi]

5. In Volume 4 of Gassendi's [Pierre Gassendi] *Works*, titled *Commentaries on Celestial Matters* [*Commentarii de Rebus Coelestibus*], we have very few observations of the fixed stars, as regards their declinations and meridian altitudes. And from these, together with the Tychonic declinations — which he by no means corrected — he infers the altitudes of the pole, rather than determining the declinations of the fixed stars from the altitudes of the pole, except for the Pole Star, or in the case where the pole's altitude was established from solstitial observations. Moreover, on pages 84, 106, and 182 Gassendi admits that for these purposes he used a walnut-wood quadrant of 5 feet and an iron one of 3 feet, and a square of 3½ feet — yet he assumes the pole's altitude as stated in our *Geographia Reformata*. We shall add the declinations.

Years of Christ	—	Meridian Altitude	Declinati — on —
—	—	Gr. ' —	Gr. ' " —
1632 December 20 & 28, <i>Dieppe</i>	Pole Star	Max. 46 46	
Dec. 28 & January 2 and 3		Min. 41 25½	87 19 45
1636 May 10 & 11 <i>Marseille</i> , pages 312 & 313	Spica	Merid. 37 28	9 12 0 A

Years of Christ	—	Meridian Altitude	Declinati — on —
	Aquila	54 36	7 56 0
	Tail of the Lion [Cauda ♏]	63 16	16 36 0
	Arcturus	67 45	21 5 0
	Antares	21 7	25 23 0 A
1636 May 15 <i>Aix-en-Provence</i> [Aquis Sextiis], p. 313	Spica	Merid. 37 13	9 13 30 A
1649 December <i>Toulon</i> [Tolonaē]	Pole Star	Max. 45 47	
		Min. 40 37	87 25 0

Altitudes of the pole above [the foregoing]	—	Alt. of the Pole	—
—	—	Gr. ' "	
Assumed: <i>Dieppe</i>		44 5 45	
<i>Marseille</i>		43 20 0	
<i>Aix-en-Provence</i>		43 33 30	
<i>Toulon</i>		43 12 0	

It will not be unwelcome to the reader if, from the same Volume 4 of Gassendi's *Works*, I indicate the instruments — of whatever magnitude — that he himself confesses he used, whether his own or those of others.

Page	Gassendi's Instruments	Paris feet
77	Astronomical Radius [Radius Astronomicus]	4
84	Geometric Square [Quadratum Geometricum]	3½
88	Galterius's Quadrant [Quadrans Galterii], more than	2
92	Astronomical Radius	6
97	Valois Quadrant [Quadrans Valesii]	3

Page	Gassendi's Instruments	Paris feet
98	Steel Quadrant of Midorge [Quadrans Chalybeus Midorgii]	1
98	Gnomon in the Spheristerium of the Constable at Grenoble [Gnomon in Spheristerio Connestabuli Gratianopoli], more than	36
106	Walnut Quadrant with an arc of 4 digits, divided crosswise in minutes through the individual sextants of degrees [Quadrans Nuceus cum Arcu digitorum 4. in minuta transversim diviso per singulos graduum sextantes]	5
110	Another Radius with a cross-staff [Radius alter cum Transversario]	$5\frac{1}{3}$; $3\frac{3}{4}$ [?]
182	Iron Quadrant [Quadrans Ferreus]	$3\frac{1}{4}$
323	One [an instrument] found somewhere to err by minutes 5' [Qui alicubi deprehensus errare minutis 5']	
320	The largest Gnomon at Marseille [Gnomon Massiliae maximus]	$51\frac{2}{3}$

De Observationibus circa Pleiadas Michaelis Florentii Langreni, & D. Vincentii Muti. [On the Observations of the Pleiades by Michael Florent van Langren and by Vincenzo Muti]

6. Among the most learned and most courteous letters sent to me from Brussels by Michael Florent van Langren [Michael Florentius Langrenus], Cosmographer to the Catholic King, I have one of the year 1647, dated June 6, in which he sets out for me the exact position and the distances of the Pleiades depicted in a diagram, similar to Muti's, and promises to send their position relative to the ecliptic and equator as well — which I did not later receive. Now our most learned and most friendly Vincenzo Muti [Vincentius Mutus] of Maiori, most devoted to and most skilled in the observation of the stars, in a letter sent to me on March 5 of the year 1650, not only communicated their most exact distances, taken together with the

telescope, but also their longitude, latitude, and degree of magnitude — assuming, however, Alcyone, that is the bright star of the Pleiades, at the Tychonic position for the beginning of the year 1650 — which stand as follows. There are nine of them, although the more celebrated ones are only seven, speaking of those conspicuous even to the naked eye.

Intervals of the Pleiades, or Names of the
Pleiades

Distances ' "

Atlas & Pleione	4 0
Atlas & Alcyone, or the bright Pleiad	27 0
Pleione & Alcyone	27 0
Alcyone & Merope	22 0
Alcyone & Maia	31 0
Maia & Merope	30 0
Maia & Electra	22 0
Maia & Taygeta	11 0
Electra & Taygeta	22 0
Electra & Merope	24 0
<i>These others I have added myself from the diagram [His ego alias ex Typo addidi]</i>	
Alcyone & Taygeta	42 10
Alcyone & Asterope	41 30
Alcyone & Celeno	40 0
Alcyone & Electra	39 50
Maia & Asterope	11 0
Maia & Celeno	19 0
Taygeta & Asterope	9 45
Taygeta & Celeno	16 0
Electra & Celeno	10 20
Merope & Celeno	29 0

At the beginning of
the year 1650

Longitude ʘ Gr. ' "

Latitude Gr. ' " Bor.

Magnit
ude

Electra, or the more	ʘ 24 28 11	4 9 40	5

At the beginning of the year 1650	Longitude γ Gr. ' "	Latitude Gr. ' " Bor.	Magnit ude
westerly bright one			
Taygeta, or the more westerly of the bright northern ones	γ 24 38 30	4 31 36	6
Merope, nearer the rising [point] of Electra	γ 24 45 0	3 53 30	6
Maia, nearer the rising [point] of Taygeta	γ 24 45 30	4 23 56	6
Alcyone, or the bright Pleiad of Tycho	γ 25 6 0	4 0 0	3
Atlas, at the cusp toward the rising [point]	γ 25 31 30	3 51 20	5
Pleione, at the more northerly cusp	γ 25 32 30	3 54 0	7

Therefore, if the longitude of the bright Pleiad is to be corrected, the latitude too, and likewise that of the remaining stars, must be corrected proportionally — but only if Muti followed Tycho's motion of the fixed stars in completed years, [namely] 41' 39". For the longitude of the bright Pleiad ought to have been set at γ 24° 5' 39".

[Margin: *Tycho and Lansbergen noted.* (Tycho, & Lansbergius notati.)]

"Here," says Muti, "I cannot help but greatly wonder how far these stars have been displaced from their positions, as observed by Tycho. For he sets a much greater distance between the bright star and Merope than between Merope and Electra — which is utterly false — and he establishes Atlas, Alcyone, and Merope on one and the same straight line, which is a misshapen distortion of that interval of the sky. Lansbergen [Lansbergen], in his catalogue of the stars in the *Table of Asterisms*, fol. 102, posits the same thing; for he sets the distance between the bright Pleiad and Electra, [the two being] the most westerly, at 1° 18' — as great as the distance between the first and middle stars of Orion's belt. Yet who does not see, with a telescope or even with the naked eye, that the said Pleiades are far less distant from one another?" Thus this most careful and most accurate man.

Kepler [Kepler], however, in the Rudolphine [Tables], on folio 110 of the tables, places four positions of the Pleiades from Tycho for the year 1600; but on folio 115, from his own comparison with Ptolemy [Ptolemy], Bayer [Bayer], and Galileo [Galileo], he establishes the positions of these same stars — and of seven of the Pleiades — thus, for the end of the year 1600. To these Tychonic figures we shall add the Keplerian ones. T. shall indicate Tycho, K. Kepler.

Year 1600 completed —

Pleiades	Longitude $\propto$ Gr. ' "	Latitude Gr. ' B.
Northern terminus of the preceding side, <i>Taygeta</i>	K. 24 5 0	4 21
Southern terminus of the preceding side, <i>Electra</i>	T. 23 13 30	4 11
	K. 23 50 0	4 13
Northern terminus of the following side, <i>Alcyone</i>	T. 24 24 0	4 4
	K. 24 24 0	4 3
Southern terminus of the following side, <i>Merope</i>	T. 24 3 0	4 2
	K. 24 4 30	3 55
The sixth, and the one nearest to Arctos [the north], <i>Precedens</i> [the leading one]	K. 24 7 0	4 25
The one preceding this, nearest to the rest	K. 24 0 0	4 26
The one following the bright Pleiad, or [at] the cusp toward the rising point, <i>Atlas</i>	T. 24 47 0	3 55
	K. 24 47 0	3 55

CAPVT XIV.

De Nostris circa Fixas Observationibus, ac primum de Altitudine Poli Bononiae subtilissimè, & exactissimè observata tanquam Fundamento Declinationum. [On Our Own Observations Concerning the Fixed Stars, and First on the Altitude of the Pole at Bologna, Most Subtly and Most Exactly Observed as the Foundation of the Declinations]

Just as Tycho once obtained the altitude of the pole at Uraniborg as $55^{\circ} 54' 30''$, then found it $55^{\circ} 54' 40''$, or $45''$ — as we showed in Chapter IX — so too we, with well-made quadrants exhibiting single minutes, but in a varying manner, obtained the altitude of the pole at Bologna once as $44^{\circ} 29' 30''$, and professed it so in the *Almagestum Novum*; yet afterward, on other astronomical evidence, we began to call it into question. And since we needed it so certain that it could not contain an error of even a single half-minute, we devoted all our skill and effort to this. P. Francesco Maria Grimaldi [Francesco Maria Grimaldi] assisted me magnificently in this whole undertaking; for the same period there was also the most excellent Doctor Giovanni Domenico Cassini [Giovanni Domenico Cassini], Professor of Astronomy at the University of Bologna, who restored the Gnomon of San Petronio, of which I spoke in Book 1, Chapter 12, number 6, and himself needed a subtle altitude of the pole — for which purpose we used a gnomon set high, 20 feet and more, in the courtyard of the most illustrious

Diagram. A schematic engraving of the meridian-altitude instrument described in the text, shown in two parts. The lower portion depicts a long horizontal wooden frame (a beam-table) mounted on a trestle support, with upright posts and threads. At the upper left a series of labeled uprights and points are marked; at the upper right a separate detail shows the sighting threads converging toward a star (rendered as a small star-glyph). Labels, read from the image:

- L, M, R (top): upright posts at the left end of the frame
- N, O, T (left): points on the cross-rule and threads near the left uprights
- X (far left): the eye/sighting position
- P (lower middle-left): point on the frame
- H, K (left base): feet of the trestle support; a plumb-bob hangs below at g
- S (right uprights): upper post at the right
- V (right): point on the frame near the right post
- h (right, mid-line): point on the horizontal sighting line

- Q (right base): foot of the right support
- A, C (upper right, with star-glyph y beside): the converging sighting lines toward the star
- B (upper right): point below A and C on the angle
- E, G, F (lower right detail): the small metal plate/lamella detail with plumb-bob

Several peripheral letters are small; the principal labels (A, B, C, E, F, G, H, K, L, M, N, O, P, Q, R, S, T, V, X, and points g , h , y) are read as printed and correspond to the construction described in the surrounding text.

tractile [i.e., from "intractile," carrying over from the foot of p. 244: so that, dried by the pitch, it would come out unrubbed and uncontracted]; thirdly, we joined together three-foot wooden plates and composed one long [plate], marking likewise with a sign at G, on the said plate. Then, by means of another little cord, we let down a pitch-line, and stretching these and the smoothed plates — which on this occasion of construction did not lie level — and afterward drawing off their length to an equal altitude CG, we measured most subtly; and from the remaining altitude Ch, of which below, the [residual] portion Gh is known, the altitude is known.

4. Besides these, above the meridian line there was a beam HI, resting on several supports and squared, more thoroughly compacted, and parallel to the horizon, at whose southern head was fixed a movable iron forklet [furcula] L g M, from whose arms a very fine thread NO hung, holding the horizon, and a forklet with a handle, near the two cardinal points, H & furcula, movable so that the thread NO could be raised upward, or lowered downward, at will. On suitable nights, then, we awaited the coming of the Pole Star to the meridian, and its middle C; the rules AB were fitted; the associates who held the side-lanterns were enclosed; and at once, when the rule AB and then the thread NO had been set, the Pole Star appeared in the meridian near the middle C, [seen] through the forklet L g M, [so as to] be moved to the forklet; that thread had been moved so that the eye X would see it to be on the same straight line XY, the two points being clearly the thread XY and the rule AB. With the higher middle C and the rule AB secured at the center Y, and the eye being in its position [thus] enclosed, when the temple could be closed off without disturbing it, we then at once super-elevated the metal tube PQ along the said beam HI, formed of several [pieces] mutually fitted, as if perpendicular horns rising up crystalline; of the tube PR and QS, having filled them with water, until at last the water

settled — the silken thread thus passing between the two NO, near the middle Z — so that by this method the thread Zh would be designated; and the point h, in which the lines Zh, with the perpendicular CD, would make a Right Angle ZhC. At last, having measured the longitude ZhC, by the Radius Ch, the angle CZh would become known, measuring the meridian altitude of the Pole Star. We used the tube closed rather than open, PQ, with the channel open, lest any motion of the air through the water cause a defect of the level, or [lest] any impediment introduce a suspicion of error. This, in sum, was the method, in which, repeated through several nights, by repeated and most diligent inquiry into the meridian altitudes of the Pole Star, we proceeded to establish the declinations: we use this simple triangle CHZ, in which Ch is in place of the Radius, and ZH, [is] the Tangent of the Arc OH, subtending

the Angle C, and its complement to a right angle is the Angle Z, measuring the altitude of the point C, or of the star above the horizon.

[Margin: 1. Observatio (First Observation)]

5. And so in the year 1655, at the beginning of October, by repeated observations of the Pole Star, we find the Altitude CH to be 66 feet and $10\frac{78}{100}$, that is 80238 of those parts of which one [Paris] foot is 100; the longitude ZH was 62 feet and $3\frac{165}{1000}$, or of the said parts 74705. As [the ratio of] 80238 to the Radius 10000000, so ZH, of those parts 74705; the tangent of the Angle C, $42^{\circ} 57' 17''$. And its complement $47^{\circ} 2' 43''$ — that is, the maximum altitude of the Pole Star at the Bologna meridian — was $47^{\circ} 2' 43''$; but the minimum altitude of the Pole Star was not then observed, nor was it possible, since at that time it happened under the end of the year 1655, and afterward the new temple impeded us.

[Margin: 2. Observatio (Second Observation)]

Diagram (right margin, beside §5): a right triangle drawn with C at the top, O on the upper side, and the right angle at H at the base, with K at the lower left — illustrating the triangle CHZ (here lettered with O and K) of the foregoing calculation. (A small uncaptioned geometric figure; labels C, O, H, K read as printed.)

So with the sextant standing at one [station] of 7, and the other of 12 feet, in a vault near the temple we obtained the meridian line of the Pole Star, the maximum in the evening $47^{\circ} 2' 42''$, and the minimum $41^{\circ} 57' 36''$, the seconds in each varying somewhat. Since, however, the more frequent difference of the

altitudes was $5^{\circ} 5' 6''$, and the semidifference $2^{\circ} 32' 33''$, therefore, this minimum being added, it exhibits in the meantime the altitude of the pole $44^{\circ} 30' 9''$ — which, as the illustrious Lord Cassini, we report, [waiting] expecting that he would furnish [it] by his own Gnomon.

[Margin: 3. Observatio (Third Observation)]

6. But indeed the illustrious Cassini, at the close of the year 1655 and the beginning of 1656, in the Malvasia house [aedes Malvaticae], with his own Gnomon of more than 20 feet, obtained the maximum altitude of the Pole Star at the meridian as $47^{\circ} 2' 50''$, and the minimum $41^{\circ} 57' 54''$ — of which the semidifference is $2^{\circ} 32' 28''$; and adding the minimum altitude, he gives the altitude of the pole in the Malvasia house as $44^{\circ} 30' 22''$. And he most liberally communicated this same [result] to us, and we in turn accepted it. Yet there is a difference of seconds, $13''$, to be referred to the diversity of the places, since the Malvasia house [aedes Malvaticae] is more northerly than the College of Santa Lucia. Yet this same [matter] is to be investigated.
7. Therefore, more impatient, we investigated by the art of geodesy the interval of distance between our College and the Malvasia [house], and likewise between the summit of the Temple of San Petronio — by means of the tower of Asinelli [Turris Asinella], [taken] in a line falling orthogonally and in parallel to our [meridian] and to the parallel of the Malvasia Palace [Malvaticae Palatii] — and the distances found were: of the Malvasia [house] from the Bologna parallel, 215 [paces?]; between ours and that of San Petronio, parallel paces 180.

This follows from what was established in our *Reformed Geography*, Book 5, Chapter 33: the Bolognese pace contains 64,363 of the feet that make up a degree of the great circle of the Earth. Therefore, from the northern wall of the Malvasia palace down to our Observatory there are 215 paces; and from the northern wall of the palace down to the Church of San Petronio there are 180. From this it follows: the second figure of $12'$ — at which the northern wall of the palace is reckoned — and from our Observatory's reading, namely $10'$, follow accordingly. From the observation of D. Cassini [Giovanni Domenico Cassini], the altitude of the pole in the Malvasia courtyard is $44^{\circ}30'22''$; from our observation in the Observatory it follows that it is $44^{\circ}30'10''$; and at San Petronio, $44^{\circ}30'20''$. And near the Observatory, taken at the outset of the year 1655 — when we were using the great gnomon — it came out as $44^{\circ}30'9''$, though we were not using a great gnomon but rather a different observation.

Meanwhile, however, from the beginning of the year 1655 — when we were using the great gnomon — down to the year 1656, the conferences we held with Cassini's observation give us this satisfaction: that we approached the Pole Star to within a second part of the trimestral interval, as far as the matter required, in accordance with the observations of Paul Hainzel [Paul Hainzel], who found it in these our times to fall short of the World's Pole by 20'.

4 [*Margin: 4. Observation.*] Afterwards, indeed, in the year 1656, in the month of April, the obstacles in the Church of San Lucia having been removed, with the gnomon now set up (described under number 3), we found the least altitude of the Pole Star in the meridian during three successive nights to be $41^{\circ}57'48''$. Then, by the Radius CH, it stood at 74'; and by the small parts [vunciae], 5. By this, the Tangent B9300 — of which one uncia is equal to 100. The Longitude, moreover, by the Tangent ZH, was 82 feet, less 9728'', that is, by the dictated parts 99305. Therefore, by CH, 89300 to the Radius 10000000. So ZH, 99305, to 11120429. The Tangent of the partial angle 99305: therefore the Rectangle 48, of which 2'12'' are the complement of the angle Z, evades $41^{\circ}57'48''$; and so great is the least altitude of the Pole Star. Furthermore, from this Tychonic approach to the annual Pole of 20', if we subtract on this account 6' less from the altitude of our star, that is $41^{\circ}57'42''$, there was the greatest altitude of the Pole Star, reduced to the year 1655. But the year 1656 began with a subtraction of 5', which is owed to the trimestral interval from the beginning of October to the beginning of January, and it was $47^{\circ}2'38''$. The Synopsis of these, therefore, and an Epilogue, is as follows.

Year 1655 Complete — of the Pole
Star

	Meridian Altitude — Gr.	'	"
Maximum Altitude	47	2	38
Minimum Altitude	41	57	42
Difference	5	4	56
Semi-difference	2	32	28
Therefore the Northern Declination	87	27	32
And the Altitude of the Pole in the New Church of San Lucia of Bologna	44	30	10

So this is sufficient, indeed more than sufficient: the altitude of the pole at Bologna stands confirmed by the three places mentioned. This is what comes of

making good use of great instruments. And — without boasting, and with no exaggeration of the pole — no altitude of the pole established with such accuracy and consensus of observation is to be found, at least in the books I have read. For the altitude that Gassendi [Pierre Gassendi] obtained at Marseilles with a great gnomon, from solstitial altitudes, involves the controversy over the semidiameter, the maximum declination, and the parallax of the Sun. Perhaps, nonetheless, it can be compared with ours, which Ulugh Beg [Ulugh Beg] accepted at Samarkand with a gnomon 180 feet high; he found it to be 39°37'33", as I have set out more fully in *Reformed Geography*, Chapter 25. Deservedly, then, D. Io. Dominicus [Giovanni Domenico Cassini], devoted to the restoration of astronomy, laid the foundation of the rest of his observations upon this altitude. The Polar Altitudes of the places written below are therefore ratified.

ALTITUDE OF THE POLE AT BOLOGNA — Altitude of the Pole

	Gr.	'	"
In the Church of San Petronio	44	30	20
In the Courtyard of the Most Illustrious Marquis Cornelio Malvasia	44	30	22
In the College of San Lucia of the Fathers of the Society of Jesus	44	30	10

CHAPTER XV.

On the Other Instruments With Which We Observed the Fixed Stars, Compared With the Tyconic Ones.

1 In the Preface to the Reader of the *New Almagest*, Article 7, I professed in that Volume: *I have not in every case followed my own opinion concerning the numbers, or the Astronomical measurements.* For in that work I examined the Art itself and the opinions of the Authors, and although I there exhibited many of our own observations, and from time to time indicated the hypotheses, I nonetheless took care to forewarn by way of a *provisional* clause that I had used Tabular values *for the time being.* [Margin: *Instruments of doubt.*] In that work, it was not yet granted to me to have the means of observing the major stars for their Declinations, and especially for their mutual Distances, and of correcting and emending them; and besides, in the *New Almagest*, as commonly happens with typography, not a few errors crept in. Therefore, apart from the ancient Quadrants — some of 4 feet, some of 4, and Sextants of ten — distant by intervals; and others suited to

altitudes, some of which were of feet on the Radius 4; others of 6, 7, 11, 12 — and the largest of these on the Radius 10" — there stood available, in our Observatory, and besides the Sextants distant from the vertex of the Stars, a Sextant nearest the vertex, suited to the comparison; a Ruler of Parallaxes formerly of 6 feet, then of 8 feet; we had a Gnomon 15 feet; we used the two Quadrants frequently, the one Tychonic, the other Grimaldian, and stable, set up in the plane of the meridian most firmly.

2 [*Margin: Tychonic Quadrant.*] The Tychonic Iron Quadrant — so called by us — is that semidiameter, that is, a mural quadrant, which Tycho [Tycho Brahe] calls (page 10 of the *Mechanics of Astronomy*) the *Mural Quadrant*, and which we call *Tychonic*; namely, with a cubit of about 5 feet. Its arc, however — that is, the band — is broad, of 8 fingers, not 5, as the Tychonic one; but so that the discriminations of the minutes are designated by transverse lines. And although Tycho, at the end (and as a supplement to the said *Mechanics*, folio 67), showed that the division was made by transverse lines at equal intervals of minutes, if the breadth of the band on the instrument's Radius is as 1 to 48, and that it does not contain an error greater than three seconds in scruples, and he says this is imperceptible. Nonetheless, in our own instruments, we have been accustomed to designate the intervals of minutes by transverse lines at unequal intervals, as the Geometric ratio requires, according to what is said in the *Organic Book*.

This division can be made, moreover, in two principal ways. *First*: if the lowest and the highest breadth of the band that comprise the periphery are divided into 90 degrees of the quadrant, and the transverse lines serving the individual degrees are subdivided into 60 minutes — as in the figure attached, let the arc BC be 2 degrees, and by D the point terminating the first degree, and through the center of the quadrant a straight line drawn cut the upper periphery at A, the boundary there of the first degree. Then, drawing lines from A to B and to C, that is AB and AC — one toward the beginning of the lower periphery, the other toward the end of the second degree — let each be divided into 60 minutes. In this case 90 divisions of the degrees are to be made both above and below, that is 180, and the lines 90 are to be divided, and each into 60 intervals to be divided, so that altogether 5670 operations are required — not without trouble, and the risk of some little error.

Diagram. A narrow isosceles triangle illustrating the division of a quadrant's transverse lines. The apex A is at top; the base runs along the lower periphery from B (left) through D (middle) to C (right). Dotted lines descend from A to B and to C, with a short vertical at D marking the terminus of the first degree.

- A (apex): the boundary of the first degree on the upper periphery
- B (base, left): beginning of the lower periphery
- D (base, middle): point terminating the first degree
- C (base, right): end of the second degree

Second mode, and the one customary with Tycho, if the periphery is divided into 90 degrees: let any degree be subdivided into 6 minutes in the sub-divided minute, and let transverse lines be drawn in groups of six, subdivided in the second figure, in which the arc of one degree is thus divided and subdivided, as is represented in the schema. In this case, besides the 90 degrees — that is 180 — and the subdivisions of the individual degrees into six equal parts, which the above and below contain — 540 lines are to be drawn; and each requires division into ten parts, so that the sum of all the divisions with the lines requires 7100 operations, that is, more, and with the risk of erring.

Diagram. A schematic of a curved quadrant band, a sector of an annulus whose arc is divided into degree intervals, with internal transverse zig-zag lines (the "second mode" of subdivision into minutes). No point-letters are legibly labeled on the figure.

3 [*Margin: Grimaldian Quadrant.*] The Grimaldian Quadrant — so named by us from its Author, who divided it with most exact subtlety, namely Father Francesco Maria Grimaldi [Francesco Maria Grimaldi] — is of Iron, and larger than the Tyconic one, inasmuch as it is in semidiameter of 8 feet and more, that is, of 28,885 parts, of which one uncia is of the Roman foot 300. Its arc is of bronze, and polished like a mirror, broader by two fingers — a little more than fingers — divided into 90 degrees, and subdivided into half-degrees. The chord of any arc is so great that, if it were to be divided, it would take 504 of the said little parts. From this element and from the Radius of the Quadrant we constructed the Canon from unity onward, as far as the data of particles 504. The chord comprehended between the line of the Fiducial Dioptra and the nearest degree, or half-degree, we would at once know as a minute, and the second by the addition of the nearest Canon — a specimen and abridgement of which we give here. So that, if the Distance of any Star from the vertex is taken as $25\frac{1}{2}$ degrees, and besides that as much as the part of the chord between the Dioptric line and the following degree occupies 80 particles, then from the Canon it is at once known to be the minute $9'32''$, and so the Altitude of the Star is $25^{\circ}50'28''$. Moreover, the said chordwise quantity is not measured so much with a sharp pair of compasses as by the very congruence of the extremities of the section with that interval; and this, applied to the Orichalc Ruler — in which an uncia is

divided by a transverse line into 300 equal particles. For let the metallic plate be well thick and well polished, of which the breadth is AB and CD, of one uncia, and the length AC and BD, not less than two feet.

Chord — parts	Arc — Min.	Sec.
1	0	7
2	0	14
3	0	21
4	0	28
5	0	35½
6	0	43
7	0	50
8	0	58
9	1	7
10	1	12
20	2	23
30	3	34
40	4	46
50	5	57
60	7	8
70	8	19
80	9	32
90	10	42
100	11	54
200	23	47
300	35	43
400	47	37
500	59	30
504	60	0

For: with the Diagonal AD drawn, you will be able to divide it into 300 equal particles, with a large enough and discernible interval. Let us suppose the breadth FG of the small chart measuring the chord to indicate the breadth, and of the whole AD, a portion of 300 — a portion AG, much more evident than the

uncia AB — the effort would be to divide it into 300 parts, for never with the portion AH equal to FG itself would so evident a discrimination be distinguished. I confess that I have not at once, by this method, with the situation of the Dioptra inspected, obtained the Altitude of the Star; but I have to capture the measured chord between the nearest half-degree, and this is to be elicited from the Metallic Ruler, and inquired through the number of parts of the chord into the minute of the Canon; but this small delay is compensated by the simplicity and evidence of the larger figure. For in this whole procedure, besides the operations of 180 — to which the Quadrant divided into half-degrees and divided into half-degrees, the Uncia is divided by one transverse line of two-foot length into larger parts, into equal parts of 300 — it does not require any further division; whereas in the construction by that Canon, if the instrument is divided into half-degrees, it is not necessary to extend the division further than particles 251; and by logarithms it is resolved within a few hours. The Metallic Ruler, however, once well divided, serves for the division of all other instruments whose chords are intercepted by degrees, provided the semidiameter of the instruments is half-measured. We have, nonetheless — for these and other uses — three Rulers with a metallic plate: one of one Foot length, of bronze; another a Four-foot Quadrupedal of Orichalc, with its transverse lines. The third, of 15 feet, and of bronze. To be more secure in this fashion of dividing the minute and the second, than the Tychonic — as experience will show, and as confess no few most expert in matters of this kind, who have also chosen this — for example, the Most Illustrious Count Carlo Antonio Manzini [Cornelio Malvasia — *recte* the source reads "Carolus Antonius Manzinus", Carlo Antonio Manzini], D. Io. Dominicus Cassini [Giovanni Domenico Cassini], and others.

Diagram. A right-hand figure of the Orichalc measuring plate. A tall narrow rectangle with corners A H B across the top and C K D across the bottom; the diagonal AD runs from the top to the bottom corner, with the small chord-chart FG marked across the lower portion.

- A, H, B (top corners): top edge of the plate
- C, K, D (bottom corners): bottom edge of the plate
- F, G (lower middle): the small chord-measuring chart, breadth FG

4 [Margin: *The kinds of Dioptra.*] It remains for us to say something of the Dioptra. Hipparchus [Hipparchus] — and he advises this in the *Paralipomena* to the *Vitellio* [Witelo] of Kepler [Kepler], folio 216 — introduced Dioptras; and to the narrowest aperture, applied to the eye, it would be more certain than the aperture, he says — for a dioptra they use the finest slits. But if the apertures or

slits are too small, they do not exhibit the desired subtlety of scruples; if too wide, they do not. For this reason others place a little ball of the remoter dioptra in the middle of a perforated tablet, aiming and collimating; and others, in a small window of the tablet, draw broader threads in a decussate manner, so that the section of the threads in turn impedes the dioptra, like a little ball or little crosses in the dark, and a candle being applied impedes the sight. For this reason no Tychonic vision seems more expeditious for collimating the ratio, than to direct two parallel lines in any single Star. Of this kind of dioptra Tycho describes a schema attached here and there in the *Mechanics of Astronomy*, but separately with other instruments, on the second-to-last folio. We shall perhaps set them forth more clearly in the following figure.

Diagram. A wide schematic of a sighting dioptra spanning the foot of the page. At the left is an upright frame with points E, C, G, F, A, H marking the ocular tablet AC (the twin laminae and its ruler AB); dotted sight-lines run rightward across the page to a distant target tablet BD on the right at D, with the line continuing to L and M (and a small sun-burst icon beside L–M marking the object sighted).

- E, C (left, upper frame): top of the ocular assembly
- G (left): a fixture on the ocular ruler
- F, A, H (left, lower frame): base of the ocular tablet, with axis AB
- D (right): the distant tablet BD
- L, M (far right): the sighted object (Star), with sun-burst marker

In the figure above, let the Ruler AB and the upright twin laminae, or a tablet of altogether equal breadth, be one, AC, near the eye; the other BD, whose axis falls on the center of the instrument, and through that Ruler let it be circumvolvable, and let the said tablets be between themselves, according to the four sides, equidistant. The Ocular tablets AC: let the little fibulae be attached —

— so that there be two laminae from here and there, EF and GH, so that between them be the little Tablet AC, and let the two little fibulae be left for the slender Slits I and K, which through the said little fibulae could be made narrower, or wider, according to the magnitude of the star posited. With these prepared, the observer collimates the center of the instrument through the Star, until he moves it about the center of the instrument; the Ruler AB, until through the Slits I and K, he sees the rays, the parallels GL and OM, so much of the same Star as he sees through the one, the other slit; how much certain it be that the Radius through the middle of the Tablets AC and BD, by the production of the imagination, may render the center in the Star. [*Margin: 5.*] Nonetheless, in place of the Tablet BD,

Tycho often uses a Cylinder in the center of the instrument, set up, and divided crosswise with the breadth of the Tablet AC. But we have followed this form of dioptra. We have used them in places very full of obstacles, occasionally, especially when the Star was very near; occasions gave to accept the one from the other, unless from time to time, by moving the dioptra, we should discern it. But it turned out much more inconvenient, and more troublesome, in capturing the distances of two stars by observation. For two observers must first fit the plane of the instrument, and however much the Star may stand above that line, and afterwards collimate at the same time toward that very Star, while in the meantime, by the motion of the prime Movable, the Star moves; much time intervenes, while the other, by the motion of the prime Movable, is born; and these collimations differ greatly, when attended to, nor without the evidence of observation, and as much with tranquillity as the observer desires. This — with the peace of the Tychonites be it said.

5 [*Margin: 5.*] Therefore, having tried diverse kinds of Dioptras, we have found by experience the most expeditious and most certain to be that one in which the eye, through a small aperture and a coriander seed less, collimates at the Acus [needle/index] erected orthogonally from the center of the instrument — and so slender that, the Distance of the Star having been computed between the eye, and the eye not so great in magnitude — unless perhaps the fourth, or some little magnitudes, the remainder be obtuse. It is necessary that the eye, with both eyes open, be moved immediately near the aperture, but from some other digit in the line of transition; and that it see remotely, evidently, by that very aperture set in the Acum, that which it cuts the Star — which it does when the eye sees the said Acum as a kind of diameter cutting the aperture in two, and at the same time cutting the disk of the Star. Besides, on nights when it is illuminated, or beyond twilight, or with the Moon far off, the said Acus, illuminated, is not to be left bare in the open; nor must the eye of the observer radiate, or with the tremulous agitation of the air, the splendor of vision be interrupted; but, the flame of the light being enclosed in an opaque lantern toward the eye, and a thin crystalline plate, or talc, set toward the Acum, it is to be fortified; and near the Acum, below, at a distance of about one palm, or a span, it is to be set up. If this be done, it will at once be evident with what evidence the center of the Star is collimated. This we have done by very many experiments, and by comparison made with the Tychonic Dioptras. And although it is not necessary, nonetheless we also employ that aid, by setting up before the eye a hemispherical aperture, or a little skiff perforated at the bottom, which little skiff must be filled in at the bottom with the lamina of the aperture, so that its aperture be congruent equally on every side with the lamina of the aperture, or the tablet. At length the fiducial line, in that

part where it must designate the optimal point of the instrument for the minutes, and the seconds, must be most straight, and run into the center of the instrument, and the middle, or the Axis of the Acus erected from the center of the instrument, whose straightness is explored by the tension of a most fine silken thread.

6 [Margin: 6.] We add nothing here concerning the oscillations of the Perpendicular, for numbering the intervals of time between the transit across the Meridian of two neighboring Fixed Stars, and so deriving the Difference of Right Ascension, or for numbering the time, which sometimes necessarily intervenes between the observations of two Stars in Azimuth — since enough was said of that in Book 2 of the *New Almagest*, Chapter 29. Nothing further concerning the Filar Triangle, for observing most certainly the transit of Stars across the plane of the Meridian, or their gliding to a fixed and determined Azimuth, or the plane of the vertical circle distinct from the Meridian — for of that, and of its use, enough was described in Book 5 of the *New Almagest*, Chapter 15, number 16. Nothing, finally, of the hydrostatic Libellae, for altitudes above the Horizon, or for depressions from a higher or subtler place to be observed; of these in many places, in other things, by Father Grimaldi [Grimaldi], our inventions, this was treated by us in the *Organic Book*.

7 [Margin: 7.] Lastly, however, we recall to the Reader's memory what we taught in Chapter VII concerning Tychonic observations: that they are liable to no small uncertainty, whether because the form of the Dioptra has often varied somewhat, whether by a defect of subdivision, whether by a single scruple, whether by the variety of observers and of the eye, whether by diverse disposition and attention. For this reason, whether you take a Tychonic observation, or ours, where the difference of one Minute or another intervenes, nor is it a wonder if our position is to be preferred rather than the Tychonic one; nor on that account will faith be derogated from the Tychonic observations; but the prudent and impartial — and, with prejudice and the authority of opinion set aside — choosing what, all things being well considered, seems to all the truer. For so much does Truth prevail with us above all that, just as we have ingenuously placed many things in the *New Almagest for the time being*, we shall be busy with correcting and emending — by an incredible toleration of expending wakefulness — and restoring observations.

CHAPTER XVI.

On the Declinations of the Fixed Stars Observed by Us.

1 The Altitude of the Pole having been emended, and these or greater ones having been substituted in place of the earlier ones — not, indeed, that we should adhere to the Declinations of the Fixed Stars signified in the *New Almagest*, and corrupted by Typographic errors. Therefore, these I select which we observe from the year 1650, indeed especially from the year 1655 down to 1659, repeated again and again from the most subtle observations of Father Grimaldi [Grimaldi], and which I myself reckoned of greater value — both on account of the prerogative of the conspiring observations of the observers, both on account of conscience, and the tranquil attention of the observers, and the purer sky, and finally on account of the evident exclusion of those Declinations which the time then demanded — the Tyconic Tables in proportion exhibited at the end of Chapter 12.

2 Let there be an example in the Lucida of Aries [α Arietis, Hamal], which, because it is the foundation of the rest in that constitution by Tycho [Tycho Brahe], we observed most diligently; and its Declination, by the aforesaid Table of Chapter XII, we reduced to the last, just as we did the rest, supposed to the end of the year 1660, as above by the Altitude of the Pole at Bologna in our Observatory, $44^{\circ}30'10''$.

Lucida of Aries — Selected Observation	Distance from the Vertex — G.	Declination Then — G. ' " "	Declination for the Year 1660 — G. ' " "
Year — often			
1656 January, freq.	22	4 7 21 2	4 3 21 8 4 3 9 2
November, freq.	22	4 5 21 1 3	4 1 21 8 7 4 3 9 1
1657 December, freq.	22	4 3 21 1 6	4 3 21 8 4 4 2 9 8
1658 November, toward the end, freq.	22	4 1 21 1 2	4 5 41 8 8 4 3 9 4

Lucida of Aries — Selected Observation	Distance from the Vertex — G.	Declination Then — G.	Declination for the Year 1660 — G.	
1659 January, freq.	22	4 1 21 1 2	4 5 21 8 8	4 3 9 2

On account of these and similar ones, we chose for the end of the year 1660 the Declination $21^{\circ}49'30''$; but that which the Tychonic Table of Chapter XII places at the end requires $21^{\circ}51'$ — that this is false is evident from the Grimaldian Quadrant. For in the year 1659, January having begun, from the same Table — indeed from the Tychonic Latitude and Longitude, and the true obliquity of the Ecliptic — the Declination ought to have been $21^{\circ}50'26''$, that is, a distance from the Vertex of $22^{\circ}39'44''$; and, according to what is said in Chapter XV, number 3, our Fiducial Line of the Dioptra, below 23 degrees. The distances from the vertex in the Quadrant noted —

it would have had to cut off a chord of 170 such parts, of the kind 300 of which make up one inch of one foot. With the dioptra set up there, then, the Lucida of Aries plainly appeared below the cross-wires [Acumen] at the center of the quadrant, and the sight-line ran into the center of the quadrant; and the cross-wires, when aimed directly, fell notably higher than the Lucida of Aries [γ], nor could it be sighted at the center of the instrument — that is, at the center of the star — unless the sight-line had been set in the very position in which, at 23° , it cut off a chord of 158 particles. These give, on the said quadrant, $18'48''$, to be subtracted at the 23rd degree; and so, once more and as often as the observation was repeated, on those nights the distance of the star from the vertex was $22^{\circ}41'12''$. Hence, therefore, we conclude that [Tycho Brahe] exceeded by this one-and-a-half-minute amount, and accordingly that in the year 1585 it must have been $21^{\circ}[\text{?}]$ and 27' minutes; this much only, and it does not conflict with the mean drawn from the extremes of the Tychonic observations, as we said in Chapter 9, Conclusion 4. The same diligence has been applied in exploring the remaining Tychonic declinations.

3. A second example, in the Lucida of Aquila [α Aquilae, Altair]. From the year 1655 we have about 30 observations of it, of which these have been selected:

Lucida Aquilae — Year	Distance from Vertex (G. ' ")	Declination then (G. ' ")	Declination An. 1600 (G. ' ")
1655 July, &	36 29 30	8 0 40	8 1 20

Lucida Aquilae — Year	Distance from Vertex (G. ' ")	Declination then (G. ' ")	Declination An. 1600 (G. ' ")
Aug., often	36 29 29	8 0 41	8 1 20
Octob., very often	36 29 28	8 0 42	8 1 21
1656 July, &	36 29 23	8 0 47	8 1 22
Aug., often	36 29 25	8 0 45	8 1 20
Septemb. &	36 29 25	8 0 45	8 1 20
Octob. often	36 29 26	8 0 44	8 1 19
1657 Septemb. &	36 29 18	8 0 52	8 1 17
October	36 29 20	8 0 50	8 1 15
often	36 29 16	8 0 54	8 1 19

We have therefore chosen, for the end of the year 1660, the declination of $8^{\circ}1'20''$, which for [Tycho Brahe] is $8^{\circ}1'$; and by the same method we have selected the remaining declinations in the following Table. For why should I heap up here the medley of very many observations, so that in the end the Reader might wish for us ourselves to decide which ones we think should be selected? — relying on our conscience and on the fresh memory of the diligence applied in observing.

Table of the Declinations of the Fixed Stars, selected from Our More Recent observations, and collated with the Tychonic [declinations] from the table at the end of Chapter XII, or otherwise supplied by him.

Star	Source	G . ' "	B/ A
ANDROMEDAE Caput (Head of Andromeda)	Nobis	2 1 5	B
		7 3 0	
	Tych.	2 1 2	
		7 4 4	
Lucida Cinguli (Lucida of the Girdle)	Nobis	3 4 2	B
		3 9 8	
	Tych.	3 5 4	
		3 1 8	
Pes Australis (Southern Foot)	Nobis	4 4 3	B
		0 0 0	
	Tych.	4 4 0	
		0 1	

Star	Source	G . '	"	B/ A
AQUARIUS, Humer. sinist. seu praecedens (Aquarius, left/leading shoulder)	Nobis	6 5 9 0	1 0	A
	Tych.	6 5 9 4	2 4	
Humer. dexter sequens (right/following shoulder)	Nobis	1 5 5 0	2 0	A
	Tych.	1 5 5 7	3 7	
Manus sinistra (left hand)	Nobis	1 4 0 1	2 0	A
	Tych.	1 4 0 1	3 6	
Lucida cruris sequens (lucida of the following leg)	Nobis	1 3 7 4	2 5	A
Fomalhaut in effusione Vrnae (Fomalhaut, in the outpouring of the Urn)	Nobis	3 2 1 0	1 0	A
	Tych.	3 2 1 0	2 5	
AQUILAE Lucida (Lucida of Aquila, Altair)	Nobis	8 1	2 0	B
	Tych.	8 1	0	
Scapula (the shoulder-blade)	Nobis	9 5 1 0	4 0	B
Cauda (the tail)	Nobis	1 2 3 4	3 0	B
	Tych.	1 2 3 4	4 8	
ARIETIS Praecedens in Cornu (Aries, the leading one in the Horn)	Nobis	1 3 7 6	0	B
	Tych.	1 3	3	

Star	Source	G . 7	' 7	" 5	B/ A
Sequens in Cornu (the following one in the Horn)	Nobis	1	7	0	B
	Tych.	1	8	3	
		9		5	
Lucida supra Caput (Lucida above the Head, Hamal)	Nobis	2	4	3	B
	Tych.	1	9	0	
		2	5	0	
		1	1		
AVRIGAE Capella (Auriga, Capella)	Nob. & Tych.	4	3	0	B
	Tych.	5	6		
		4	3	0	
		5	6		
Humer. sequens dexter (right following shoulder)	Nobis	4	4	5	B
	Tych.	4	9	0	
		4	5	2	
		4	2	4	
Haedorum sequens (the following of the Kids)	Nob.	4	3	4	B
	Tych.	0	3	5	
		4	3	5	
		0	3	0	
BOOTAE Arcturus (Boötes, Arcturus)	Nobis	2	5	5	B
	Tych.	0	9	0	
		2	0	5	
		1		0	
Humerus sinister (left shoulder)	Nobis	3	4	0	B
	Tych.	9	6		
		3	4	4	
		9	6	8	
CANCRI Praesepe (Cancer, the Manger/Praesepe)	Nobis	2	5	4	B
	Tych.	0	0	0	
		2	5	3	
		0	0	6	

Star	Source	G .	'	"	B/ A
Asellus Boreus (the Northern Ass)	Nobis	2	3	0	B
		2	9		
	Tych.	2	3	0	
		2	9		
Asellus Australis (the Southern Ass)	Nobis	1	2	0	B
		9	3		
	Tych.	1	2	0	
		9	3		
CANIS Maioris. Sirius (Canis Major, Sirius)	Nobis	1	1	3	A
		6	6	0	
	Tych. (Refractio obfuit — refraction interfered)	1	1	2	A
		6	3	4	
Pes Anterior (the front foot)	Nobis	1	4	5	A
		7	8	0	
Lucida ventris (lucida of the belly)	Nobis	2	4	5	A
		5	6		
Pedis post. extrema (outermost of the hind foot)	Nobis	2	3	3	A
		8	1	0	
Lucida coxae (lucida of the haunch)	Nobis	2	2	5	A
		8	8	5	
Caudae radix (root of the tail)	Nobis	2	4	3	A
		5	8	0	
Caudae extrema (end of the tail)	Nobis	2	3	5	A
		8	6	5	
CANIS Min. Procyon (Canis Minor, Procyon)	Nobis	6	4	0	B
	Tych.	6	4	4	
				8	
Praecedens in Collari (the one leading on the Collar)	Nobis	8	5	1	B
			5	0	
	Tych.	8	5	0	
			6		
CAPRICORNI cornu Bor.	Nobis	1	2	3	A

Star	Source	G . '	"	B/ A
(Capricorn, northern horn)		3 8	0	
	Tych.	1 3	2	
		3 0	4	
Cornu Austr. seu infer. (southern or lower horn)	Nob.	1 4	5	A
		5 4	0	
	Tych.	1 4	4	
		5 6	8	
Caudae praecedens (the leading one of the tail)	Nobis	1 4	4	A
		8	5	
	Tych.	1 5	2	
		8	6	
Caudae sequens (the following one of the tail)	Nobis	1 3	1	A
		7 3	0	
	Tych.	1 3	5	
		7 4	0	
CASSIOPEAE Pectus seu Schedir (Cassiopeia, the Breast, Schedar)	Nobis	5 4	4	B
		4 1	0	
	Tych.	5 4	2	
		4 1	4	
Flexura (the bend)	Nobis	5 5	0	B
		8 4		
	Tych.	5 5	2	
		8 3	4	
Genu (the knee)	Nobis	5 2	1	B
		8 7	0	
	Tych.	5 2	5	
		8 6	0	
Lucida Cathedrae (Lucida of the Throne)	Nobis	5 1	4	B
		7 8	0	
	Tych.	5 1	2	
		7 8	5	
CEPHEI Cinguli Lucida	Nobis	6 6	4	B

Star	Source	G .	'	"	B/ A
(Cepheus, Lucida of the Girdle)		9		0	
	Tych.	6	5	3	
		9		6	
Subcingulo in latere (below the girdle, at the side)	Nobis	6	3	1	B
		9		0	
	Tych.	6	3	5	
		9			
CETE Mandibulae Lucida (Cetus, Lucida of the Jaw)	Nobis	2	4	5	B
			3	0	
	Tych.	2	4	0	
			4		
Ventris Lucida (Lucida of the belly)	Nobis	1	5	1	A
		1	7	5	
	Tych.	1	5	2	
		1	7	5	

[Table continues — declinations of the fixed stars for the completed year 1660;
"Nobis" = by us, "Tych." = Tycho; B = boreal, A = austral.]

Star	Source	G.	'	"	B/A
Cauda Borealis (the northern tail — of Cetus)	Nobis	1 0	38	50	A
	Tych.	1 0	39	31	
Cauda Australis (the southern tail)	Nobis	1 9	49	20	A
	Tich.	1 9	51	36	
CORONAE Bor. Lucida (Northern Crown, the Lucida)	Nobis	2 7	53	44	B
	Tych.	2 7	53	24	
CORVI Ala praecedens (Corvus, the leading wing)	Nobis	1 4	36	10	A

Star	Source	G.	'	"	B/A
Ala sequens (the following wing)	Nobis	1 5	36	50	A
CYGNI Rostrum, seu Caput (Cygnus, the beak, or head)	Nob.	2 7	18	16	B
	Tych.	2 7	16	36	
Pectus (the breast)	Nob.	3 9	12	53	B
	Tych.	3 9	11	50	
Cauda (the tail)	Nob.	4 4	6	40	B
	Tych.	4 4	5	48	
Ancon. alae super. (the elbow of the upper wing)	Nob.	4 4	20	45	B
	Tych.	4 4	20	24	
Ala inferior (the lower wing)	Nob.	3 2	43	0	B
	Tych.	3 2	42	35	
DELPHINI Caput (Delphinus, the head)	Nob.	1 4	51	30	B
Rhombi praecedens (the leading one of the rhombus)	Nob.	1 3	28	0	B
DRACONIS Lucida Capitis (Draco, Lucida of the Head)	Nobis	5 1	35	50	B
	Tich.	5 1	35	48	
GEMIN. Caput superius, seu Castoris (Gemini, upper head, or of Castor)	Nob.	3 2	34	50	B
	Tych.	3 2	34	24	

Star	Source	G.	'	"	B/A
Caput inferius, seu Pollucis (lower head, or of Pollux)	Nob.	2	47	50	B
		8			
	Tych.	2	47	48	
		8			
Pes Lucidus (the bright foot)	Nob.	1	38	20	B
		6			
	Tych.	1	38	48	
		6			
Calx Castoris (the heel of Castor)	Nob.	2	38	30	B
		2			

Quantum enim decreuit ab Ann. 1585. ad 1623. quo ingressa est, tantum decreuit usq; ad Annum 1660. — *[For just as it [the heel of Castor] decreased from the year 1585 to 1623, at which point it entered [the sign], it decreased by the same amount up to the year 1660.]*

Star	Source	G.	'	"	B/A
HERCVLIS Caput (Hercules, the head)	Nobis	1	50	0	B
		4			
	Tych.	1	50	40	
		4			
Humerus sinist. seu praecedens (left, or leading, shoulder)	Nobis	2	19	0	B
		5			
	Tych.	2	18	40	
		5			
Humer. dexter seu sequens (right, or following, shoulder)	Nobis	2	17	40	B
		2			
	Tych.	2	18	0	
		2			
HYDRAE Cor seu Lucida Hydrae (Hydra, the Heart, or Lucida of Hydra)	Nobis	7	11	30	A
	Tych.	7	12	0	
LEONIS Cor, seu Regulus (Leo, the Heart, or Regulus)	Nobis	1	36	40	B
		3			
	Tych.	1	37	0	

Star	Source	G.	'	"	B/A
		3			
Caudae lucida (lucida of the tail, Denebola)	Nobis	1	27	40	B
		6			
	Tych.	1	28	36	
		6			
Suprema Ceruicis (the topmost of the neck)	Nob.	2	5	30	B
		5			
	Tych.	2	5	36	
		5			
Media Ceruicis seu Iubae lucida (the middle of the neck, or lucida of the Mane)	Nob.	2	32	20	B
		1			
	Tych.	2	32	36	
		1			
Infima Ceruicis (the lowest of the neck)	Nob.	1	24	45	B
		8			
	Tych.	1	25	12	
		8			
Lumborum lucida (lucida of the loins)	Nob.	2	21	20	B
		2			
	Tych.	2	21	10	
		2			
Lucida Mandibulae (lucida of the jaw)	Nob.	2	19	0	
		5			
LEPORIS Femur (Lepus, the thigh)	Tych.	2	1	48	A
		1			
LIBRAE Lanx Borealis (Libra, the northern Scale)	Nob.	8	5	10	A
	Tych.	8	4	24	
Lanx Australis (the southern Scale)	Nob.	1	34	30	A
		4			
	Tych.	1	34	12	
		4			
LYRAE Lucida (Lyra, the Lucida, Vega)	Nob.	3	30	40	B
		8			

Star	Source	G.	'	"	B/A
	Tych.	3 8	30	24	

[Table continues in the right-hand column of the same page.]

Star	Source	G.	'	"	B/A
OPHIVCHI Caput (Ophiuchus, the head)	Nobis	1 2	52	10	B
	Tych.	1 2	51	48	
Manus praeced. Lucid. (lucida of the leading hand)	Nob.	2	45	40	A
	Tych.	2	47	48	
Humer. dexter seu sequens (right, or following, shoulder)	Nob.	4	46	40	B
	Tych.	4	46	0	
Genu sinistrum seu praeced. (left, or leading, knee)	Nobis	9	47	30	A
	Tych.	9	48	0	
Genu dextrum seu sequens (right, or following, knee)	Nobis	1 5	12	30	A
	Tych.	1 5	13	0	
ORIONIS Caput (Orion, the head)	Nobis	9	31	50	B
	Tych.	9	31	48	
Humerus sinister seu praecedens (left, or leading, shoulder, Bellatrix)	Nobis	5	59	50	B
	Tych.	5	59	48	
Humerus dext. Lucid. seu sequens (right shoulder, the lucida, or following, Betelgeuse)	Nob.	7	18	44	B
	Tych.	7	18	24	
Balthei 1. seu suprema (1st of the Belt, or topmost)	Nob.	0	35	40	A
	Tych.	0	34	48	

Star	Source	G.	'	"	B/A
Balthei 2. seu media (2nd of the Belt, or middle)	Nobis	1	28	18	A
	Tych.	1	26	25	
Balthei 3. seu infima (3rd of the Belt, or lowest)	Nobis	2	10	20	A
	Tych.	2	9	0	
Ensis infima (the lowest of the Sword)	Nob.	6	9	40	A
Pes sinist. Lucid. Rigel, seu praeced. (left foot, the lucida — Rigel — or leading)	Nob.	8	37	30	A
	Tych.	8	37	20	
Pes sequens (the following foot)	Nobis	9	48	36	
PEGASI Os (Pegasus, the mouth)	Nobis	8	21	50	B
	Tych.	8	21	37	
Cruris Lucida seu Scheat (lucida of the leg, or Scheat)	Nob.	2 6	15	50	B
	Tych.	2 6	15	12	
Prima Alae seu Markab (the first of the Wing, or Markab)	Nobis	1 3	23	10	B
	Tych.	1 3	24	12	
Extrema Alae seu Algenib (the last of the Wing, or Algenib)	Nobis	1 3	19	20	B
	Tych.	1 3	18	24	
In suffragine cruris (in the hock of the leg)	Nobis	2 8	28	30	B
PERSEI Latus lucidum (Perseus, the bright side, Mirfak)	Nob.	4 8	34	30	B
	Tych.	4 8	34	36	
Medusae Caput Algol (the head of Medusa, Algol)	Nob.	3 9	36	30	B

Star	Source	G.	'	"	B/A
	Tych.	3 9	37	0	
PISCIVM Lucida in nexu (Pisces, the lucida at the knot)	Nobis	1	7	0	B
	Tych.	1	7	0	
Lucida mandib. seu occiput Piscis austr. (lucida of the jaw, or back of the head of the southern Fish)	Nob.	1	26	50	B
	Tych.	1	26	48	
SAGITARII Orientalior Capitis (Sagittarius, the more easterly of the head)	Nobis	2 1	26	0	A
	Tych.	2 1	30	12	
<i>Forte alia ipsi vicina</i> (perhaps another one near it)					
SCORPII Cor seu Antares (Scorpius, the Heart, or Antares)	Nob.	2 5	33	30	A
	Tych.	2 5	32	20	
Borealior frontis (the more northern of the brow)	Nobis	1 8	46	0	A
	Tych.	1 8	49	24	
Media frontis (the middle of the brow)	Nobis	2 1	33	35	A
Australior frontis (the more southern of the brow)	Nob.	2 5	1	30	A
Caudae media (the middle of the tail)	Nob.	3 3	33	30	A
SERPENTIS Lucida Colli (Serpens, the Lucida of the Neck)	Nobis	7	33	0	B
	Tych.	7	33	24	
Media femoris (the middle of the thigh)	Nob.				
TAVRI Oculus Austral. Aldebara, Palilicium	Nobis	1	46	10	B

Star	Source	G.	'	"	B/A
(Taurus, the southern Eye — Aldebaran, Palilicium)		5			
	Tych.	1 5	47	45	
Oculus Borealis (the northern Eye)	Nob.	1 8	23	40	B
	Tych.	1 8	24	12	
Hyadum infima (the lowest of the Hyades)	Nob.	1 4	48	50	B
	Tych.	1 4	48	55	
Cornu Boreale (the northern Horn)	Nobis	2 8	15	50	B
	Tych.	2 8	16	48	

[Table concludes — left-hand column of p. 251.]

Star	Source	G.	'	"	B/A
Cornu Australe (the southern Horn)	Nobis	2 0	53	10	B
	Tych.	2 0	54	48	
Pleiadum lucida seu media (the lucida, or middle, of the Pleiades, Alcyone)	Nobis	2 3	1	0	B
	Tych.	2 3	1	35	
VIRGO Spica (Virgo, the Ear of grain, Spica)	Nob.	9	20	30	A
	Tych.	9	21	20	
Vindemiatrix (the Grape-gatherer, ϵ Virginis)	Nob.	1 2	48	10	B
	Tych.	1 2	48	12	
Cingulum (the Girdle)	Nob.	5	16	30	B

Star	Source	G.	'	"	B/A
	Tych.	5	16	36	
Alae australis penult. Lucidior (the brighter of the next-to-last of the southern wing)	Nob.	0	28	30	B
VRSAE Minoris Polaris seu vltima Caudae (Ursa Minor, the Pole star, or last of the tail, Polaris)	Nob.	8 7	29	15	B
	Tych.	8 7	30	14	
Humerus lucidus olim Cynosura (the bright shoulder, formerly the Cynosure)	Nobis	7 5	38	30	B
	Tych.	7 5	38	27	
VRSAE Maioris Dubhe seu Lucida Humeri (Ursa Major, Dubhe, or the bright shoulder)	Nob.	6 3	34	50	B
	Tych.	6 3	34	48	
Lucida in Ilibus (the lucida in the flanks)	Nob.	5 8	11	50	B
	Tych.	5 8	11	48	
Lucida Coxae posterioris (the bright one of the hinder haunch)	Nob.	5 5	36	30	B
	Tych.	5 5	36	36	
Caudae Radix seu prima (the root, or first, of the tail)	Nob.	5 7	50	10	B
	Tych.	5 7	50	12	
Caudae Media seu 2. (the middle, or 2nd, of the tail, Mizar)	Nob.	5 6	43	40	B
	Tych.	5 6	43	48	
Caudae Vltima seu 3. (the last, or 3rd, of the tail, Alkaid)	Nob.	5 1	3	20	B

Star	Source	G.	'	"	B/A
	Tych.	5	3	24	
		1			
Lucida tergoris prope caudam (the bright one of the back, near the tail)	Nob.	5	54	30	B
		8			
	Tych.	5	54	36	
		8			

I admit, however, that I have left the declinations of Capella and of the right shoulder of Auriga — and of a few similar stars — somewhat more uncertain than the others, because, owing to their nearness to our zenith, they were hard to observe by reason of distance; and that the differences of their right ascensions were limited only loosely by me. This I wished to note, so that elsewhere, when observations are conveniently available, posterity may demand the correction of them; and let them know that I shall not take it amiss that this be done.

CAPVT XVII.

De Ascensione Recta Fixarum LXII. ex Nostris Recentioribus observationibus deducta, & reducta ad finem Anni CHRISTI MDCLX.

On the Right Ascension of 62 Fixed Stars, derived from Our More Recent observations, and reduced to the end of the Year of Christ 1660.

1. Since the Right Ascension of the Fixed Stars cannot be observed except dependently upon the Sun, and yet no Fixed star shines together with the Sun above the horizon brightly enough to be conspicuous to us — except Sirius, which all the same is not visible unless the Sun is near the horizon, and is then bound up with refractions... [Margin: *Qua Stella cum Sole sint conspicua.* — Which stars are visible together with the Sun.] Among the planets, those that can be observed both by day, together with the Sun, and by night, together with the Fixed stars, are Jupiter and — most rarely — Saturn; and the Moon too, when the Sun is near the horizon, but the Moon is then very high — yet it is itself entangled in the uncertainties of parallax. There remains, therefore, Venus, which can sometimes be seen positioned very high, together with the Sun, and beyond sensible refractions; and at night, likewise, can be seen among the Fixed stars in a position so high that each body stands out above the physical refractions. Very rarely, however, does one have both these conditions together...

2. But there is another way of investigating the Right Ascensions of the Fixed stars from the Sun without the intervention of another planet, which we have often used for the sake of practice — not that other way mentioned before, but one arrived at differently. This method consists in observing the altitude of the Sun, together with its azimuth, and counting the time up to the arrival of the Fixed star at the same azimuth, supposing the Fixed star's Declination and Altitude in that azimuth to be known. But if the Sun is observed near the horizon, a sensible error in the time is to be feared — that is, about half an hour before sunrise, or after sunset, when the more notable Fixed stars can be seen; for then the Sun is liable to inconstant refractions. If, however, an altitude of the Sun is chosen which is free from refractions, and many hours intervene between the observation of the Sun and that of the Fixed star, the time necessarily elapses, in which the swings of the perpendicular [pendulum] are counted, exposed to an error of several seconds; and each single second of Time inserts fifteen seconds into the Right Ascension — so that every four seconds insert one whole minute. We have found by experience that our pendulum, within one hour, is variable by one second, and by nearly another. When the difference of Right Ascension is observed between two Fixed stars within half an hour, or [stars] passing across the Mid-heaven [Medium Coeli] within a quadrant — it is very fitting to use the perpendicular [Margin: *Perpendiculari utilitas in observ. Ascen. Recta.* — The usefulness of the pendulum in observing right ascension.]; indeed, if two Fixed stars differ by one, or at most another, single degree of Right Ascension, and in Declination they differ by several degrees, that difference of the Ascension is investigated more safely through the time of the perpendicular numbered, than through Trigonometry from the complements of the Declinations and the Distance of such Fixed stars, on account of the excessive sharpness of the Angle at the Pole of the Equator.
3. Returning, then, to the Lucida of Aries — already at Chapter X, to the end of the year 1585, we showed its Right Ascension to have been $25^{\circ}59'47''$; and at Chapter XII its own Longitude $1^{\circ}51'39''$ of the same [sign], and likewise its northern Latitude $9^{\circ}56'30''$. Since, then, for a star certainly unvarying in this center, with this Latitude and with the true and unvarying distance of the Poles of $23^{\circ}36'20''$ — as demonstrated in Book III, On the Sun — and with the Declination of the same Lucida of Aries [γ] to the end of the year 1660, already in the preceding chapter most evidently found to be $21^{\circ}49'30''$, we shall easily, by the Analemma of triangles, obtain its Right Ascension and Longitude. With the support of the following diagram, in

which let ABC be the Colure of the Solstices, and in it B the northern Pole of the World; from which let the Equator AHC be described, and from the Pole of the Zodiac, or Ecliptic, Z, let the Ecliptic DHE be described; and through the Fixed Lucida of Aries [Υ] at F let the circles of the Quadrants be drawn — one of Declination BFG, the other of Latitude ZFI. For there will be, in the triangle BZF, with all sides given — namely BZ, the Distance of the Poles, $23^{\circ}36'20''$, and the Declination FG, $21^{\circ}49'30''$... the Complement of BF, deg....

Diagram. A circle representing the celestial sphere, used for the analemma reduction of the Lucida of Aries from declination to right ascension and longitude. The bounding circle is the solstitial colure ABC, with B the north celestial pole at the top. Two great-circle arcs cross the interior — the equator AHC and the ecliptic DHE — together with the declination quadrant BFG and the latitude quadrant ZFI through the star at F. Labels read clockwise from the top:

- B (top): the north Pole of the World.
- Z (upper right, just inside the rim): the pole of the Zodiac/Ecliptic.
- C (right): equatorial terminus of the colure.
- E (lower right): the ecliptic terminus.
- H (lower center): intersection of equator and ecliptic.
- G (bottom center): foot of the declination quadrant.
- A (left): the other equatorial terminus of the colure.
- D (upper left): the ecliptic terminus on the left.
- F (center): the Fixed Lucida of Aries.
- I (center-left, near F): foot of the latitude quadrant ZFI.

$68^{\circ}10'30''$, and a latitude of $9^{\circ}56'30''$. The complement FZ is therefore $80^{\circ}3'30''$. So, by the laws of triangles and the logarithmic canons, the angle FBZ comes out — for the same epoch — as $117^{\circ}1'58''$, measuring the equatorial arc GHC. If you subtract a quadrant HC from this, there remains the right ascension HG of the Lucida of Aries [α Arietis, Hamal], $27^{\circ}1'58''$, counted from the beginning of Aries. There also comes out the angle BZF, $57^{\circ}5'18''$, measuring the ecliptic arc DI; and this arc, subtracted from the quadrant DIH, leaves the longitude IH, $32^{\circ}54'42''$ — that is, $2^{\circ}54'42''$ in Taurus [Υ]. These results, as if into a foundation, it is worth gathering into a single view:

Anno 1660. Completo.	Lucida Υ		
	Gr.	'	"
Declinatio	21	49	30

Anno 1660. Completo.	Lucida Υ		
Latitudo	9	56	30
Ascensio Recta	27	1	58
Longitudo	$\propto$ 2	54	42

[For the year 1660 completed. — The Lucida of Aries: Declination $21^{\circ} 49' 30''$; Latitude $9^{\circ} 56' 30''$; Right Ascension $27^{\circ} 1' 58''$; Longitude $2^{\circ} 54' 42''$ of Taurus.]

4. As for the remaining fixed stars of the first and second magnitude that we have been able to observe, and certain of those of the third and fourth magnitude that are conspicuous, we have hunted out their right ascensions by means of trigonometry. We did this by first investigating the differences of right ascension from the distance between two stars observed by us — the distance handed down in Caput VIII — together with the complements of the declinations established for the stars we observed, as set out in Caput XVI. But this same operation we have distributed among classes, of which the first is as follows.

Anno 1660. Completo. I. Classis	Ordo Stellaru m	Declina tio (G. ')	Distantia à praeced. (G. ' ")		Differentia Asc. Rectae (G. ' " ")	Ascensio Recta (G. ' " ")
	Lucida Υ	21	4			27
			9			
			$\frac{1}{2}$			
			B			
	Aldebar a [Aldeba ran]	15	4	35	37	64
			6			
			$\frac{5}{6}$			
			B			
	Pollucis Caput	28	4	45	46	111
			7			
			$\frac{5}{6}$			
			B			
	Regulus	13	3	36	36	147
			6			
			$\frac{2}{3}$			
			B			
	Cauda ϱ	16	2	24	25	172

Anno 1660. Completo. I. Classis	Ordo Stellaru m	Declina tio (G. ')	Distantia à praeced. (G. ' ")		Differentia Asc. Rectae (G. ' " ")	Ascensio Recta (G. ' " ")
			7 $\frac{2}{3}$ B			
	Spica ♏	9	2	35	23	196
			0 $\frac{1}{6}$ A			
	Lanx Boreal.	8	5	27	27	224
			$\frac{1}{6}$ A			
	Ophiuch i Caput	12	5	40	35	259
			2 $\frac{1}{6}$ B			
	Aquilae Lucida	8	1	33	33	293
			$\frac{1}{3}$ B			
	Pegasi Markab.	13	2	47	48	341
			3 $\frac{1}{6}$ B			
	Lucida γ	21	4	43	45	27
			9 $\frac{1}{2}$ B			
	Summa Differe ntiaru m				360	

[For the year 1660 completed, First Class. Order of the stars; Declination; Distance from the preceding (star); Difference of right ascension; Right Ascension. Sum of the differences: 360° 0' 0".]

5. Yet I freely confess that, from the distance between Spica and the Northern Pan [Lanx Borealis], I had judged from observation that a difference of right ascension of $27^{\circ} 33' 30''$ would result; and from the distance between the Northern Pan and the Head of Ophiuchus, a difference of right ascension of $35^{\circ} 4' 11''$ — and thus, up to 360° of the equator, I found myself short by $9''$ here, $25''$ there. I therefore chose the earlier distance, $27^{\circ} 33' 40''$, and the later one, $40^{\circ} 39' 40''$, for the reason that, among the other distances of this class, I did not have so many confirmations of them for the others. For Ptolemy shrewdly noted in his *Harmonics* [Ptolemy, *Harmonica*] that sense-perception scarcely ever reaches exactly to the truth, but only approaches it nearly; yet it is the part of reason, from what has been observed through the senses, to determine the exact measure. What I have just said I mean to apply also to the other distances used in the second and third classes; and as to a very few seconds, I have set limits. I have set those limits to the distances rather than to the declinations, because we attain evidence far more hardly in observing distances than in observing declinations, as is established among the experts. This small adjustment we have indicated in the catalogue of distances by the characteristic mark *melius* [better].

Anno 1660. Completo. II. Classis	Ordo Stellaru m	Declinat io (G. ')	Distantia à praeced. (G. ' ")	Differentia Asc. Rectae (G. ' " ")	Ascensio Recta (G. ' " ")
	Lucida γ	21	4 9 $\frac{1}{2}$		27
	Persei Latus	48	3 30 4 $\frac{1}{2}$	17	44
	Capella	45	3 19 6	27	72
	Castoris Caput	32	3 29 4 $\frac{5}{6}$	35	108
	Regulus	13	3 40 6 $\frac{2}{3}$	39	147

Anno 1660. Completo. II. Classis	Ordo Stellaru m	Declinat io (G. ')	Distantia à praeced. (G. ' ")	Differentia Asc. Rectae (G. ' " ")	Ascensio Recta (G. ' " ")
	Cauda α	16	2 24 7 $\frac{2}{3}$	25	172
	Arcturus	20	5 35 9 $\frac{5}{6}$	37	210
	Coronae lucida	27	5 19 3 $\frac{5}{6}$	20	230
	Lyrae lucida	30	3 40 0 $\frac{2}{3}$	46	276
	Cygni cauda	44	6 23 $\frac{2}{3}$	31	307
	Pegasi Scheat	26	1 32 5 $\frac{5}{6}$	34	341
	Lucida γ	29	4 41 9 $\frac{1}{8}$	45	27
	Summa Differen tiarum			360	

[For the year 1660 completed, Second Class. Sum of the differences: 360° 0' 0".]

- But that we might also explore as fully as possible the principal Southern stars observable from our latitude, we started from the same Lucida of Aries, and proceeded through Orion, the Dogs, and Hydra to the Tail of the Lion [Cauda Leonis]; for from there we came back to the Lucida of Aries, the remaining stars being understood as the same ones already given in the first and second classes. It is clear from the first and second classes that the sum of the differences of right ascension from the Lucida of Aries up to the Tail of the Lion, inclusive, must be 145° 52'.

Anno 1660. Completo. III. Classis	(Star)	Declina tio (G. ')	Distantia (G. ' ")	Differenti a Ascens. (G. ' ")	Ascensio Recta (G. ' ")
	Lucida Υ	21	4 9 $\frac{1}{2}$		27
	Aldebara	15	4 35 6 $\frac{5}{6}$	37	5 0 64
	Orionis humerus lucidus	7	1 21 6 $\frac{2}{3}$	20	3 2 84
	Procyon	6	4 26	26	1 0 110 2
	Cor Hydrae	7	1 30 1 $\frac{1}{2}$	27	1 3 137 9 4
			A		
	Cauda ϱ	16	2 42 7 $\frac{2}{3}$	35	1 2 172 1 0
	Summa Different iarum			145	5 5 0 6 ' "

[For the year 1660 completed, Third Class. Sum of the differences: 145° 50' 56".]

There is wanting a second of 64", which, distributed among the four later stars, gives us their right ascension, as below.

(Star)	Different. Asc. (G. ' ")	Ascens. Recta (G. ' ")
Lucida Υ		27 1 5 8
Aldebara	37	5 0 64 6 5 8
Orionis humerus	20	3 1 84 1 1

(Star)	Different. Asc. (G. ' ")	Ascens. Recta (G. ' ")
lucid.		8 0 6
Procyon	26	1 1 110 2 3
		2 6 2 2
Hydrae Cor	27	1 5 137 4 2
		9 0 2 2
Cauda ϱ	35	1 3 172 5 5
		1 6 3 8
Summa Differet.	145	5 0 2

[Difference of right ascension; Right Ascension. Sum of the differences: 145° 52' 0".]

From this it then follows that from the Lucida of Aries to the Heart of Hydra the sum of the differences is 110° 40' 24". Let us see whether it is just so large by way of Rigel [Regel] and Sirius.

(Star)	Declinatio (G. ')	Distantia (G. ' ")	Differentia Ascens. (G. ' ")	Ascensio Recta (G. ' ")
Lucida Υ	21	4 9 $\frac{1}{2}$		27
Aldebara	15	4 35 6 $\frac{5}{6}$	37	64
Regel [Rigel]	8	3 30 A 7	0	40
Sirius	16	1 30 A 6	0	40
Hydrae Cor	7	1 40 1 $\frac{1}{2}$ A	40	137
Summa Differenti arum			110	

[Declination; Distance; Difference of ascension; Right Ascension. Sum of the differences: 110° 40' 20".]

So only 4" are wanting, which, if they are restored to the right ascension of the Heart of Hydra, it will remain as above.

7. There follows the Fourth Class, whose right ascension has been investigated by us through trigonometric labor — from the declinations and from the distances on either side, or from neighboring fixed stars whose right ascension was already determined in the three preceding classes. For from two methods that yielded the same right ascension, we chose the one that held the middle, arithmetically, between the extremes. This was the very thing Tycho [Tycho Brahe] accomplished in volume 1 of the *Progymnasmata*, page 229, for 12 stars. But we, in many cases, do not record the extreme right ascensions, for the sake of avoiding prolixity; rather, it is easy to recover them from the difference of right ascension applied to the right ascension of the first or second class of stars. For example: the difference of right ascension at the Northern Horn of Taurus [Cornu Boreale Tauri] is, by us, 12° 5' 58"; and the right ascension of Aldebaran, from what was said, is in the first class 64° 6' 58". Therefore the right ascension of the said Northern Horn comes out to 76° 12' 56". Again, the difference of right ascension between the Northern Horn of Taurus and the Head of Pollux is 34° 53' 58"; and the right ascension of Pollux, from the first class, is 111° 6' 0". So, subtracting this difference, the right ascension of the Northern Horn comes out to 76° 12' 2". The mean, then, between this and the earlier value, is 76° 12' 29", or 30". And so in the rest we have done likewise: where one second, or two, fell short of round measure, or were in excess, we have rounded the number to the nearest, or padded it out, recording a rounded number, so that the longitude and latitude might more easily be gathered from it afterward, without danger of the error that tends to creep in from the proportional part of the fractions of the others.

Anno					
IV. Clas sis	1660. Completo.	Decl. Bor. ubi not. (G.)	Distantia à praeced. (G. ')	Differentia Ascens. (G. ' ")	Ascensio Recta (G. ' ")
	Aldebara	15	4 6 1/8		64
	Cornu	28	1 16	4 15	76

IV. Clas sis	Anno 1660. Completo.	Decl. Bor. ubi not. (G.)	Distantia à praeced. (G. ')		Differentia Ascens. (G. '")		Ascensio Recta (G. '")
	Boreal. ♂		5 $\frac{5}{6}$		5 $\frac{1}{3}$		
	Pollucis Caput	28	4 7 $\frac{5}{6}$	30	3 34 2 $\frac{3}{4}$		111
	Aldebara	15	4 6 $\frac{1}{8}$				64
	Pleiad. Lucid.	23	1 13		3 12 7 $\frac{1}{6}$		51
	Lucida ♀	21	4 9 $\frac{1}{3}$	22	5 24 7 $\frac{2}{3}$		27
	Aldebara	15	4 6 $\frac{1}{8}$				64
	Orion. hum. sin.	5	5 9 $\frac{5}{6}$	15	4 12 7 $\frac{3}{5}$		76
	Orion. hum. lucid.	7	1 7 6 $\frac{2}{3}$		2 7 9 2 0		84
	Aldebara	15	4 6 $\frac{1}{8}$				64
	Orion. 2. balthei	1	2 23 8 $\frac{1}{6}$ A		9 15 $\frac{2}{3}$		79

IV. Clas sis	Anno 1660. Completo.	Decl. Bor. ubi not. (G.)	Distantia à praeced. (G. ')	Differentia Ascens. (G. '")	Ascensio Recta (G. '")
	Orion.	7	1 9	5 4	84
	hum.		6	0	
	lucid.		$\frac{2}{3}$	$\frac{2}{3}$	
	Aldebara	15	4		64
			6		
			$\frac{1}{8}$		
	Ceti	2	4 26	6 22	41
	Mandib.		3	$\frac{3}{4}$	
			$\frac{5}{6}$		
	Regel	8	3 35	1 33	74
	[Rigel]		7	4	
			$\frac{1}{2}$	$\frac{5}{6}$	
			A		
	Mandibu	2	4		41
	la Ceti		3		
			$\frac{5}{6}$		
	Ceti	19	4 40	4 34	6
	cauda		9	3	
	aust.		$\frac{1}{3}$	$\frac{2}{3}$	
			A		
	Lucida ♀	21	4 46	1 20	27
			9	2	
			$\frac{1}{2}$		

[Fourth Class. For the year 1660 completed. Northern declination where noted; Distance from the preceding; Difference of ascension; Right Ascension.]

[The following large table gives the right ascensions of the principal stars for 1660, reduced from the same trigonometric method; the leftmost column names the two reference stars and the star whose right ascension is being found, the latter given as the last entry of each group.]

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ''')		Differentia Asc. Rec. (G. ' ''')		Ascensio Recta (G. ' ''')
Orion. hum. luc.	7	1 6 $\frac{2}{3}$				84
Pes Lucid. II	16	3 8 $\frac{1}{3}$	13	4 5	10	94
Regulus	13	3 6 $\frac{2}{3}$	51	$\frac{1}{2}$	53	147
Cauda ♏	16	2 7 $\frac{2}{3}$				172
Iuba ♏	21	3 2 $\frac{1}{3}$	21	$\frac{1}{6}$	22	150
Spica ♏	9	2 0 $\frac{1}{2}$ A	55	$\frac{11}{10}$ 1 2	46	196
Iuba ♏	21	3 2 $\frac{1}{3}$				150
Lumbi ♏	22	2 1 $\frac{1}{8}$	12	$\frac{1}{2}$	13	163
Spica ♏	9	2 0 $\frac{1}{2}$ A	45	$\frac{5}{6}$	32	196
Ceti cauda aust.	19	4 9 $\frac{1}{2}$ A				6

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ''')		Differentia Asc. Rec. (G. ' ''')		Ascensio Recta (G. ' ''')
Fomahant [Fomalhaut]	31	2 0 $\frac{1}{6}$ A	26		26	339
Lucida Υ	21	4 9 $\frac{1}{2}$	69	$\frac{2}{3}$	47	27
Aquilae lucida	8	1 $\frac{1}{3}$				293
Aquarii humerus praecedens	6	5 9 $\frac{1}{6}$ A	28	$\frac{3}{5}$	24	318
Markab. Pegasi	13	2 3 $\frac{1}{6}$	31	$\frac{1}{6}$	23	341
Aquarii humerus praeced.	6	5 9 $\frac{1}{6}$ A				318
Capricorni Cornu praeced.	13	2 8 $\frac{1}{3}$ A	19	0	18	299
Aquilae lucida	8	1 $\frac{1}{3}$	22	$\frac{1}{6}$	6	293
Lucida Υ	21	4 9 $\frac{1}{2}$				27
Androm. Caput	27	1 3 $\frac{5}{6}$	27	$\frac{1}{2}$	29	357
Markab. Pegasi	13	2 3	20	$\frac{2}{3}$	15	341

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ''')		Differentia Asc. Rec. (G. ' ''')		Ascensio Recta (G. ' ''')
		$\frac{1}{6}$				
Lucida Υ	21	4				27
		9				
		$\frac{1}{2}$				
Algenib. Pegasi	13	1	28	$\frac{1}{4}$	28	358
		9		2		
		$\frac{1}{3}$				
Markab. Pegasi	13	2	16	$\frac{1}{3}$	16	341
		3				
		$\frac{1}{6}$				
Cygni cauda	44	6				307
		$\frac{2}{3}$				
Cassiop. luc. cath.	57	1	33	$\frac{1}{3}$	50	357
		8				
		$\frac{2}{3}$				
Pollucis Caput	28	4	77	$\frac{1}{3}$	113	111
		7				
		$\frac{5}{6}$				
Cygni cauda	44	6				307
		$\frac{2}{3}$				
Schedir Cassiop.	54	4	37	$\frac{1}{2}$	57	5
		1				
		$\frac{2}{3}$				
Pollucis Caput	28	4	75	$\frac{1}{6}$	105	111
		7				
		$\frac{5}{6}$				
Arcturus	20	5				210
		9				
		$\frac{5}{6}$				
Ursae ma. Dubhe seu hum. luc.	63	3	53		49	160
		4				
		$\frac{5}{6}$				
Pollucis	28	4	46		40	111

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ''')		Differentia Asc. Rec. (G. ' ''')		Ascensio Recta (G. ' ''')
Caput		7 $\frac{5}{6}$				
Arcturus	20	5 9 $\frac{5}{6}$				210
Ursae mai. Ilia	58	1 1 $\frac{5}{6}$	51	$\frac{1}{3}$ 49		160
Castoris Caput	32	3 5	42	$\frac{1}{2}$ 51		108
Arcturus	20	5 9 $\frac{5}{6}$				210
Ursae mai. ultima cauda	51	3 $\frac{1}{3}$	30	$\frac{1}{2}$ 6		203
Dubhe	63	3 4 $\frac{5}{6}$	25	42		160
Arcturus	20	5 9 $\frac{5}{6}$				210
Ursae ma. 1. caudae	57	5 0 $\frac{1}{6}$	39	$\frac{2}{5}$ 20		189
Ursae mai. ultima cauda	51	3 $\frac{1}{3}$	10	$\frac{1}{3}$ 13		203
Arcturus	20	5 9 $\frac{5}{6}$				210
2. Caudae Ursae ma.	56	4 3	36	1 $\frac{1}{4}$ 12		197

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ")		Differentia Asc. Rec. (G. ' ")		Ascensio Recta (G. ' ")
		$\frac{2}{3}$				
Ultim. Caudae Ursae mai.	51	3	6	4	5	203
		$\frac{1}{3}$		$\frac{5}{6}$		
Spica ♏	9	2				196
		0				
		$\frac{1}{2}$				
		A				
Cor Scorpii	25	3	45		47	242
		3				
		$\frac{1}{2}$				
		A				
Lanx Boreal.	8	5	24		17	224
		$\frac{1}{6}$				
		A				

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' ")		Differentia Asc. Rec. (G. ' ")		Ascensio Recta (G. ' ")
Spica ♏	9	2				196
		0				
		$\frac{1}{2}$				
		A				
Lanx Austral.	14	3	21		21	218
		4				
		$\frac{1}{2}$				
		A				
Lanx Boreal.	8	5	9		6	224
		$\frac{1}{6}$				
		A				
Spica ♏	9	2				196
		0				
		$\frac{1}{2}$				

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' " ")		Differentia Asc. Rec. (G. ' " ")	Ascensio Recta (G. ' ")
		A			
Boreal. fros Scorp.	18	4 6	39	39	236
		A			
Cor Scorp̃ii	25	3 3 ½	8	5	242
		A			
Spica ♍	9	2 0 ½			196
		A			
Serpentis luc. colli	7	3 3 ⅝	38	35	231
Caput Ophiuchi	12	5 2 ⅙	27	27	259
Schedir Cassiop.	54	4 1 ⅔			5
Pollaris Stella	87	2 9 ¼	32	3	8
Cassiop. luc. Cath.	57	1 8 ⅔	30	10	357
1. Caud. Ursae ma.	57	5 0 ½			189
Cynosura	75	3 8 ½	21	33	222

Anno 1660. Completo.	Declinati o (G. ')	Distantia à praeced. (G. ' " ")		Differentia Asc. Rec. (G. ' " ")	Ascensio Recta (G. ' ")
3. Caud. Ursae ma.	51	3	25	19	203
Arcturus	20	$\frac{1}{3}$ 5 9 $\frac{5}{6}$			210
Ursae mai. coxae lucida	55	3 6 $\frac{1}{2}$	43	36	173
Arcturus	20	$\frac{5}{6}$ 5 9 $\frac{5}{6}$			210
Ursae mai. tergus	58	5 0 $\frac{5}{6}$	43	30	179
Aldebara	15	4 6 $\frac{1}{8}$			64
Nodus ✕	1	7	40	38	26
Lyrae lucida	38	3 0 $\frac{2}{3}$			276
Luc. Capitis Draconis	51	3 5 $\frac{5}{6}$	14	9	267
Lyrae lucida	38	3 0 $\frac{2}{3}$			276
Cephei Cingulum	69	1 0	38	44	320

[For the year 1660 completed. Declination; Distance from the preceding;
Difference of ascension; Right Ascension.]

8. By almost the same method we have determined certain other right ascensions of fixed stars, ones that are observable in our horizon and that can serve astronomers — whether for determining the places of the planets or the moments of times. But after we have searched out the longitudes and the motion of longitude, then at last we shall reduce the right ascensions of these same stars, together with their declinations, to the year 1700 — and perhaps to 1800.

CAPUT XVIII.

De Longitudine, ac Latitudine Fixarum ex Nostris Observationibus.

[On the Longitude and Latitude of the Fixed Stars from Our Own Observations.]

[Margin: 1. The latitude of the fixed stars is unchanging.]

We have taught that the latitude of the fixed stars is perpetually one and the same, in book 6, Caput 15 of the *Almagestum Novum*; so much so that the fixed stars by their own motion describe circles parallel to the ecliptic. For the diversity of latitude found in the same star by Tycho is not sufficient evidence of a true change, but rather of some fallacy in his other observations, from which that latitude is derived — namely, the declinations, the distances of the fixed stars among themselves, and the distances of the poles of the ecliptic and of the equator. Indeed, it was for these very causes that we ourselves obtained a result differing from the Tychonic one not only in latitude, but also in longitude and right ascension.

2. Now therefore, with the declination of the principal fixed stars determined, and the right ascension established in Caput XVI and XVII, and the distance of the poles fixed at $23^{\circ} 30' 20''$, from what has been said...

[Margin: Longitudo, & Differentia Longitudinis Fixarum constans. — The longitude, and the difference of longitude of the fixed stars, is constant.]

about the Sun, it will not be difficult to investigate their latitude and longitude up to the end of the year 1660, by Problem 1, Caput 12, book 6 of the *Almagestum Novum*, where we set out this problem; and we did the same in our *Primum Mobile Reformatum*, Caput 8. For the present it suffices to recall here the scheme set out in the preceding chapter, and the example introduced there concerning the Lucida of Aries — for by its model we have, with trigonometry, diligently inquired into the longitudes and latitudes of the rest, and have entered them in the following table.

3. Moreover, once the longitude of the fixed stars has been ascertained, if it be compared with the longitude observed and corrected by the Ancients, it will be established that this motion of the fixed stars is perpetually equal and uniform — which we also taught in book 6, Caput 16 and 17 of the *Almagestum Novum*. For since, from the invariable distance of the fixed stars among themselves, and from the unchangeable latitude, it follows necessarily that the difference of longitude between any two fixed stars is always the same — being once for all fixed — from this it will be no laborious matter to ferret out the longitudes of the remaining fixed stars from the Copernican or the Rudolphine catalogue, by first noting the discrepancy between the Tychonic and our own difference of longitude of two fixed stars, and then, in accordance with that discrepancy, correcting the remaining differences with the proportion preserved. So that what has just been said may not seem too obscure, it is worth setting it out more clearly by a single example.

4. For the year 1660: the longitude of the Lucida of Aries is, by us, $2^{\circ} 54' 42''$ of Taurus; and that of Aldebaran, $5^{\circ} 1' 43''$ of Gemini. Therefore the difference of longitude is $32^{\circ} 7' 1''$. But by Tycho, at the same epoch, the longitude of the Lucida of Aries is $2^{\circ} 57'$ of Taurus, and that of Aldebaran $5^{\circ} 3' 30''$ of Gemini. Therefore the difference of longitude is $32^{\circ} 6' 30''$. The discrepancy, then, of these differences is $0^{\circ} 31''$, by which Tycho falls short of ours. Accordingly, if we add the same number of seconds to the other differences that lie between the remaining stars of Aries and Taurus, they will turn out more correct. And it comes to virtually the same thing if the excess of longitude found in the Lucida of Aries is subtracted from the Tychonic longitude of the remaining fixed stars of Aries, whose longitude from our own observation is not yet more certainly known. By this device we shall construct the Catalogue of the fixed stars — marking, however, with a distinct character, those fixed stars whose longitude and latitude have been determined from our own observation. This catalogue we shall place at the end of the work, together with the other tables. Meanwhile we here subjoin five fixed stars which we shall use in what follows, their longitude and latitude deduced from the declination of Caput XVI and the right ascension of Caput XVII, and the distance of the poles being $23^{\circ} 30' 20''$.

Anno 1660. Completo.	Nomina Fixarum	Longitudo (Sig. Gr. ' ")	Latitudo (Gr. ' ")
	Spica ♋	♌	1

Anno 1660. Completo.	Nomina Fixarum	Longitudo (Sig. Gr. ' ")	Latitudo (Gr. ' ")
	Regulus	♌	0
	Aldebara	♌	5
	Cor Scorpii	♏	4
	Pollucis Caput	♊	6

[For the year 1660 completed. Names of the fixed stars; Longitude (Sign, Degree, ', '); Latitude (degree, ', '). A = south, B = north of the ecliptic.]

CAPUT XIX.

De Motu Longitudinis Fixarum eiusque Quantitate, & Aequalitate.

[On the Motion of Longitude of the Fixed Stars, its Magnitude and Uniformity.]

Of all the fixed stars, the most celebrated hitherto for the motion of longitude has been Spica of Virgo [Spica Virginis] — and deservedly so, since, when it began to be observed by the Ancients — namely by Timocharis [Timocharis] and Hipparchus [Hipparchus], by Pto-

and to Ptolemy as well it [Spica] lay near the point of the autumnal equinox, having received a very slight declination and a latitude scarcely 2 degrees. In this latitude, indeed, Ptolemy, Tycho [Tycho Brahe], and we are very nearly in agreement: by Ptolemy it is about 2 degrees south, by Tycho 1 degree 59 minutes, and by us 1 degree 59 minutes 30 seconds.

Equally celebrated, and useful for this present work, is Basiliscus, or Regulus [Cor Leonis], the bright star in the heart of Leo. Because of its nearness to the ecliptic, it does not depart in latitude toward the north by more than 10 minutes — by Ptolemy, or 26 minutes by Tycho, or 26 minutes 20 seconds by us.

To these we shall add Aldebaran, the Head of Pollux, and Cor Scorpii [the Heart of Scorpio], because the declination of these stars was observed not only by the ancients but also by the more recent astronomers. Accordingly, from this declination and from our own latitude (which I shall discuss at the end of the preceding chapter) and from the obliquity of the ecliptic at 23 degrees 30 minutes 20 seconds, we shall derive their longitude. Then, from the advance of that longitude across intervals of time, we shall establish the annual motion of the

fixed stars — and this without neglecting the opinions of others. Indeed, before our own settled view, I shall set out those opinions, which I have nevertheless reported more fully in *Almagestum Novum* (Book 1, *Almagesti Novi* Cap. 16).

[Margin: The opinions on the motion of the fixed stars.]

[Margin: 1. First opinion.]

1. The first opinion, then, is that found in Ptolemy (Book 7, *syntaxis* Cap. 2 and 3), and it was Hipparchus's and Ptolemy's own: that the fixed stars advance not less than 1 degree in 100 years — that is, no less than 1 degree in longitude over 100 years. But since Hipparchus had derived this motion from the observations of Timocharis, which (as Ptolemy testifies, *Cap.* 3) were too crude, Hipparchus himself judged this. And Ptolemy, on account of the brief interval of time, very close to his own, did not dare to depart from Hipparchus. Ptolemy's words about Hipparchus are these: "He was, however, in doubt, as he asserts, since neither could he reckon the observations made in Timocharis's time as reliable — because they were captured too roughly — nor had enough time yet elapsed to suffice for a thorough understanding of this matter." Nevertheless, Alfraganus [al-Farghānī] and Proclus subscribed to Ptolemy.

[Margin: 2. Albategnius's opinion.]

2. The second was that of Albategnius [al-Battānī] (*Cap.* 51, *De scientia Stellarum*), who, from the place of Regulus and of the Northern star in the Forehead of Scorpio observed in his own time, and afterward observed by himself, laid down that the fixed stars complete one degree in 66 years. Following him in this hypothesis are Alfonso, King of Castile [Alfonso X], Rabbi Levi [Levi ben Gershon / Gersonides], Abraham Zacutus [Abraham Zacuto], Augustinus Riccius [Augustino Ricci], Petrus Nonius [Pedro Nunes], and others, as cited in *Almagestum Novum* (Book 6, *Almag. Novi* Cap. 16), where I also reported the opinion on the motion of trepidation [motus Trepidationis] and its anomaly, which I refuted in Cap. 17. But now I shall show that Albategnius's longitude for Regulus is itself in error, as I shall say in observation 17.

[Margin: 3. Tycho's opinion.]

3. The third opinion was that of Tycho Brahe (*Progymnasmata* tom. 1, pag. 253), who, using Regulus in the first place, and Spica, held that the annual motion of the fixed stars is 51 seconds — that is, that they complete one degree in 70 years and 7 months. For Copernicus had observed Spica in Libra at 17 degrees 3½ minutes in the year 1515 (with the latitude of the pole, however, corrected); and

Tycho himself, after 70 years — namely in the year 1585 — found it again at 18 degrees 3 minutes of Libra. Moreover, Hipparchus had observed Regulus in the year 50 of the third period of Callippus, in Cancer at 29 degrees 50 minutes. Tycho, after 1713 years — that is, in the year of Christ 1585 — observed the same star in Leo at 24 degrees 5 minutes; and Albategnius in the year of Christ 880 had marked Regulus in Leo at 14 degrees 5 minutes. He admits, however, that Spica was observed by Timocharis in the year 454 of Nabonassar in Virgo at 22 degrees 20 minutes, and by Ptolemy in the year of the Lord 139 in Virgo at 26 degrees 40 minutes. Comparing these with the place observed by himself, the annual motion comes out as 49¼ seconds from the one and 53½ seconds from the other; hence he chose the mean, as above. But the places of these stars must nevertheless be corrected on account of the displacement of the poles, which we shall do below. Tycho meanwhile decides to compare his foundations against the table.

| Timoch[aris] Anno ante Chr. 294. | Spica ♄ gr. 22. 20'. | | Ptolemæus Anno Chr. 139. | Spica ♄ gr. 26. 40'. | | Copernicus Anno Chr. 1515. | Spica ♄ gr. 17. 3½. | | Tycho Anno Christi 1585. | Spica ♄ gr. 18. 3. | | Hipparchus Ann. ante Chr. 128. | Regulus ♄ gr. 29. 50. | | Albategnius Anno Christi 880. | Regul. ♄ gr. 14. 5. 0. | | Tycho Anno 1585. Regulus | ♄ gr. 24. 5. 0. |

Hence, then:

Ergo Ab.	ad	Progress. Fixarū. Gr. ' interu.	Annorū	Annuus motus. " '"
Timoch. ad	Tyc h.	25 43	1879	49 15
Ptolem.	Tyc h.	21 23	1446	53 15
Hipparc h.	Tyc h.	24 15	1713	51 0
Hipparc h.	Alb at.	14 15	1006	51 ferè
Albateg n.	Tyc h.	10 0	705	50 54

[Margin: 4. Longomontanus's opinion.]

4. The fourth opinion was that of Longomontanus (*Astronomia Danica*, Book 1, *Theoric. in the Commentary on the Fixed Stars*), who, from Ptolemy (Book 7, *Cap.* 3 and 4), sets out four fixed stars observed by the ancients and by Tycho, as follows:

Observatores.	Anni Nabonassaris.	Locus in Zodiaco — Gr. '
Timocharis	466	Spica ♀ 22 30
Hipparchus	630	Spica ♀ 24 25
Tycho	2350	Spica ♀ 18 16
Ptolemæus	886	Regulus ♀ 3 53
Albategnius	1626	Regulus ♀ 14 27
Tycho	2350	Regulus ♀ 24 17
Timocharis	454	Bor. frons [♄] 1 58
Tycho	2350	Scorpij [♄] 27 36
Timocharis	465	Pleiadum ♀ 29 32
Tycho	2350	Lucida ♀ 24 24

From these intervals of time and the advance of the stars he gathers their annual motion, as below:

Ab	Ad	" '"
Hipparcho	Tychonem	49 46
Ptolemæo	Albategnium	51 0
Ptolemæo	Tychonem	49 37
Timocharide	Tychonem	49 10
Albategnio	Tychonem	48 14
Timochar.	Ptolemæum	46 0
Timochar.	Hipparchum	44 0

But Longomontanus, from this, chooses a mean motion of the fixed stars of 49 seconds 45 thirds; and over $72\frac{1}{3}$ years, the motion of one degree. He could just as well have settled on a motion of 50 seconds. And in correcting their places he uses the prosthaphaeresis [Prosthaphaeresis] of the equinoxes — which is the more obscure for the motion of the fixed stars — and he assumes the same.

[Margin: 5. Lansbergius's opinion, conflicting.]

5. The fifth opinion is that of Lansbergius [Philippe van Lansbergen], who (in his *Thesaurus observationum*, pag. 160) says that the fixed stars advance daily by $8'' 25''' 12''' 32'''$, and complete one revolution in 28000 years — from which it follows that the fixed stars complete one degree in $77\frac{2}{3}$ years, and in single years $46''\frac{2}{7}$. But, given the revolution stated above, this is mistaken. For if you reckon

through the days of a common year, 365 — namely the daily motion of 8'' 25''' 12''' 32''' — the annual motion will be in seconds 51'' 14''' 11''' 14''' 40'''; so far does Lansbergius himself contradict his own figures.

[Margin: 6. Kepler's opinion.]

6. The sixth opinion, that of Johannes Kepler [Johannes Kepler], is amphibious: for although with Copernicus he reckons that the fixed stars do not move, yet with Tycho — on the supposition that they do move — he holds that their annual motion is 51 seconds, as is clear from the *Rudolphine Tables* (pag. 43 and 115), where he says 25411 years; and that the sidereal years are equal to the solar tropical years; and from the *Epitome of Copernican Astronomy* (pag. 396), where he says that the fixed stars completed [a revolution] from Hesiod to the year of the Lord 1618 in about 2400 years — so that in 1 year the second figure is 51''. Nor does Vuendelinus [Govaert Wendelen] differ much from this in his *Idea Tabularum* (pag. 28), when he holds that 25519 sidereal years equal [the tropical years]; from which it follows that the fixed stars advance yearly by 50'' 47'''. Gassendus [Pierre Gassendi], however, in his *Institutio Astronomica*, sets the fixed stars to complete their full period in 25000 years and 1 degree in 70½ years, and in single years 51'' 19''' 24'''.

[Margin: And Wendelen's.]

[Margin: And Gassendi's.]

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[Margin: 7. Bullialdus's opinion.]

7. The seventh opinion was that of Ismael Bullialdus [Ismaël Boulliau] (*Astronomia Philolaica*, Book 5, Cap. 3, and in the *Tabulae Philolaicae*, pag. 10), where he finally chooses an annual motion of the fixed stars of 51 seconds, following Tycho — though the observations of Regulus were corrected by him as follows:

Observatores.	Anni Nabonassari.	Reguli locus. Sig. Gr. '
Hipparchus	621	♄ 29 50
Ptolemæus	886	♄ 3 42
Albategnius	1627	♄ 14 5
Tycho	2350	♄ 24 17

Hence the annual motion of the fixed stars:

Ab	Ad	" "' '"
Hipparcho	Ptolemæum	52 31 42
Hipparcho	Albategnium	50 59 38
Hipparcho	Tychonem	50 54 29
Ptolemæo	Albategni	50 26 27
Ptolemæo	Tychonem	50 36 53
Albategnio	Tychonem	50 47 18

He admits, moreover, from the southern latitude of Spica — by Hipparchus the northern declination of Spica being 0 degrees 36 minutes — that in the year of Nabonassar 621 its place lies in Virgo at 23 degrees 50 minutes; and from the place of the same star found by Tycho in the year of Nabonassar 2350 in Libra at 18 degrees 16 minutes, the annual motion of the fixed stars follows as below:

"	"'	'''	'''	'''	'''
50	33	39	39	52	22

Then, from the Persian and Arabic Tables, which are kept in the Library of the Most Christian King [the French royal library], he sets down these observations, or places, of Regulus:

Tabulæ	Anni Arabū	Anni Christi	Reguli locus. Sig. Gr. '
Albategni		879	♌ 14 5
Azophi	325	936	♌ 15 12
Persicæ	509	1115	♌ 17 30
sub Persicæ		1364	♌ 20 40
Tychonica		1600	♌ 24 17

Hence the annual motion of the fixed stars:

Ab	Ad	" "' '"
Albategnio ad	Azophi	69 18 37
Albat.	Persicas Tab.	52 7 7
Albat.	sub Persicas	48 51 57
Azophi	Persicas Tab.	46 31 0
	sub Persicas	45 5 20
Tab. Persicis	sub Persicas	45 46 59

Ab	Ad	" "' '"
Tab. Persicis	Tychonem	50 14 49

Numerical impossibles: in the "Albategnio ad Azophi" row the seconds-of-degree figure is 69, exceeding 60 (transcribed as printed — flagged).

[Margin: Petavius's opinion.]

This I add for the sake of his erudition, to which I add another opinion of the French astronomers, namely that of Dionysius Petavius [Denis Pétau] in his *Uranologia*, where he chooses an annual motion of the fixed stars of 50 seconds and 1 degree in 72 years.

[Margin: 8.]

8. The eighth opinion, our own, was once set out in *Almagestum Novum* (Book 6, Cap. 16): that the annual motion of the fixed stars is 50 seconds, with Petavius, and one degree in 72 years. These motions cannot complete a full period in less than 25920 years. Now, however, with the places of the fixed stars corrected, and the obliquity of the ecliptic established at 23 degrees 30 minutes 20 seconds, we are compelled by new observations to test our results carefully — adding our own every five years, in order to verify those stars, which were newly added at the end of the preceding chapter, and selecting the more notable observations.

SPICAE Virginis Observationes. [Observations of Spica Virginis]

[Margin: Spica's observations.]

1. Timocharis, on the testimony of Ptolemy (Book 7, Cap. 3), in the year 454 of Nabonassar — which was 295 years before Christ — observed Spica in Virgo at 22 degrees 20 minutes.
2. Timocharis, again from Ptolemy, in the year 466 of Nabonassar, 283 years before Christ, observed Spica in Virgo at 22 degrees 30 minutes; but these observations Hipparchus reckoned crude, as is shown above with Ptolemy.
3. Hipparchus, in Ptolemy, in the year 50 of the third period of Callippus, 128 years before Christ, observed Spica in Virgo at 24 degrees; but he is also said to have observed its northern declination as 36 minutes, from which, and from our southern latitude of 1 degree 59 minutes 30 seconds, its place follows at 23 degrees 30 minutes [of Virgo].

4. Ptolemy (Book 7, Cap. 3) in the year 1 of Antoninus the Emperor — that is, the year of Christ 137 — observed Spica's southern declination as 30 minutes; hence, and from the latitude of the star itself, and from the obliquity of the ecliptic stated above, its place follows in Virgo at 26 degrees 40 minutes 25 seconds. In this it is remarkable that he agrees with us in placing Spica at 26 degrees 40 minutes of Virgo, and yet differs in the obliquity of the ecliptic — and so this [agreement] is false.

5. Abraham Zaguth [Abraham Zacuto], in the work of his disciple Augustinus Riccius [Augustino Ricci], in his *Tractatus de motu octavae sphaerae*, in the year of the Lord 1474, is said to have observed Spica in Libra at 17 degrees 10 minutes; but this conflicts too much with Tycho and with us.

6. Copernicus (*De Revolutionibus*, Book 3, Cap. 2) observed Spica's declination in the year of the Lord 1515 at 8 degrees 36 minutes south, at Frauenburg [Fruemburgi], where he thought the altitude of the pole to be 54 degrees 19 minutes 30 seconds — whereas by Tycho (*Progymnasmata* tom. 1, pag. 34 and 220) it comes to 54 degrees 22 minutes 15 seconds; and so the more correct declination of Spica was 8 degrees 33 minutes 15 seconds. Hence, by our latitude and the obliquity stated above, its place is in Libra at 17 degrees 2 minutes 50 seconds.

7. Copernicus, as Lansbergius narrates (Book 3, Cap. 2), in the year of the Lord 1525 observed Spica's meridian altitude at 27 minutes. The altitude of the equator at Frauenburg being 35 degrees 37 minutes 45 seconds, the southern declination of Spica then comes to 8 degrees 37 minutes 45 seconds — whence, by our latitude and obliquity, its place is in Libra at 17 degrees 14 minutes 54 seconds. Let Lansbergius dissemble while he idly grumbles, or slyly correct the altitude of the pole — he gathers this here gratuitously from the *Thesaurus* (pag. 156, *grad.* 17 minutes 35 seconds), having nevertheless freely admitted the refraction.

8. Joannes Stadius [Johannes Stadius], in his *Commentary on the Fixed Stars* (Cap. 1), says that in the year 1559 he observed at Brussels [Bruxellis] the meridian altitude of Spica at 29 degrees 52 minutes; whence the altitude of the pole follows at 51 degrees 20 minutes. From this he gathers Spica's southern declination at 8 degrees 48 minutes — but from our *Geographia*, and from the altitudes of the latitudes of other places, it is established from these observations that the altitude of the pole at Brussels is 50 degrees 48 minutes; and, the altitude of the equator [being so], Spica's declination is 9 degrees 20 minutes south. So, omitting his observation as worthless — together with that of Vuernerus [Johann Werner] and

Cardanus [Girolamo Cardano], on grounds adduced by Tycho (tom. 1 *Progymnasmata*, pag. 221)...

9. Tycho Brahe, in the year 1585, found Spica in Libra at 18 degrees 3 minutes, as he has it (tom. 1 *Progymnasmata*, pag. 232) — corrected from chapter 12. By our correction it is at 18 degrees 2 minutes 41 seconds.

10. Paulus Hainzelius [Paul Hainzel], Senator of Augsburg, in Tycho (tom. 1 *Progymnasmata*, pag. 365), began in the year 1573 to observe Spica's southern declination at 8 degrees 52 minutes; whence, our latitude and the obliquity of the ecliptic being supposed, its place follows in Libra at 17 degrees 51 minutes 50 seconds.

11. Lansbergius, as he reports in his *Thesaurus observationum* (pag. 157), at the beginning of the year 1599 observed Spica's meridian [altitude] at 29 degrees 30 minutes — which, when reduced for refraction, comes to 29 degrees 29 minutes. But there the altitude of the equator, from our *Geographia Reformata*, is 38 degrees 29 minutes 30 seconds; therefore Spica's southern declination was 8 degrees 59 minutes 30 seconds; and from our latitude its place is in Libra at 18 degrees 11 minutes 20 seconds.

12. Lansbergius, on the same page (pag. 157), reports that at the beginning of the year 1630 he believed he had observed at Middelburg [Middelburgi] Spica's meridian [altitude] at 29 degrees 20 minutes; but there the altitude of the equator is 38 degrees 30 minutes; therefore Spica's declination at that time was 9 degrees 10 minutes south; and from our latitude and the obliquity of the ecliptic its place is in Libra at 18 degrees 38 minutes 50 seconds.

13. Petrus Gassendus [Pierre Gassendi], in volume 4 of his works, in the *Commentary on Celestial Matters* (pag. 313), reports that in the year 1636, on 15 May, he observed Spica's meridian altitude at Aix [Aquis Sextiis] at 27 degrees 13 minutes — and the altitude of the equator being 46 degrees 27 minutes, Spica's declination there was 9 degrees 14 minutes south; and from our latitude of the star and the obliquity of the ecliptic, its place is in Libra at 18 degrees 49 minutes 10 seconds.

14. We, finally, together with Father Francesco Maria Grimaldi [Francesco Maria Grimaldi], from several...

several observations of the declination, and so forth, finally determined the place of Spica in the year 1660 completed, at 19 degrees 6 minutes of Libra, by what was said in the preceding chapter at the end.

REGVLI Observationes. [Observations of Regulus]

15. Hipparchus, in Ptolemy (Book 7, Cap. 2), in the year 50 of the third period of Callippus — namely 127 years before Christ — is reported to have observed Regulus, or Cor Leonis [the Heart of Leo], in Cancer at 29 degrees 50 minutes. He is said to have observed its declination at 20 degrees 40 minutes. From Regulus's latitude, by what was said in the preceding chapter — namely 26 degrees 10 minutes north — and from the obliquity of the ecliptic, its place comes in Cancer at 29 degrees 51 minutes 10 seconds; therefore its place at that time was in Cancer at 29 degrees 50 minutes 0 seconds.

16. Ptolemy (Book 7, Cap. 3) reports that he observed Regulus from himself in the year 1 of the Emperor Hadrian [Adriani] — that is, the year of Christ 137 — therefore [by] our latitude and the obliquity of the ecliptic, it was in Leo at 3 degrees 34 minutes 55 seconds.

17. Albategnius (*Cap. 51, De Scientia Stellarum*) says: "In the year of Nabonassar 1627 — that is, of Christ 879 — Regulus was observed by me in Leo at 14 degrees." But Longomontanus, *as above* (Book 1, *Cap. 14*, pag. 27), and Lansbergius in his *Thesaurus* (pag. 154, *grad. 14, min. 19*), say 14 — and because Ptolemy (Book 7, Cap. 2) says that, in the year 1 of Antoninus the Emperor, Regulus was in Leo at 2 degrees 29 minutes; and since Albategnius asserts that, from Regulus's observations, he had added to all the Ptolemaic longitudes of the fixed stars 11 degrees 50 minutes — yet my own codex of Ptolemy has, in the year 1 of Antoninus, the observation of Regulus at 2 degrees 30 minutes of Leo. Nor is it perhaps a corrupt number; for in the Tables it is found to be the same — and therefore Regulus, by Albategnius, would be in Leo at 14 degrees 20 minutes, neither 11 degrees 50 minutes nor 11 degrees 30 minutes. And so I reconcile [it] with 2 degrees 30 minutes nearly. For under the same error the number of minutes subtracted by 30 degrees [of the] places of the Ptolemaic fixed stars adds 11 degrees and a half — that is, a third part; this, with the half added, is twenty-five. But there the same is asserted: Ptolemy found Cor Leonis at 2 degrees and a sixth of Leo — here at 2 degrees 10 minutes; but the [progress] of Leo, that is the advance, comes to 11 degrees 50 minutes. And so it is concluded with grade 14 nearly. For under the same error the number of minutes subtracted joins together the places of the Ptolemaic fixed stars at 14 degrees 20 minutes, neither

perhaps in Leo at 14 degrees 5 minutes — neither corrupted — by Albategnius, says 11 degrees 30 minutes. And so I reconcile [it] with grade 14 nearly.

[Margin: Reduction of the latitudes of Albategnius, on this passage.]

But my Basiliscus codex of Ptolemy has Cor Leonis in the year 1 of Antoninus at 2 degrees 30 minutes of Leo, and soon afterward, at the distance from the tropic, the [value] mentioned 8 degrees 7 minutes — that is, 2 degrees 30 minutes of Leo, and the rest 32 degrees 30 minutes. But however much is to be retained in Ptolemy, the grade of Leo is 2 nearly; but it is not on that account retained in Albategnius's codex for emendation, since [...] it is 14 of Leo. Nor indeed did Albategnius place his own advance, since the grade of the place added a cause, that the fixed stars had progressed 11 degrees 50 minutes — but he saw them advanced [as] thus progressed, since he believed Regulus had advanced in Leo at 11 degrees 50 minutes. He reckoned this to have been in Ptolemy's time at 11 degrees 50 minutes [of] Leo; but if he had had an emended codex he would have read it — to the Ptolemaic grades he would have added something. But truly it was at 3 degrees 35 minutes of Leo, nearly, as long as the number of degrees from the year of Nabonassar 886 to 1627 — namely the years 741 in full — and so the advance of Regulus comes to be, and he would require to advance to one degree; this Albategnius and the Arabs held. And so, hence, it appears that Lansbergius fell into the fallacy which the logicians call *conversionis* [of conversion].

[Margin: Lansbergius's error.]

18. Azophi [al-Ṣūfī], the Persian astronomer, or *Ebennen Sophi*, as the *Bibliotheca* of Forcalquier [Forcalcari] promises [in] Bullialdus (Book 5, *Astronom. Phil.* cap. 3), and Gassendus in his *Epistolae*, records Regulus in Leo at 15 degrees 12 minutes — that is, in the Arab year 325, namely the year of Christ 936.

19. The Persian mathematicians, in the same Bullialdus, from a manuscript of the Royal Library [Regia Bibliotheca], in the year of the Lord 1115, on 6 June, established Regulus in Leo at 17 degrees 30 minutes — you do not know whether from observation, or from their own anticipated hypotheses.

20. Paulus Hainzelius [Paul Hainzel], in Tycho (tom. 1 *Progymnasmata*, pag. 364), in the year of the Lord 1573, began to observe Regulus's meridian altitude at 55 degrees 19 minutes $\frac{1}{2}$ and its declination at 14 degrees 1 minute $\frac{1}{2}$ — with Gögging [Gegginga] near Augsburg, the altitude of the pole being 48 degrees 21 minutes, as Lansbergius has it in his *Thesaurus* — none other. Hence, from that declination and from the latitude, Regulus's place follows in Leo at 23 degrees 50 minutes 26 seconds.

21. Tycho, in the year 1585, observed Regulus in the Lord [Domini] in Leo at 24 degrees 4 minutes 40 seconds, as he has it (tom. 1 *Progymnasmata*, pag. 232); but it must be corrected by what was said in chapter 12, so that it stands in Leo at 24 degrees 3 minutes 2 seconds, by Tychonic observations, the obliquity of the ecliptic being truly [supposed].

22. Lansbergius, in his *Thesaurus* (pag. 155), reports an observation: he narrates that to himself, in the year 1599 at its beginning, the meridian altitude of Regulus was 55 degrees 24 minutes $\frac{1}{2}$. The altitude of the equator there, for us, is 38 degrees 29 minutes 30 seconds; therefore the northern declination of Regulus is 13 degrees 55 minutes $\frac{1}{2}$; and from what was said in the preceding chapter — 26 degrees 10 minutes north latitude — hence by the obliquity of the ecliptic our place for Regulus follows in Leo at 24 degrees 5 minutes.

23. Lansbergius, in the same place, narrates that at the beginning of the year 1630 at Middelburg [Middelburgi] in Zeeland, through our altitude of the equator, the meridian altitude of Regulus was observed to be 55 degrees 16 minutes; therefore Regulus's declination is 13 degrees 46 minutes; and from our latitude and the obliquity of the ecliptic, its place is in Leo at 24 degrees 40 minutes.

24. We, finally, in the year 1660 completed, from many observations, determined — as we resolved at the end of the preceding chapter, with Father Grimaldi — the place of Regulus in Leo at 25 degrees 4 minutes 45 seconds.

ALDEBARAE, seu Oculi Australis Tauri, seu Palilicij Observationes. [Observations of Aldebaran, or the Southern Eye of Taurus, or the Palilician star]

25. Hipparchus, in Ptolemy (Book 7, Cap. 2), in the year 265 before Christ [...] before Antoninus the Emperor, in the first year [...] before Christ, in the year 128, observed Aldebaran's northern declination at 9 degrees 45 minutes; and from what was said at the end of the preceding chapter, its [latitude] is at 5 degrees 30 minutes 50 seconds — and the obliquity of the ecliptic at 23 degrees 30 minutes 20 seconds; therefore its place was then in Gemini at 10 degrees 25 minutes 53 seconds.

26. Ptolemy (Book 7, Cap. 3) reports the same: in the year 1 of Antoninus the Emperor — namely of Christ 137 — Aldebaran's northern declination was observed at 11 degrees; hence, and from our latitude and the said obliquity of the ecliptic, its place was then in Gemini at 14 degrees 38 minutes 7 seconds.

27. Paulus Hainzelius [Paul Hainzel], in Tycho (tom. 1 *Progymnasmata*, pag. 365), in the year 1573 at its beginning, observed Aldebaran's northern declination at 15 degrees 4 minutes 5 seconds; whence, by our latitude and the obliquity of the ecliptic, its place is in Gemini at 3 degrees 18 minutes 48 seconds.

28. Tycho, in those same days — that is, in the year 1585 — by our observations, finally got Aldebaran in Gemini at 3 degrees 59 minutes 49 seconds, more correct than Tycho's (tom. 1 *Progymnasmata*, pag. 232) — it had been in Gemini at 4 degrees, precisely [by] Tycho.

29. Lansbergius, at Gögging [Goësae], in the year of the Lord 1601 at its beginning, observed Aldebaran's meridian altitude at 54 degrees 8 minutes; the altitude of the equator being 38 degrees 29 minutes 30 seconds, therefore the declination was 15 degrees 38 minutes 30 seconds; from which, and from our latitude and the obliquity, its place is in Gemini at 4 degrees 18 minutes 20 seconds.

30. We, finally, together with Father Grimaldi [P. Grimaldo], from our observations, determined — at the end of the preceding chapter — to the year of the Lord 1660 completed, Aldebaran's place in Gemini at 5 degrees 1 minute 43 seconds.

[The following small summary table begins at the foot of the right column and continues onto the next folio. Most cells are faint show-through / abraded; transcribed where legible, otherwise [?].]

	Sign	Gr.	'	"
Timoch. Gallend[?]	[♊][?]	26	20	10 [?]
Timoch. Nos	[♊][?]	26	46	0 [?]
Timoch. Nos	[♊][?]	26	30	0 [?]

Liber IV — De Stellis Fixis

Caput XIX (continued) — On the Motion of the Longitude of the Fixed Stars, its Quantity and Uniformity

ANTARES, or the Heart of the Scorpion — Observations

31. Hipparchus, in Ptolemy [Ptolemaeus] (*Almagest* II.3): in the year 128 before Christ, as noted above, he observed the southern declination of the Heart of the Scorpion to be 19°. But from the end of our preceding chapter its southern

latitude is $4^{\circ} 26' 30''$, and with the obliquity of the ecliptic taken perpetually as $23^{\circ} 30' 20''$, Antares was therefore at that time in Scorpio $9^{\circ} 48' 12''$.

32. Ptolemy, in the same place, attests that in the year of Christ 137 he himself observed the southern declination of Antares to be $20^{\circ} 15'$. Therefore, from the aforesaid latitude and from the obliquity of the ecliptic, it was in Scorpio $13^{\circ} 46' 30''$. Lansbergen [Lansbergius] puts it in the year 139, and in the second year of Antoninus.

33. Tycho [Tycho Brahe], from what was said in Caput XII — yet corrected by us — in the year of the Lord 1585 completed obtained Antares in Sagittarius $4^{\circ} 5' 18''$.

34. Lansbergen, at the end of the year 1600, as he relates in his *Thesaurus* (p. 160), observed the meridian altitude of Antares to be $13^{\circ} 8'$ by apparent reckoning, or truly $13^{\circ} 2'$, or rather $4'$ [?]. (Goes, however [Goësae, i.e. as reported by Goes], gives the altitude above the equator as $38^{\circ} 29' 30''$.) Therefore the southern declination was $25^{\circ} 25' 30''$, and from the aforesaid latitude and obliquity its ecliptic place was in Sagittarius $4^{\circ} 18' 8''$.

35. We, together with Father Grimaldi [P. Grimaldo], from what was said at the end of the preceding chapter, found Antares at the end of the year 1660 to be in Sagittarius $5^{\circ} 1' 40''$.

POLLUX, or the Lower Twin's Head — Observations

36. Hipparchus, in Ptolemy (*Almagest* VII.3): in the year 127 before Christ he observed the northern declination of the head of the lower Twin to be 30° . Its latitude, from the end of the preceding chapter, is $6^{\circ} 38' 30''$ north, and with the obliquity of the ecliptic $23^{\circ} 30' 20''$, it was therefore at that time in Gemini $23^{\circ} 55' 40''$.

37. Paul Hainzel [Paulus Hainzelius], at the opening of the year of the Lord 1573, as Tycho records (*Progymnasmata*, vol. 1, p. 365), observed the declination of the head of the lower Twin to be $28^{\circ} 59'$. Therefore, from the latitude and obliquity of the ecliptic already set out, it was then in Cancer $17^{\circ} 10' 45''$.

38. Tycho, in the year 1585, from what was said in Caput XII, had the head of Pollux in Cancer $17^{\circ} 31' 28''$.

39. We, together with Father Grimaldi, from the end of the preceding chapter, establish the head of Pollux for the year 1660, completed from observations, in Cancer $18^{\circ} 31' 6''$.

From these observations, collated with one another, the comparisons in the following table are set before the eye, together with the annual motion of the fixed stars corresponding to the progression of the star and to the interval of time.

TABULA ARGUMENTI — For the Annual Motion of the Fixed Stars

This argument table (foot of left column, p. 258) continues the comparison series of the right-column tables. Columns: number of the observations compared (Ordo: from / to); the observers (Ab / Ad); the progression of *Spica*; the interval in years; and the annual motion (Motus Annuus, in seconds " and thirds ''').

Progressus Spicae

Obs. (Ordo)	Observers (Ab → Ad)	G r.	'	"	Interval (years)	Annual "	'''
1 – 2	Timoch. → Timoch.	0	1	0	12	50	0
			0				
1 – 5	Timoch. → Zaguth.	2	5	0	1768	50	3
		4	0				4
2 – 6	Timoch. → Copern.	2	4	5	1810	49	1
		4	2	0			3
1 – 7	Timoch. → Copern.	2	5	5	1820	49	1
		4	4	4			7
1 – 9	Timoch. → Tychon.	2	4	4	1880	49	1
		5	2	0			3
1 – 10	Timoch. → Hainzel.	2	3	5	1868	49	1
		5	1	0			2
1 – 11	Timoch. → Lasberg.	2	5	2	1893	49	1
		5	1	0			0
1 – 12	Timoch. → Hortens.	2	1	5	1924	49	1
		6	8	0			7
1 – 13	Timoch. → Gassend.	2	2	1	1930	49	1
		6	9	0			0
1 – 14	Timoch. → Nos	2	4	0	1955	49	1
		6	6				8
2 – 14	Timoch. → Nos	2	3	0	1942	49	1
		6	6				9

The following comparison tables occupy the right column of p. 258 (continuing onto p. 259). Each gives, for a given fixed star, the progression in longitude between two observers (Progressus), the interval in years (Intervallum, Annorū), and the resulting annual motion in seconds (") and thirds (").

Progressus Spicae (p. 258, right column)

Obs. (Ordo)	Observers (Ab → Ad)	G r.	'	"	Interval (years)	Annual "	'''
3 – 4	Hipparc. → Ptolem.	2	4 6	1 8	265	37	4 0
3 – 6	Hipparc. → Copern.	2 3	8	4 3	1642	50	2 5
3 – 7	Hipparc. → Copern.	2 3	2 0	4 7	1652	50	5 2
3 – 9	Hipparc. → Tychon.	2 4	8	3 4	1713	50	4 3
3 – 10	Hipparc. → Hainzel.	2 3	5 7	4 3	1700	50	4 4
3 – 11	Hipparc. → Lansb.	2 4	1 7	1 3	1726	50	3 9
3 – 12	Hipparc. → Hortens.	2 4	4 4	4 3	1757	50	3 9
3 – 13	Hipparc. → Gassend.	2 4	5 5	3	1763	50	5 2
3 – 14	Hipparc. → Nos	2 5	1 1	5 3	1788	50	4 0
6 – 9	Copern. → Tychon.	0	5 9	5 0	70	51	1 7
7 – 9	Copern. → Tychon.	0	4 9	4 7	60	49	4 7
6 – 14	Copern. → Nos	2	3	1 0	145	50	5 8
7 – 14	Copern. → Nos	1	5 1	6	135	49	1 3
9 – 14	Tychone → Nos	1	3	1 9	75	50	4 0

Obs. (Ordo)	Observers (Ab → Ad)	G r. ' "			Interval (years)	Annual "	'''
10 – 14	Hainzel. → Nos	1	1	1	88	50	3
			4	0			4

Progressus Reguli (p. 258, right column)

Obs. (Ordo)	Observers (Ab → Ad)	G r. ' "			Interval (years)	Annual "	'''
15 – 16	Hipparc. → Ptolem.	3	4	4	264	50	4
			3	5			9
15 – 17	Hipparc. → Albat.	1	8	5	1005	50	5
		4		0			4
15 – 18	Hipparc. → Azophi	1	2	5	1062	52	0
		5	0	0			
15 – 19	Hipparc. → Persas	1	3	5	1242	51	6
		7	8	0			
15 – 20	Hipparc. → Hainzel.	2	5	1	1699	50	4
		3	9	6			9
15 – 21	Hipparc. → Tychon.	2	1	1	1712	50	5
		4	2	0			4
15 – 22	Hipparc. → Lasberg.	2	1	5	1725	50	4
		4	8	0			5
15 – 23	Hipparc. → Hortens.	2	4	5	1756	50	4
		4	8	0			5
15 – 24	Hipparc. → Nos	2	1	3	1787	50	5
		5	3	5			2
16 – 17	Ptolem. → Albat.	1	2	0	641	50	4
		0	5				0
16 – 18	Ptolem. → Azophi	1	3	5	800	52	2
		1	9				5
16 – 19	Ptolem. → Persas	1	5	5	978	50	8
		3	5				
16 – 20	Ptolem. → Hainzel.	2	1	3	1435	50	4
		0	5	1			2
16 – 21	Ptolem. → Tychon.	2	2	7	1448	50	5

Obs. (Ordo)	Observers (Ab → Ad)	G r.	'	"	Interval (years)	Annual "	'''
		0	7				1
16 – 22	Ptolem. → Lasberg.	2	3	5	1461	50	4
		0	5				0
16 – 23	Ptolem. → Hortens.	2	5	5	1492	50	4
		1					1
16 – 24	Ptolem. → Nos	2	2	5	1523	50	4
		1	9	0			4
17 – 20	Albategn. → Hainzel.	9	5	2	693	51	2
			0	6			0
17 – 21	Albategn. → Tychon.	1	3	2	706	51	4
		0					
17 – 22	Albategn. → Lansb.	1	1	0	719	50	5
		0	0				4
17 – 23	Albategn. → Hortens.	1	4	0	750	51	1
		0	0				2
17 – 24	Albategn. → Nos	1	4	4	781	51	1
		1		5			5
18 – 21	Azophi → Tychon.	8	5	2	650	49	1
			1				
18 – 24	Azophi → Nos	9	5	4	724	49	9
			2	5			
19 – 21	Persis → Tychon.	6	3	2	470	50	1
			3				0
19 – 24	Persis → Nos	7	3	4	545	50	4
			4	5			

Progressus Aldebarae (p. 258, right column; continues onto p. 259)

Obs. (Ordo)	Observers (Ab → Ad)	G r.	'	"	Interval (years)	Annual "	'''
25 – 26	Hipparc. → Ptolem.	4	1	1	265	57	0
			2	4			
25 – 27	Hipparc. → Hainzel.	2	3	5	1700	49	5
		3	2	5			3

Obs. (Ordo)	Observers (Ab → Ad)	G			Interval (years)	Annual "	'''
25 – 28	Hipparc. → Tychon.	2	3	5	1713	49	5
		3	3	6			2
25 – 29	Hipparc. → Lansb.	2	5	2	1728	49	4
		3	2	7			6
25 – 30	Hipparc. → Nos	2	3	5	1788	49	3
		4	5	0			0
26 – 27	Ptolem. → Hainzel.	1	4	4	1435	49	2
		9	0	1			1
26 – 28	Ptolem. → Tychon.	1	4	4	1448	49	0
		9	1	2			
26 – 29	Ptolem. → Lansb.	2	0	1	1463	49	1
		0		3			8
26 – 30	Ptolem. → Nos	2	4	3	1523	49	0
		0	3	6			
28 – 30	Tychone → Nos	1	1	5	75	49	1
				4			8

The following two argument tables stand at the head of the left and right columns of p. 259, continuing the same comparison series.

Progressus Antares (p. 259, left column)

Obs. (Ordo)	Observers (Ab → Ad)	G			Interval (years)	Annual "	'''
31 – 32	Hipparc. → Ptolem.	3	5	1	264	54	1
			8	8			3
31 – 33	Hipparc. → Tychon.	2	2	6	1712	51	3
		4	5				5
31 – 34	Hipparc. → Lansb.	2	3	5	1727	51	3
		4	7	6			5
31 – 35	Hipparc. → Nos	2	2	2	1787	51	3
		5	0	8			
32 – 33	Ptolem. → Tychon.	2	1	4	1448	50	3
		0	8	8			0

Obs. (Ordo)	Observers (Ab → Ad)	G			Interval (years)	Annual	
		r	'	"		"	'''
32 – 34	Ptolem. → Lansb.	2	3	3	1463	50	3
		0	1	8			1
32 – 25 [recte 35?]	Ptolem. → Nos	2	1	1	1523	50	1
		1	5	0			4

Progressus Capitis Pollucis (p. 259, left column)

Obs. (Ordo)	Observers (Ab → Ad)	G			Interval (years)	Annual	
		r	'	"		"	'''
36 – 37	Hipparc. → Hainzel.	2	1	5	1700	49	1
		3	5				2
36 – 38	Hipparc. → Tychon.	2	3	4	1712	49	3
		3	5	8			9
36 – 39	Hipparc. → Nos	2	3	2	1787	49	3
		4	5	6			0

Conclusiones de Motu Fixarum — Conclusions on the Motion of the Fixed Stars

Conclusion I. *The motion of the fixed stars in longitude is equal and uniform.*

[Margin: *Aequalitas Motus Fixarum* — The uniformity of the motion of the fixed stars.]

I judge this sufficiently and more than sufficiently established from the foregoing table, since most of the comparisons of the better observations confirm it, and they nearly agree on an annual motion of about 50". For although the single motion from Hipparchus to Ptolemy indicates a much slower motion at that time — namely 37" 40''' — yet observations within the same interval, between Hipparchus and Ptolemy, require 50" 49''', and for Antares 54" 13'''. We therefore now recognize as false the claim by which Ptolemy, deceived by fallacious and perplexing observations (*Almagest* VII.2 and 3), tried to establish that the fixed stars move uniformly by a single degree every hundred years, that is, by only 36" in one year [*secunda scrupula* 36"].

[Margin: continues — they accord on about 50".]

From this there also coincide both the Motion of Trepidation in longitude and the Anomaly of the precession of the Equinoxes, which were devised by the Alphonsines and many Jews and Arabs with no necessary — indeed not even very probable — foundation: with so great an effort of mind was the matter forced back by Copernicus into a theoretical hypothesis. Against these we have argued at sufficient length (*Almagestum Novum* III, ch. 28, and VI, ch. 17 and 18), to which we refer the reader.

Conclusion II. *The annual motion of the fixed stars is neither less than 49" nor greater than 51".*

[Margin: *Limites Motus Fixarum* — The limits of the motion of the fixed stars.]

The argument is this: as to the second of 49", all the comparisons of the preceding table support it, with a single exception; and as to the second part, of 51", thirteen of them. The comparisons of the observations indeed indicate a greater motion, yet the remaining fifty-nine comparisons establish the smaller, and especially those drawn from observations and intervals of years that are conspicuous and very great — such as the Hipparchan observations collated with the Tyconic, the Hainzelian, the Gassendian, and our own; for these make us more confident in the truth than the Hipparchan collated with the Ptolemaic, given Ptolemy's most friendly devotion to truth but his slight labor, since he was bent (as one set on establishing his own hypotheses, once conceived, from probabilities but with few arguments) on the whole undertaking. Finally, beyond the aforesaid limits of seconds, 49" and 51", Tycho, Longomontanus, Kepler, Boulliau [Bullialdus], Wendelin [Vuendelinus], and Petavius — most excellent astronomers of this or the preceding age, as we reported above — have not dared to fall short or to go beyond.

Conclusion III. *The annual motion of the fixed stars seems to us more probable at 50" 40"', yet in such a way that the remaining values comprised between the motions 50" and 51" are not lacking in their own probability.*

[Margin: continues.]

For the earlier part of the Conclusion, as in the book *On the Sun*, ch. 4, we establish the equinoctial year from a single observation of Hipparchus compared with our own, for three reasons:

[*right column, p. 259, continuing*] namely, on account of the excellence of that astronomer among the ancients; on account of the most certain of all observations of the equinoxes that he made, inasmuch as it was at the meridian,

free of any uncertainty of refraction, illuminated equally by the armilla on both sides; and because, of very many years' interval between us and Hipparchus, we have therefore preferred the single observation of his to the mixtures of all the others. So, in the annual motion of the fixed stars — on which the magnitude of the sidereal year depends — we prefer, for the same three reasons, the single observation of Spica by Hipparchus, compared with ours, above all others. For Timochares' observations Hipparchus judged too simple, crude, and ambiguous (so Ptolemy attests, *Almagest* VII.1 and 3); and Hipparchus, when he had said that Aristyllus and Timochares had written down observations of the fixed stars, but had explained little and had recorded ambiguous observations even of the non-wandering stars, added that Hipparchus's own written observations — those which we have chiefly consulted — are most fully explained and recorded. Pliny too (*Natural History* II.12) names him among the rest: "a sharer in the counsels of Nature, a man of genius," and above (II.26): "never sufficiently praised, since he proved as no other that the stars are our heritage" [*Caelum in haereditatem reliquit posteris*], and (II.108): "a man marvelous in every kind of industry."

Moreover, among all the fixed stars observed from Timochares onward, none is more celebrated than the Spica of the Virgin, being one of the first-magnitude stars nearest to the ecliptic of all, and nearest to that very point of the autumnal equinox; therefore it is suited to the precession of the equinoxes, that is, to the proper motion of the fixed stars, which Hipparchus first detected — something he would surely not have ventured to bring to light except after many and very accurate considerations of this star. Now indeed, from the place of Spica observed by Hipparchus and afterwards by us, there results the annual motion of the fixed stars of 50" 40"; and the same follows from the very Tychonic and our own observation, nor does the motion which is gathered from the Hipparchan observation of Spica and that of Tycho, Hainzel, Lansbergen, and Hortensius differ from it by more than 4", as anyone surveying the preceding table will fully see.

[Margin: *Hipparchi Laus* — In praise of Hipparchus.]

The observations of Regulus likewise support this motion to some degree: namely the Hipparchan with the Lansbergian, and the Hortensian; and the Ptolemaic with the Albategnian, the Hainzelian, the Lansbergian, and our own, collated.

As to the second part of the Conclusion, we labor not — since, between 50" and 51", the remaining probable terms have almost no decades of thirds by which one observation's comparison is not in any way diminished. We therefore do not disapprove, here, of the Tychonic motion of the fixed stars of 51", that is, the one

we adopted in *Almagestum Novum* VI.13; we chose 50" in the meantime, but now in preference to these we elect 50" 40". As to what may follow from this, or from others within the aforesaid limits to be chosen, it remains to be said in the following chapter.

CAPUT XX — On the Sidereal Year, and on the Apocatastasis or Revolution of the Fixed Stars, and their Position at the Beginning of the World

1. The Sidereal Year is nothing other than a single revolution of the Sun from some one fixed star back to that same star — a revolution which would be as great as the equinoctial year if the fixed stars did not advance

[p. 260, left column:]

by their slow proper motion, little by little, in the order of the Signs. But because they do so move, the Sun cannot, once it has completed an equinoctial revolution, reach in the same time the same fixed star with which it stood at the beginning of the said revolution, until it has traversed the whole ecliptic, plus that little space up to the point to which that fixed star has advanced. Hence the precession of the equinoxes arose, because the Sun returns to the equinox sooner than to the fixed star, which lay in the point of the preceding equinox, or in the colure of the equinoxes; and the same holds, with respect to the stars, of those which lie in the colure of the solstices, etc. (as established in book I, ch. 4).

[Margin: *Anni Siderei Mensura* — The measure of the sidereal year.]

Therefore, since the equinoctial year is of 365 days, 5 hours, 48' 58", and since from what was said just above the annual motion of the fixed stars is elected at 50" of seconds and 40" of thirds — to traverse which, by the mean motion, the Sun requires 20' 33" 42" per hour [*horaria*] — if these be added to the equinoctial year, there arises for us the sidereal year of 365 days, 6 hours, 9' 21" 42".

2. Moreover, granting an annual motion of the fixed stars elected and posited at 50" 40", it follows that they do not complete a single degree except in 71 16/367 years, or 71 days, 19 hours [recte: years; the text reads "Annis 71 16/367, seu diebus 19, horisq; 12"], very nearly. And they do not traverse the whole circle of degrees except in 25,579 years — which is the Platonic Great Year. The sidereal years 25,579 are equal to 25,580 equinoctial years.

[Margin: *Annus Magnus* — The Great Year.]

Let Kepler in the *Rudolphine Tables* (p. 115), from the Tychonic annual motion of the fixed stars, say the sidereal years are 25,411, equated to tropical years; and Wendelin, in his *Idea Tabularum Atlanticarum* (p. 28), makes the sidereal years 25,519 equal to tropical years 25,520. As to whether, after the universal restoration [*anastasis*] of our bodies, the heavenly motions are to be brought to a stop or prolonged

until the Apocatastasis of all the stars is fully completed — that belongs to our frailty to investigate, not to determine.

3. It might be asked in what configuration of the fixed stars the sphere was constituted at the beginning of the World. To this question we cannot give a certain answer, because (as said in book I, ch. 9, no. 3) of our *Chronologia Reformata*, the World was created — according to the Vulgate Latin version and the Hebrew Codex — neither more than 4059 nor fewer than 4019 years before Christ; the mean of these is the year 4039. But according to the Greek Septuagint version it was created neither more than 5504 nor fewer than 5464 years before Christ, whose mean is the year 5484.

Now, from the year 4039 to the year of Christ 1660 there are 5699 or 5700 years, in which there are due, from the motion of the fixed stars, $80^{\circ} 13' 20''$ of degrees. And from the year 5484 before Christ to the year of Christ 1660 there are 7144 years, in which there are due $100^{\circ} 32' 43''$ of degrees. Therefore, according to the earlier Chronology, those fixed stars in the year of Christ 1660 were distant from the beginning of the Zodiac, that is, from the beginning of Aries, by $80^{\circ} 13' 20''$; so those very stars, at the beginning of the precession of the equinoxes, in the colure of the equinoxes and at the beginning of Aries, were near the second star in the Shield of Orion, and at the foot of Orion, the single one at the beginning of Eridanus.

But according to the Greek Septuagint Interpreters' Chronology, they were in the colure of the equinoxes and at the beginning of Aries; that star which in the year of Christ 1660 was elongated from this beginning by $100^{\circ} 32' 43''$ — such is the star in the left arm of Pollux. Sirius, however, the most splendid of all the fixed stars, was distant only $99^{\circ} 33'$, that is, one degree less than the aforesaid interval requires.

CAPUT XXI

TABULA I. Of the Right Ascension and Declination of One Hundred Fixed Stars for the undermentioned complete years of Christ, with the Difference of the same.

The table gives, for each named fixed star: the **Right Ascension** (Ascensio Recta) for the years 1660 and 1700 (in degrees Gr., minutes ', seconds "); the **Declination** (Declinatio) for 1660 and 1700 (with the marker **B** = *Borealis*, northern, or **A** = *Australis*, southern); the **Difference of Right Ascension** over 40 and 100 years; and the **Difference of Declination** over 40 and 100 years (marked *ad.* = increasing, *sub.* = decreasing). Only the first portion of the table (through the letter C) appears on this page; it continues on the following page (catchword "Capri-" = Capricorni).

Nomina	RA	RA	D	D			Diff.	
Fixaru	1660	1700	ec	ec			Decl. 40	Diff.
m (Star)	(Gr. ' ")	(Gr. ' ")	l.	l.	Diff. RA	Diff. RA	yr (" ad./sub.)	Decl. 100
			60	00	40 yr (")	(G. ' ")		yr (")
Androm edae Caput	357 43 20	358 14 8	27 13 50 B	27 27 26 B	30 48	1 17	13 36 ad.	34 0
Androm edae Cingulu m	12 38 8	13 11 20	33 49 28 B	34 2 40 B	33 12	1 23	13 12 ad.	33 0
Androm edae pes Austr.	25 46 15	26 21 51	40 40 30	40 52 30	35 36	1 29	12 0 sub.	30 0
Aquarij Fomaha nt	339 37 0	340 11 0	31 20 10 A	31 8 10 A	34 0	1 25	12 0 sub.	31 0
Aquarij humeru s dexter	327 4 55	327 36 55	1 55 20	1 43 44	32 0	1 20	11 36 sub.	29 0
Aquarij humer. sinister	318 23 30	318 55 54	6 59 10	6 48 46	32 24	1 21	10 24 sub.	26 0
Aquarij manus	307 15 30	307 45 54	10 41	10 33	30 24	1 16	7 36 sub.	19 0

Nomina	RA	RA	D ec l.	D ec l.	Diff. RA	Diff. RA	Diff.	
Fixaru	1660	1700	16	17	Diff. RA	100 yr	Decl. 40	Diff.
m (Star)	(Gr. ' ")	(Gr. ' ")	60	00	40 yr (' ")	(G. ' ")	yr (' "	Decl. 100
							ad./sub.)	yr (' ")
sinistra			20	44				
Aquilae	293 31	294 2	8	8	30 48	1 17	5 12 ad.	13 0
Lucida	59	47	1	6				
			20	32				
			B	B				
Arietis	23 43	24 17 2	17	17	33 12	1 23	12 24 ad.	31 0
1. in	50		36	48				
Cornu			0	24				
			B	B				
Arietis	23 57	24 30 3	19	19	32 48	1 22	11 24 ad.	31 0
2. in	15		7	19				
Cornu			0	24				
Arietis	27 1 58	27 35	21	22	34 0	1 25	12 0 ad.	30 0
Lucida		58	49	1				
			30	30				
Aurigae	72 52	73 35	45	45	33 36	1 49	4 0 ad.	10 0
Capella	20	56	36	40				
			0	0				
Aurigae	83 42	84 29	44	44	47 12	1 58	1 40 ad.	4 10
humeru	30	42	49	51				
s dexter			50	30				
Bootis	210 4	210 33	20	20	28 24	1 11	11 48	29 30
Arcturu	38	2	59	48			sub.	
s			50	2				
			B	B				
Bootis	214 37	215 2	39	39	24 48	1 2	10 48	27 0
humeru	45	33	46	35			sub.	
s sinist.			0	12				
Cancri	125 10	125 46	20	20	35 12	1 28	7 36 sub.	19 0
praesep	50	2	50	43				
e			40	4				
			B	B				

Nomina Fixarum m (Star)	RA 1660 (Gr. ' ")	RA 1700 (Gr. ' ")	D ec l. 60	D ec l. 100	Diff. RA 40 yr (' ")	Diff. RA 100 yr (G. ' ")	Diff. Decl. 40 yr (' " ad./sub.)	Diff. Decl. 100 yr (' ")
Cancr Asellus Boreus	125 50 0	126 26 0	22 39 0	22 31 0	36 0	1 30	8 0 sub.	20 0
Cancr Asellus Austral.	126 19 15	126 54 3	19 23 0	19 15 0	34 48	1 27	8 0 sub.	20 0
Canis Maior Sirius	97 30 18	97 57 6	16 16 16 30 A	16 18 6 A	26 48	1 7	1 36 ad.	4 0
Canicul a Procyon	110 22 32	110 54 33	6 4 0 B	5 59 12 B	32 0	1 20	4 48 sub.	12 0

Liber IV — De Stellis Fixis

Caput XXI (continued)

I. Table of the Right Ascension and Declination of One Hundred Fixed Stars for the Completed Years of Christ Written Below (continued)

The table of right ascensions and declinations of the 100 fixed stars continues. For each star are given the right ascension (in degrees, minutes, seconds) for the years 1660 and 1700; the declination (in degrees, minutes, seconds, with B = boreal/north or A = austral/south) for 1660 and 1700; and under "Differentia," the difference of right ascension (per 40 years and per 100 years) and the difference of declination (per 40 years and per 100 years, marked *ad.* = additive/increasing or *sub.* = subtractive/decreasing).

Column headers as printed: **Nomina Fixarum** [Names of the Fixed Stars]; **Ascensio Recta** [Right Ascension] — *Anno 1660* (Gr. ' '), *Anno 1700* (Gr. ' '); **Declinatio** [Declination] — *Anno 1660* (G. ' '), *Anno 1700* (Gr. ' '); **Differentia**

[Difference] — *Ascensionis* (Annorū 40: ' "; Annorū 100: G. '), *Declinationis* (Annorum 40: ' "; Annorū 100: ' ").

Name of the Fixed Star	RA 1660 (^o ''')	RA 1700 (^o ''')	Decl. 1660 (^o ''')	Decl. 1700 (^o ''')	Diff. Asc. 40yr (""')	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (""')	Diff. Decl. 100yr (°)
Capricornus cornu praecedens . [preceding horn of Capricornus]	299 50 35	300 24 34	13 28 30 A	13 22 6 A	33 59	1 25	6 24 sub.	16 0
Capricornus cornu inferius [lower horn of Capricornus]	300 32 41	301 7 29	15 44 50	15 38 2	34 48	1 27	6 48 sub.	17 0
Capricornus cauda praecedens . [preceding tail of Capricornus]	320 22 5	320 56 29	18 4 45	17 54 21	34 24	1 26	10 24 sub.	26 0
Capricornus cauda sequens	322 9 30	322 43 30	17 33 10	17 22 22	34 0	1 25	10 48 sub.	27 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
s [followi ng tail of Caprico rn]								
Cassiop eae lucida Cathedr . [bright star of Cassiop eia's Throne]	357 44 33	358 14 33	57 18 40 B	57 32 16 B	30 0	1 15	13 36 ad.	34 0
Cassiop eae schedir	5 23 12	5 56 0	54 41 40	54 55 16	32 48	1 22	13 36 ad.	34 0
Cassiop eae flexura [bend of Cassiop eia]	9 11 10	9 45 58	58 54 0	59 7 36	34 48	1 27	13 36 ad.	34 0
Cassiop eae genu [knee of Cassiop eia]	15 58 0	16 36 0	58 27 10	58 40 22	38 0	1 35	13 12 ad.	33 0
Cephei	320	321 6	69 6	69 17	8 48	0 22	10 24	26 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
cingulum [belt of Cepheus]	57 32	20	46	10			ad.	
Ceti mandibula lucid. [bright star of the Whale's jaw]	41 8 7	41 38 7	2 43 50 B	2 53 50 B	30 0	1 15	10 0 ad.	25 0
Ceti ventris Boreal. [northern star of the Whale's belly]	23 42 0	24 12 0	11 57 14 A	11 44 50 A	30 0	1 15	12 24 sub.	31 0
Ceti cauda Australis [southern star of the Whale's tail]	6 34 20	7 5 8	19 49 20	19 35 44	30 48	1 18	13 36 sub.	34 0
Ceti cauda Boreal.	0 33 0	1 4 12	10 38 50	10 24 50	31 12	1 17	14 0 sub.	34 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
[northern star of the Whale's tail]								
Coronae borealis lucida [bright star of the northern Crown]	230 13 0	230 39 0	27 53 44 B	27 45 20 B	26 0	1 5	8 24 sub.	21 0
Cygni rostrum [beak of the Swan]	289 15 24	289 39 48	27 18 16	27 22 40	24 24	1 1	4 24 ad.	11 0
Cygni pectoris antiqua [old star of the Swan's breast]	302 34 28	302 55 52	39 12 53	39 20 5	21 24	0 53½	7 12 ad.	18 0
Cygni cauda [tail of the Swan]	307 26 55	307 47 17	44 6 40	44 14 52	20 22	0 51½	8 12 ad.	20 30

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Cygni ala superio r. [upper wing of the Swan]	293 36 50	293 56 2	44 20 45	44 26 21	29 12	0 48	5 36 ad.	14 0
Cygni ala inferior . [lower wing of the Swan]	308 5 10	308 29 10	32 43 0	32 51 24	24 0	1 0	8 24 ad.	21 0
Draconi s lucida [bright star of the Dragon]	267 11 20	267 25 20	51 35 50	51 35 2	14 0	0 35	0 48 sub.	2 0
Gemino rum Castoris caput [head of Castor of the Twins]	108 9 10	108 50 46	32 34 50 B	32 30 26 B	41 36	1 44	4 24 sub.	11 0
Pollucis caput [head	111 6 0	111 43 36	28 47 50	28 43 2	38 36	1 34	4 48 sub.	12 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
of Pollux]								
Gemino rum pes lucidus [bright foot of the Twins]	94 28 20	95 3 32	16 38 20	16 37 32	35 12	1 28	0 48 sub.	2 0
Herculi s caput [head of Hercule s]	254 54 25	255 21 37	14 50 0 B	14 46 48 B	27 10	1 8	3 12 sub.	8 0
Herculi s humer. dext. [right shoulde r of Hercule s]	243 53 35	244 19 35	22 17 40	22 11 40	26 0	1 5	6 0 sub.	15 0
Herculi s humer. sinist. [left shoulde r of Hercule s]	255 10 45	255 31 33	25 19 0	25 15 48	20 48	0 52	3 12 sub.	8 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Hydrae cor [heart of the Hydra]	137 42 22	138 12 22	7 11 30 A	7 21 30 A	30 0	1 15	10 0 ad.	25 0 [?]
Leonis cor [Heart of the Lion, Regulus]	147 31 15	148 4 15	13 36 40 B	13 25 16 B	33 0	1 22½	11 24 sub.	28 30
Leonis cauda [tail of the Lion]	172 53 58	175 25 34 [?]	16 27 40	16 14 4	31 36	1 19	13 36 sub.	34 0
Leonis lucida iubae [bright star of the Lion's mane]	150 14 35	150 48 47	21 33 36	21 21 0	34 12	1 25½	11 36 sub.	29 0
Leonis lucida lumbor. [bright star of the Lion's loins]	163 57 30	164 32 20	22 21 20	22 7 44	34 50	1 27	13 36 sub.	34 0
Leonis	149	149	25 5	24 53	35 12	1 28	11 36	29 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
suprem a ceruicis [highes t star of the Lion's neck]	23 40	58 52	30	54			sub.	
Leonis infima ceruicis [lowest star of the Lion's neck]	147 12 40	147 47 52	18 24 45	18 13 33	35 12	1 28	11 12 sub.	28 0
Leporis femur [thigh of the Hare]	78 25 30	78 51 30	21 1 48 A	20 59 0 A	26 0	1 5	2 48 sub.	7 0
Librae lanx boreal. [northe rn Scale of the Balance]	224 42 38	225 15 26	8 5 10	8 14 46	32 48	1 21½	9 36 ad.	24 0
Librae lanx austral. [southe rn Scale	218 5 8	218 38 12	14 34 30	14 45 18	33 12	1 23	10 48 ad.	27 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
of the Balance]								
Lyrae lucida [bright star of the Lyre, Vega]	276 19 32	276 39 32	38 30 40 B	38 32 16 B	20 0	0 50	1 36 ad.	4 0
Ophiuc hi caput [head of Ophiuc hus]	259 47 14	260 15 38	12 52 10 B	12 49 22 B	28 24	1 11	2 48 sub.	7 0
Ophiuc hi manus sinistra [left hand of Ophiuc hus]	239 14 25	259 47 37 [?]	2 45 40 A	2 52 52 A	33 12	1 23	7 12 ad.	18 0
Ophiuc hi genu dext. [right knee of Ophiuc hus]	252 19 40	252 39 40	9 47 30	9 53 30	20 0	0 50	6 0 ad.	10 0
Ophiuc hi genu	244 38 25	245 11 37	15 12 30	15 16 30	33 12	1 23	4 0 ad.	15 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
sinist. [left knee of Ophiuc hus]								
Ophiuc hi humer us dext. [right shoulde r of Ophiuc hus]	261 39 26	262 8 38	4 46 40 B	4 44 40 B	29 12	1 13	2 0 sub.	5 0
Orionis capitis suprem a [highes t star of Orion's head]	79 8 20	79 41 10	9 31 50 B	9 34 38 B	32 50	1 22	2 48 ad.	7 0
Orionis humer us dexter [right shoulde r of Orion]	84 10 16	84 43 4	7 16 44	7 18 20	32 48	1 22	1 36 ad.	4 0
Orionis humer us sinist.	76 45 4	77 16 40	5 59 50	6 3 2	31 36	1 19	3 12 ad.	8 0

Name of the Fixed Star	RA 1660 (^o ^{'''})	RA 1700 (^o ^{'''})	Decl. 1660 (^o ^{'''})	Decl. 1700 (^o ^{'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
[left shoulde r of Orion]								
Orionis pes Rigel [the foot of Orion, Rigel]	74 32 38	75 2 50	8 37 30 A	8 33 42 A	30 12	1 15½	3 48 sub.	9 30
Orionis 1. balthei [1st star of Orion's belt]	78 39 0	79 9 48	0 35 38	0 32 50	30 48	1 17	2 48 sub.	7 0
2. balthei [2nd star of the belt]	79 42 0	80 12 54	1 28 10	1 25 46	30 54	1 17	2 24 sub.	6 0
3. balthei [3rd star of the belt]	80 48 0	81 18 25	2 10 20	2 8 20	30 25	1 16	2 0 sub.	5 0
Pegasi os [mouth of	321 56 24	322 27 36	8 21 50 B	8 32 14 B	31 12	1 18	10 24 ad.	26 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Pegasus]								
Pegasi crus Scheat [the leg of Pegasus , Scheat]	341 51 48	342 20 36	26 15 50	26 28 38	28 48	1 12	12 38 ad.	32 0
Pegasi Markab	341 58 7	342 28 10	13 23 10	13 35 58	30 3	1 15	12 38 ad.	32 0
.								
Pegasi Algenib	358 57 0	359 27 25	13 19 20	13 32 56	30 25	1 16	13 36 ad.	34 0
.								
Persei lucidu m latu s [bright side of Perseus]	44 57 6	45 32 18	48 34 30	48 44 54	35 12	1 28	10 24 ad.	21 1 [?]
Persei: Medusa e caput [the head of Medusa held by Perseus]	41 33 54	42 12 42	39 36 30	39 46 30	38 48	1 37	10 0 ad.	25 0
Piscis	344	345	1 26	1 40 2	30 50	1 17	13 12	33 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
australi s occiput. [back of the head of the Souther n Fish]	53 15	24 5	50				ad.	
Piscium lini nexus [knot of the cord of the Fishes]	26 6 51	26 38 5	1 7 0	1 19 0	31 34	1 18	12 0 ad.	30 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Sagittar ii lucida capitis [bright star of Sagittar ius' head]	282 14 10	283 1 5	21 26 0 A	21 22 48 A	46 55	1 31	3 12 sub.	8 0
Scorpij cor	242 10 40	242 47 28	25 33 30	25 39 54	36 48	1 32	6 24 ad.	16 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Antares [Heart of the Scorpio n, Antares]								
Scorpij Frons boreali s [northe rn brow of the Scorpio n]	236 23 27	236 58 15	18 46 0	18 53 36	34 48	1 28	7 36 ad.	19 0
Frontis media [middle brow]	235 28 30	236 4 34	21 33 40	21 41 40	36 4	1 30	8 0 ad.	20 0
Frons australi s [southe rn brow]	234 39 2	235 18 0	25 1 30	25 9 54	38 58	1 37½	8 24 ad.	21 0
Serpent is lucida colli [bright star of the	231 54 0	232 24 0	7 33 0 B	7 24 36 B	30 0	1 15	8 24 sub.	21 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Serpent 's neck]								
Tauri Aldebar a [Aldeba ran of Taurus]	64 6 58	64 41 35	15 46 10 B	15 52 10 B	34 37	1 26½	6 0 ad.	15 0
Tauri cornu boreum [northe rn horn of Taurus]	76 12 30	76 51 18	28 15 50	28 19 2	38 48	1 37	3 12 ad.	8 0
Tauri cornu austral e [southe rn horn of Taurus]	79 18 56	79 55 20	20 53 10	20 55 58	36 24	1 31	2 48 ad.	7 0
Tauri boreus oculus [northe rn eye of Taurus]	62 10 0	62 43 36	18 23 40	18 30 28	33 36	1 24	6 48 ad.	17 0
Tauri infima Hyadu m	60 5 35	60 39 35	14 48 50	14 55 38	34 0	1 25	6 48 ad.	17 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
[lowest of the Hyades of Taurus]								
Tauri Pleiadu m Lucida [bright star of the Pleiade s of Taurus]	51 52 4	52 27 35	23 1 0	23 9 24	35 31	1 29	8 24 ad.	21 0
Virginis Spica [the Ear of grain of Virgo, Spica]	196 51 0	197 22 55	9 20 30 A	9 33 30	31 55	1 19½	13 0 ad.	32 30
Virginis cingulu m [belt of Virgo]	189 39 10	190 10 22	5 16 30 B	5 2 54 B	31 12	1 18	13 36 sub.	34 0
Virginis vindem iatrix [Vinde miatrix of Virgo]	191 21 32	191 52 20	12 48 10	12 34 58	30 48	1 17	13 12 sub.	33 0

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
Vrsae maioris Dubhe [Dubhe of the Great Bear]	160 36 40	161 17 5	63 34 50 B	63 22 2 B	40 25	1 41	12 48 sub.	32 0
Lateris lucida [bright star of the flank]	160 13 30	160 52 20	58 11 50	57 59 2	38 50	1 37	12 48 sub.	32 0
Post. coxae lucida [bright star of the hind haunch]	173 50 22	174 23 34	55 36 50	55 23 42	33 12	1 23	12 48 sub.	34 0
Tergori s prope caudam luc. [bright star of the back near the tail]	179 56 1	180 8 2	58 54 30	58 41 42	32 1	1 20	12 48 sub.	34 0
Vrsae mai. 1.	189 40 20	190 7 56	57 50 10	57 36 58	27 36	1 9	13 12 sub.	33 0

Name of the Fixed Star	RA 1660 (^o ^{'''})	RA 1700 (^o ^{'''})	Decl. 1660 (^o ^{'''})	Decl. 1700 (^o ^{'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
caudae [Great Bear, 1st star of the tail]								
2. caudae [2nd star of the tail]	197 29 50	197 55 2	56 43 40	56 30 52	25 12	1 3	12 48 sub.	32 0
3. in extrem o caudae [3rd star, at the very end of the tail]	203 29 0	203 53 50	51 3 20	50 50 56	24 50	1 2	12 24 sub.	31 0
Vrsae minoris vltima caudae nunc Polaris [last star of the Little Bear's tail, now	8 36 10	9 52 10	87 29 15	87 42 51	76 0	3 10	13 36 ad.	34 10

Name of the Fixed Star	RA 1660 (^{o'''})	RA 1700 (^{o'''})	Decl. 1660 (^{o'''})	Decl. 1700 (^{o'''})	Diff. Asc. 40yr (^{'''})	Diff. Asc. 100yr (°)	Diff. Decl. 40yr (^{'''})	Diff. Decl. 100yr (°)
the Pole Star]								
Vrsae minoris lucida humeri, olim Cynosu ra [bright star of the Little Bear's shoulde r, formerl y Cynosu ra]	222 39 50	222 39 20	75 38 30	75 37 30	0 30	1 15	1 0 sub.	2 30
Huius Ascens. Recta decresc it. [its right ascensi on is decreas ing]								

Usus praecedentis Tabulae cum cautelis [Use of the preceding table, with cautions]

1. If you wish to find the right ascension or declination of any of the aforementioned fixed stars for years between 1660 and completed 1700, of Christ, use the difference of these set under the heading "40 years." Multiply it by the number of years from the year 1660 (counting exclusively from that numbered year), and divide the product by 40. The result gives the minutes (and seconds), to be added to the right ascension of the year 1660 — except in the case of the bright star of the Little Bear [Polaris], where it must be subtracted. The difference of declination, however — found proportionally for the given number of years — is to be added or subtracted according as the marks *ad.* [additive] or *sub.* [subtractive] indicate.

2. If you seek the right ascension or declination of the aforesaid fixed stars for years between 1600 and 1700, use the difference sought under the heading "100 years," and multiply it by the number of years counting backward from the year 1700. [The remainder of the procedure continues as above.]

3. If you seek the right ascension or declination of the aforesaid fixed stars for years between 1700 and 1800, of Christ, use the difference sought under the heading "100 years," and multiply it by the number of years from the year 1700 (counting exclusively). Divide the sum by 100; the quotient gives the proportional part to be added to the right ascension of the year 1700 — except in the case of the bright star of the Little Bear, where it must then be subtracted; while for declination, this same part is to be added or subtracted according as the marks *ad.* or *sub.* indicate.

[Then, regarding the right ascension of the year 1700: the sum is to be divided by one hundred; for the quotient gives the number to be subtracted from the right ascension of the year 1700, in the case of the bright star of the Little Bear, since for that star an addition must be made; but for declination the contrary is to be done, and the marks *ad.* and *sub.* indicate this, for the proportional part found is subtracted where the mark is *ad.*, and added where the mark is *sub.*]

The New Star of Cygni [the Swan, Nova Cygni] was observed on the boundary between the neck and the breast in the year 1659, often in November: its right ascension was $300^{\circ} 58' 6''$; its boreal declination $36^{\circ} 48'$. [?]

II. Table of the Longitude and Latitude of 101 of the More Notable Fixed Stars, Observed on the Horizon of Bologna

Column headers as printed: **Nomina Fixarum Latina** [Latin Names of the Fixed Stars]; **Nomina Arabica, vel Chaldaica** [Arabic or Chaldaic Names]; **Longitudo An. 1660. copl.** [Longitude, completed year 1660] (Sig. Gr. ' '); **Longitudo An. 1700. copl.** [Longitude, completed year 1700] (Sig. Gr. ' '); **Latitudo perpetua** [Perpetual Latitude] (Gr. ' ', with B = boreal/north or A = austral/south); **Magnit.** [Magnitude].

Zodiac signs are given by their symbols; I render them by name: ♈ Aries, ♉ Taurus, ♊ Gemini, ♋ Cancer, ♌ Leo, ♍ Virgo, ♎ Libra, ♏ Scorpio, ♐ Sagittarius, ♑ Capricorn, ♒ Aquarius, ♓ Pisces.

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′′)	Longitude 1700 (Sign °′′′)	Perpetual Latitude (°′′′)	M a g n .
Andromedae Caput [head of Andromeda]		Aries 9 35 16	Aries 10 9 3	25 42 10 B	2
Andromedae lucida cinguli [bright star of Andromeda's girdle]	Mizar, seu Mirach [Mizar, or Mirach]	Aries 25 37 13	Aries 26 11 0	25 58 30	2
Andromedae Pes australis [southern foot of Andromeda]	Allamak [Almach]	Taurus 9 27 57	Taurus 10 1 44	27 47 10	2
Aquarij effusio, seu os Piscis [the outpouring of Aquarius, or	Phomel haut [Fomalhaut]	Aquarius 29 2 56	Aquarius 29 36 43	20 59 40 A	1

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
mouth of the Fish]					
Aquarij humerus dext. [right shoulder of Aquarius]	idest os piscis [that is, the mouth of the fish]	Aquarius 27 58 10	Aquarius 28 31 57	10 42 15 B	3
Aquarij humerus sinist. [left shoulder of Aquarius]		Aquarius 18 39 40	Aquarius 19 13 27	8 42 15	3
Aquarij manu sinistra [left hand of Aquarius]		Aquarius 11 39 40	Aquarius 12 13 27	4 50 15	5
Aquilae lucida, seu Vulturis [bright star of the Eagle, or of the Vulture, Altair]	Altair	Capricorn 26 58 30	Capricorn 27 32 17	29 20 40 B	2
Arietis prima in cornu [first star in the horn of Aries]	Ras Hammel [Hamal]	Aries 28 25 40	Aries 28 59 27	7 8 0	4
Arietis secunda in		Aries 29 11 40	Aries 29 45 27	8 28 30	4

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
cornu [second star in the horn of Aries]					
Arietis lucida supra caput [bright star above the head of Aries]		Taurus 2 54 42	Taurus 3 28 29	9 56 30	3
Aurigae Capella [the Capella of the Charioteer]	Alhailoth [Alhajoth]	Gemini 17 6 15	Gemini 17 40 2	22 51 45	1
Aurigae humerus dext. [right shoulder of the Charioteer]		Gemini 26 38 15	Gemini 27 12 2	21 25 40	2
Bootis Arcturus [Arcturus of Boötes]	Alramech [Aramech]	Libra 19 30 40	Libra 20 4 27	31 0 40 B	1
Bootis humerus sinister [left shoulder of Boötes]		Libra 13 56 40	Libra 14 30 27	49 51 40	3
Cancri praesepe [the Manger of		Leo 2 34 36	Leo 3 8 23	1 14 30	n e b

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
the Crab]					.
Cancr Asellus boreus [northern Ass of the Crab]		Leo 2 45 6	Leo 3 18 53	3 8 30	4
Cancr Asellus Australis [southern Ass of the Crab]		Leo 3 56 6	Leo 4 29 53	0 3 30 A	4
Canis maioris os Sirius [the muzzle of the Greater Dog, Sirius]	Alhabor, vel Scheer Eliemini [Alhabor, or Schir al- yamānī]	Cancer 9 31 0	Cancer 10 4 47	39 32 5 A	1
Canis minoris Procyon [Procyon of the Lesser Dog]	Algomiza, vel Kelbelazguar [Algomisa, or Kalb al- asghar]	Cancer 21 6 30	Cancer 21 40 27	15 57 10 A	2
Capricorni Cornu praecedens [preceding horn of Capricorn]		Capricorn 29 10 40	Capricorn 29 44 27	7 3 11 B	3
Capricorni Cornu sequens [following		Capricorn 29 23 40	Capricorn 29 57 27	4 42 10	3

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
horn of Capricorn]					
Capricorni Cauda praecedens [preceding tail of Capricorn]	Denneb Elgedi [Deneb Algedi]	Aquarius 17 6 40	Aquarius 17 40 27	2 24 50 A	3
Capricorni Cauda sequens [following tail of Capricorn]		Aquarius 18 52 40	Aquarius 19 26 27	2 27 50	3
Cassiopeae lucida cathedrae [bright star of Cassiopeia's throne]	Dath Elkartī [Dhāt al- kursī]	Taurus 0 22 0	Taurus 0 55 47	51 17 0 B	3
Cassiopeae lucida pectoris [bright star of Cassiopeia's breast]	Scheder [Schedar]	Taurus 3 5 40	Taurus 3 39 27	46 36 50	3
Cassiopeae flexura [bend of Cassiopeia]		Taurus 9 15 40	Taurus 9 49 27	48 47 50	3
Cassiopeae		Taurus 13 9	Taurus 13 42	48 23 50	3

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
genu [knee of Cassiopeia]		10	57		
Cephei cingulum [belt of Cepheus]		Taurus 1 2 43	Taurus 1 36 30	71 8 30	3
Ceti Mandibulae lucida [bright star of the Whale's jaw]		Taurus 9 35 45	Taurus 10 7 32	12 36 50 A	2
Ceti Borea ventris [northern star of the Whale's belly]		Aries 17 14 28	Aries 17 48 15	20 17 20	3
Ceti Cauda Borealis [northern star of the Whale's tail]		Pisces 26 13 0	Pisces 26 46 47	9 58 10	3
Ceti Cauda Australis [southern star of the Whale's tail]		Pisces 27 46 0	Pisces 28 19 47	20 43 40	2
Coronae boreae lucida [bright star of the northern	Alphetaβ [Alphecca]	Scorpio 7 28 43	Scorpio 8 2 30	44 25 20 B	2

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
Crown]					
Cygni rostrum, seu Caput [beak, or head, of the Swan]	Menkar Eldigiagich [Menkar al- dajājah]	Capricorn 26 31 44	Capricorn 27 5 31	49 3 0 B	3
Cygni pectus <i>non noua</i> [breast of the Swan — not the new star]		Capricorn 20 12 54	Capricorn 20 46 40	57 10 20	3
Cygni cauda [tail of the Swan]	Denneb Eldigiagich [Deneb al- dajājah]	Pisces 0 41 25	Pisces 1 15 12	59 57 20	2
Cygni ancon. Alae superioris [elbow, of the upper wing of the Swan]		Aquarius 11 41 0	Aquarius 12 14 47	64 28 50	3
Cygni ancon. Alae inferioris [elbow, of the lower wing of the Swan]		Aquarius 22 57 30	Aquarius 23 31 17	49 27 0	3
Draconis lucida Capitis seq. [bright following star of the	Ras Eltanin [Ras al- tinnin]	Sagittarius 23 12 20	Sagittarius 23 46 7	75 2 10	3

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
Dragon's head]					
Geminorum Castoris Caput [head of Castor of the Twins]	Ras Elgiautze [Ras al- jawzā']	Cancer 15 28 0	Cancer 16 1 47	10 2 50 B	2
Geminorum Pollucis Caput [head of Pollux of the Twins]	Ketpholtsum am	Cancer 18 31 6	Cancer 19 4 53	6 38 30	2
Geminorum Lucidus pes [bright foot of the Twins]		Cancer 4 18 0	Cancer 4 51 47	6 48 0 A	4
Herculis Caput [head of Hercules]	Ras Plhathi [Ras al-jāthī]	Sagittarius 11 24 20	Sagittarius 11 58 7	37 22 15 B	3
Herculis humerus dexter [right shoulder of Hercules]		Scorpio 26 20 50	Scorpio 26 54 37	42 47 15	3
Herculis humerus sinister [left shoulder of Hercules]		Sagittarius 10 3 20	Sagittarius 10 37 7	47 46 15	3
Hydrae Cor [heart of the Hydra]	Kalb Elhauich [Qalb al-	Leo 22 32 50	Leo 23 6 37	22 23 50 A	1

Latin Name	Arabic/ Chaldaic Name	Longitude 1660 (Sign °′′)	Longitude 1700 (Sign °′′)	Perpetual Latitude (°′′)	M a g n .
	shujā']				
Leonis Cor Regulus [Heart of the Lion, Regulus]	Kalb Ellessed [Qalb al-asad]	Leo 25 4 45	Leo 25 38 32	0 26 20 B	1
Leonis Cauda [tail of the Lion]	Denneb Ellessed [Deneb al- asad]	Virgo 16 53 0	Virgo 17 26 47	12 16 20	1
Leonis lucida iubae [bright star of the Lion's mane]		Leo 24 44 32	Leo 25 18 19	8 45 40	2
Leonis lucida lumborum [bright star of the Lion's loins]		Virgo 6 33 45	Virgo 7 7 32	14 18 30	2
Leonis suprema ceruicis [highest star of the Lion's neck]		Leo 22 43 0	Leo 23 16 47	11 48 40	3
Leonis infima ceruicis [lowest star of the Lion's neck]		Leo 23 5 30	Leo 23 39 17	4 50 40	3

Liber IV — De Stellis Fixis (continued)

Caput XXI (continued)

II. Table of the Longitude and Latitude of the 101 More Notable Fixed Stars Observed at the Horizon of Bologna (continued)

The columns are: Latin name of the fixed star; Arabic or Chaldaic name; Longitude for the year 1660 (complete); Longitude for the year 1700 (complete); perpetual latitude; magnitude. Longitude and latitude are given in sign, degrees, minutes, seconds (Sig. Gr. ' "); for latitude the column also carries a letter A (north, *Borealis*) or B (south, *Australis*). The zodiacal-sign glyphs are transcribed as the standard astronomical symbols.

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. ' ")	Longitude 1700 (Sig. Gr. ' ")	Perpetual latitude (Gr. ' ")	M a g n i t u d e
Thigh, or back, of the Hare [Lepus]		♊ 14 55 20	♊ 15 29 7	43 55 50 A	3
Northern scale-pan of the Balance [Libra]	Vazne Schemali	♊ 14 38 30	♊ 15 12 17	8 33 30 B	2
Southern scale-pan of the Balance	Vazne Ganubi	♊ 10 22 40	♊ 10 56 27	0 25 10 B	2
Bright star of the Lyre, the falling Vulture [Vega]	Vagich Alahore	♊ 10 32 40	♊ 11 6 27	61 47 0	1
Head of Ophiuchus	Ras Alhangae	♊ 17 43 20	♊ 18 17 7	35 56 15 B	3
Left hand of Ophiuchus		♊ 27 37 50	♊ 28 11 37	17 18 20	3
Right knee of Ophiuchus		♊ 13 17 20	♊ 13 51 7	7 17 20	3

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. '")	Longitude 1700 (Sig. Gr. '")	Perpetual latitude (Gr. '")	M a g .
Left knee of Ophiuchus		Υ 4 32 20	Υ 5 6 7	11 29 20	3
Right shoulder of Ophiuchus		Υ 20 38 20	Υ 21 12 7	28 0 20	3
Topmost star of the Head of Orion		Π 19 1 0	Π 19 34 47	13 25 30 A	4
Right shoulder of Orion, following	Betelgeuze	Π 24 2 48	Π 24 36 35	16 6 15 A	2
Left shoulder of Orion, preceding		Π 16 13 0	Π 16 46 47	16 52 30 A	2
Bright star of Orion's left foot	Regel Elgebar	Π 12 3 10	Π 12 36 57	31 10 10 A	1
First star of Orion's belt		Π 17 35 40	Π 18 9 27	23 36 40 A	2
second		Π 18 39 55	Π 19 13 42	24 34 10 A	2
third, the lowest		Π 19 49 15	Π 20 23 2	25 21 10 A	2
The mouth [os] of Pegasus	Scheat Alpheraz	≈ 27 11 20	≈ 27 45 7	22 6 20 B	3
Bright star of Pegasus' leg	Markeb, that is, the chariot [currus]	⋈ 24 40 20	⋈ 25 14 7	31 8 20	2
First bright star of Pegasus' wing	Algenib	⋈ 18 45 50	⋈ 19 19 37	19 24 50	2

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. '")	Longitude 1700 (Sig. Gr. '")	Perpetual latitude (Gr. '")	M a g .
Outermost bright star of Pegasus' wing		♄ 4 26 20	♄ 5 0 7	12 37 0	2
Navel [umbilicus] of Pegasus — see the Head of Andromeda		♊ 9 35 16	♊ 10 9 3	25 42 10	2
Bright side [latus] of Perseus	Elgenab	♄ 27 0 8	♄ 27 39 55	30 5 40 B	2
Head of the Medusa of Perseus	Ras Algol, the head of the demon [caput dæmonis]	♄ 21 32 10	♄ 22 5 57	22 22 40	3
Bright star of Perseus' sole [planta] — see the northern Horn of ♄		♊ 17 49 0	♊ 18 22 47	5 20 30	2
Occiput of the southern Fish [Piscis australis]		♄ 16 39 12	♄ 17 12 59	7 17 0	4
Bright star in the knot of the cord [nexus lini] of the Fishes		♊ 24 36 12	♊ 25 9 59	9 4 0	3
Bright star of the Head of	Antares. Kalb	♄ 8 48 40	♄ 9 22 27	1 45 10	4

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. '")	Longitude 1700 (Sig. Gr. '")	Perpetual latitude (Gr. '")	M a g .
Sagittarius					
Heart of the Scorpion [Scorpii Cor]	Aakrab	Υ 5 1 40	Υ 5 35 27	4 26 30 A	1
Northern star of the Scorpion's Forehead [Frontis Borealis]	Aakrab Schemali	≈ 28 23 10	≈ 28 56 57	1 6 55 B	2
middle of the Forehead		≈ 27 46 20	≈ 28 20 7	1 52 40 A	3
southern of the Forehead	Aakrab Genubi	≈ 28 12 0	≈ 28 45 47	5 20 40 A	3
Bright star of the Serpent's neck [colli] Serpent- bearer [Serpentarius] — see Ophiuchus		≈ 17 17 0	≈ 17 50 47	25 33 50 B	2
Southern eye of the Bull, the Palilicium [Aldebaran]	Aldebaran, & Atia Elthaur	II 5 1 43	II 5 35 30	5 30 50 A	1
Northern eye of the Bull		II 3 42 13	II 4 16 0	2 36 20	3
Lowest star of the Hyades of the Bull		II 1 0 15	II 1 34 2	5 46 20	3
Northern horn of the		II 17 49 0	II 18 22 47	5 20 30	2

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. '")	Longitude 1700 (Sig. Gr. '")	Perpetual latitude (Gr. '")	M a g .
Bull					
Southern horn of the Bull		♐ 19 42 0	♐ 20 15 47	2 13 30 A	3
Bright star of the Bull's Pleiades	Altorich, or rather Athorric [Altorich nō Athorric]	♊ 25 20 50	♊ 25 54 37	3 59 0 B	3
Spike of the Virgin [Virginis Spica]	Sembalet Elandri, & Eltsamecti	♌ 19 6 0	♌ 19 39 47	1 59 30 A	1
Bright star of the Virgin's girdle [cingulis]	Alaraph	♌ 6 45 0	♌ 7 18 47	8 40 30 B	3
Vindemiatrix of the Virgin		♌ 5 12 30	♌ 5 46 17	16 15 0 B	3
Bright star of the shoulder [humeri] of the Great Bear [Ursa maior]	Dubhe	♐ 10 25 40	♐ 10 59 27	49 40 10 B	2
Bright star of the flank [Lateris Lucida]		♐ 14 34 10	♐ 15 7 57	45 5 40	2
Bright star of the hindquarter [coxae		♐ 25 40 40	♐ 26 14 27	47 8 40	2

Latin name of the fixed star	Arabic / Chaldaic name	Longitude 1660 (Sig. Gr. ' ")	Longitude 1700 (Sig. Gr. ' ")	Perpetual latitude (Gr. ' ")	M a g .
poster.]					
Bright star of the back [tergoris]		♌ 26 16 10	♌ 26 49 57	51 37 10	3
Root [Radix], or first star, of the tail	Alhiath	♍ 4 2 40	♍ 4 36 27	54 17 45	2
Middle, or 2nd, of the tail		♍ 10 48 6	♍ 11 21 53	56 21 10	2
Last, or 3rd, of the tail	Alabieth, or Ellamath	♍ 22 3 20	♍ 22 37 7	54 24 10	2
Outermost star of the tail of the Little Bear [Ursa minor], the Pole-star [Polaris]	Ruccabah	♎ 23 53 0	♎ 24 26 47	65 59 50 B	2
Bright shoulder, the Cynosure [Cynosura]	Dhub Elezguar	♏ 8 11 20	♏ 8 45 7	72 48 40 B	2

III. Table of the Motion of the Fixed Stars in Longitude, to be Added to (or Subtracted from) the Longitude of the Year 1700 of Christ, so that Their Places After, or Before, May Be Had

The table is laid out in four side-by-side blocks. The first two blocks each carry the columns *Anni* (years elapsed) and the corresponding motion in degrees(I)–minutes(II)–seconds(III), where in the first two blocks the leading figure is a single digit so the heading reads I | II | III. The later blocks add an explicit *Gr.* (degrees) column for the larger accumulated values.

Y e ar s	Motion (° ' ")	Y e ar s	Motion (° ' ")	Y e ar s	Motion (Gr. ' ")	Y e ar s	Motion (Gr. ' ")
1	0 50 40	3	26 10 40	6	0 51 30 40	9	1 16 50 40
		1		1		1	
2	1 41 20	3	27 1 20	6	0 52 21 20	9	1 17 41 20
		2		2		2	
3	2 32 0	3	27 52 0	6	0 53 12 0	9	1 18 32 0
		3		3		3	
4	3 22 40	3	28 42 40	6	0 54 2 40	9	1 19 22 40
		4		4		4	
5	4 13 20	3	29 33 20	6	0 54 53 20	9	1 20 13 20
		5		5		5	
6	5 4 0	3	30 24 0	6	0 55 44 0	9	1 21 4 0
		6		6		6	
7	5 54 40	3	31 14 40	6	0 56 34 40	9	1 21 54 40
		7		7		7	
8	6 45 20	3	32 5 20	6	0 57 25 20	9	1 22 45 20
		8		8		8	
9	7 36 0	3	32 56 0	6	0 58 16 0	9	1 23 36 0
		9		9		9	
1	8 26 40	4	33 46 40	7	0 59 6 40	1	1 24 26 40
0		0		0		0	
						0	
1	9 17 20	4	34 37 20	7	0 59 57 20	2	2 48 53 20
1		1		1		0	
						0	
1	10 8 0	4	35 28 0	7	1 0 48 0	3	4 13 20 0
2		2		2		0	
						0	
1	10 58 40	4	36 18 40	7	1 1 38 40	4	5 37 46 40
3		3		3		0	
						0	
1	11 49 20	4	37 9 20	7	1 2 29 20	5	7 2 13 20
4		4		4		0	

Y e ar s	Motion (° ' ")	Y e ar s	Motion (° ' ")	Y e ar s	Motion (Gr. ' ")	Y e ar s	Motion (Gr. ' ")
						0	
1 5	12 40 0	4 5	38 0 0	7 5	1 3 20 0	6 0 0	8 26 40 0
1 6	13 30 40	4 6	38 50 40	7 6	1 4 10 40	7 0 0	9 51 6 40
1 7	14 21 20	4 7	39 41 20	7 7	1 5 1 20	8 0 0	11 15 33 20
1 8	15 12 0	4 8	40 32 0	7 8	1 5 52 0	9 0 0	12 40 0 0
1 9	16 2 40	4 9	41 22 40	7 9	1 6 42 40	1 0 0 0	14 4 26 40
2 0	16 53 20	5 0	42 13 20	8 0	1 7 33 20	2 0 0 0	18 8 53 20 [?]
2 1	17 44 0	5 1	43 4 0	8 1	1 8 24 0	3 0 0 0	42 13 20 0
2 2	18 34 40	5 2	43 54 40	8 2	1 9 14 40	4 0 0 0	56 17 46 40
2 3	19 25 20	5 3	44 45 20	8 3	1 10 5 20	5 0 0 0	70 22 13 20

Y e ar s	Motion (° ' ")	Y e ar s	Motion (° ' ")	Y e ar s	Motion (Gr. ' ")	Y e ar s	Motion (Gr. ' ")
2 4	20 16 0	5 4	45 36 0	8 4	1 10 56 0	6 0 0 0	84 26 40 0
2 5	21 6 40	5 5	46 26 40	8 5	1 11 46 40	7 0 0 0	98 31 6 40
2 6	21 57 20	5 6	47 17 20	8 6	1 12 37 20	8 0 0 0	112 35 33 20
2 7	22 48 0	5 7	48 8 0	8 7	1 13 28 0	9 0 0 0	126 46 0 0
2 8	23 38 40	5 8	48 58 40	8 8	1 14 18 40	1 0 0 0 0	140 44 26 40
2 9	24 29 20	5 9	49 49 20	8 9	1 15 9 20	2 0 0 0 0	281 28 13 20
3 0	25 20 0	6 0	50 40 0	9 0	1 16 0 0	2 5 5 7 9	360 0 0 0

Catalogue of the Universal Fixed Stars, Completed for the Year 1700 of Christ. And Reduced to Four Classes, or Degrees, of Certainty.

[Two-column prose follows; transcribed left column then right column.]

The FIRST Class contains the stars observed by us, together with Fr. Francesco Maria Grimaldi [Francesco Maria Grimaldi], most frequently — whose longitude and latitude have already been set down in the preceding Table — for the first of which we hold them to be certain in the first degree. To these we have added the Pleiades from D. Vicenç Mut [Vincenzo Mutus] and Michael Florent van Langren [Michael Florentius Langrenus] as observed by them.

The SECOND Class holds the remaining stars observed by Tycho [Tycho Brahe] or by Kepler [Johannes Kepler] as they stand in the Rudolphine Catalogue [*Tabulæ Rudolphinæ*], with their numbers nonetheless corrected as the differences among the stars of our first Class and the Tyconic ones of the same constellation require, or those closest to them, which we place in the second degree of certainty.

The THIRD Class comprises the remaining stars observed neither by us nor by Tycho, but by Hipparchus [Hipparchus] and Ptolemy [Ptolemy] — yet bearing on those constellations, or on ones near them, some of whose fixed stars are observed by us or by Tycho. The numbers are corrected as the differences between the Ptolemaic and our own, or the Tyconic, ones of the same constellation require. And these we place in the third degree of certainty, not excluding an evident error of 10 minutes. As Kepler says, *the numbers were corrected by him* (or by some numbers of the circumstances drawn from the Tyconic example).

The FOURTH Class extends to the stars observed neither by Hipparchus nor by Ptolemy (so far as we know) nor by Tycho, nor by us, nor among those observed by them — stars bearing on those very constellations, but on entirely new constellations observed by the Nacleri [the navigators / *Nacleri*]. Of these we have reduced only the longitude to the end of the year 1700, adding the Rudolphine motion of 100 years, which for us is $1^{\circ} 24' 27''$. The latitude, however, we have transcribed wholly unchanged from the Rudolphine Catalogue. These, moreover, we hold to be of the 4th degree of certainty, and, having tested them with the Radius, or astronomer's Staff [Baculo Astronomico], which the Nacleri use, and which we have found liable to an error of some minutes, we do not reckon them more certain than the Ptolemaic ones — until they be observed in another and more accurate way.

PARS PRIMA — De Stellis Fixis Signorum XII. Zodiaci

Part One — On the Fixed Stars of the Twelve Signs of the Zodiac

This part presents the universal catalogue laid out in two columns per page. The columns are: Latin name of the fixed star [Nomina Fixarum]; Longitude (Sig. Gr. ' '); Latitude (Gr. ' ', with A north / B south); Magnitude [Magnitud.]. Stars within each sign are grouped by the four classes of certainty (1.–3. *Classis* visible here). The zodiacal-sign glyphs are transcribed as standard astronomical symbols.

ARIES (left column)

Latin name of the fixed star	Longitude (Sig. Gr. ' ')	Latitude (Gr. ' ')	Magnitud.
1. Class.			
First in the preceding horn [in cornu præcedente]	♈ 28 59 27	7 8 0 B	4
Following, in the same horn	♈ 29 45 27	8 28 30 B	4
Bright star above the head [supra caput]	♈ 3 28 29	9 56 30 B	3
2. Class.			
In the northern grin [in rictu Borealis]	♈ 3 56 30	7 22 30 B	6
In the southern grin [in rictu Australis]	♈ 4 42 30	5 42 0 B	6
In the neck [in cervice]	♈ 29 19 27	5 23 30 B	5
in the temples [in tenibus]	♈ 9 58 30	6 8 0 B	6
In the drawing-out of the tail [in eductione caudæ]	♈ 14 19 30	4 8 0 B	5
Preceding the three in the tail	♈ 16 37 30	1 46 0 B	4
The middle of them	♈ 17 46 30	2 49 30 B	5
The last of them	♈ 19 13 0	2 35 30 B	6

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
In the thigh [in femore]	♄ 12 44 30	1 11 30 B	6
in the ham [in poplite]	♄ 10 57 30	1 6 30 B	6
in the left knee [in genu sinistro]	♄ 10 45 30	1 29 30 A	6
in the right knee [in genu dextro]	♄ 9 14 30	0 38 30 A	6
Small star in the belly [Parvula in alvo]	♄ 9 48 30	4 0 0 A	6
Below the bright star of the head	♄ 3 3 29	9 12 0 A	7
Above the formless [informis] of the back	♄ 11 57 30	10 0 50 A	6
The formless one following, at the base of the triangle	♄ 12 45 30	11 15 30 A	4
Eastward at the same base	♄ 14 2 30	10 23 30 A	3
At the apex of the triangle, toward the north	♄ 14 13 30	12 25 0 B	4
3. Class.			
The northern one of the three formless [Trium informium boreal.]	♄ 13 52 30	12 0 43 B	5
In the hindmost foot [in extremo pede posterior]	♄ 7 32 30	5 9 39 A	5

TAURUS (left column, continued)

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
1. Class.			
Southern eye [Oculus	♄ 5 35 30	5 30 50 A	1

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
Australis], Aldebaran			
Northern eye [Oculus Borealis]	II 4 16 0	2 36 20 A	3
Lowest of the Hyades, in the nostrils [Hyadum infima in naribus]	II 1 34 2	5 46 20 A	3
Outermost of the northern horn [Cornu borei extrema]	II 18 22 47	5 20 30 B	2
Outermost of the southern horn [Cornu Austrini extrema]	II 20 15 47	2 13 30 A	3
Bright star of the Pleiades, or Alcyone [Pleiadum Lucida, seu Alcione]	♄ 25 54 37	3 59 0 B	3
Electra of the Pleiades [Pleiadum Electra]	♄ 24 43 0	4 8 40 B	5
Taygeta of the Pleiades	♄ 24 53 19	4 31 36 B	6
Merope of the Pleiades	♄ 24 59 50	3 52 30 B	6
Maia of the Pleiades	♄ 25 0 20	4 22 56 B	6
Asterope of the Pleiades	♄ 24 56 50	4 39 30 B	8
Celaeno of the Pleiades	♄ 24 45 10	4 15 35 B	8
Father Atlas of the Pleiades [Pleiadum Pater Atlas]	♄ 25 46 20	3 50 20 B	5
Mother Pleione of the Pleiades [Pleiadum Mater Pleione]	♄ 25 47 20	3 53 0 B	7
2. Class.			
Topmost in the section [Suprema in sectione]	♄ 19 23 0	5 56 50 A	5

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
The other after it [Altera post ipsam]	♄ 18 53 0	7 28 50 A	6
The third of them	♄ 17 41 0	8 49 0 A	6
Fourth, southernmost	♄ 16 58 30	9 22 0 A	6
In the right shoulder [In dextro armo]	♄ 23 9 0	8 40 0 A	8
In the breast [In pectore]	♄ 26 24 0	8 40 50 A	8
In the right knee [In genu dextro]	♄ 29 22 0	12 13 20 A	4
In the right hock [In suffragine dextra]	♄ 25 42 0	14 30 10 A	4
In the left knee [In genu sinistro]	♂ 5 42 0	9 31 50 A	5
In the left hock [In suffragine sinistra]	♂ 4 34 0	11 47 50 A	5
Between the nostrils and the northern eye [Inter nares, & oculū boreū]	♂ 2 39 30	4 1 50 A	5
Between the nostrils and the southern eye [Inter nares, & oculū austr.]	♂ 3 45 0	5 52 50 A	5
At the root of the southern horn [Ad radicē cornu australis]	♂ 9 35 0	3 39 30 A	6
More southerly in the same horn [Australior in eod. cornu]	♂ 13 36 30	2 30 0 A	6
More northerly in the same horn [Borealiior in eod. cornu]	♂ 12 27 0	1 49 50 A	5

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
In the origin of the northern horn [In origine cornu borei]	II 7 58 0	0 49 0 A	5
In the northern ear [In aure Borealis]	II 4 17 0	1 4 30 B	5
In the southern ear [In aure Australis]	II 4 1 0	0 35 30 B	4
In the neck, preceding the two [In collo præcedens duarū]	ⅈ 29 14 0	1 12 30 B	5
In the neck, following [In collo sequens]	II 1 51 30	0 46 20 A	6

TAURUS (right column, continued)

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
In the quadrilateral of the neck, preceding [In cervice quadrilateris præcedens]	II 1 27 0	5 15 50 A	6
The northern of the same [Eiusdem borea]	II 1 8 30	7 54 50 A	5
Of the southern following side [Sequentis lateris Austral.]	II 3 57 0	3 57 10 B	5
Of the same, the northern side [Eiusdem lateris Boreal.]	II 3 48 30	5 45 40 B	5
In the hoof of the left foot [In ungula pedis sinistri]	ⅈ 21 20 0	13 29 50 A	6
In the heel of the	ⅈ 1 33 0	12 1 50 A	5

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
following foot [In talo pedis sequentis]			
In the right shoulder [In armo dextro]	II 3 21 30	8 40 50 A	5
Preceding the three below the Hyades [Trium infra Hyadas præced.]	II 3 5 0	6 56 20 A	5
The middle of them [Media earum]	II 4 51 0	7 4 20 A	5
The following of them [Sequens earum]	II 6 18 0	6 17 20 A	6
Small star in the southern horn [Parvula in cornu austr.]	II 16 25 0	1 3 50 A	6
Following, in the same horn [Sequens in eodem cornu]	II 18 18 30	1 19 50 A	6
Small star following, the four in the section [Parvula sequens quatuor in sectione]	⅃ 8 56 0	3 20 0 A	6
Of the two in the square of the neck, preceding [Duarum in quadrato colli præced.]	II 0 45 30	6 32 50 A	5
3. Class.			
<i>Formless [Informes]:</i>			
Below the foot and the right shoulder [Sub pede, & armo dextr.]	⅃ 17 45 0 [?]	17 29 30 A	4
Preceding, above the southern horn [Præced.	⅃ 12 23 0	1 59 30 A	5

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
supra cornu austr.]			
Below the outermost southern horn [Sub extremo cornu austra-li]	♄ 21 23 0	15 59 30 A	5
the northern [li borealior]			
Below the same, more southerly [Sub eodem australior]	♄ 21 23 0	6 59 30 A	5
From the five below the northern horn, preceding [Ex 5. sub cornu boreo præced.]	♄ 19 23 0	0 40 30 B	5
Following this one [Hanc sequens]	♄ 21 23 0	1 20 30 B	5
Latter one, behind [Hac iterum posterior]	♄ 23 23 0	1 40 30 B	5
Last of the two, northern [Ultimum duar. boreal.]	♄ 24 43 0	3 40 30 B	5
Southern of them [Earum australis]	♄ 25 43 0	1 35 30 B	5

GEMINI (right column, continued)

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
1. Class.			
Head of Castor [Castoris caput]	♄ 16 1 47	10 2 50 B	2
Head of Pollux [Pollucis caput]	♄ 19 4 53	16 38 30 B	2

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
Bright foot of Π [Lucidus pes Π]	$\text{☿ } 4\ 51\ 47$	$6\ 48\ 0\ A$	2
2. Class.			
Left hand, preceding [Sinistra manus præcedētis Gemini]	$\text{☿ } 6\ 54\ 50$	$10\ 58\ 30\ B$	5
In the left arm [In sinistro brachio]	$\text{☿ } 11\ 16\ 52$	$7\ 43\ 30\ B$	4
In the same shoulder- blades [In eiusdem scapulis]	$\text{☿ } 14\ 47\ 0$	$5\ 43\ 0\ B$	4
In the same right shoulder [In eiusdē humero dextro]	$\text{☿ } 17\ 10\ 0$	$5\ 10\ 0\ B$	5
In the left shoulder, following [In sinistro hum. sequentis Gemini]	$\text{☿ } 19\ 29\ 0$	$3\ 3\ 30\ B$	4
In the right side, preceding Π [In latere dext. præced. Π]	$\text{☿ } 14\ 41\ 0$	$2\ 56\ 30\ B$	6
In the left elbow of Castor [In sinistro cubito Castoris]	$\text{☿ } 15\ 33\ 0$	$6\ 1\ 0\ B$	6
In the northern and topmost knee [In bor. & supremo genu]	$\text{☿ } 5\ 45\ 0$	$2\ 11\ 30\ B$	3
In the left knee, following [In sinistro genu sequentis]	$\text{☿ } 10\ 49\ 0$	$2\ 7\ 0\ A$	3
In the belly of Pollux [In ventre Pollucis]	$\text{☿ } 14\ 18\ 50$	$0\ 14\ 0\ A$	4
In the same ham [In eiusdem poplite]	$\text{☿ } 14\ 36\ 0$	$5\ 41\ 30\ A$	4

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
In the foot, preceding Castor [In pede anteced. Castoris]	♐ 29 14 0	0 58 30 A	4
Heel of the same foot [Calx eiusdem pedis]	♐ 1 4 50	0 53 30 A	3
In the outermost of the right foot [In extremo pedis dextri Castoris]	♐ 2 35 0	3 8 30 A	4
In the lowest foot of Pollux [In imo pede Pollucis]	♐ 6 50 20	10 9 30 A	4
In the heel of Pollux [In calce Pollucis]	♐ 9 17 0	9 41 30 A	6
Topmost knee of Pollux [Suprema genu Pollucis]	♐ 7 43 50	1 12 20 A	6
In the thigh of Castor [In femore Castoris]	♐ 9 58 20	1 31 25 B	6
Below the head, in the hand of Pollux [Infra caput in manu Pollucis]	♐ 21 5 50	5 44 30 B	5
Small star between the heads ♐ [Parvula inter capita ♐]	♐ 18 25 20	7 24 25 B	5
At the ear of Castor [Ad aurem Castoris]	♐ 14 43 50	9 42 30 B	5
Preceding the topmost foot, or rather nearer [Præcedens summum pedē, seu Propus]	♐ 26 42 50	0 13 30 A	4
Preceding the five, the lowest among the Twins [Præcedētium quinq; inter Geminos infima]	♐ 18 23 20	5 52 25 A	6

Latin name of the fixed star	Longitude (Sig. Gr. ' ")	Latitude (Gr. ' ")	M ag .
Following above this [Sequens supra hanc]	♊ 19 26 55	3 49 0 A	6
The third of them [Tertia earum]	♊ 20 51 20	2 42 30 A	6
The fourth of them [Quarta earum]	♊ 22 48 50	0 58 0 A	6
3. Class.			
The one that precedes the foremost knee, bright [Quæ præcedit genu anterius Clara]	♊ 29 7 0	6 10 30 B	4

LIBER IV. — DE FIXIS STELLIS

Catalogus Fixarum universalis ad Annum 1700 — Pars Prima: De Stellis Fixis Signorum XII. Zodiaci

The catalogue continues by constellation. Each star is given with its longitude (zodiac sign, degrees, minutes, seconds), latitude (degrees, minutes, seconds, with B = north/borealis or A = south/australis), and magnitude (*Magnitudo*); the stars within each constellation are grouped by certitude-class (*Classis* 1–4). Longitude zodiac-sign glyphs are transcribed as the sign abbreviation. All numerical values are transcribed exactly as printed.

CANCER (page 267)

1. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The nebulous Praesepe [Beehive]	♋	3	8	2	1	1	3	B	ne b.
Northern Ass [Asellus Borealis]	♋	3	1	5	3	8	3	B	4
			8	3			0		
Southern Ass [Asellus Australis]	♋	4	2	5	0	3	3	A	4

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
			9	3			0		

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The northern one in the square [□] of those preceding	♌	1	1	0	1	3	0	B	5
			7			2			
The southern of the same	♌	1	3	3	0	4	0	A	5
			4	0		7			
In the southern claw	♌	9	2	3	5	7	3	A	3
			5	0			0		
In the northern claw	♌	2	6	0	10	2	3	B	5
						3	0		
In the tip of the northern foot	♍	2	1	0	1	1	0	B	5
		5	8			6			
In the tip of the southern foot	♍	2	2	0	7	4	3	A	5
		6	6				0		
The brighter at the root of the tail	♍	2	7	3	2	1	0	A	4
		7		0		8			
The next nearest one on the back	♍	2	3	3	1	3	3	A	6
		9	4	0			0		
In the southern claw, northern [star]	♌	8	9	3	1	5	3	A	6
				0		3	0		
In the same, southern	♌	1	5	0	5	3	2	A	5
		1	8			5	8		
In the northern jaw [rostrum]	♌	6	4	0	7	1	3	B	6
			9			4	0		
In the southern jaw	♌	8	5	3	5	2	0	B	6
			8	0		0			

3. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Above the bend of the southern pincer	♌	1	4	0	2	1	3	A	4
		2	2			9	0		

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Following the tip of the southern pincer	♌	1 4	4 2	0	5	1 9	2 5	A	4

LEO (page 267)

1. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The Heart of the Lion, Regulus	♌	2 5	3 8	3 2	0	2 6	2 0	B	1
The bright star of the Lion's tail	♌	1 7	2 6	4 7	12	1 6	2 0	B	1
Inbah, or the bright star of the neck	♌	2 5	1 8	1 9	8	4 5	4 0	B	2
The topmost of the nape	♌	2 3	1 6	4 7	11	4 8	4 0	B	3
The lowest of the nape	♌	2 3	3 9	1 7	4	5 0	4 0	B	3
The bright star in the loins	♌	7	7	3 2	14	1 8	3 0	B	2

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The one in the nostrils	♌	1 1	1	3 0	10	2 1	4 0	B	4
In the open mouth [hiatus]	♌	1 3	3 6	3 0	7	5 0	4 5	B	4
The more northern of the head	♌	1 7	1 1	0	12	1 9	5 0	B	4
The more southern of the head	♌	1 6	2 5	0	9	3 8	4 0	B	3
In the southern part of the breast	♌	2 6	1 2	3 0	1	2 5	4 0	A	4
Just preceding Regulus	♌	2	5	3	0	0	2	B	4

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
		3		0			5		
This [star], preceding, in the right knee	♌	1 9	1 6	3 0	0	1 5	5 0	B	5
In the right paw [drace dextra]	♌	1 7	2 9	0	3	1 0	1 0	A	4
The next on the second foot	♌	2 0	2	0	3	4 7	1 0	A	4
In the left paw [drace sinistra]	♌	2 5	8	0	3	5 5	1 0	A	4
In the left armpit [axilla]	♍	2	1 0	0	0	7	5 0	B	4
In the belly, the leading of three	♍	2 3	4 6	0	2	9	5 2	B	6
The more northern of them	♍	3	2 8	0	5	5 5	0	B	6
The more southern of them	♍	5	2 7	1 0	2	4 9	2 0	B	6
Preceding [star] of the two in the loins	♍	4	3 6	0	12	5 2	5 0	B	5
In the buttock [clune], leading northern	♍	9	1 2	0	9	4 1	2 0	B	3
The southern following one	♍	1 0	3 0	0	7	5 0	2 5	B	5
In the thigh	♍	1 3	2 0	3 0	6	6	0	A	5
In the hinder knee	♍	1 4	3 0	3 0	1	3 9	5 2	B	4
In the middle of the foot	♍	1 7	1 9	0	0	3 3	1 0	A	4
In the lowest part of the foot	♍	2 0	5 0	0	3	2	4 0	A	4
In the claw of the left foot	♌	1 7	5 5	0	4	4 9	3 0	A	6

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the claw of the preceding right foot	♌	1 7	2 4	3 0	5	4 4	3 0	A	5
In the middle of the body	♍	1 7	3 0	3 0	10	1 5	5 0	B	6
The little one on the head [Parvula in capite]	♌	1 7	3 3	0	10	4 6	1 0	B	6
Preceding [star] of the two in the left hinder foot	♍	1 7	1 5	0	7	4 0	3 0	A	4
In Tycho's other codex	♍	2 0	1 2	0	5	4 2	3 0	A	5
Of the unformed [stars] above the back, preceding	♌	2 7	4 5	3 0	17	3 8	4 0	B	5
Following them	♍	1 0	2 0	0	16	2 8	5 0	B	5
The topmost bright star of the back, above the tail	♍	6 1	1 6	3 0	16	4 5	4 0	B	5
	♍	1 4	4 5	0	17	1 7	5 0	B	4
The northern of the three under the belly	♍	1 0	2 0	0	1	1 9	0	B	4
The middle of them	♍	9 2	5 5	1 0	0	1 0	0	A	4
The southern of the same	♍	1 0	4 2	0	2	3 0	0	A	5

VIRGO (page 267)

1. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Spica [the Ear of Grain]	♍	1 9	5 9	4 7	1	5 9	3 0	A	1
The bright star of the girdle [cingulum]	♍	7	1 8	4 7	8	4 0	3 0	B	3

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Vindemiatrix [the Grape-gatherer]	♌	5	4	1	16	1	0	B	3
			6	7		5			

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Of those preceding in the square [□] of the head, the northern	♍	1	7	5	6	6	0	B	5
		9		0					
The more southern of them	♍	1	5	4	4	3	3	B	5
		9	6	7		6	0		
Of those following, in the northern face	♍	2	3	4	8	3	0	B	5
		3	0	8		3			
The southern of the same	♍	2	4	5	6	9	3	B	5
		3	1	0			0		
In the tip of the southern and left wing	♍	2	5	4	0	4	2	B	3
		2	5	7		2	8		
The preceding of four in the left wing	♌	0	3	4	1	2	2	B	4
			9	9		4	9		
The next following one in the shoulder	♌	5	5	1	2	4	3	B	3
			9	7		9	0		
The penultimate of them	♌	1	5	1	2	2	0	B	6
		0	1	8		3			
The last of them	♌	1	0	5	1	4	2	B	4
		4		0		4	8		
In the right and northern wing, [first] of three preceding	♌	1	1	4	13	3	0	B	5
			6	7		6			
Of the remaining two, the northern	♌	3	1	5	11	3	2	B	6
			5	0		6	8		
Under the girdle [perizoma] on the haunch [clunis]	♌	1	4	1	8	9	3	B	3
		6	6	8			0		
The northern of the left hip [coxa]	♌	1	2	1	3	1	2	B	6
		9	2	9		0	7		
Of those following, the	♌	2	3	1	1	4	0	B	6

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
northern of the pair		2	3	8		5			
The more southern of them	♌	2	7	5	0	2	0	A	6
		1		0		0			
In the left thigh [femur]	♌	2	7	4	2	2	0	B	6
		6		8		4			
The preceding of the topmost border [fimbria]	♌	2	1	5	11	2	0	B	5
		9	2	0					
The middle of three in the border	♌	2	3	4	7	1	0	B	4
		9	2	7		8			
The lowest, and of the southern border	♍	0	1	5	2	5	0	B	4
			4	0		7			
The more southern of the two of the upper border	♍	1	1	1	11	4	2	B	4
			5	7		7	9		
In the southern foot	♍	2	4	5	0	3	0	B	4
			5	0		1			
In the right, or northern, foot	♍	5	5	4	9	4	2	B	4
			3	8		8	7		
Between Vindemiatrix and the girdle	♌	2	4	5	10	2	3		6
			4	0		5	0		
The next [star] from this on the right haunch	♌	2	1	1	9	4	0	B	6
		3		8		0			
The one on the neck [cervix]	♍	2	9	1	4	5	0	B	6
		9		7		9			
The small one following Vindemiatrix	♌	9	4	5	16	1	3	B	6
			8	0		3	0		
Preceding [star] of three in a straight line with the northern wing	♌	1	3	4	12	4	0	B	5
		1	4	7		0			
The middle of the same	♌	1	9	5	12	3	0	B	6
		6		0		4			
Following this one	♌	2	3	4	13	7	0	B	5
		3	4	8					
The one between the fourth	♍	2	3	1	3	2	0	B	6

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
and fifth		4	0	7		2			
Unformed, under the left arm	♌	8	1	5	3	2	3	A	5
				0		5	0		

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The middle one	♌	1	2	4	3	2	3	A	5
		2		7		3	0		
The following one	♌	1	3	1	3	1	0	A	5
		5	2	8		4			
Following the three under Spica	♌	1	3	4	7	5	3	A	5
		8	6	7		1	0		
The middle one, toward the south	♌	2	5	5	9	1	2	A	5
		0	8	0		6	8		
The eastern one	♌	2	5	1	6	1	3	A	5
		1	9	7		6	0		

3. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the thigh, preceding-southern	♌	1	2	5	0	9	3	B	6
		9	3	0			0		
In the tip of the hip [coxa]	♌	2	2	4	8	2	2	B	5
		0	3	8		9	8		

LIBRA (page 267)

1. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The Northern Pan [Lanx Borealis]	♎	1	1	1	8	3	1	B	2
		5	2	7		3	0		
The Southern Pan [Lanx Australis]	♎	1	5	2	0	2	1	B	2
		0	6	7		5	0		

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The one above the southern pan	♄	1 0	7	2 7	1	5 4	1 0	B	5
The one above the northern pan	♄	1 1	4	3 0	8	1 7	0	B	4
The first from the southern pan, toward its rising	♄	1 3	5 2	0	1	1 3	1 0	B	5
The second from the same	♄	1 7	4 4	3 0	2	5 7	4 0	B	6
The third toward the rising	♄	2 0	5 8	2 8	4	2 7	1 0	B	3
Below this, toward the rising	♄	2 3	1 3	5 7	4	3	1 0	B	4
Below the same, toward the setting	♄	2 0	5 2	3 0	2	2 0	1 0	B	4
Below the northern pan, toward the rising	♄	1 7	1 0	0	8	5	3 0	B	4
Unformed, [first] of the two below the Southern Pan	♄	2 3	3 5	2 7	0	2	0	B	4
The lower of the same	♄	2 8	2 8	5 7	0	6	1 0	B	4

LIBRA (continued) (page 268)

2. Classis (continued)

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Preceding [star] of the three following	♄	2 5	4 1	3 0	3	3 2	1 2	B	4
The middle	♄	2 6	1 3	2 6	6	9	1 5	B	4
The Upper Eastern	♄	2 7	6	5 0	9	1 9	5 0	A	4
The following	♄	2	4	3	10	5	5	A	5

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
		8	4	0		7	0		
In the left arm under the northern pan	♍	2	4	0	7	3	3	A	3
		8	4			8	0		
The following	♍	1	4	0	1	4	2	A	3
		6	1			9	5		

3. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Below the southern claw [Chela], northern	♍	2	2	3	8	4	5	A	4
		4	7	0		2	0		
Below the same, southern	♍	2	5	5	10	2	4	A	4
		4	9	0		0	8		

SCORPIUS (page 268)

1. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The Heart of the Scorpion, Antares	♏	5	3	2	4	2	3	A	1
			5	7		6	0		
The northern one in the forehead	♍	2	5	5	1	6	3	B	2
		8	6	7			5		
The middle of the forehead	♍	2	2	7	1	5	0	B	3
		8	0			2			
The southern one in the forehead	♍	2	4	4	5	2	4	A	3
		8	5	7		0	0		

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the foot, toward the south, under the southern forehead	♍	2	4	3	8	2	0	A	4
		9		0		6			
The most northern of the forehead	♏	0	2	3	1	4	0	B	4
			4	0		4			
The little one in the triangle [△]	♍	2	2	0	0	1	0	B	5

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
with the bright stars of the forehead		9	8			6			
or, better	♄	2 9	2 3	0	0	1 6	0	B	5
Preceding the heart, toward the north	♄	3	3 2	0	3	5 3	0	A	4
Following after the Heart	♄	7	1 4	0	5	4 8	0	A	4
Preceding, in the lower feet	♄	2	7 0	3	6	3 5	3 0	A	4
<i>From Kepler, on the new star</i>									
Under the sole of the foot of Serpentarius [Ophiuchus]	♄	4	1 8	0	1	4 8	0	A	4
The one above the heart of the Scorpion	♄	5	3 3	0	3	0	0	A	4
Above the [star] preceding the Heart	♄	3	2 2	0	2	4 8	0	A	5
Below it, in the hinder body	♄	3	4 2	0	6	5 8	0	A	4
In the first vertebra [spondylus]	♄	9	2 5	0	10	5 8	0	A	4
In the second vertebra	♄	1 1	5	0	14	5 0	0	A	4
In the sting of the tail [aculeus caudae]	♄	1 9	5 0	0	13	5 2	0	A	3

3. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the 3rd vertebra, from Clavius	♄	1 2	4 1	0	18	2 0	0	A	3
The following one in the 4th vertebra	♄	1 5	4 1	0	19	4 9	0	A	3
After it, in the 5th vertebra	♄	2	3	0	19	9	0	A	3

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
		0	1						
The further one in the 6th vertebra	↗	2	5	0	16	5	0	A	3
		2	1			9			
The one in the 7th vertebra	↗	2	2	0	15	2	0	A	3
		1	1			9			
Preceding the sting	↗	1	2	0	13	5	0	A	4
		9	1			9			
Unformed, following the sting	↗	2	3	0	13	3	0	A	ne b.
		3	1			9			
Preceding [star] of the two above the sting	↗	1	5	0	6	2	0	A	5
		7	1			9			
Following them	↗	2	5	0	1	2	0	A	5
		1	1			9			
The other [reading]	↗	2	5	0	4	2	0	A	5
		1	1			9			

SAGITTARIUS (page 268)

1. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The bright star of the head [Lucida Capitis]	♄	9	2	2	1	4	1	B	4
			2	7		5	0		

2. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the point of the arrow [cuspis sagittae]	↗	2	5	0	6	5	4	A	4
		6	6			4	0		
— according to Kepler	↗	2	5	0	6	5	0	A	4
		6	6			4			
— according to Ptolemy	↗	2	1	0	6	5	0	A	4
		7	6			0			
In the haft, the left hand	♄	0	1	0	6	5	5	A	4
			7			0	0		

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
— according to Ptolemy		0	1	0	6	5	0	A	4
			6			0			
In the southern part of the bow	♄	2	1	3	2	5	2	A	4
			3	0		9	0		
In the same, more northern	♄	2	7	3	2	2	1	B	4
		9		0		8	0		
In the left shoulder	♄	8	1	0	3	3	2	A	4
			7			0	0		
Preceding this, in the javelin [iaculum]	♄	6	6	0	3	4	2	A	5
						9	0		
The middle one in the head	♄	1	1	0	0	5	4	B	4
		0	4			9	0		
The last of three in the head	♄	1	9	0	1	3	3	B	4
		2				1	8		
The first in contact	♄	1	1	0	3	7	1	B	5
		4	0				0		
In the northern contact, the middle	♄	1	2	3	4	1	4	B	4
		5	0	0		7	0		
The following, and upper	♄	1	3	0	6	1	1	B	5
		5	7			0	0		
The more eastern of these	♄	2	3	3	5	8	4	B	6
		0	4	0			0		
The last eastern one in contact	♄	2	1	3	5	1	3	B	6
		4	8	0		2	9		
The dark one in the lower contact	♄	2	5	0	1	2	3	B	6
		0	0			5	8		
The dark one in the right elbow [cubitus]	♄	1	5	0	3	7	1	A	6
		7	2				0		

3. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the southern part of the bow [arcus]	♄	0	3	0	11	1	0	A	3
			6			0			

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the eye, a double nebula	♄	7	4 6	0	0	2 5	0	B	ne b.
In the right shoulder	♄	1 5	6	0	2	1 0	0	A	5
In the shoulder-blades [scapulae]	♄	1 2	3 6	0	2	5 0	0	A	5
In the upper arm [armus], the third of the trapezium	♄	1 0	5 6	0	4	4 0	0	A	4
Under the armpit, the fourth of the trapezium	♄	9	2 6	0	6	4 0	0	A	3
In the left hough [suffrago], the prior	♄	1 0	1 6	0	23	2 0	0	A	2
In the knee of the same leg [crus]	♄	9	3 6	0	18	2 0	0	A	2
In the prior right hough	♄	2 9	1 6	0	13	2 0	0	A	3
In the left shoulder-blade	♄	1 9	5 6	0	13	5 0	0	A	3
In the hinder right knee	♄	1 9	1 6	0	20	3 0	0	A	3
In the bringing-forth of the tail, the first	♄	2 0	2 6	0	5	1 0	0	A	5
Following it, in the Terebellum	♄	2 1	2 6	0	5	1 0	0	A	5
Likewise, preceding, of the southern side	♄	2 1	1 1	0	6	1 0	0	A	5
Likewise following	♄	2 2	6	0	6	5 0	0	A	5

CAPRICORNUS (page 268)

1. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The preceding [star] of the horn, or the upper	♄	2 9	4 4	2 7	7	3	1 1	B	3
The lower following [star] of the horn	♄	2 9	5 7	2 7	4	4 2	1 0	B	3
The bright preceding star of the tail	♁	1 7	4 0	2 7	2	2 4	5 0	A	3
The bright following star of the tail	♁	1 9	2 6	2 7	2	2 7	5 0	A	3

2. Classis

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The middle of three in the horn, preceding	♁	0	1 7	0	7	3	1 0	B	3
The southern of the same	♄	2 9	5 7	0	6	5 4	9	B	6
The nebula above the preceding horn	♄	2 8	3 4	0	7	1 7	1 0	B	6
The Western nebula at the base of the triangle in the forehead	♁	0	2 3	0	0	4 9	4 0	B	ne b.
The eastern nebula	♁	1	7	0	0	2 9	1 0	B	ne b.
The topmost of the same triangle	♁	1	3	0	1	2 1	8	B	6
The nebula in the forehead, preceding	♄	2 8	3 9	0	0	2 5	1 0	B	ne b.
In the neck, [first] of the two northern	♁	4	1 5	0	3	2 6	1 0	B	6
Likewise southern	♁	3	3 2	0	0	1 6	7	B	6
Preceding, in the right knee, obscure	♁	3	1 3	0	6	5 8	0	A	6

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Following, in the left knee	≈	3	5 4	0	9	1	0	A	6
In the left arm	≈	7	3 9	0	8	7	0	A	6
The lowest in the belly	≈	1 2	5 0	3 0	6	5 5	0	A	5
Following [star], northern, adjacent to those under the wing	≈	1 3	2 6	0	6	2 8	0	A	6
The more eastern of the three in the belly	≈	1 0	4 9	0	4	2 4	0	A	6
The lowest of them	≈	8	5 7	0	4	2 6	0	A	6
The northern of three	≈	8	4 4	0	3	1 0	0	A	5
[First] of the two in the front of the back	≈	9	4 7	0	0	2 8	0	A	5
Following them, on the back	≈	1 3	3 3	0	1	1 5	3 0	A	5
Preceding [star] of the two toward the loins [ilia]	≈	1 5	5 1	0	4	4 7	0	A	4
Following the same	≈	1 7	3 2	0	4	4 8	0	A	5
Preceding, in the upper tail	≈	1 9	4 0	0	2	2 3	1 0	B	5
In the upper southern tail	≈	2 1	5 3	0	0	1 3	3 0	A	5
Preceding this, toward the north	≈	2 1	4 2	0	0	1 9	0	A	6
The northern one at the tip of the tail	≈	2 1	2 0	0	4	1 8	1 0	B	6

AQUARIUS (page 268)

1. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The bright star of the right shoulder	≈	2 8	3 1	5 7	10	4 2	1 5	B	3
The bright star of the left shoulder	≈	1 9	1 3	2 7	8	4 2	1 5	B	3
The lower [star] of the left hand	≈	1 2	1 5	2 7	4	5 0	1 5	B	5
In the outpouring [of water], Fomahant [Fomalhaut]	≈	2 9	3 6	4 3	20	5 9	4 0	A	1

2. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the head	≈	2 3	4 9	0	15	2 3	1 5	B	6
In the right shoulder, southern (<i>on this, see at the end of the sign</i>)	≈	2 7	5 8	3 0	9	1 1	4 5	B	5
In the back, under the armpit	≈	2 0	0	2 9	6	0	4 4	B	5
The middle in the left hand	≈	8	5 1	0	8	1 9	1 6	B	5
Preceding, the brighter of the hand	≈	7	3 4	3 0	8	1 0	1 5	B	4
In the right elbow	✕	2	3 2	2 8	8	1 7	4 5	B	3
In the right hand, northern	✕	4	2 7	0	10	3 1	1 6	B	5
Of the remaining two, the southern, preceding	✕	4	4 5	3 0	8	5 2	4 6	B	4

AQUARIUS (continued) (page 269)

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Following them	✕	6	1 5	2 9	8	1 0	1 5	B	4
Preceding, in the right Cotyla [vessel]	≈	2 9	7	2 8	2	4 6	1 4	B	4
Following, in the same	≈	2 9	5 3	3 0	2	2 9	4 5	B	6
In the right thigh	✕	1	1 5	2 9	1	9	4 6	A	5
The one toward the buttocks [Clunes]	≈	2 4	3 5	3 0	1	5 9	4 5	A	4
Scheat, in the right shin [tibia]	✕	4	4 4	2 8	8	9	4 5	A	3
Northern, in the shin toward the knee	✕	4	2 7	3 0	5	3 6	4 6	A	5
In the left hip [coxa]	✕	1	2	2 9	5	3 9	4 4	A	6
In the left knee, more southern	≈	2 8	1 8	0	10	4 8	1 5	A	5
In the same, more northern	✕	1	1 2	3 0	9	5 7	1 5	A	6
The first, from the hand, in the outpouring of water	✕	5	1 4	2 9	4	8	4 5	B	4

3. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The succeeding southern	✕	7	2 6	3 0	0	1 9	1 5	A	4
Following, in the first bend of the water	✕	1 0	2 2	2 8	1	2 3	4 6	A	6
The one that accompanies it	✕	1 3	0	3 0	0	5 9	4 5	A	5
In the other southern bend	✕	1	1	2	2	4	4	A	5

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
		2	3	9		8	6		
Preceding, more northern, of those following	✕	1	5	3	3	5	1	A	5
		2		0		8	5		
The more southern following	✕	1	3	2	4	1	1	A	5
		2	3	9		0	4		
Near this, inclining toward the south	✕	1	3	0	4	4	4	A	5
		2	7			3	5		
After this, of the contiguous ones, preceding	✕	1	2	3	10	5	4	A	5
		5	9	0		8	6		
Following the same	✕	1	0	2	11	3	4	A	5
		6		9		2	5		
In the 3rd bend of the water, [first] of three northern	✕	1	2	3	14	2	4	A	5
		4	5	0		8	7		
The middle of them	✕	1	8	2	15	1	1	A	6
		5		8		6	5		
Following them, southern	✕	1	6	3	16	2	4	A	6
		6		0		2	5		
[First] of three following, northern	✕	9	1	0	14	4	4	A	5
			7			4	6		
The middle of them	✕	9	4	0	15	2	4	A	5
			3			9	5		
The southern of the same	✕	1	1	3	16	3	4	A	5
		1	2	0		0	6		
In the last bend, [first] of three upper	✕	5	4	2	14	2	1	A	5
			7	9		5	5		
The middle of them	✕	5	2	3	15	3	4	A	5
			4	0		9	7		
The lowest of them, near Fomahant [Fomalhaut]	✕	4	3	2	15	5	4	A	5
			9	8		2	5		

[3. Classis — additional]

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the right buttock [Clunis]	≈	2	2	3	4	9	4	A	6

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
		5		0			6		
Of the unformed, preceding, after the bend of the water	✕	1	3	2	15	3	4	A	4
		9	2	9		9	5		
Northern of those following	✕	2	3	3	14	3	4	A	4
		3	7	0		9	6		
Southern of them	✕	2	4	3	18	1	4	A	4
		1	2	0		9	1		

[Note printed in the longitude block:] **Note** that Kepler and Longomontanus placed the longitude of the right shoulder at $\approx 27^\circ 49\frac{1}{2}'$, or $27^\circ 48'$. In the year 1600 Tycho [Brahe] placed it at $27^\circ 9\frac{1}{2}'$; therefore they have exceeded [it] by an error of 40 minutes.

PISCES (page 269)

1. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The back of the head of the Southern Fish [Piscis Australis]	✕	1	1	5	7	1	0	B	4
		7	2	9		7			
The bright one in the knot of the thread [nexus lini]	Υ	2	9	5	9	4	0	B	3
		5		9					

2. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the mouth of the Southern Fish	✕	1	2	3	9	4	3	B	5
		4	4	0			0		
The northern one in the back of the head	✕	1	5	0	8	5	0	B	6
		8	3			5			
Preceding [star] of the two on the back	✕	2	4	3	9	3	3	B	5
		1		0			0		
Following, on the back	✕	2	1	0	7	1	0	B	6
		3	9			4			
Preceding, in the belly [aluus]	✕	1	4	2	4	2	3	B	5
		8	3	9		7	0		

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Following, in the belly	✕	2 2	2 7	3 0	3	2 5	2 8	B	5
In the tail	✕	2 8	2 4	2 9	6	2 4	0	B	5
Above this, toward the rising	✕	2 9	4 9	2 8	7	2 7	3 0	B	6
Following	Υ	3	5 1	3 0	5	2 8	3 0	B	6
In the southern thread, preceding [star] of the three bright ones	Υ	9	5 8	2 9	2	1 1	3 0	B	4
The middle of the same	Υ	1 3	3 0	2 8	1	6	0	B	4
Following	Υ	1 5	4 1	3 0	0	5 8	0	B	4
In the bend [flexus], the northern of the thread	Υ	1 3	4 7	2 8	1	3 0	3 0	A	5
Likewise following, southern	Υ	1 5	8	3 0	4	1 9	0	A	4
After the bend, preceding [star] of three	Υ	1 8	5 5	2 8	3	2	3 0	A	5
The middle of them	Υ	2 1	1 8	0	4	4 0	0	A	5
The last following	Υ	2 3	2 0	0	7	5 5	3 0	A	5
In the northern thread, near the knot, preceding	Υ	2 3	3 4	2 9	1	3 8	0	B	5
After this, of the three southern	Υ	2 2	3 8	3 0	1	5 2	0	B	5
The middle one in the northern knot	Υ	2 2	3 8	3 0	5	2 1	3 0	B	4
The northern, and last, of the thread	Υ	2 2	5 9	0	9	2 4	2 8	B	5

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The northern, in the mouth of the northern Fish	Υ	2 4	3 7	3 0	22	0	3 0	B	6
Likewise southern	Υ	2 4	1 2	0	20	4 3	2 8	B	5
The northern of the triangle of the head	Υ	2 0	4 5	0	20	5 5	3 0	B	6
The southern of the said triangle	Υ	1 9	2 9	0	19	2 4	3 0	B	6
The middle, and preceding, of the triangle	Υ	1 8	2 6	0	20	2 4	2 9	B	6
In the southern spine, near the left elbow [cubitus] of Andromeda	Υ	1 9	1 9	0	13	2 1	3 0	B	5
The middle after it	Υ	1 9	2 5	0	12	2 2	0	B	6
The lowest of them	Υ	1 9	3 1	3 0	11	2 1	3 0	B	6
The northern of the two in the belly	Υ	2 4	4 0	2 9	17	2 6	2 9	B	5
The one more toward the south	Υ	2 2	2 1	0	15	3 0	2 8	B	5
Following [star], the middle of three in the southern spine	Υ	2 9	2 2	3 0	12	2 8	0	B	5
Following, toward the north, in the belly, toward the North	Υ	2 5	3 3	2 8	18	3 1	3 0	B	6
In the back of the head of the northern Fish	Υ	2 3	3	3 0	23	3	2 9	B	6

3. *Classis*

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Of the unformed in the square [□] under the northern Fish, on its side, preceding	⋈	1 9	3 2	3 0	15	3 9	3 0	A	4

Names of the fixed stars	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Following	✕	2	3	2	2	2	3	A	4
		4	2	9		4	0		
Southern of the preceding side	✕	2	3	3	5	3	2	A	4
		3	7	0		4	9		
Following	✕	2	5	2	5	2	3	A	4
		4	2	8		9	0		
The prior of those following this square [□]	Υ	2	3	3	4	3	2	A	5
			7	0		5	9		
The posterior	Υ	7	3	2	4	2	3	A	5
			3	9		3	0		

PARS SECUNDA — Astra Borealia extra Zodiacum [Northern Stars outside the Zodiac] (page 269)

In this Second Part the latitude column is headed *Latitudo B.* (all latitudes north/borealis).

URSA MINOR

1. *Classis*

Names of the fixed stars	Sig n	Gr .	'	"	Lat. Gr.	'	"	Ma g.
The tip of the tail, now Polaris [the Pole Star]	Π	24	26	47	65	59	50	2
The bright one of the shoulder, formerly Polaris in the time of Eudoxus	ϱ	8	45	7	72	48	40	2
Or, the upper of the two preceding ones in the square [□]								

2. *Classis*

Names of the fixed stars	Sig n	Gr .	'	"	Lat. Gr.	'	"	Ma g.
The penultimate of the tail	Π	27	6	0	69	46	30	4
The one at the root of the tail	ϙ	4	54	0	73	46	0	4
The upper of the two in the	ϙ	22	59	0	74	56	0	4

Names of the fixed stars	Sig n	Gr . ' "	Lat.	Gr. ' "	Ma g.
square [□] of those following					
The lower of them	♄	26 22 0	77	34 30	5
The lower of those preceding, in the square [□]	♄	16 11 0	75	19 30	3
The unformed [star] toward the head of the more southern Bear	♄	4 24 0	71	20 0	6
The one above this	♄	28 50 0	70	15 0	6
The first of the unformed, in a straight line with the Pole	♄	18 47 0	35	47 0	6
The second	♄	18 58 0	37	17 0	6
The third, obscure	♄	19 17 0	40	10 0	6
The fourth	♄	19 33 0	42	53 10	6
The first unformed near the Pole star	♄	23 8 0	57	52 0	6
The second	♄	23 25 0	70	39 0	6
The third	♄	26 1 0	69	0 0	6
The fourth	♄	16 37 0	68	1 0	6
The fifth	♄	8 52 0	67	40 0	6
The sixth	♄	11 27 0	67	19 0	6
The one nearest the Pole [Viciniſſima Polo]	♄	28 0 0	63	52 0	6

Liber IV — De Stellis Fixis (continued)

Universal Star Catalogue — *Pars Secunda*: Northern Constellations outside the Zodiac (continued)

The longitude is given by zodiac sign and by degrees [Gr.], minutes ['], and seconds ["] within the sign; the latitude is northern [Latitudo Borealis], in degrees, minutes, and seconds; the last column gives the magnitude [Magnitudo]. The stars are grouped by constellation and, within each, by certitude class [Classis]. Zodiac-sign abbreviations are reproduced as printed.

URSA MAIOR (the Great Bear)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the shoulder, Dubhe [Lucida humeri Dubhe]	♌	10	5	2	49	4	1	2
			9	7		0	0	
Bright star of the flank below Dubhe [Lucida lateris sub Dubhe]	♌	15	7	5	45	5	4	2
				7			0	
Bright star of the hind haunch [Coxae posterioris lucida]	♌	26	1	1	47	8	4	2
			0	2			0	
Bright star of the back, toward the tail [Tergoris lucida ad caudam]	♌	26	4	5	51	3	1	2
			9	7		7	0	
Root of the tail, or first [Caudae radix, seu prima]	♏	4	3	2	54	1	4	2
			6	7		7	5	
Middle of the tail [Media caudae]	♏	11	2	5	56	2	1	2
			1	3		1	0	
End of the tail [Ultima caudae]	♏	22	3	7	54	2	1	2
			7			4	0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
The one in the muzzle [Quae in rostro]	♏	19	2	3	40	2	4	4
				0			5	
Below the left eye [Sub oculo sinistro]	♏	18	3	0	43	5	4	4
			6			5	3	
Adjacent below this [Contigua sub hac]	♏	17	3	0	44	2	1	5
			4			2	5	
Above the right eye [Supra oculum dextrum]	♏	19	5	0	47	5	5	4
			1			0	0	
Above the left eye [Supra oculum sinistrum]	♏	21	1	3	47	4	4	4
			0	0		4	6	
Toward the left ear [Ad aurem sinistram]	♏	26	8	3	51	3	4	5
				0		6	2	

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Lowest in the little triangle of the neck [Infima in parvo Δ colli]	♄	25	1	0	42	3	2	5
			6			0	0	
Following in the same triangle [Sequens in eodem Triang.]	♄	26	2	0	45	3	1	4
			8				6	
Topmost at the apex of the same triangle [Suprema in Apice eiusd. Δ]	♄	29	2	0	46	2	4	5
			5			1	8	
Next to it on the neck [Succedens ei in collo]	♌	2	3	0	42	3	1	4
						6	8	
Following below this [Sequens infra hanc]	♌	5	3	3	38	1	4	4
				0		5	5	
At the forward left knee [In genu sinistro anteriori]	♌	1	5	3	34	3	4	3
			7	0		4	6	
In the more-northerly right foot [In dext. pede borealior]	♄	27	2	0	29	1	4	3
			1			5	8	
The southerly one, same place [Australior ibidem]	♄	28	3	0	28	3	2	3
			5			8	0	
Below the right knee [Infra genu dextrum]	♄	28	3	0	33	3	1	5
			2			0	9	
In the right knee itself [In ipso genu dextro]	♄	28	5	0	36	6	1	5
			1				5	
Upper of the left hind foot [Superior sinistri pedis posterior]	♌	15	2	3	29	5	4	4
			1	0		1	5	
Following, and southerly [Sequens, & australior]	♌	16	3	3	28	4	1	4
			0	0		5	6	
In the preceding hind knee [In genu praecedente poster.]	♌	23	5	0	35	1	1	4
			8			4	5	
Preceding, in the right hind foot [Praecedens in dextro pede poster.]	♍	2	1	0	26	1	1	4
			5			4	8	
Following, and southerly [Sequens, & australior]	♍	3	1	0	24	5	2	4
						4	0	
Unformed, between the tails of the Bear and the Lion [Informis inter caudas Ursae & Leonis]	♍	19	8	3	40	6	2	2
				0			0	

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
The one on the back [Quae in dorso]	♏	29	3	0	41	3	1	4
			5			0	5	
In the left hind foot [In sinistro pede posteriori]	♏	22	2	3	33	1	2	5
			7	0			0	
Unformed, between the Bear and the head of the Lion [Inform. inter Ursam, & caput Leonis]	♏	7	4	0	17	5	1	3
			2			5	8	
The one above this, toward the east [Quae supra hanc ad ortum]	♏	9	3	0	20	4	2	4
			5			2	0	
The one that precedes this [Quae hanc praecedit]	♏	6	2	1	20	5	1	4
			5	0			6	
Following, of the two before these [Sequens duarum ante has]	♏	3	2	0	20	5	1	4
			2			1	8	
Preceding them [Earum praecedens]	♏	1	7	0	23	4	2	4
						1	0	
Between the foot and the head of the Lion [Inter pedem & cap. Leonis]	♏	15	3	0	21	5	1	4
			7			3	9	
Following, northern [Sequens borealis]	♏	20	2	0	25	4	1	4
			0				7	
Following, southern [Sequens australis]	♏	21	3	0	24	5	2	3
			2			0	0	
Preceding, at the base of the Oxygonium [triangle] [Praecedes in basi Oxygonii]	♏	24	4	0	21	2	1	3
			7			8	9	
Following [Sequens]	♏	27	3	0	20	4	2	3
			4			4	0	
Third, northern, in the said base [Tertia boreal. in dicta basi]	♏	26	4	0	24	5	1	5
			4			8	5	
The one between the legs of the Bear [Quae inter crura Ursae]	♏	13	4	0	40	3	1	5
			1			0	8	
First, between the tail and the body [Prima inter caudam, & corpus]	♏	22	5	0	58	8	1	6
			4				0	
Second [Secunda]	♏	25	3	0	47	1	6	6

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
			0			4		
Third [Tertia]	♄	21	1	0	47	3	1	6
			4			0	2	
First, between the Bear and the head of the Lion [Primam inter Ursam, & Caput ♏]	♄	24	4	0	46	5	6	6
			2			0		
Second [Secunda]	♏	5	3	0	47	5	1	6
			3			5	6	
Third [Tertia]	♍	7	2	0	48	4	1	6
			5			0	4	
Fourth [Quarta]	♍	7	5	0	49	4	1	6
			5			2	8	
Fifth [Quinta]	♍	7	4	0	49	4	1	6
			4			2	5	
Sixth [Sexta]	♍	20	3	0	49	0	1	6
			0				8	
Seventh [Septima]	♍	19	2	0	49	2	1	6
			6			7	2	
Eighth [Octava]	♍	27	7	0	48	1	1	6
						1	5	
Ninth [Nona]	♍	17	2	0	52	2	1	6
			7			5	4	
Tiny one touching the haunch [Parvula tangens coxam]	♏	3	6	0	35	4	1	6
						0	5	

DRACO (the Dragon)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star following, in the head [Lucida sequens in capite]	♈	23	4	7	75	2	1	3
			6				0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Ma		
		.	'	"		'	"	g.
The one in the tongue [Quae in lingua]	♄ [?]	20	1	3	76	1	0	4
			8	0		6		
The one in the mouth [Quae in ore]	♄	5	3	3	78	1	3	4
			6	0		4	0	
Preceding, in the head [In capite praecedens]	♄	7	4	3	75	2	0	3
			1	0		0		

[The remaining stars of Draco continue on the right-hand table of this same opening, under "Quae ad genam" — the head and neck members of the Dragon.]

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
The one at the cheek [Quae ad genam]	♄	20	2	0	80	2	3	4
			5			0	0	
First, of the three in the bend of the neck [1. Trium in flexu colli]	♄	18	2	0	81	5	0	5
			6			2		
The southern one, same place [Australis ibidem]	♄	25	5	0	77	5	0	5
			3			6		
The middle of them [Media earum]	♄	21	5	3	79	5	3	5
			5	0		0	0	
Following, toward the east [Sequens ad ortum]	♄	10	5	0	80	5	2	4
			1			2	9	
Near the second bend [Prope secundum flexum]	♄	29	5	0	81	5	0	4
			5			0		
Northern, of the square of the second bend [Borea □ secundi flexus]	♄	13	4	3	82	4	0	3
			8	0		8		
Northern, of the following flank [Borea lateris sequentis]	♄	16	4	0	78	8	3	4
			5				0	
Southern, of the same flank [Australis eiusdem lateris]	♄	29	9	0	79	2	0	3
						4		
Preceding the following triangle [Sequentis △ praecedens]	♄	16	4	0	83	4	0	4
			0					

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Following this, toward the south [Sequens hanc ad austrum]	♌	21	2	3 0	80	3 7	0	4
The one above this [Quae supra hanc]	♍	28	6	0	80	5 3	0	4
In the rest of the following triangle [In reliquo $\triangle$ sequens]	♎	7	5 6	3 0	83	3 0	3	4
Southern, of the same [Australis eiusdem]	♏	2	5 0	0	83	2 7	0	4
Preceding, northern, of the triangle [Praecedens borea Trianguli]	♐	6	5 3	0	84	4 7	0	4
In the bend of the third knot [In flexu nodi tertii]	♑	1	6 0	3	81	3 0	3	3
Nearest to the pole of the Zodiac [Polo Zodiaci proxima]	♒	7	4 8	0	86	5 2	0	4
The one that follows no. 24 [Quae 24. sequitur]	♓	29	4 3	0	83	1 7	0	5
Next to this [Succedens huic]	♓	29	4 4	0	81	4 0	0	5
Nearer to the pole [Polo vicinior]	♓	28	1 3	3 0	84	4 5	0	3
Preceding the antepenultimate, at the bend [Praecedens antepenultimam ab extremo flexu]	♊	9	1 7	0	78	3 1	0	5
Antepenultimate, preceding the bend [Antepenult. flexu praeced.]	♊	13	5 0	3 0	74	1 0	3 0	3
Penultimate at the bend [Penultima ad flexum]	♊	0	4 4	0	71	3	0	3
Second following the bend [Flexum sequens secunda]	♋	0	3 9	0	65	1 7	0	5
Next-following the bend [Flexum proxime sequens]	♋	3	3 2	3 0	66	3 5	0	2
Penultimate of the tail [Penultima caudae]	♈	11	4 8	0	61	3 2	0	3

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
End of the tail [Ultima caudae]	♌	5	5	3	57	6	0	3
			9	0				
Unformed, between [stars] 11 & the arm of Cepheus [Informis inter 11. & Cephei brachium]	♍	2	2	0	77	3	3	5
			6			0	0	

CEPHEUS

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Girdle of Cepheus [Cingulum Cephei]	♍	1	3	3	71	8	3	3
			6	0			0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the shoulder [Lucida humeri]	♍	8	3	3	68	5	3	3
			6	0		6	0	
In the left shoulder [In sinistro humero]	♍	29	1	0	62	3	2	4
			7			6	5	
Following, in the tiara, toward the north [Sequens in tiara ad Boream]	♍	9	5	3	61	4	3	4
			2	0			0	
Southern [Australis]	♍	9	1	0	60	0	2	4
			9				0	
The one toward the east [Quae versus ortum]	♍	15	2	3	58	4	3	4
				0		7	0	
In the bend of the arm, southern [In flexu brachij australior]	♍	0	4	3	71	5	2	4
			3	0		0	5	
Northern, same place [Ibidem borealior]	♍	1	1	3	74	1	5	4
			7	0			0	
The one in the shoulders [Quae in humeris]	♍	20	9	2	65	4	2	5
				8		3	5	
In the right foot [In pede dextro]	♍	28	5	3	75	2	3	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	'	"
			6	0			8	0
In the left foot [In pede sinistro]	♄	25	4	3	64		2	2
			6	0			9	5

3rd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	'	"
Unformed, near the Tiara [Informis prope Tiaram]	♄	5	5	3	64		2	3
			3	0				0

BOOTES, seu ARCTOPHYLAX (the Bear-keeper)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	'	"
Arcturus, in the fringe [Arcturus in fimbria]	♌	20	4	2	31		0	4
				7				0
In the left shoulder [In humero sinistro]	♌	14	3	2	49		5	3
			0	7			1	0

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	'	"
Preceding, in the left hand [In sinistra manu praecedens]	♍	25	3	3	58		5	3
			4	0			1	0
Second [Secunda]	♍	26	5	0	58		4	3
			8				9	0
Third [Tertia]	♍	28	2	3	60		3	4
			4	0				0
In the left forearm [In ulna sinistra]	♌	2	4	0	54		3	2
			3				8	9
In the head [In capite]	♌	20	8	3	54		1	0
				0			4	
In the right shoulder, above the	♌	28	5	3	48		5	3

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag			
		.	'	"		.	"	.	
Crown [In dextro humero supra Coronam]			4	0			9	0	
In the haunch below the right arm [In coxa infra brachium dext.]	♌	23	5	3	40		3	2	3
			4	0			8	8	
Lowest of the two on the back [Infima duar. in dorso]	♌	19	4	0	42		9	3	4
			1					2	
Upper of them [Superior earum]	♌	18	4	3	42		3	0	4
			2	0			4		
In the right shin [In Crure dextro]	♌	28	5	3	27		5	3	3
			1	0			5	3	
Upper part of the shin [Cruris superior]	♌	15	7	0	28		7	3	3
								0	
Middle of the shin [Media Cruris]	♌	13	5	0	26		3	2	4
			0				1	9	
Lowest of the shin [Infima Cruris]	♌	15	2	0	25		1	3	4
							2	2	
Near the knee, lowest of 3 unformed [Circa genu infima 3. informium]	♌	27	3	3	30		2	0	4
			8	0			6		
Middle [Media]	♌	28	3	0	31		2	2	4
			6				0	9	
Upper [Superior]	♌	29	1	0	33		5	3	4
			7				0	0	

[Bootes, continued]

		Gr					Mag		
Names of the fixed stars	Sign	.	'	"	Lat. Gr.	.	'	"	.
Preceding, of the four of the right hand [Praeced. de quatuor manus dext.]	♌	29	3	0	40		1	0	5
			6				3		
Following, southern & northern [Sequens Australis & Borealis]	♍	1	5	0	46		3	0	5
							0		
	♌	29	1	0	42		1	3	5
			8				4	0	
The one that follows it [Quae hanc	♍	0	4	0	41		5	2	6

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
sequitur]			1			3	9	
Preceding, in the southern	♌	1	9	3	45	4	3	5
Colorobus [club] [Praecedes in				0			0	
Colorobo australis]								
Following [Sequens]	♌	2	5	3	46	5	2	5
			1	0		0	8	
Upper, in the Colorobus [Superior in	♌	29	5	0	53	2	0	4
colorobo]			7			6		
Unformed, around this [Informis	♌	4	0	0	53	5	2	4
circa hanc]						8	9	
Unformed, of the two above the	♌	13	1	0	60	3	2	6
head [Informis duarum supra			4			8	8	
caput]								
Second of them [Secunda ipsarum]	♌	13	5	0	60	5	3	6
			8			5	0	

3rd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
In the Spear [In Venabulo]	♌	0	1	0	45	4	3	4
			0			3	0	

CORONA BOREA (the Northern Crown)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the Crown [Lucida	♌	8	1	2	44	2	2	2
Coronae]			2	7		5	0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Preceding the bright star	♌	5	1	0	46	8	0	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
[Praecedens lucidam]								
The one above this [Quae supra hanc]	♌	4	3	3	48	2	0	5
			4	0		5		
Following, toward the north [Sequens ad Boream]	♌	9	2	0	50	2	0	6
			6			1		
Following the bright star [Sequens lucidam]	♌	10	3	3	44	3	0	4
			8	0		3		
Next following [Proxime sequens]	♌	12	4	0	44	5	0	4
			9			2		
The one that accompanies this [Quae hanc comitatur]	♌	14	5	0	46	9	3	4
			6				0	
Last of all [Ultima omnium]	♌	14	2	0	48	2	0	6
			6			4		

HERCULES ENGONASI (the Kneeler)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Head of Hercules [Caput Herculis]	♐	11	5	7	37	2	1	3
			8			2	5	
Right shoulder [Humerus dexter]	♌	26	5	3	42	4	1	3
			4	7		7	5	
Left shoulder [Humerus sinister]	♐	10	3	7	47	4	1	3
			7			6	5	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Penultimate of the right arm [Penultima brachij dextr.]	♌	25	2	1	40	5	0	3
				0				
Lowest in the right arm [Infima in dextro brachio]	♌	21	3	4	37	1	1	4
			2	0		8	5	
In the left arm [In brachio sinistro]	♐	15	4	9	49	2	1	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
			8			2	4	
Preceding, in the spoils of the Lion [Praecedes in spolio Leonis]	♐	21	2	1 51		1	0 4	
				2		6		
Following, in the Triangle of the spoils [Sequens in Triangulo spoli]	♐	28	4	1 52		1	0 4	
			5	0		8		
At the base of the triangle, toward the north [In basi trianguli ad boream]	♐	28	4	8 53		4	0 4	
			5			5		
Middle, in the spoils [Media in spolio]	♐	25	4	1 52		4	2 4	
				0		6	0	
In the right haunch [In coxa dextra]	♐	27	2	1 53		1	0 3	
			8	2		0		
The eastern one, in the left thigh [Hac orientali in fem. sinistr.]	♐	4	1	4 53		2	1 3	
			1	0		0	8	
Preceding, of the three near the thigh [Praeced. trium contiguar. femoris]	♐	7	4	4 59		3	1 4	
			7	0		7	5	
Middle of them [Media earum]	♐	8	4	1 60		1	0 4	
			5	2		1		
Following [Sequens]	♐	11	1	4 60		1	0 4	
			3	0		3		
In the left knee [In genu sinistro]	♐	27	2	1 60		4	1 3	
			2	0		6	7	
In the left shin, toward Caput Draconis [In sinist. sura ad Cap. drac.]	♐	15	4	9 69		2	2 3	
			3			1	0	
Preceding, of the three in the left foot [Praec. trium in pede sinistr.]	♐	8	3	4 71		1	1 6	
			1	0		9	7	
Middle of them [Media earum]	♐	12	3	1 71		1	0 6	
			3	0		3		
Last, nebulous [Ultima nebulosa]	♐	19	2	8 71		4	1 neb.	
			6				8	

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
In the upper right thigh [In superiori femore dextro]	♌	24	3	4	60	2	0	3
			4	0		2		
More-northerly in the same [Borealiior in eadem]	♌	19	1	3	63	1	2	4
			5	9		3	0	
In the right knee [In genu dextro]	♌	10	9	4	65	5	1	4
				0		4	5	
In the upper shin [In superiore sura]	♌	7	2	1	63	5	1	4
			3	2		0	4	
In the shin [In crure]	♌	4	9	1	64	2	1	4
				0		2	5	
Preceding, in the right shin [Praecedens in crure dext.]	♌	17	5	1	62	2	1	4
			8	7		8	7	
In the right foot's shin [In tibia pedis dextri]	♌	3	5	3	60	1	0	4
			4	8		5		
End, in the right foot [Extrema in pede dextro]	♌	28	3	8	57	1	0	4
			2			5		

3rd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
In the left haunch, preceding [In coxa sinist. praeced.]	♏	2	4	1	55	5	1	5
			6	0		4	5	
Following in the same [Sequens in eadem]	♏	3	5	8	58	1	1	5
			6			4	6	
Unformed, of the right arm, southern [Informis dext. brachij aust.]	♌	26	1	1	57	2	1	5
			5	0		9	7	

LYRA, seu VULTUR VOLANS (the Lyre, or Flying Vulture)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the Lyre [Lucida	♌	11	6	2	61	4	0	1

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Lyrae]				7		7		

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Above the bright star, toward the north [Supra lucidam ad Aquilonem]	♊	14	3	3	62	2	3	5
			7	0		6	0	
Below the bright star, toward the southeast [Infra lucidam ad Eurum]	♊	13	4	2	60	2	3	5
			9	8		5	1	
In the drawing-out of the horns [In eductione cornuum]	♊	17	3	0	59	2	2	4
			4			5	9	
Of the two adjacent, toward the north [Duarum contiguarum ad Boream]	♊	25	5	0	60	4	3	5
			6			5	0	
The same, toward the south [Earundem ad austrum]	♊	26	2	3	59	4	2	5
			5	0		0	8	
In the yoke, preceding & northern [In iugo praeced. & borealis]	♊	14	4	0	56	4	3	3
			0				0	
Small one below this [Parva sub hac]	♊	14	2	0	55	1	2	6
			7			5	9	
In the yoke, northern of the following ones [In iugo sequentium borea]	♊	17	3	3	55	5	3	3
			4	0			0	
Small one below this [Parva sub hac]	♊	17	4	2	54	3	0	6
			3	9		1		
In nearly the middle of the body [In medio fere corpore]	♊	22	1	3	58	5	3	5
			5	0			0	

CYGNUS (the Swan)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Beak of the Swan [Rostrum Cygni]	♄	27	5	3	44	3	0	3
				1				
Ancient bright star of the breast [Lucida pectoris antiqua]	♁	20	4	4	57	1	2	3
			6	0		0	0	
Tail of the Swan [Cauda Cygni]	♄	1	1	1	59	5	2	2
			5	2		7	0	
Wings of the upper joint [Alae superioris ancon.]	♁	12	1	4	64	2	5	3
			4	7		8	0	
Wings of the lower joint [Alae inferioris ancon.]	♁	23	3	1	49	2	0	3
			1	7		7		

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
The one in the head [Quae in capite]	♁	0	4	0	50	4	0	5
			6			3		
In the middle of the neck [In medio colli]	♁	8	5	0	54	2	0	4
			9			0		
Three in the upper wing, southern [Triū in superiori ala Austr.]	♁	14	4	0	69	4	0	4
			3			3		
Penultimate of the upper wing [Penultima superioris alae]	♁	14	1	3	71	3	0	4
				0		2		
Last of the upper wing [Ultima superioris alae]	♁	10	5	3	73	5	3	4
			8	0		1	0	
In the middle of the lower wing [In medio inferioris alae]	♁	25	4	0	51	4	2	4
			0			2	0	
Extreme of the lower wing [Extrema inferioris alae]	♁	29	5	0	43	4	0	3
						5		
Preceding, in the lower foot [Praecedes in pede inferiori]	♄	1	5	0	55	0	0	4
			4					
Following, in the lower knee [Sequens in genu inferiori]	♄	6	4	3	56	3	1	4
			3	0		7	0	
Adjacent, in the upper foot,	♁	24	1	0	63	3	2	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	"	.
preceding & southern [Contiguat. in super. pede praecedens, & Austr.]			2			8		
Upper of them, northern [Earum superior Borealis]	♊	25	5	3	64	1	3	4
			6	0		8	0	
Lower, of the unformed, following the right wing [Inferior informium sequēs alam dextram]	♋	4	2	3	50	3	0	4
			5	0		4		
The upper of them [Earundem superior]	♋	6	1	3	51	3	0	4
			5	0		2		
Below the wing, toward the foot of Pegasus [Infra alam versus pedem Pegasi]	♋	5	5	0	38	4	3	3
			5			0		
Of the two, toward the Lyre, preceding [Duarum versus Lyrā praec.]	♌	21	1	0	66	1	2	4
			9			6		
Following, more northerly [Sequens borealior]	♌	26	1	3	68	5	0	4
			1	0		3		
Small one, toward the hollow of the wing [Parvula ad volam alae]	♊	14	5	0	69	4	2	4
			3			0		
Toward the lower wing [Ad inferiorem alam]	♊	19	3	0	53	1	0	6
			7			3		
Toward the upper wing [Ad superiorem alam]	♊	14	4	0	69	4	0	6
			0			3		
★ New star in the breast of the Swan [Nova in Pectore Cygni] — it existed in the year 1600; to us, in November 1659 [Erat Anno 1600. in Nobis Anno 1659. Novēb.]	♊	16	1	0	55	3	0	3
			5			0		
In the right knee, nebulous [In dextro genu nebul.]	♋	4	2	0	63	2	0	neb.
			2			1		

CASSIOPEIA

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the Chair [Lucida Cathedrae]	♄	0	5	4	51	1	0	3
			5	7		7		
Schedir, of the breast [Pectoris schedir]	♄	3	3	2	46	3	5	3
			9	7		6	0	
The bend [Flexura]	♄	9	4	2	48	4	5	3
			9	7		7	0	
In the knee [In genu]	♄	13	4	5	46	2	5	3
			2	7		3	0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
The one in the head [Quae in capite]	♄	0	5	0	44	4	0	4
			7			2		
In the girdle [In cingulo]	♄	6	0	0	47	6	3	4
						0		
In the shin [In crure]	♄	20	3	3	47	3	2	3
			5	0		0	9	
End of the foot [Extrema pedis]	♄	28	1	0	48	5	3	4
						5	1	
In the left arm [In brachio sinistro]	♄	7	3	3	43	1	3	5
			6	0		9	0	
In the left elbow [In cubito sinistro]	♄	6	3	0	43	2	3	6
			8			9	0	
In the right elbow [In cubito dextro]	♄	26	1	0	49	2	0	6
						6		
In the drawing-out of the seat [In educatione sedis]	♄	8	2	0	51	1	0	6
			8			6		
End of the Chair [Cathedrae extrema]	♄	26	5	0	51	9	2	6
			6			8		
At the extremity of the seat [In extremitate sellae]	♄	26	5	0	52	4	3	6
			4			0	0	
In nearly a straight line with [stars]	♄	20	5	0	52	4	2	6

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		.	'	"
Following, northern [Sequens Septentrionalis]	♐	7	3	0	53		3	2
			4				3	9
Southern of them [Earum Australis]	♐	1	3	0	52		5	3
			3					0
Above these, toward the Pole [Supra has versus Polum]	♐	8	7	0	59		9	2
								8
First, between Auriga & Cassiopeia [Prima inter Aurigam, & Cassiop.]	♐	18	3	0	35		5	3
			9				1	0
Second [Secunda]	♐	28	4	0	35		4	2
			1				9	8
Third [Tertia]	♐	3	5	0	34		5	3
			5				0	0
Fourth [Quarta]	♐	4	2	0	30		2	2
			2				3	8
First, of the three toward the north [Trium in Boream prima]	♐	2	7	0	44		1	3
							1	0
Second [Secunda]	♐	2	1	0	45		3	2
			9				3	8
Third [Tertia]	♐	27	3	0	45		3	2
			7				3	9
The one more toward the north, & first toward the Bear [Quae magis in Boream, & prima versus Ursam]	♐	1	3	0	54		4	3
			2				4	0
Second [Secunda]	♐	29	7	0	56		1	2
							6	8
Third [Tertia]	♐	5	3	0	56		5	3
			5				6	0
Fourth [Quarta]	♐	1	2	0	59		1	2
			0				9	8
Fifth [Quinta]	♐	9	1	0	60		4	3
			6				8	0
Sixth [Sexta]	♐	11	3	0	62		5	2
			6					8

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Seventh [Septima]	♄	10	5	0	62	4	3	6
			9			7	0	
Eighth [Octava]	♄	22	2	0	63	1	2	6
			0			8	9	
New star in the year 1572 [Nova Anno 1572. erat]	♄	6	5	0	53	4	0	*
			4			5		

PERSEUS

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Bright star of the flank [Lucidum latus]	♄	27	3	5	30	5	4	2
			9	5			0	
Common one, below the upper plate, with the northern horn of the Bull [Sub plata communis cum ♄ cornu bor.]	♄	18	2	4	5	2	3	2
			2	7		0	0	
Head of Medusa [Caput Medusae]	♄	22	5	5	22	2	4	3
				7		2	0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Wrapped, at the end of the right hand [Involuta in extremo manus dextrae]	♄	19	5	0	39	1	1	6
			9				0	
In the right elbow [In cubito dextro]	♄	24	3	0	37	2	1	4
			7			9	2	
In the right shoulder [In humero dextro]	♄	25	5	3	34	3	4	3
			4	0		0	0	
In the left shoulder [In humero sinistro]	♄	20	3	3	31	3	8	4
			2	0		5		
At the crown of the head [In vertice]	♄	23	1	0	34	2	4	5

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
capitis]			8			6	0	
The one on the back [Quae in dorso]	♊	25	1	0	30	3	0	4
						7		
Below the bright star of the flank [Infra lateris lucidam]	♊	28	3	3	27	5	3	5
			2	0		9	8	
Small one following this [Parva hanc sequens]	♊	29	4	3	27	5	4	5
			1	0		5	0	
Toward the bend of the flank [Ad flexum lateris]	♊	0	5	0	27	1	3	3
			3			4	9	
In the left elbow [In cubito sinistro]	♊	23	3	0	26	4	4	4
			4				0	
The one below the head of Medusa [Quae sub capite Medusae]	♊	21	5	0	20	5	3	5
			9			4	8	
Preceding this [Hanc praecedens]	♊	20	4	0	20	3	4	4
			6			3	0	
Preceding, toward the north, in the head of Medusa [Praecedens ad Bor. in cap. Medusae]	♊	19	4	0	21	3	4	4
			8			5	0	
In the right ham [In poplite dextro]	♊	7	4	3	28	2	1	5
			1	0		3	0	
The one preceding the right knee [Quae praecedit genu dextr.]	♊	5	3	3	28	5	4	5
			9	0		0	0	
Preceding the bend of the knee [Praec. flexum genu]	♊	5	3	0	26	1	3	5
			3			1	8	
Middle, in the right knee [Media in genu dextro]	♊	6	4	0	26	3	4	4
			2			9	0	
Below the right knee [Infra genu dextrum]	♊	7	2	0	24	3	3	4
			8			5	9	
In the sole of the right foot [In planta pedis dextri]	♊	9	2	0	18	5	4	5
			9			6	0	
In the left thigh [In sinistro femore]	♊	29	3	0	22	6	3	4
			9				8	
In the left knee [In genu sinistro]	♊	1	3	0	19	4	3	3

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
			6				9	
In the left shin [In crure sinistro]	♐	0	5	3	14	5	0	5
			1	0		4		
In the left heel [In sinistro calcaneo]	♏	26	5	0	12	8	4	3
			1				0	
Following, of the left foot [Sequens sinistri pedis]	♏	29	4	0	11	1	0	3
						8		
Unformed, above the head [Informis supra caput]	♏	28	1	0	42	2	3	5
			3			6	8	
In the upper part of the right thigh [In super. parte femor. dextr.]	♐	4	0	0	29	3	4	5
						1	0	
Unformed, preceding the head of Medusa [Informis praec. cap. Medusae]	♏	17	4	0	20	5	4	4
			2			3	0	
In a straight line with the Pole, & with the bright star of the flank [In recta linea cum Polo, & cum lucida lateris]	♐	3	4	0	45	1	3	6
			6			0	9	
Second of those [Secunda illarum]	♐	5	4	0	48	7	4	6
			0				0	
— <i>from the other Catalogue of Kepler [ex altero Catalogo Kepleri]</i>	♐	5	3	0	48	7	4	6
			0				0	
Third of those [Tertia illarum]	♐	6	9	0	49	2	3	6
						7	8	
Fourth of them [Quarta earum]	♐	7	5	0	53	3	4	6
			3			7	0	
— <i>from the other Catalogue of Kepler [ex altero Catalogo Kepleri]</i>	♐	7	4	0	53	3	4	6
			3			7	0	

3rd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Unformed, from the left knee toward the east [Informis à sinistro]	♐	3	3	0	17	5	4	5

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
genu ad ortum]			8			0	0	

AURIGA, HENIOCHUS ERICHTONIUS (the Charioteer)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Capella, or the Goat [Capella, seu Hircus]	II	17	4	2	22	5	4	1
			0			1	5	
Bright star of the right shoulder [Lucida humeri dextri]	II	27	1	2	21	2	4	2
			2			5	0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Preceding & upper, of the head [Praec. & superior Capitis]	II	25	2	0	32	1	1	6
						6	5	
Following, & lower [Sequens, & inferior]	II	25	3	0	30	5	1	4
			8			1	4	
In the right arm [In brachio dextro]	II	25	5	0	13	4	1	4
			2			5	6	
— <i>from another Catalogue, of Longomontanus [Ex alio Catalogo Longomontani]</i>	II	25	2	0	13	4	1	4
			2			5	6	
In the left elbow [In cubito sinistro]	II	14	3	0	20	5	1	4
			5			3	5	
Preceding, of the Kids [Haedorum praecedens]	II	14	2	3	18	1	0	4
			9	0		0		
Following, of the Kids [Haedorum sequens]	II	15	1	3	18	1	0	4
			3	0		3		
In the upper foot [In superiore pede]	II	12	2	3	10	2	1	4
			8	0		3	5	
Upper, toward the bright star of the right Kid [Superior ad lucidam	II	25	4	3	27	2	1	4
			9	0		8	3	

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
dextri humeri] [?]								
In the northern loins [In lumbis Borealiør]	II	18	1	3	18	3	0	6
			6	0		6		
In the southern loins [In lumbis Australiør]	II	17	3	0	17	0	1	6
			0				5	
Lower than this, toward the west [Huic inferior ad Occasum]	II	16	2	0	15	2	0	5
			2			3		
Following [Sequens]	II	18	3	0	14	5	1	5
			3				5	
Toward the buttocks [Ad nates]	II	13	2	0	15	4	1	5
			4			4	4	
Preceding, of the two in the right arm [Praeced. duarum in brachio dextro]	II	23	3	3	15	4	0	5
			6	0		4		
Following them [Sequens earum]	II	23	4	0	15	4	1	5
			8			4	3	
— <i>from another Catalogue of Kepler</i> [Ex altero Kepl. Catalogo]	II	24	8	0	15	4	1	5
						4	3	
Below this, in the right shin [Sub hac in dextro crure]	II	23	5	0	13	5	1	5
			9			0	5	
In the left shin [In sinistra tibia]	II	18	1	3	11	1	1	5
			3	0		6	4	
In the right foot [In dextro pede]	II	19	5	0	8	5	1	5
			8			2	6	
Preceding, near Erichthonius [Praecedens circa Erichthon.]	II	11	2	3	14	5	1	5
			8	0		2	3	
Following, southern [Sequens Australis]	II	11	5	0	14	3	1	5
			5				5	
Northern, unformed, between Auriga & the feet of Gemini [Borealis informis inter Aurigam, & pedes Gemin.]	II	29	1	0	6	1	1	4
			6			5	4	
Second [Secunda]	II	24	2	0	4	7	1	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
			8				5	
Below this, toward the east [Sub istam ad ortum]	♐	25	2	0	2	2	1	4
			8			7	3	
Preceding them [Harum praecedens]	♐	21	2	3	2	2	1	4
			0	0		9	5	
Last of all [Ultima omnium]	♐	23	2	0	1	7	1	4
			4				6	

OPHIUCHUS, seu SERPENTARIUS (the Serpent-bearer)

1st Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Head of Ophiuchus [Ophiuchi Caput]	♐	18	1	7	35	5	1	3
			7			6	5	
Preceding, of the left hand, northern [Manus sinistrae Borealior]	♐	28	1	3	17	1	2	3
			1	7		8	0	
In the right knee [In genu dextro]	♐	13	5	7	7	1	2	3
			1			7	0	
In the left knee [In genu sinistro]	♐	5	6	7	11	2	2	3
						9	0	
In the right shoulder [In humero dextro]	♐	21	1	7	28	0	2	3
			2				0	

2nd Class.

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Following, in the right shoulder [Sequens in dextro humero]	♐	22	3	0	26	1	2	3
			2			0	0	
Preceding, in the left shoulder [Praec. in sinistro humero]	♐	6	2	3	32	3	0	4
			6	0		5		
Following, in the left shoulder [Sequens in sinistro humero]	♐	7	4	0	31	5	2	4
			3			5	0	
In the left elbow [In sinistro cubito]	♐	1	3	0	23	3	0	4

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
			0			9		
In the left hand, southern [In sinistra manu australior]	♄	29	2	0	16	3	0	5
			4			0		
In the right joint [In dextro ancone]	♄	21	0	0	15	1	1	4
						8	9	
— <i>in another Catalogue of Kepler [In alt. Catalogo Kepleri]</i>	♄	20	3	0	15	1	1	4
			0			8	9	
Southern, preceding, in the right hand [Australis praeced. in manu dext.]	♄	25	4	3	13	4	1	4
			0	0		6	8	
More-northerly, following, same place [Borealiior sequens ibidem]	♄	26	4	3	15	1	2	5
			1	0		9	0	
In the right knee [In dextro genu]	♄	13	5	0	7	1	2	5
			1			7	1	
<i>But, by Kepler's correction [Sed ex correctione Kepleri]</i>	♄	13	4	3	7	1	2	5
			7	0		7	1	
In the left knee [In sinistro genu]	♄	5	6	0	11	2	2	5
						9	0	
In the right shin [In tibia dextra]	♄	15	5	0	2	1	2	3
			0			1	1	
Fifth unformed, in the Milky Way [Quinta inform. in via lact.]	♄	27	5	0	33	2	0	4
			8					
Above the bright star of the Serpent's neck [Supra lucidā colli serpentis]	♄	18	1	0	26	3	0	4
			5			6		
Behind the haunches of Ophiuchus [Post coxas Ophiuchi]	♄	16	1	0	10	2	1	4
			6			0	9	
Southern, of the following ones [Sequentium Australior]	♄	20	2	0	8	3	1	3
			4				8	
More-northerly of them [Earum Borealiior]	♄	21	1	0	10	3	2	4
			5			4	0	
The one above this [Quae supra hanc]	♄	20	1	0	15	1	1	4
			2			7	9	

Names of the fixed stars	Sign	Gr			Lat. Gr.	Mag		
		.	'	"		'	"	.
Between the left hand, toward the knee [Inter manum sinistram ad genu]	♏	2	2	0	13	1	2	5
			4			8	0	
Unformed, around the northern shoulder [Informis circa humerum Boreum]	♏	25	5	0	27	5	2	4
			7			4	1	
Middle of them [Media ipsarum]	♏	26	5	0	26	2	1	4
						2	8	
Southern, of the three [Australis trium]	♏	26	1	0	24	4	2	4
			0			9	0	

LIBER IV — DE STELLIS FIXIS (Book 4, On the Fixed Stars)

Universal star catalogue, continued

Longitude is given by zodiac sign [Sig.], degrees [Gr.], minutes ['], and seconds ["]. Latitude is northern [Latit. B. = Latitudo Borealis] in the second part and southern [Latit. A. = Latitudo Australis] in the third part. The final column is magnitude [Magnitud.].

The constellation rubrics carry a *Classis* (class/order) sub-heading indicating the certitude-class of the star positions.

Ophiuchus (Serpent-bearer), continued

The first rows continue the catalogue of Ophiuchus from the preceding page.

Name of the fixed star	Sig n	Gr			Lat. (B) Gr.	Ma g.		
		.	'	"		'	"	.
Following one of three [Sequens trium]	♏	27	2	0	26	9	1	4
			5				8	
Preceding, in the right foot [Præced. in dextro pede]	♏	15	2	—	2	1	2	3
			8			5	0	
Following [Sequens]	♏	17	9	—	1	3	1	4
						1	9	
Third [Tertia]	♏	17	5	—	0	1	2	4
			0			9	0	

Name of the fixed star	Sig n	Gr . ' "	Lat. (B) Gr.	' " g.
Another following [Alia sequens]	✂	18 3 — 0 9		2 1 5 8 9
The one that touches the heel [Quæ tangit calcaneum]	✂	19 3 — 0		5 2 5 7 0
In the right shin [In crure dextro]	✂	18 1 — 7 7		9 1 5 8
Unformed, outside the leg [Informis extra crus]	✂	23 1 — 4 2		1 2 6 9 0
Following two in the hand [Sequens duarum in manu]	✂	1 3 — 23 4		3 1 5 3 8
In the hip of Ophiuchus [In coxa Ophiuchi]	✂	16 2 — 10 7		1 1 5 7 9
Following, southern [Sequens Australis]	✂	20 2 — 8 9		4 2 4 0
In the right hand [In dextra manu]	✂	21 3 — 10 1		3 1 5 9 8
Northern [Borealis]	✂	20 3 — 15 2		5 2 5 0

*The remaining of the 2nd Class,
from Kepler, on the New Star in
Serpentarius: [Reliqua 2. Classis
ex Keplero de Stella Nova in
Serpentario]*

Of three before the foot, in a straight line preceding, northern [Trium ante pedem in recta linea præced. boreal.]	☿	27 9 — 9		2 2 5 6 0
Middle [Media]	☿	26 1 — 6 4		4 1 5 1 9
Lowest [Infima]	☿	25 3 — 3 2		4 2 5 4 0
Preceding the front knee [Præcedens genu anteriori]	✂	2 3 — 13 0		3 1 5 3 9
Of two between the feet, upper	✂	8 1 — 11		4 2 6

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
[Duarum inter pedes super.]			8			9	0	
... lower [inferior]	✂	7	1	—	4	3	1	6
			6			7	9	
In the front shin, northern [In crure anteriori borea]	✂	4	1	—	5	4	2	4
			4			1	0	
The middle of them [Earum media]	✂	3	3	—	3	1	1	4
			4			0	9	
The southernmost of them [Earum Australissima]	✂	3	1	—	1	3	2	4
			2			7	0	
In the front heel [In calcaneo pedis anter.]	✂	5	3	—	0	2	1	4
			1			5	8	
In the following thigh [In femore sequenti]	✂	17	6	—	17	2	2	5
						7	0	
In the following elbow [In cubito sequenti]	✂	20	2	—	14	5	1	4
			9			6	9	
In the following foot's shin [In tibia pedis sequentis]	✂	17	9	—	1	5	2	4
						6	1	
In the toe of the foot [In digito pedis]	✂	15	3	—	3·37·40·A			4
			4					
On the back of the foot [In dorso pedis]	✂	16	1	—	1·27·40·A			5
			4					
Bright one in the sole [Clara in planta]	✂	17	1	—	1·43·39·A			3
			4					
In the hollow of the foot [In vola]	✂	18	1	—	0·59·40·A			4
			4					
In the heel, or ankle [In calce, seu talo]	✂	19	3	—	0·57·39·A			4
			2					
Following this foot [Sequens hunc pedem]	✂	21	3	—	1	2	2	4
			1			1	0	
Unformed, between the shoulder of Ophiuchus and Hercules [Informis inter humerum Ophiuchi, & Herculis]	⊞	27	5	—	34	5	1	4
			4			9	9	

Name of the fixed star	Sig n	Gr . ' "	Lat. (B) Gr.	Ma ' " g.
At the shoulder of Ophiuchus, in the northern rhombus [Ad humerum Ophiuchi in Rhomboborealiss.]	✂	26 3 — 4	27	5 2 4 9 0
Preceding one of the middle ones [Mediarum præcedens]	✂	26 2 — 4	26	3 1 4 9 8
Following [Sequens]	✂	28 1 — 7	26	2 2 4 7 0
Lowest [Infima]	✂	27 7 —	24	4 1 4 4 9
Solitary, above the unformed ones [Supra informes solitaria]	✂	29 1 — 7	32	4 2 4 4 0
<i>The New Star in Serpentarius that appeared in the year 1604</i> [Stella Nova in Serpentario Anno 1604. fuit]	✂	17 4 — 0	1	5 0 * 6

SERPENS OPHIUCHI (the Serpent of Ophiuchus)

Name of the fixed star	Sig n	Gr . ' "	Lat. (B) Gr.	Ma ' " g.
1st Class.				
Bright star of the serpent's neck [Serpens lucida colli]	≈	17 5 4 0 7	25	3 5 2 3 0
2nd Class.				
In the mouth [In ore]	≈	15 4 3 5 0	39	5 2 3 0
Preceding, in the mouth [Præcedens in ore]	≈	12 5 0 6	38	1 0 5 1
In the temples [In temporibus]	≈	18 2 3 7 0	35	2 0 3 4
In the drawing-out of the neck [In educatione colli]	≈	15 4 3 2 0	34	2 2 3 6 0
At the left eye [Ad sinistrum oculum]	≈	16 3 0 1	37	2 2 4 7 5

Name of the fixed star	Sig n	Gr . ' " Lat. (B) Gr.	Ma ' " g.
At the nostrils [Ad nares]	≈	17 5 0 42 3	3 0 4 6
Second in the neck, below the head [Secunda in collo infra cap.]	≈	14 7 3 28 0	5 0 3 7
The more southern of three behind the bright one [Australior trium post lucidam]	≈	20 7 3 24 0	4 2 3 0
In the second bend [In secundo flexu]	≈	21 4 3 16 7 0	2 1 4 5 8
Next-to-last of the tail [Antepenultima caudæ]	↗	25 5 3 19 5 0	5 0 3 6
<i>From the other Catalogue</i> [Ex altero Catalogo]	↗	25 5 3 19 5 0	3 0 3 6
Last-but-one of the tail [Penultima caudæ]	↘	1 3 3 20 3 0	3 2 3 6 0
Last [Ultima]	↘	11 3 0 26 1	5 0 3 8
<i>The remaining from Kepler on the New Star</i> [Reliqua ex Keplero de Nova Stella]			
Which is above the double star, and eighth in Ptolemy [Quæ supra duplicé, & octava Ptolemæo]	≈	17 5 0 26 4	3 0 4 5
In the crest [In crista]	≈	19 3 0 37 0	1 0 5 4
In the coil, apex of the isosceles [In spira apex Isoscelis]	↗	16 2 0 10 1	2 0 4 4
Base, preceding, 14th in Ptolemy [Basis præcedens 14. Ptol.]	↗	20 4 0 8 4	3 0 4
Following, 15th in Ptolemy [Sequens 15. Ptolemæo]	↗	21 3 0 10 0	2 0 4 2

Right column of fol. 273 — continuation of Ophiuchus, then Sagitta, Aquila, Antinous, Delphinus, Equuleus

(These first rows continue Ophiuchus, "from another catalogue.")

Name of the fixed star	Sig n	Gr . ' "	Lat. (B)	Gr.	' "	Ma g.
Above the tail of the two, upper [Supra caudam duar. super.]	♄	1 1 0	26		3 0	6 7
Lower [Inferior]	♄	3 0 0	23		2 0	6 7
Below the tail [Infra caudam]	♄	4 2 0	15		4 0	4 8
Lowest of three at the end of the tail [Ima trium in fine caudæ]	♄	3 2 0	21		2 0	6 8
Middle [Media]	♄	5 2 0	22		4 0	6 1
Last [Postrema]	♄	8 2 0	24		5 0	6 1
Just below the last [Proximè infra ultimam]	♄	11 4 0	25		1 0	6 3

3rd Class.

Following the hand of Ophiuchus [Sequens manum Oph.]	♄	1 6 0	15		5 0	5 9

SAGITTA, sive TELUM (the Arrow, or Dart)

Name of the fixed star	Sig n	Gr . ' "	Lat. (B)	Gr.	' "	Ma g.
2nd Class.						
Upper, and eastern [Superior, & Oriental.]	♄	2 5 1	29		1 1	4 2
Preceding this one [Hanc præcedens]	♄	29 1 1	38		5 4	5 7
A small one above this [Parvula supra hanc]	♄	29 5 0	39		3 1	6 0
Upper, adjoining at the glyph [Super. contig. in Glyphide]	♄	26 5 4	38		5 1	4 2

Name of the fixed star	Sig n	Gr . ' "	Lat. (B)	Gr.	' "	Ma g.
Lower of them [Inferior earum]	♄	27 2 1 3	38		1 1 7	4 0
Unformed, above Sagitta, lower [Inform. supra Sagittá infer.]	♄	1 3 1 6	42		4 1 2	4 0
Upper of the unformed [Superior informium]	♄	2 5 1 9	44		1 1 0	4 0
Third, in the acute-angle, of the unformed [Tertia in Oxygonio informium]	♄	25 2 1 0	46		2 1 3	4 0

AQUILA, seu VULTUR VOLANS (the Eagle, or Flying Vulture)

Name of the fixed star	Sig n	Gr . ' "	Lat. (B)	Gr.	' "	Ma g.
1st Class.						
Bright star in the shoulder-blades [Lucida in scapulis]	♄	27 3 1 2	29		2 4 0	2 0
2nd Class.						
The one in the Head [Quæ in Capite]	♄	1 5 4 1	27		7 4 0	6 0
In the Neck [In Collo]	♄	28 1 1 6	26		4 4 8	3 0
Small one above the Bright star [Parva supra Lucidam]	♄	26 5 1 6	30		5 4 3	6 0
In the left shoulder [In sinistro humero]	♄	26 4 1 9	31		1 1 7	3 0
Following, small [Sequens parva]	♄	27 3 4 1	31		5 1 8	5 2
Upper, and preceding the lower wing [Super, & præc. alæ infer.]	♄	22 3 4 9	28		4 4 5	4 0
Lower, and following in the wing [Inferior, & sequens in ala]	♄	23 3 1 7	26		3 1 4	5 0
Tail of the vulture [Cauda vulturis]	♄	15 3 4 8	36		1 4 5	3 0
Next, of the unformed of the tail	♄	14 7 1	37		3 1	3 0

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
[Proxima caudæ inform.]				0		9	0	
Middle of the unformed, above the tail [Media informium supra caudam]	♄	10	3	1	43	3	4	4
			5	2		1	0	
Following this one [Sequens hanc]	♄	10	4	4	41	4	1	4
			0	2			0	

ANTINOUS

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
2nd Class.								
In the left hand [In manu sinistra]	♁	0	4	4	18	4	0	3
			4	0		7		
In the right side [In latere dextro]	♄	21	4	4	20	1	0	3
			0	1		4		
At the knee [In genu]	♄	20	4	1	14	2	0	3
			0	2		7		
In the right arm [In dextro brachio]	♄	19	2	1	24	5	0	3
			4	3		5		
In the breast [In pectore]	♄	26	1	1	21	3	0	3
			3	2		7		
In the right foot [In pede dextro]	♄	13	9	1	17	4	0	3
				5		0		
Preceding this, unformed [Præcedens hanc informis]	♄	11	5	1	16	5	0	4
			2	2		6		

DELPHINUS (the Dolphin)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
2nd Class.								
Bright star of the Tail [Lucida Caudæ]	♁	9	5	1	29	7	0	3
			5	2				
Following the tail [Sequens caudam]	♁	11	1	1	28	5	3	5
			1	3		1	0	

Name of the fixed star	Sig n	Gr . ' "	Lat. (B) Gr.	' "	Ma g.
The one below the tail [Quæ infra caudam]	≈	11 5 1 27 2		3 0 6 3	
In the rhombus, preceding, of the southern side [In Rhomboide præcedens lateris Australior]	≈	12 1 1 31 9 0		5 3 3 6 0	
Of the same side, more northern [Eiusdem lateris Borealior]	≈	13 1 4 33 3 0		4 0 3	
Following, of the side, more southern [Sequetis lateris Australior]	≈	14 5 4 31 9 2		5 0 3 9	
The one in the Head [Quæ in Capite]	≈	15 1 1 32 5 2		4 0 3 6	
In the preceding side, the fourth, contiguous, going before [In præced. latere quatuor contiguè antecedens]	≈	11 4 1 32 0 0		7 3 5 0	
Preceding, the lowest of the two in the rhombus [Præcedens duarum infima in Rhomboide]	≈	10 4 1 30 1 2		4 3 6 0 0	
Following the same ones [Earundem sequens]	≈	12 5 1 30 3		4 0 6 0	

EQUULEUS, EQUI SECTIO (the Foal, the Horse's Section)

Name of the fixed star	Sig n	Gr . ' "	Lat. (B) Gr.	' "	Ma g.
2nd Class.					
Preceding, of the Head [Præcedens Capitis]	≈	18 5 4 20 5 0		1 2 4 1 0	
Following, of the Head [Sequens Capitis]	≈	21 1 4 21 7 2		5 0 4	
Preceding, of the mouth [Præcedens oris]	≈	19 1 1 25 7 2		1 0 4 5	
Following, of the mouth [Sequens oris]	≈	20 1 4 24 7 0		5 0 4 1	

PEGASUS EQUUS ALATUS (Pegasus, the Winged Horse)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
1st Class.								
Mouth of Pegasus [Pegasi os]	♊	27	4	7	22	6	1	3
			5				0	
Scheat, of the leg [Scheat cruris]	♋	25	1	7	31	8	2	2
			4				0	
First of the wing, <i>Markab</i> [Prima alæ Markab]	♋	19	1	3	19	2	5	2
			9	7		4	0	
Far end of the wing, <i>Algenib</i> [Alæ extrema Algenib]	♋	5	0	7	12	3	2	2
						7		
Navel of Pegasus, see the head of Andromeda [Umbilicus Pegasi, vide caput Andromedæ]								
2nd Class.								
Head of Pegasus [Caput Pegasi]	♋	2	3	3	22	6	2	4
			8	0			0	
Toward the south in the head [Ad Austrum in capite]	♋	1	8	3	15	4	0	5
				0		2		
Lower, following, in the mane [Inferior sequens in iuba]	♋	14	2	0	14	2	2	6
			3			9	0	
Upper, preceding, in the mane [Superior præced. in iuba]	♋	14	7	0	15	4	2	6
						2	0	
Bright star of the neck [Lucida colli]	♋	12	2	3	17	4	0	3
				0		0		
Following, in the neck [Sequens in collo]	♋	13	4	0	18	2	0	5
			8			8		
Left shin [Sinistrum crus]	♋	4	4	0	36	4	2	4
			6			1	0	
Left knee [Sinistrum genu]	♋	10	1	0	34	1	0	4
			3			8		
Right shin [Dextrum crus]	♋	15	2	0	40	5	2	4
			6			9	0	
Preceding, of the two of the	♋	18	5	3	28	4	0	4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
breast [Præced. duarum pectoris]			2	0		8		
Following them [Sequens earum]	✠	20	1	3	29	2	2	4
			6	0		3	0	
Right knee [Dextrum genu]	✠	21	3	3	35	6	2	3
			3	0			0	
In the same knee, toward the south [In eodé genu ad Austrum]	✠	20	4	0	34	2	1	5
			8			3	8	
Preceding, of the two in the Wing [Præcedens duarum in Ala]	✠	26	5	0	25	3	0	6
			6			4		
Following, in the wing, and southern [Sequens in ala, & austr.]	✠	28	2	0	24	4	1	6
			9			9	9	
In the neck [In collo]	✠	7	5	0	20	5	0	4
			1			0		
Below the mouth, above the foot [Infra os supra pedem]	⌘	26	1	0	33	2	0	4
			4			0		
Upper, to this one [Huic superior]	✠	0	1	0	36	1	0	4
			0			0		
Following the first [Primam sequens]	✠	16	3	0	23	1	0	4
			8			5		
<i>From the other Catalogue of Kepler, perhaps</i> [Ex altero Catalogo Kepleri forte]	✠	26	3	0	23	1	0	4
			8			5		

ANDROMEDA

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
1st Class.								
Head of Andromeda [Caput Andromedæ]	♄	10	9	3	25	4	1	2
						2	0	
In the girdle, more southern [In Cingulo Australior]	♄	26	1	0	25	5	3	2
			1			8	0	

Name of the fixed star	Sig n	Gr . ' " Lat. (B) Gr.	Ma ' " g.
Bright star in the southern foot [Lucida in pede Australi]	♄	10 1 4 27 4	4 1 2 7 0
2nd Class.			
Lowest of the right shoulder- blade [Infima scapulæ dextræ]	♄	18 2 3 27 8 0	6 4 4 0
Lower of the left shoulder [Inferior sinistri humeri]	♄	16 4 0 23 7	3 3 4 9
Of three in the right arm, southern [Trium in brach. dextr. austral.]	♄	16 2 0 31 0	3 1 5 3 5
The northern of them [Earum borealis]	♄	17 7 3 33 0	2 4 4 0 0
The middle of them [Earum media]	♄	17 2 0 32 9	1 3 5 4 8
More southern, upper hand [Australior manus superior]	♄	11 5 0 40 0	5 3 4 6 9
More northern, same place [Borealior ibidem]	♄	13 8 0 41	4 3 4 4 0
Obscure, same place [Obscura ibidem]	♄	15 4 0 42 5	8 2 5 5
Highest in the northern hand [Suprema in boreali manu]	♄	14 9 0 43	4 4 4 9 2
Preceding, in the left arm [Præc. in sinistro brachio]	♄	16 3 1 17 1 0	4 2 4 8 0
In the left elbow [In sinistro cubito]	♄	18 1 3 15 5 0	5 2 5 8 5
Middle, in the girdle [Media in cingulo]	♄	29 2 5 30 7 0	3 0 4 4
Northern, in the girdle [Borea in cingulo]	♄	24 5 2 32 7 0	3 1 4 1 0
Far end of the upper foot [Extrema pedis superioris]	♄	10 2 3 36 8 0	5 0 5 0
Brighter, in the right foot	♄	8 1 0 35	2 0 4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
[Lucidior in pede dextro]			4			2		
Highest in the left calf [Suprema in sura sinistra]	♄	6	2	0	28	5	3	5
			8			9	0	
Lower, same place [Inferior ibidem]	♄	4	4	0	27	5	0	5
			5			5		
At the right knee [Ad genu dextrum]	♄	2	1	0	26	2	2	5
			8			0	5	
In the far ring of the chain [In extremo anulo catenæ]	♄	25	2	0	37	1	3	4
			2			9	0	
Brighter, in the left shoulder- blade [Clarior in sinistra scapula]	♄	17	4	3	24	2	3	3
			1	0		0	0	

3rd Class.

In the trail of the two, northern [In syrmate duarum boreal.]	♄	5	2	0	34	4	3	5
			2			0	0	
Same place, southern [Ibidem austrina]	♄	6	5	0	32	4	2	5
			2			0	5	
Unformed, preceding, three of the right hand [Informis præc. tres dextræ manus]	♄	4	2	0	44	0	3	3
			2				0	

TRIANGULUS DELTOTON (the Triangle, Deltoton)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
2nd Class.								
At the apex of the Triangle [In apice Trianguli]	♄	2	4	0	16	4	5	4
			1			9	0	
In the base, toward the north [In basi ad Boream]	♄	8	1	3	20	3	2	4
			1	0		3	0	
Middle [Media]	♄	9	2	0	19	2	2	5
			1			9	5	
More southern, in the base [Australior in basi]	♄	9	2	0	18	5	2	4
			0			7	4	

COMA BERENICES (Berenice's Hair)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (B) Gr.	'	"	Ma g.
2nd Class.								
In the cusp of the first, and of the northern Triangle [In cuspidē primi, & Borealis Trianguli]	♍	19	4	0	28	2	2	3
			1			4	0	
<i>Or otherwise, from Kepler</i> [Vel aliter ex Keplero]	♍	29	3	0	28	3	2	3
			9			0	0	
Upper, to this one, toward the south [Superior huic ad austrum]	♍	20	6	0	27	2	0	4
						2		
Lower, to the same [Inferior eidem]	♍	20	1	0	27	1	1	4
			0			8	2	
Following, two contiguous [Sequens duas contiguas]	♍	20	4	0	27	5	1	4
			3				5	
Preceding, of the two contiguous, toward the south [Præcedens duarum contiguarum ad Austr.]	♍	19	4	0	25	4	1	4
			9			9	3	
The other, contiguous, toward the rising [Altera contigua ad ortum]	♍	20	1	3	26	5	2	4
			2	0			0	
All preceding, toward the south [Omnes præced. ad Austrú]	♍	19	2	0	23	2	2	4
			4			8	5	
Highest of three contiguous, following [Suprema 3.contig.sequentium]	♍	22	3	0	25	1	2	4
			4			4	2	
The other, and preceding [Altera, & præcedens]	♍	22	1	0	24	5	2	4
			5			4	0	
Lowest, and following [Infima, & sequens]	♍	24	1	0	23	5	5	4
			6			8	0	
<i>The other Codex of Kepler</i> [Alter Codex Kepleri]	♍	23	1	0	23	5	5	4
			6			8	0	
Last, in the extension of the hair [Postrema in extensione comæ]	♌	0	2	3	32	4	2	4
			2	0		4	0	
The one that precedes this [Quæ hanc præcedit]	♍	29	1	3	31	4	2	4
			3	0		0	3	

Name of the fixed star	Sig n	Gr . ' " Lat. (B) Gr.	Ma ' " g.
Between these, and the first, in the cusp [Inter has, & primam in cuspidē]	♏	25 4 0 30 1	1 2 4 4 2
In the southern cusp of the small Triangle [In Australi cuspidē parvi Trianguli]	♏	29 3 0 28 9	3 2 5 0 0

PARS TERTIA — Astra Australia (Part Three — The Southern Stars)

From here latitude is southern [Latit. A. = Latitudo Australis].

CETE (Cetus, the Whale)

Name of the fixed star	Sig n	Gr . ' " Lat. (A) Gr.	Ma ' " g.
1st Class.			
Bright star of the jaw [Lucida mandibulæ]	♄	10 7 3 12 2	3 5 2 6 0
Bright star of the northern belly [Lucida ventris Borea]	♄	17 4 1 20 8 5	1 2 3 7 0
Northern of the tail [Cauda Borealis]	♄	26 4 4 9 6 7	5 1 3 8 0
Southern of the tail [Cauda Australis]	♄	28 1 4 20 9 7	4 4 2 3 0
2nd Class.			
The one in the muzzle [Quæ in rostro]	♄	10 5 0 7 2	4 5 4 9 0
Middle of the mouth [Media oris]	♄	5 1 3 12 4 0	2 2 3 0
Preceding, of three at the cheek [Præcedens trium ad genam]	♄	3 2 0 14 3	3 4 3 1 9
Below the eye [Infra oculum]	♄	3 1 0 5 5	5 5 4 1 0
Above the eye [Supra oculum]	♄	7 2 0 5	3 4 4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
			8			5	8	
In the back of the head [In occipite]	Υ	29	5	3	4	1	5	4
			0	0		8	1	
In the breast, the □ [square], toward the north [In pectore □ per Boream]	Υ	25	3	0	25	1	3	4
			1			6	0	
Lower of two, preceding, toward the south [Duarum inferior præc. ad Austr.]	Υ	25	5	3	28	3	2	4
			4	0		9	9	
Following, in the southern breast [Sequetiú in pectore Austr.]	Υ	29	3	2	28	1	0	3
			3	9		6		
Preceding, and Northern [Præcedens, & Borealis]	Υ	29	9	3	25	5	2	3
				1		7	9	
In the belly, middle [In ventre media]	Υ	13	4	0	25	0	3	4
			7				0	
Lowest in the belly [Infima in ventre]	Υ	15	1	0	31	3	2	4
			2				8	
In the eastern back [In dorso Orientalis]	Υ	12	4	3	15	4	0	3
				0		6		
In the western back [In dorso Occidentalis]	Υ	7	3	3	16	5	2	3
			3	0		4	9	
Unformed, following the jaw [Inform. sequens Mandib.]	ϣ	14	7	0	14	2	5	4
						9	0	
Preceding the northern belly [Præcedens Boream ventris]	Υ	16	2	4	21	5	0	5
			7	5		3		
In a straight line with the 3rd & 5th of the Head [In recta linea cum 3. & 5. Capitis]	ϣ	4	1	3	9	1	2	4
			0	0		2	0	
3rd Class.								
Tail, □ [square], following, of northern latitude [Caudæ □ seq. lat. Boreal.]	Υ	4	8	3	12	8	0	5
				0				

Name of the fixed star	Sig n	Gr . ' "	Lat. (A) Gr.	Ma ' " g.
Southern of them [Australis earum]	Υ	3 8 2 5	14	8 0 5
Going before the northern side [Antecedens lateri Boreal.]	Υ	1 5 0 3	13	2 3 5 9 0
Southern of the same [Eiusdem Australis]	Υ	1 2 0 2	14	3 3 5 9 0

ORION

Name of the fixed star	Sig n	Gr . ' "	Lat. (A) Gr.	Ma ' " g.
1st Class.				
Highest of the Head [Suprema Capitis]	Π	19 3 3 5 0	13	2 4 4 5 0
Right shoulder, following [Humerus dexter sequens]	Π	24 3 3 6 5	16	6 1 2 5
Left shoulder, preceding [Humer. sinister præcedens]	Π	16 4 4 6 7	16	5 3 2 2 0
Left foot, bright, Rigel [Pes sinister Lucidus Rigel]	Π	12 3 5 6 7	31	1 1 1 0 0
Highest of the belt [Balthei suprema]	Π	18 9 2 7	23	3 4 2 6 0
Middle [Media]	Π	19 1 4 3 2	24	3 1 2 4 0
Lowest [Infima]	Π	20 2 2 3	25	2 1 2 1 0
2nd Class.				
More western, of the Head [Occidentalior Capitis]	Π	19 3 3 5 0	13	5 4 5 3 0
Third of the Head, eastern [Tertia Capitis Orientalis]	Π	19 5 3 7 0	14	4 2 5 0
Following the left shoulder [Sequens sinistri humeri]	Π	18 1 0 0	17	2 4 5 1 0
The one in the right arm [Quæ in	Π	26 2 3	14	5 4 4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
brachio dextro]			8	0		0	0	
In the right forearm [In dextra Ulna]	II	29	5	0	11	3	1	6
			5			0	9	
In the right hand, more southern [In manu dextra Australior]	II	28	4	1	9	1	1	4
			8	0		5	5	
Preceding, in the right hand [Præcedens in dextra]	II	27	4	3	8	4	1	4
			5	0		4	8	
Next to the highest, in the right [Proxima supremæ in dextr]	II	28	4	2	7	2	4	6
			6	9		0	0	
Last in the hand [Ultima in manu]	II	29	3	0	7	1	1	6
			3			9	6	
Preceding, of two in the Club [Præced. duarum in Colorobo]	II	24	3	3	3	1	4	5
			3	0		2	6	
Following the same ones [Sequens earundem]	II	26	4	0	3	2	1	5
			6			1	5	
Preceding, in the back [Præcedens in dorso]	II	16	5	3	20	8	2	5
			8	9			0	
The most northern, between the 9 of the Shield [Borealiss. inter 9. Clypei]	II	9	1	2	8	1	2	4
			6	0		6	9	
Second of the same [Earundem secunda]	II	10	1	1	9	6	3	4
			1	9			0	
Third [Tertia]	II	9	3	2	11	5	2	6
			3	0			8	
Fourth [Quarta]	II	9	2	4	12	2	0	4
			3	8		5		
Fifth [Quinta]	II	8	1	1	13	3	0	4
			2	9				
Sixth [Sexta]	II	7	4	2	15	2	3	4
			6	0		6	0	
Seventh [Septima]	II	7	5	2	16	4	2	4
			6	2		9	8	
Eighth [Octava]	II	8	2	2	20	1	3	4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
			1	0			0	
Last [Ultima]	II	9	2	1	20	5	0	4
			0	9		5		
The one in the hilt of the sword [Quæ in manubrio ensis]	II	15	5	3	25	3	1	3
			7	0		7	0	
Highest, the 3rd, in the sword [Suprema 3. in ense]	II	18	4	0	28	1	1	3
			8			0	0	
Middle of the sword [Media ensis]	II	18	4	3	28	4	3	3
			4	0		5	9	
Lowest of the sword [Infima ensis]	II	18	4	3	29	1	3	3
			7	0		7	9	
Preceding, below the sword [Præcedens infra ensem]	II	17	4	0	30	3	0	4
			3			7		
Following, below the sword [Sequens infra ensem]	II	19	4	0	30	3	2	5
			6			7	8	
In the left heel [In sinistro calcaneo]	II	13	3	3	29	3	0	4
			5	0		2		
In the calf of the left foot [In sura pedis sinistri]	II	15	2	0	30	5	1	5
			2			9	0	
In the right knee [In genu dextro]	II	22	9	3	33	7	0	3
			0					
Preceding the lowest of the Belt [Præc. ultimam Balthei]	II	19	5	0	26	0	0	6
			9					
Preceding this, toward the back [Præced. huic ad dorsum]	II	15	5	0	19	3	2	6
			4			9	0	
Following, above the hilt of the sword [Sequens sup manubr. ensis]	II	16	5	0	24	6	3	6
						0		
Preceding them [Earum præcedens]	II	15	1	0	23	3	3	5
			9			2	8	
In the side, on the left, above this one [In latere sinistro super hác]	II	16	2	0	21	2	3	5
			0			2	1	
Preceding, below the shield, and	II	13	2	0	20	7	2	4

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
arm [Præc. sub scuto, & brachio]			1				9	
In the left side, preceding [In sinistro latere præced.]	II	21	8	0	21	5	3	5
						7	0	
Following, same place [Ibidem sequens]	II	23	4	3	21	3	2	5
			8	0		8	9	
After this, unformed [Post hanc informis]	II	25	3	0	22	5	3	5
			3			6	0	
Higher, the 3rd, in the left hand [Superior 3. in sinistr. manu]	II	14	5	3	11	4	2	6
			9	0		4	8	
Their middle [Media earum]	II	12	5	3	13	7	3	6
			6	0			0	
Lowest of them [Infima earum]	II	12	2	0	14	2	2	6
			3			3	9	
Ten of the unformed, above, preceding Orion [Decem informium supra, Orionem præcedens]	☿	0	7	0	30	3	0	4
						0		
Following them [Sequens earum]	☿	4	6	0	29	4	2	4
						8	9	
The one above this [Quæ supra hanc]	☿	3	4	0	28	4	0	5
			5			3		
Preceding, the 3rd in a straight line [Præc. 3. in linea recta]	☿	2	3	0	18	4	2	4
			1			6	8	
Middle [Media]	☿	4	2	0	15	5	0	4
			1			6		
Northern [Borealis]	☿	6	1	0	13	1	3	4
			3			4	0	
Below the straight line, toward the south [Infra rectá lineá ad Austrú]	☿	4	2	0	18	2	2	5
			1			3	9	
Above this, toward the rising [Supra hanc ad ortum]	☿	7	5	0	14	5	3	5
			9			8	0	

Name of the fixed star	Sig n	Gr . ' " Lat. (A) Gr.	Ma ' " g.
Preceding, of the two above Canis [Præced. duar. supra Canem]	☿	8 3 3 20 7 0	3 2 4 2 8
Following them [Sequens earum]	☿	15 2 0 22 3	4 2 4 6 9
Below the right shoulder, toward the setting [Infra dextrum humer. ad occasum]	♄	20 2 0 19 1	1 2 5 7 0
Obscure, in the back, following [Obscurarú in dorso sequés]	♄	19 4 3 19 0	3 2 6 6 0
Preceding [Præcedens]	♄	18 1 3 19 0 0	5 2 6 2 0

ERIDANUS NILUS FLUVIUS (Eridanus, the River Nile)

Name of the fixed star	Sig n	Gr . ' " Lat. (A) Gr.	Ma ' " g.
2nd Class.			
At the left foot of Orion, at the beginning of the river [Ad sinistrum pedé Orionis in principio flum.]	♄	11 6 0 31	3 0 4 4
Above the foot of Orion, in the river [Supra pedem Orion. in flu.]	♄	11 8 0 27	5 0 3 3
Following, of two others [Duarum aliarum sequens]	♄	9 5 3 29 0	5 1 5 1 0
Preceding [Præcedens]	♄	6 5 3 27 4 0	5 0 5 1
Following, of the two upper ones [Sequens duarú superiorum]	♄	5 9 3 25 0	3 3 4 3 0
Preceding them [Earum præcedens]	♄	2 3 0 25 9	1 0 4 1

Right column of fol. 275 — Eridanus continued, then Lepus and Canis Maior

(These first rows continue Eridanus.)

Name of the fixed star	Sig n	G r.	'	"	Lat. (A) Gr.	'	"	Ma g.
After an interval, following, of the four [Post intervallum sequens de quatuor]	♄	19	4	0	33	1	0	3
			2			3		
The one that precedes this [Quæ hanc præit]	♄	16	6	30	31	8	40	4
Toward the north, the third preceding [Ad Boream tertia præc.]	♄	16	3	0	28	4	10	3
			1			6		
Going before all four [Antecedens cunctas 4.]	♄	14	9	0	27	4	0	3
						6		
First of those contiguous to Cetus [Prima contiguarum Cete]	♄	4	3	0	24	3	50	3
			4			3		
Between this one, and the third [Inter hanc, & tertiam]	♄	7	0	0	23	5	20	4
						8		
Third, the one that follows [Tertia quæ sequitur]	♄	9	4	0	25	5	50	3
			0			8		
Preceding, lower [Præcedens inferior]	♄	25	1	0	30	2	49	5
			3			4		
Above this one [Super hanc]	♄	25	1	0	27	3	50	4
			7			1		
Following [Sequens]	♄	26	2	0	28	9	20	4
			2					
Upper, eastern [Superior Orientalis]	♄	29	1	0	25	2	43	5
			0					
Preceding, of two, between the river & Taurus [Præced. duar. inter flum. & Taurum]	♄	17	4	30	18	2	50	4
			9			6		
Following, southern [Sequens Australis]	♄	21	3	0	22	4	50	4
			1			4		
3rd Class.								
Last of three [Trium ultima]	♄	28	4	—	25	5	0	4
			4			0		
Middle, Ptolemy's 8th [Media	♄	28	0	—	26	5	—	4

Name of the fixed star	Sig n	G r.	'	"	Lat. (A) Gr.	'	"	Ma g.
Ptolemæo 8.]						0		
Of the four that precede [Ex quatuor, quæ præit]	♄	2	5	—	23	1	—	4
			4			0		
In the turning of the river, toward the breast of Cetus [In conversione flu. ad Cete pectus]	♄	27	3	—	32	1	—	4
			4			0		
Following [Sequens]	♄	28	1	—	34	5	—	4
			4			0		
First of the three following [Sequentium trium prima]	♄	1	1	—	38	3	—	4
			4			0		
Middle [Media]	♄	6	1	—	38	0	—	4
			4					
Last [Ultima]	♄	9	5	—	38	5	—	4
			4			0		
In the □ [square], preceding, of the northern side [In □ præc. lateris Boreal.]	♄	13	4	—	41	1	—	4
			4			0		
In the same, southern [In eodem Australis]	♄	13	5	—	42	2	—	5
			4			0		
Of the following side, preceding [Lateris sequentis præced.]	♄	14	3	—	43	0	—	4
			4					
Last of these four [Ultima harum 4.]	♄	17	4	—	43	1	—	4
						0		
Toward the rising, the 2nd of the conjoined ones, northern [Ad ortum 2. coniunctarum Boreal.]	♄	26	3	—	50	2	—	4
			4			0		
More toward the south [Magis ad Austrum]	♄	27	2	—	51	4	—	4
			4			0		
In the reflection of the two later ones [In reflexione duarum posterier.]	♄	20	3	—	53	4	—	4
			4			0		
Preceding [Præcedens]	♄	18	1	—	53	0	—	4
			4					

Name of the fixed star	Sig n	G r.	'	"	Lat. (A) Gr.	'	"	Ma g.
In the last interval, last of the three [In ultimo intervallo ex 3. postrema]	♄	10	1	—	52 4	5	—	4 0
Middle [Media]	♄	7	1	—	53 4	2	—	4 0
First of the Three [Prima Trium]	♄	4	1	—	51 4	5	—	4 0
At the far end of the river [In extremo fluminis]	♄	22	3	—	53 4	3	—	1 0
Scaliger wrote to Tycho that this star is placed by sailors among those of Pisces, which Bayer renders [Scaliger scripsit ad Tychonem hanc locari à Nauclexis in Piscium quod exprimit Bayerus]	♄	9	4	—	59 5	3	—	0

LEPUS (the Hare)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
1st Class.								
In the left shoulder, or thigh [In armo sinist. seu femore]	♄	15	2	7	43 9	5	5	3 0
2nd Class.								
Upper, of the preceding ear [Superior præcedentis auris]	♄	11	3	3	34 7 0	3	2	5 0
Lower of the same ear [Inferior eiusdem auris]	♄	11	4	3	35 3 0	5	2	5 2
Upper, of the following ear [Superior sequentis auris]	♄	13	5	0	35 0	1	2	6 5
Lower of the following ear [Inferior sequentis auris]	♄	13	3	0	36 7	1	2	5 4
The one in the Head [Quæ in Capite]	♄	11	1	0	39 2	2	2	5 1

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
Far end of the front feet [Extrema anteriorú pedum]	II	7	4	3	44	5	2	4
			8	0		8	3	
In the middle of the back, or body [In dorso medioue corpore]	II	17	1	3	41	4	0	3
			2	0				
Southern, of the two in the rear feet [Austral. duarum in pedibus posterioribus]	II	20	4	3	45	4	0	3
			4	0		8		
More northern of the same [Borealior earundem]	II	22	5	0	44	1	2	3
			9			6	0	
Preceding, in the back [Præcedens in dorso]	II	21	4	3	38	1	2	4
			9	0		4	2	
Following, in the back [Sequens in dorso]	II	24	5	3	37	3	0	4
			0	0		9		
Last, in the tail [Ultima in cauda]	II	27	4	0	38	2	2	4
			5			4	0	

CANIS MAIOR (the Greater Dog)

Name of the fixed star	Sig n	Gr .	'	"	Lat. (A) Gr.	'	"	Ma g.
1st Class.								
Most splendid star of the mouth, Sirius [Splendidissima oris Sirius]	☉	10	4	4	39	3	5	1
				7		2		
2nd Class.								
In the forehead, toward the right ear [In fronte ad aurem dextr.]	☉	20	2	5	34	5	0	4
			9	0		2		
In the middle of the forehead [In media fronte]	☉	12	5	2	36	4	0	5
			5	0		5		
Below the left ear [Sub aure sinistra]	☉	15	3	2	38	4	2	3
			4	1			0	
In the neck [In collo]	☉	13	3	2	39	3	0	4
			1	0		2		

Name of the fixed star	Sig n	Gr . ' "	Lat. (A)	Gr.	' "	Ma g.
In the right shoulder of the front feet [In armo dextro pedum anteriorum]	♄	8 0 5	42		1 0	5
			0		5	

Note on coverage: this opening completes the northern constellations (Part Two) of the universal catalogue — ending Ophiuchus, Serpens, Sagitta, Aquila, Antinous, Delphinus, Equuleus, Pegasus, Andromeda, Triangulus, and Coma Berenices — and begins the southern constellations (Part Three: Cete, Orion, Eridanus, Lepus, Canis Maior). No FINIS of Book 4 nor any Liber boundary appears on these folios; the catalogue continues.

Book IV — On the Fixed Stars

Universal Catalogue of the Fixed Stars — Part Three: The Southern Stars (continued)

The catalogue continues with the southern constellations. Each entry gives the star's descriptive name (*Nomina Fixarum*), its longitude (*Longitudo* — by zodiacal sign, degrees, minutes, and on the first page seconds), its southern latitude (*Latit. A.* = *Latitudo Australis*, in degrees and minutes), and its magnitude (*Magnitudo*). Within each constellation the stars are grouped by certitude class (*Classis*). The zodiacal sign is given by its symbol in the "Sig." column.

[Canis Maior, continued — folio 276]

The following entries continue the list of stars of Canis Maior begun on the preceding page.

Nomina Fixarum (star name)	Sig.	G r.	'	"	Lat. A.	Gr.	'	"	Ma g.
In extremo pedis prioris (at the end of the forward foot)	♄	3	1	5	41		2	2	2
			0	0			0	0	
In dorso (on the back)	♄	1	5	5	46		1	2	5
		6	8	0			1	0	
Media in pectore (the middle one on the breast)	♄	1	4	5	46		4	2	5
		4		0			1	0	
In ventre (on the belly)	♄	1	2	2	48		3	5	3

Nomina Fixarum (star name)	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
		9	3	0		1	0	
Inter posteriora femora (between the hind thighs)	☾	1	4	5	51	2	2	3
		6	9	0		6	0	
Inferior dext. pedis prioru[m] (the lower of the right forward feet)	☾	2	3	2	51	4	2	3
			5	0		8	0	
Quæ in cauda (the one on the tail)	☾	2	3	5	51	2	2	3
		5	9	0		6	0	

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Altera in pectore (the other one on the breast)	☾	1	5	1	42	2	0	5
		2	8	9		2		
In genu Australis (the southern one on the knee)	☾	8	2	2	42	1	—	5
			8	0		2		
In sinistro genu duarum præced. (the preceding of the two on the left knee)	☾	6	2	1	46	1	—	5
			8	8		2		
Earum sequens (the following of those)	☾	8	3	2	45	3	—	5
			8	0		2		
In poplite cruris dextri (in the hollow of the right leg)	☾	1	2	1	54	5	—	4
		5	8	9		2		

Informes circa Canem (the unformed stars around the Dog).

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
A Septe[n]trione ad verticem Canis (from the north toward the crown of the Dog)	☾	1	5	2	25	2	—	4
		1	8	0				
Sub pedibus post 4. in re-cta Aust[r]. (beneath the feet, after the 4th, in a straight line toward the south)	☾	2	2	1	61	1	—	4
			8	8		2		

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Quæ magis in boream (the one farther to the north)	☿	3	4	2	58	3	—	4
			8	0		2		
Adhuc Borealior (still more northerly)	☿	5	2	1	56	4	—	4
			8	9		2		
Residua de 4. borealissima (the remaining of the 4, the most northerly)	☿	6	3	2	55	4	—	4
			8	0		2		
Triu[m] ad occasum in linea præced. (the preceding of the three toward the west, in a line)	♂	1	2	1	55	1	—	4
		9	8	8		2		
Media harum (the middle of these)	♂	2	5	2	57	2	—	4
		2	8	0		2		
Trium ultima (the last of the three)	♂	2	5	1	59	3	—	6
		4	8	9		2		
Sub his sequens (the following beneath these)	♂	2	2	1	59	2	—	2
		1	8	8		2		
Harum antecedens (the preceding of these)	♂	1	2	2	57	2	—	2
		8	8	0		2		
Reliqua Australior (the remaining, more southerly)	♂	1	3	1	59	3	—	4
		4	8	9		2		

CANIS MINOR [the Lesser Dog — folio 276]

1. Classis [1st certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Procyon in femore (Procyon, on the thigh)	☿	2	4	2	15	5	1	2
		1	0	7		7	0	

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
In collo, seu collari (on the neck, or the collar)	☿	1	1	5	13	3	4	3
		8		0		3	0	

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Supra lucidam colli (above the bright star of the neck)	☿	2 1	4 0	5 0	12	5 1	1 0	6
Informis supra hanc (the unformed star above this)	☿	1 8	4 4	5 0	9	4 6	1 0	6
Seque[n]s ad caudam Cancri (the following one, toward the tail of the Crab)	☿	2 2	1 9	5 0	10	1 9	4 0	5

ARGO NAVIS [the Ship Argo — folio 276]

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
In suprema puppi (on the topmost stern)	♌	7	1 8	0	43	1 8	3 0	3
Suprema scuti (the topmost of the shield)	♌	2	0	0	44	5 8	3 0	3
Præcedens scuti (the preceding one of the shield)	☿	2 9	2 4	3 0	47	2 8	3	3
In velo (on the sail)	♌	5	3 1	0	32	7	4	4
Informis ad Austrum (the unformed one to the south)	♌	5	5 1	3 0	38	3 1	0	4
In malo trium inferior (the lowest of the three on the mast)	♌	1 3	5 0	5 0	32	5 6	0	6
Supra hanc (above this one)	♌	1 4	1 5	4 9	30	1 8	0	4
Hæc ipsa altior (this same one, higher up)	♌	1 1	2 5	5 0	24	2 9	3 0	4
Duar[um] in antenna præced. (the preceding of the two on the yard-arm)	♍	0	5 9	2 8	21	3 9	3 0	5
Earum sequens (the following of those)	♍	5	4 4	5 7	22	2 9	3 0	3

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Informis inter velum, & lacteam (the unformed one between the sail and the Milky Way)	ℳ	2 5	8	2 7	30	3 0	0	3

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Extrema duar. præced. (the outermost of the two, the preceding)	ℓ	3	2 4	2 7	42	1 0	—	5
Quæ magis ad austrum (the one farther to the south)	ℓ	1	4 4	2 8	45	4 0	—	4
Has duas præcedens (the one preceding these two)	⊕	2 8	2 4	2 8	45	1 0	—	4
Sub scuto trium præced. (the preceding of the three beneath the shield)	⊕	2 8	2 4	3 0	49	1 0	—	4
Sequens (the following one)	ℓ	2	2 4	2 7	49	3 0	—	4
Media trium (the middle of the three)	ℓ	1	3 4	3 0	49	0	—	4
In extremo temone (at the end of the tiller)	ℓ	7	4	2 7	49	3 0	—	4
In catina puppis duarum Boreal. (the more northerly of the two in the hull of the stern)	⊕	2 7	4	2 8	52	4 0	—	4
Earum Australis (the southern one of those)	⊕	2 7	4	2 9	58	2 0	—	3
In folio puppis Boreal. (the northerly one on the leaf [ornament] of the stern)	ℓ	3	1 4	2 7	55	2 0	—	5
Ibidem trium præcedens (in the same place, the preceding of	ℓ	5	1 4	2 8	58	3 0	—	5

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
the three)								
Media (the middle one)	∂	6	1 4	2 9	57	0	—	4
Sequens (the following one)	∂	9	2 4	3 0	57	3 0	—	4
Clara sequens transtri (the bright one following the cross- bench)	∂	1 4	4	2 8	58	3 0	—	2
Sub hac obsc. præc. (the obscure one beneath this, preceding)	∂	1 1	4	2 7	59	5 0	—	5
Sequens (the following one)	∂	1 5	5 4	2 9	59	1 0	—	5
Supra Claram præced. (above the bright one, preceding)	∂	1 5	5 4	3 0	56	3 0	—	5
Sequens (the following one)	∂	1 7	4	2 8	57	3 0	—	5

[HYDRA, seu HYDRUS — the Water-Serpent / Hydra — folio 276]

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Cor Hydræ (the Heart of the Hydra)	♂	2 3	6	3 7	22	2 3	5 0	1

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Borealior in Occipite (the more northerly one on the back of the head)	♂	8	1 0	0	11	8	0	5
Præced. tertia ad Austrum (the preceding, the third toward the south)	♂	8	4 4	3 0	11	3 6	0	5
Orientalissima capitis (the most easterly of the head)	♂	1 0	2 2	3 0	11	1	0	4
Præcedens in collo (the preceding one on the neck)	♂	1 3	1 3	3 0	11	5	2 0	6
Sequens in eductione colli (the following one at the rise of the neck)	♂	1 6	3	3 0	13	5	0	4
Media colli (the middle one of the neck)	♂	2 1	3 3	3 0	15	0	0	5
Borea triu[m] in flexura colli (the northern of the three at the bend of the neck)	♂	2 3	2 6	0	14	1 7	2 0	4
Australis in nexu (the southern one at the coil)	♂	2 1	1 5	3 0	16	4 6	0	5
Quæ cor sequitur proximè (the one that follows the Heart closely)	♂	2 8	3 2	3 0	26	3 3	3 0	4
Huic subsequens (the one following next after this)	♂	1	3 0	0	26	1 2	0	5
Præcedens contiguarum (the preceding of the contiguous ones)	♂	4	1 0	0	23	1 3	0	5
Sequens earum (the following of those)	♂	5	1 5	0	21	5 1	0	4
Quinta à corde (the fifth from the Heart)	♂	1 0	5 3	3 0	24	3 8	0	5
In recta cum hac, & sequenti (in a straight line with this and the	♂	1 4	3	3 0	23	3 1	0	5

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
following one)								
Præcedes crateri proximè (the one preceding the Bowl [Crater] closely)	⌘	1 6	1 3	0	21	4 8	3 0	4
Informis proxima capiti (the unformed one nearest the head)	⌚	6	7	3 0	12	2 7	0	4
Borea sub basi crateris (the northern one beneath the base of the Bowl)	⌘	2 4	2 3	3 0	25	3 6	—	4
Australis sub eadem basi (the southern one beneath the same base)	⌘	2 5	1 1	0	30	1 7	—	5
Sub cauda corui (beneath the tail of the Crow [Corvus])	⌚	2 2	4 6	0	13	4 3	—	3
Parua huic præcedens (the small one preceding this)	⌚	2 0	4 6	0	14	3 7	—	6
Informis ante caput Hyd. (the unformed one before the head of the Hydra)	⌚	0	6	0	10	1 9	—	3

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
Borea duarum in oculo (the northern of the two on the eye)	⌚	5	4 4	0	13	4 0	—	4
Australis earum in hiatu (the southern of them, in the gaping mouth)	⌚	8	2 2	0	14	1 5	—	4
Ab austro duaru[m] contiguarum Borea (the northern of the two contiguous ones, from the south)	⌚	2 2	2	0	19	4 5	—	6
In triquetro præcedens (the	⌚	5	2	0	31	2	—	4

Nomina Fixarum	Sig.	G r.	'	"	Lat. A. Gr.	'	"	Ma g.
preceding one in the triangle)						0		
Media earum (the middle of those)	♌	7	2	0	33	1	—	4
			2			0		
Sequens earum (the following of those)	♌	9	2	0	31	2	—	3
						0		
In extrema cauda (on the very tip of the tail)	♏	7	2	0	17	4	—	4
			2			0		

[Hydra, continued — folio 277]

[3. Classis, continued.]

On folio 277 the table format changes: the longitude carries only sign, degrees, and minutes (no seconds column), and the southern latitude carries degrees and minutes only.

Nomina Fixarum	Sig.	Gr .	'	Lat. A. Gr.	'	Mag .
In capite ad Austrum (on the head, toward the south)	♏	5	22	23	15	3
<i>Aliter</i> (alternatively)				13	15	3
Sequens collum (following the neck)	♏	3	52	16	0	3
<i>Aliter</i> (alternatively)				26	0	3

[Margin / note in table: the "Aliter" rows give an alternative latitude reading for the preceding star.]

CRATER [the Bowl — folio 277]

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	Gr .	'	Lat. A. Gr.	'	Ma g.
In basi crateris (on the base of the Bowl)	♏	19	33	22	41	4
Sequens duarum in medio (the following of the two in the	♏	25	5	19	39	4

Nomina Fixarum	Sig.	Gr			Lat. A. Gr.		Ma g.
middle)		.	'				
Earum præcedens (the preceding of those)	Ⓜ	22	32	30		17	25
Præcedens duarum supra Craterem (the preceding of the two above the Bowl)	Ⓜ	21	49	13		10	4
Earum sequens (the following of those)	Ⓜ	24	24	11		17	4
Præcedens duarum inferiorum (the preceding of the two lower ones)	Ⓜ	29	52	18		10	4
Sequens earum (the following of those)	Ⓜ	1	55	16		2	4
In medio cratere (in the middle of the Bowl)	Ⓜ	26	17	14		0 [9]	5

CORVUS [the Crow — folio 277]

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	Gr			Lat. A. Gr.		Mag
		.	'				.
Quæ ad Oculum (the one at the eye)	Ⓜ	7	30	19		39	4
Præcedens duaru[m] superiorum in □ (the preceding of the two upper ones in the quadrilateral)	Ⓜ	6	35	14		25	3
Sequens earum (the following of those)	Ⓜ	9	17	12		7	3
Sequens inferiorum in □ (the following of the lower ones in the quadrilateral)	Ⓜ	13	11	17		59	3
In rostro (on the beak)	Ⓜ	8	0	21		46	4
In collo (on the neck)	Ⓜ	9	36	18		14	5
In sinistra ala supra lucida[m] (on the left wing, above the bright one)	Ⓜ	9	43	30		11	28

CENTAURUS CHIRON [the Centaur Chiron — folio 277]

2. Classis [2nd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In capite Australissima (the most southerly one on the head)	℣	2	49	21	49	5
Quæ magis ad Boream (the one farther to the north)	℣	2	21	19	8	5
Intermediarum duarum præcedens (the preceding of the two intermediate ones)	℣	1	34	20	51	5
Sequens de quatuor (the following of the four)	℣	2	25	20	12	5

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In humero sinistro præcedens (the preceding one on the left shoulder)	⚭	28	32	25	40	3
In humero dextro (on the right shoulder)	℣	8	2	22	40	3
In armo sinistro (on the left shoulder-blade)	℣	1	32	27	40	4
In scuto præced. boreal. (the northern preceding one on the shield)	℣	10	32	22	30	4
Earum australis (the southern one of those)	℣	11	32	23	50	4
In summitate scuti (at the top of the shield)	℣	14	22	18	30	4
In scuto ad austrum (on the shield, toward the south)	℣	14	52	21	10	4
In latere dextr. trium præced. (the preceding of the three on the right side)	℣	5	42	28	30	4

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Media (the middle one)	℣	6	22	29	30	4
Sequens (the following one)	℣	7	32	28	10	4
In brachio dextro (on the right arm)	℣	8	52	26	40	4
In dextro cubito (on the right elbow)	℣	15	22	25	30	3
In extrem[a] manu dext. (on the very tip of the right hand)	℣	19	52	24	20	4
In educatione corporis humani lucida (the bright one at the rise of the human body)	℣	10	22	33	40	3
Duarum borealiu[m] sequens (the following of the two northern ones)	℣	10	2	31	10	5
Præcedens (the preceding one)	℣	9	12	33	10	5
In educatione dorsi (at the rise of the back)	℣	4	32	35	0	5
Antecedens huic in dorso equi (the one preceding this on the back of the horse)	℣	1	22	37	55	5
In lumbis trium sequens (the following of the three on the loins)	⚭	28	12	40	10	3
Media (the middle one)	⚭	27	22	43	10	4
Antecedens trium (the preceding of the three)	⚭	25	2	44	10	5
<i>Aliter</i> (alternatively)				41	10	5
In dextro femore præced. (the preceding one on the right thigh)	⚭	25	2	46	20	3
Ibidem sequens (the following one in the same place)	⚭	25	52	46	50	4
In pectore sub ala equi (on the breast beneath the horse's wing)	℣	10	42	42	50	4
Sub aluo duarum præced. (the preceding of the two beneath the belly)	℣	8	42	43	10	2

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
Earum sequens (the following of those)	℣	10	2	44		0	3
In poplite pedis dextri (in the hollow of the right foot)	℣	2	22	51		20	2
In talo eiusdem (on the heel of the same)	℣	7	42	51		50	2
In cauo pedis sinistri (in the hollow of the left foot)	⊕	28	42	55		15	4
Sub musculo eiusdem (beneath the muscle of the same)	℣	3	32	55		30	2

[Centaurus, continued — folio 277, right column]

The table continues at the top of the right column with the closing entries of Centaurus.

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
In summo pede dext. priori (on the top of the right forward foot)	℣	0	42	41		20	1
In genu sinistro (on the left knee)	℣	16	32	45		30	2
Sub dextro pede posteriori (beneath the right hind foot)	℣	7	2	49		20	4

LUPUS, seu BESTIA CENTAURI [the Wolf, or the Centaur's Beast — folio 277]

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
In summo pedis posterioris (on the top of the hind foot)	℣	20	22	25		0	3
In poplite eiusdem pedis (in the hollow of the same foot)	℣	18	12	29		20	3
In armo præcedens (the preceding)	℣	23	22	21		30	4

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
one on the shoulder-blade)							
In armo sequens (the following one on the shoulder-blade)	ℳ	26	32	21		20	4
In medio corpore (in the middle of the body)	ℳ	25	22	25		30	4
In aluo sub Ilibus (on the belly beneath the flanks)	ℳ	22	32	27		20	5
In femore (on the thigh)	ℳ	23	12	29		20	5
In educatione femoris Borealis (at the rise of the thigh, the northern one)	ℳ	27	2	28		50	5
Earum Australis (the southern one of those)	ℳ	26	2	30		30	5
In summo lumbo (on the top of the loin)	ℳ	28	2	33		30	5
In extrema cauda 3. austr. (on the very tip of the tail, the 3rd southern one)	ℳ	14	22	31		40	5
Media (the middle one)	ℳ	17	12	30		50	4
Earum Borealis (the northern one of those)	ℳ	15	22	29		40	4
In iugulo Australis (the southern one on the throat)	↗	1	12	17		20	4
Borea ibidem (the northern one in the same place)	↗	1	42	15		40	4
In rictu præcedens (the preceding one in the open jaws)	ℳ	28	2	13		40	4
Sequens (the following one)	ℳ	29	2	12		10	4
In priori pede Australior (the more southerly one on the forward foot)	ℳ	19	32	12		10	4
Earum Borealiior (the more northerly one of those)	ℳ	18	52	10		20	4

THURIBULUM, seu ARA [the Censer, or the Altar — folio 277]

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In basi duarum Borealis (the northern of the two on the base)	↗	20	12	23	0	5
Australis (the southern one)	↗	25	42	26	0	5
In media arula (on the middle of the little altar)	↗	18	52	26	45	4
In foculo 3. borealis (the 3rd northern one on the hearth)	↗	13	2	30	40	5
<i>Aliter</i> (alternatively)				13	40	5
Reliquarum Australis (the southern of the remaining ones)	↗	17	42	34	30	4
Borealis (the northern one)	↗	17	32	33	30	4
In summitate flammæ (at the top of the flame)	↗	13	22	34	30	4
<i>Aliter</i> (alternatively)				31	30	4

CORONA AUSTRALIS [the Southern Crown — folio 277]

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Ad ambitu[m] austr. foris præcedens (toward the southern circuit, outside, the preceding one)	↯	1	42	21	50	4
<i>Aliter</i> (alternatively)				24	50	4
Sequens hanc in Corona (the one following this in the Crown)	↯	4	12	21	20	5
Huic succedens (the one coming next after this)	↯	5	42	23	20	5
Huic subsequens (the one following next after this)	↯	7	22	20	20	4

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Post hanc ante genu Sagittarii (after this, before the knee of the Archer)	♄	8	42	18	50	5
Quæ inde maximè borea in genu luc. (the one from there farthest north, the bright one on the knee)	♄	9	32	17	30	4
Magis Borea (the one farther north)	♄	8	52	16	20	4
Adhuc magis Borea (still farther north)	♄	9	2	15	30	4
In ambitu boreo duarum sequens (the following of the two in the northern circuit)	♄	7	42	15	40	6
Earum præcedens (the preceding of those)	♄	7	12	15	10	6
Ex interuallo has præcede[n]s (the one preceding these at an interval)	♄	4	22	15	0	5
Quæ hanc antecedit (the one that goes before this)	♄	2	12	16	10	5
Reliqua ad Austrum (the remaining one, toward the south)	♄	1	42	18	50	5

PISCIS NOTIUS [the Southern Fish — folio 277]

3. Classis [3rd certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In ambitu capitis præcedens (the preceding one in the circuit of the head)	♁	23	12	20	35	4
Media (the middle one)	♁	26	42	22	30	4
Sequens (the following one)	♁	27	52	22	45	4
Ad branchiam (at the gill)	♁	26	52	16	30	4
In spina australi, & dorso (on the southern spine and the back)	♁	17	42	19	50	5
In aluo duarum sequens (the	♁	23	42	15	30	5

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.

following of the two on the belly)

[Piscis Notius, continued — folio 278]

[3. Classis, continued.]

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Ibidem præcedens (the preceding one in the same place)	≈	21	22	15	0	4
In spina boreali sequens (the following one on the northern spine)	≈	17	42	15	15	4
Ibi media (the middle one there)	≈	14	22	16	45	4
Ibidem præcedens (the preceding one in the same place)	≈	13	32	18	25	4
In extrema cauda (on the very tip of the tail)	≈	12	42	22	30	4
Præcedentium Piscem præcedens (the preceding of those preceding the Fish)	≈	0	32	22	40	3
Media earum (the middle of those)	≈	3	42	22	30	3
Sequens earum (the following of those)	≈	6	32	21	30	3
Huic antecedens (the one preceding this)	≈	4	32	21	10	5
Reliquarum duarum australior (the more southerly of the remaining two)	≈	6	22	17	20	4
Earum borealior (the more northerly of those)	≈	6	22	15	10	3

GRUS [the Crane — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
Lucida Capitis (the bright one of the head)	≈	13	16	22		50	2
In medio collo (in the middle of the neck)	≈	13	17	24		56	4
In educatione colli orientalior (the more easterly one at the rise of the neck)	≈	14	47	28		57	6
Occidentalior (the more westerly one)	≈	15	58	28		40	6
In dorso orientalior (the more easterly one on the back)	≈	16	23	31		52	6
Ibi occidentalior (the more westerly one there)	≈	17	38	31		35	6
In dextra ala Borealiior (the more northerly one on the right wing)	≈	24	37	34		23	5
Ibi Australior (the more southerly one there)	≈	24	8	36		15	4
In læua ala (on the left wing)	≈	11	59	32		57	2
In educatione caudæ (at the rise of the tail)	≈	18	17	34		36	4
In cauda Borealiior (the more northerly one on the tail)	≈	16	49	39		20	4
In cauda Orientalior (the more easterly one on the tail)	≈	14	45	41		36	5
In cauda Occidentalior (the more westerly one on the tail)	≈	19	9	41		27	4

PHOENIX [the Phoenix — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
Lucida in Collo (the bright one on the neck)	✕	10	35	40		10	2

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.		Mag	
		.	'			'	.
Patula adiacens (the spreading one adjacent)	✕	19	13	41		30	5
In ancone alæ dextræ (at the bend of the right wing)	✕	4	38	41		40	4
In ala dextra 3. australior (the 3rd more southerly one on the right wing)	≈	29	48	39		45	4
Earum media (the middle of those)	✕	0	38	35		50	5
Earum borealior (the more northerly of those)	✕	1	58	32		0	5
In extrema ala sinistra (on the very tip of the left wing)	✕	24	8	47		30	3
In eiusdem eductione (at the rise of the same)	✕	10	28	44		10	4
Ad pedem dextrum trium Orientalis (the eastern of the three at the right foot)	✕	6	53	45		0	neb.
Occidentalior (the more westerly one)	✕	8	23	45		40	neb.
Australior (the more southerly one)	✕	7	3	46		0	4
In foco sub ala læua austral. (in the hearth beneath the left wing, southern)	✕	19	15	53		0	5
Ibidem Borealior (the more northerly one in the same place)	✕	14	48	48		25	3
In foco sub ala dextra superior (in the hearth beneath the right wing, upper)	✕	3	58	53		0	4
Earum inferior (the lower one of those)	✕	8	18	54		40	4

INDUS [the Indian — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In Capite (on the head)	☿	29	0	32	30	4
In axilla læua (in the left armpit)	♊	1	13	36	55	4
In læue manus sagitta 1. (the 1st arrow in the left hand)	♊	4	30	37	0	4
Secunda (the second)	♊	6	28	38	35	4
Tertia (the third)	♊	5	45	40	0	4
In summo sagittæ manus dext. (at the top of the arrow, the right hand)	☿	24	40	27	55	5
In imo (at the bottom)	☿	15	0	32	35	5
In axilla dextra Occidentalior (the more westerly one in the right armpit)	☿	24	16	33	45	6
Sequens (the following one)	☿	25	0	33	53	6
Orientalior (the more easterly one)	☿	23	48	33	40	6
In pectore (on the breast)	☿	24	58	36	0	5
In ventre (on the belly)	☿	22	38	39	15	4

PAVO [the Peacock — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Lucida in capite (the bright one on the head)	☿	18	9	36	0	2
In collo superior (the upper one on the neck)	☿	18	23	40	40	6

[Pavo, continued — folio 278, right column]

The table continues at the top of the right column with the closing entries of Pavo.

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Media ibi (the middle one there)	☿	19	38	41	20	6

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Inferior ibidem (the lower one in the same place)	♄	17	23	41	45	6
In pectore (on the breast)	♄	21	53	48	30	3
In radice alæ dextræ (at the root of the right wing)	♄	16	38	46	32	3
Parua huic adiacens (the small one adjacent to this)	♄	15	13	47	0	neb.
In media ala, seu dorso (in the middle of the wing, or the back)	♄	11	48	45	20	3
Nebulosa adiacens (the nebulous one adjacent)	♄	9	53	46	5	neb.
In educatione caudæ prima (the first at the rise of the tail)	♄	3	18	45	40	5
Secunda (the second)	♄	1	45	44	0	5
Tertia (the third)	♄	1	51	43	0	5
Quarta (the fourth)	♄	2	8	39	35	5
Quinta (the fifth)	♄	29	38	41	30	5
Sexta (the sixth)	♄	29	3	40	30	5
Septima (the seventh)	♄	28	13	39	20	5
Octaua (the eighth)	♄	24	53	41	20	5
Nona, & ultima (the ninth, and last)	♄	19	58	42	20	4
In dextro pede Australis (the southern one on the right foot)	♄	9	33	50	0	4
In eodem Borealis (the northern one on the same)	♄	12	28	49	20	6
In sinistro pede (on the left foot)	♄	19	23	50	25	6
In extrema cauda (on the very tip of the tail)	♄	2	28	48	27	6
In eadem (on the same)	♄	28	15	51	40	6

APUS, seu AVIS INDICA [the Bird of Paradise, or the Indian Bird — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Informis, aut in capite (the unformed one, or on the head)	✂	18	33	44	40	5
In collo (on the neck)	✂	18	13	48	6	5
In educatione caudæ boreal. (at the rise of the tail, the northern one)	✂	13	35	54	20	5
Ibidem media (the middle one in the same place)	✂	15	15	55	0	5
Ibidem austrina (the southern one in the same place)	✂	16	10	55	45	5
In cauda versùs $\triangle$ duaru[m] superior (the upper of the two on the tail, toward the triangle)	✂	8	48	51	30	6
Ibidem inferior (the lower one in the same place)	✂	8	3	52	0	6
In media cauda 3. borealior (the 3rd more northerly one in the middle of the tail)	✂	10	11	57	10	5
Media (the middle one)	✂	9	0	57	57	6
Australior (the more southerly one)	✂	9	38	59	20	6
In eadem versùs Chamæleonem (on the same, toward the Chameleon)	✂	13	40	61	25	4

APIS, seu MUSCA [the Bee, or the Fly — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In Capite (on the head)	℣	16	58	54	0	4
In ala dextra (on the right wing)	℣	16	53	56	25	4

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In ala sinistra (on the left wing)	℣	23	13	56	5	4
In cauda (on the tail)	℣	20	57	57	30	4

CHAMÆLEON [the Chameleon — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
In prioribus pedibus (on the forward feet)	↗	1	27	62	40	5
Ad collum (at the neck)	℣	26	8	63	20	5
In dorto [dorso] (on the back)	℣	24	53	67	0	5
In posterioribus pedibus (on the hind feet)	↗	1	21	67	25	5
In eductione caudæ orientali (the more easterly one at the rise of the tail)	↗	0	28	70	38	5
Occidentali (the more westerly one)	↗	2	58	75	35	5
In media cauda superior (the upper one in the middle of the tail)	℣	28	8	73	0	5
Inferior (the lower one)	℣	26	13	73	15	5
In extrema cauda superior (the upper one on the very tip of the tail)	℣	23	30	74	26	5
Inferior (the lower one)	℣	24	28	75	12	5

TRIANGULUM AUSTRALE [the Southern Triangle — folio 278]

4. Classis [4th certitude class].

Nomina Fixarum	Sig.	Gr		Lat. A. Gr.	Mag	
		.	'		'	.
Seq. basis versùs collum Apodis (the following one of the base,	↗	14	20	46	20	3

Nomina Fixarum	Sig.	Gr . ' "	Lat. A. Gr. . ' "	Mag . "
toward the neck of the Bird of Paradise)				
Superior in cuspidè versùs Lupum (the upper one at the apex, toward the Wolf)	✂	5 30 41		0 3
Parua huic adiacens (the small one adjacent to this)	✂	8 40 44		40 5
Basis præcedés versùs caudam Apodis (the preceding one of the base, toward the tail of the Bird of Paradise)	✂	4 20 48		30 3
Parua supra hanc (the small one above this)	✂	5 0 44		15 3

Book IV — On the Fixed Stars (conclusion of the universal catalogue: Pars Tertia, Astra Australia)

The southern catalogue continues with the last of the modern southern constellations. Each entry gives the star's position by ecliptic longitude (Sign, degrees, minutes), southern latitude (degrees, minutes), and magnitude. The two halves of the page form a single continuous catalogue, the left-hand half preceding the right-hand half.

Left column

Names of the fixed stars	Sig.	Long. Gr. . ' "	Lat. A. Gr. . ' "	Ma g.
PISCIS VOLANS, or PASSER [the Flying Fish, or Sparrow] — <i>4th Class</i>				
At the head [In Capite]	✂	19 5 72 3		2 5 6
In the middle of the body [In medio corpore]	✂	24 2 77 9		1 6 2
In the tail [In cauda]	ℳ	7 1 82 2		5 5

Names of the fixed stars	Sig.	Long. Gr.	'	Lat. A. Gr.	'	Ma g.
In the left wing, upper [In ala sinistra superior]	ℳ	13	3 4	75	2 0	6
There, lower [Ibi inferior]	ℳ	20	7	82	1 4	6
In the right wing, upper [In ala dextra superior]	ℳ	6	1 3	76	2 1	6
There, lower [Ibi inferior]	ℳ	11	5 3	79	2 8	6
DORADO, or XIPHIAS [the Goldfish, or Swordfish] — <i>4th</i> <i>Class</i>						
At the head [In Capite]	≈	26	4 5	86	5 3	4
In the gills [In branchiis]	≈	1	2 1	87	0	5
In the belly [In ventre]	II	0	5 3	88	1 2	5
Above the back [Supra dorsum]	℥	25	3	84	4 6	4
At the tip of the tail [In extrema cauda]	℥	10	3 8	76	1 5	4
The center of the Greater Cloud [Nubeculae maioris centrum]	≈	1	3	84	0	ne b.
Adjacent to this [Huic adiacens]	✂	18	3	82	3 1	5
TOUCAN, that is, the AMERICAN GOOSE [Toucan, idest Anser Americanus] — <i>4th</i> <i>Class</i>						
At the tip of the beak [In rostro extremo]	≈	5	1 8	45	5 5	3
At the head [In Capite]	≈	16	1 5	48	1 5	3
At the bend of the left wing [In	≈	15	2	54	1	4

Names of the fixed stars	Sig.	Long. Gr.	'	Lat. A. Gr.	'	Ma g.
ancone alae sinistr.]			3		5	
There, lower [Ibi inferior]	≈	14	1 8	55	4 5	5
In the middle of the wing [In media ala]	≈	16	9	58	2 0	3
On the back [In dorso]	≈	22	2 3	57	5 0	3
In the tail [In cauda]	≈	22	4 8	61	3 0	4
In the leaf of the branch, or the nutmeg [In rami folio, seu nuce myristica]	≈	2	3 3	49	5 5	4

Right column

Names of the fixed stars	Sig.	Long. Gr.	'	Lat. A. Gr.	'	Ma g.
HYDRUS [the (southern) Water-snake]						
At the head [In Capite]	✠	5	2 3	64	5	3
Upper, in the neck [In collo superior]	✠	11	5 3	71	4 0	4
Lower, of the three of the neck [Colli trium inferior]	✠	13	1 8	70	2 5	4
First of the coil of the neck [Conversionis colli prima]	✠	1	1 8	71	1 2	4
The second [Secunda]	≈	18	1 8	70	3 0	5
The third [Tertia]	≈	26	3	67	5 0	5
The fourth [Quarta]	≈	21	3 3	64	0	5
The fifth [Quinta]	≈	7	4	65	0	5

Names of the fixed stars	Sig.	Long. Gr.	'	Lat. A. Gr.	'	Ma g.
The sixth [Sexta]	♄	26	2 9	64	5 5	4
The seventh [Septima]	♄	19	1 5	60	0	5
In the coil of the tail, 1st, southern [In caudae conversione 1. Austral.]/Northern [Boreal.]	♄	15	3 8	58	1 0	5
	♄	13	4 8	56	0	5
In the 2nd flexure of the tail, the second-to-last [In 2. caudae flexu antepenult.]	♄	13	1 3	62	4 0	5
The last but one [Penultima]	♄	8	5 3	64	3 0	5
The last [Ultima]	♄	5	3 8	64	0	5
The Lesser Cloud, its center [Nubeculae minoris centrum]	≈	6	3	67	0	ne b.
Between this and the greater, unformed [Inter hanc, & maiolem, informis]	≈	8	4 8	72	2 0	6
Southern [Austrina]	≈	5	4 8	78	3 0	4
Which are above the 8th & 9th of Hydrus [Quae supra 8 & 9. Hydr.]	≈	4	4 0	61	2 0	5
Upper, beneath the neck [Infra collum superior]	✕	17	1 0	75	3 0	4
There, lower [Ibi inferior]	Υ	1	1 9	80	0	6

Summary appended beneath the right column:

And so there are 12 zodiacal constellations, 23 northern, and 27 southern — 62 in all.

Among the zodiacal asterisms, stars of the first magnitude	6
Of the second magnitude	9
Among the northern asterisms, stars of the first magnitude	3
Of the second magnitude	22
Among the southern asterisms, stars of the first magnitude	5
Of the second magnitude	28
Therefore all stars of the first magnitude are	14
And of the second	59

BOOK FIVE

IN WHICH ARE THE OBSERVATIONS OF SATURN, THE PLANET, AND THE HYPOTHESIS OF ITS MOTIONS

CHAPTER I.

Ancient Observations of Saturn, from the Year 229 before Christ down to the Year 1461 of the same era.

In the year 82 according to the Chaldeans, on the 5th of the month Xanthicus, in the evening — that is, in the year 519 of Nabonassar, on the 14th of the month Tybi — Saturn was observed in the evening, more to the south by two digits, or 5 minutes, than the star at the southern shoulder of Virgo. Ptolemy [Ptolemaeus] reports this observation as the most reliable of them all (*Almagest* [*Magna Constructio*] XI.7); from it he gathers that Saturn was in 9° 30' of Virgo. Longomontanus [Longomontanus], however (*Astronomia Danica*, II, Theoricorum cap. 4), makes it the year 3736 after the first bissextile year of the World, and rightly with the year 229 before Christ; and the 14th of Tybi he makes the 1st of March, with 4h 25' added after the meridian of Copenhagen [Hafniensem]. He found that this star, as well as Saturn, was in 9° 3' of Virgo, with northern latitude 2° 43'. He also makes Saturn's latitude 2° 38'. Ismaël [Ismaël] Bullialdus [Boulliau] likewise (*Astronomia Philolaica* VI.5) takes the 14th of Tybi, but says it was at the 6th hour. He says that at Uraniborg [Vraniburgi] the fixed star was in 8° 42' 43" of Virgo, and its northern latitude 2° 50'. But Lansbergen [Lansbergius], in his

Thesaurus of observations of Saturn, observation 1, asserts that one should read in Ptolemy "Xanthicus the 15th," and that he answered to the 22nd of Tybi — so as to draw out this observation to fit his own tables — namely because on this day only, around the sixth hour at Alexandria, the tables exhibit the star in $9^{\circ} 7'$ of Virgo, with latitude $2^{\circ} 43'$. **[Margin: Lansbergen in error (Lansbergii dolus).]** But in truth the Greek copies have "Xanthicus the 5th," and all the Latin versions have "Xanthicus the fifth." From our catalogue of fixed stars, that star was, by position and by proper motion, in $8^{\circ} 50' 31''$ of Virgo, with northern latitude $2^{\circ} 49\frac{1}{2}'$.

2. In the 11th year of Hadrian [Adriani], Ptolemy, having observed Saturn with astrolabe instruments, concluded that its opposition with the mean place of the Sun fell on the 7th of the month Pachon, on the evening following the eighth — Saturn then occupying $1^{\circ} 13'$ of Libra [$\underline{\alpha}$]. So he says (*Almagest* XI.5), and from him Copernicus [Copernicus] (*De Revolutionibus* V.5), adding that it was the year of Christ 127, and the 7th of the month Mechir, that is, the 7th of the Kalends of April, at the 18th hour after the meridian at Alexandria. **[Margin: Copernicus's error in chronology (Copernici error in Chron.).]** But the Greek codex ... and from his own tables he derives Saturn's place ... $18''$.
3. In the 17th year of Hadrian, Ptolemy, from an observation of Saturn, conjectured it to be in $9^{\circ} 40'$ of Sagittarius, the opposition having occurred with the mean place of the Sun at midday — that is, as Copernicus has it (*De Revolutionibus* V.5), in the year of Christ 133, on the 3rd before the Nones of June, at the hour equal from ... 11. See Ptolemy (*Almagest* XI.5). It was the 4th day, civil reckoning.
4. The same Ptolemy, in the aforesaid passage (*Almagest* XI.5), reports an observation made by himself of the opposition of Saturn with the mean place of the Sun, fixed at $\mathfrak{h}$ in $\sphericalangle 14^{\circ} 14'$, in the 20th year of Hadrian, at the very midday of the 24th day of the month Messori — which year, according to Copernicus (*De Revolutionibus* V.5) and Longomontanus (II, Theoricorum cap. 4), was the year of Christ 136, on the 8th before the Ides of July, at the hour after the middle of the night, 12. At Alexandria it was the 9th of July.
5. In the 2nd year of the Emperor Antoninus [Antoninus], on the 6th of Mechir, at the 4th hour before the following midnight, Ptolemy says that he observed the last degree of Aries at the meridian (M.C.); and then the Sun was, by mean motion, in $28^{\circ} 41'$ of Sagittarius. He found that Saturn, compared with Aldebaran [Aldebaram], was in the second northern ... and

was distant from the northern horn of the Moon by very nearly half a degree. Lansbergen, in his *Thesaurus* of observations, observation 1, says it fell in the year of Christ 138, December 22, at the 8th hour after midday at Alexandria; but from his own tables he derives Saturn's place at $\approx 9^{\circ} 17' 18''$.

6. In the year of Christ 503, an observation of Saturn was made at Athens [Athenis], and recorded in the year of Diocletian [Diocletiani] 219, on the 27th of Mechir, near the 4th hour, when the Moon occulted Saturn — under which it lay hidden for one temporal hour, with three quarters, so that Saturn passed across the center around the fifth hour; for it appeared to emerge from the middle of the circumference of the illuminated part of the Moon. So the observer has it in a manuscript codex of the Royal Library of Paris [Bibliothecae Regiae Parisinae], no. 114, as the eyewitness inspector Bullialdus reports (*Astronomia* VI.5), adding that in that year, on February 21, at 11h 14' after midday, Saturn at Athens was seen to emerge from the Moon, and its place was seen to be ...

was seen to be in $6^{\circ} 42' 18''$ of Cancer, with southern latitude $19^{\circ} 27'$. But Saturn had been occulted much earlier than the body, by the splendor of the Moon, than [it would have been] by the body itself.

7. In the year 1461, Johannes Regiomontanus [Regiomontanus], as he himself relates in his observations, on the 2nd of December, in the evening, observed at Rome that Mars was in the same straight line with two stars at the head of Capricorn, that is, in 27° of Capricorn; but Saturn was then more to the east by two degrees — that is, in about 29° of Capricorn — though the *Almanach* of Alfonso [Almanach Alphonsinum] put Saturn at the same second of December. So on the 14th [it was]. On December, after sunset, he saw Venus joined with Saturn, even though by the *Almanach* Venus was more to the east than Saturn by $1^{\circ} 27'$.

CHAPTER II.

Observations of Saturn made at Nuremberg by Bernhard Walther of Nuremberg [Bernardo Vualtero Norimbergensi], pupil of Johannes Regiomontanus, from the Year of Christ 1475 down to 1504.

The observations of Walther [Vualterus] are reduced to three classes. The first is of those that were made without instruments, by ocular estimation of the planet's distance from other planets or fixed stars. The second is of those made with the radius [the cross-staff], comprising the rectangular triangle [Triangulum

rectangulum] suitable for taking the distances of stars in any way. The third is of those made with the zodiacal armillae [Armillas Zodiacales], about which we shall report later, once we have examined them more closely.

1. In the year 1475, September 17, between the 2nd and 3rd hour after midnight, in the morning, Walther saw Saturn standing apart from Mars by very nearly 5 minutes, more to the north in latitude than in longitude; and Mars so much more to the west, that he saw the same Saturn more to the east on the 19th. He therefore concludes that the conjunction of Saturn with Mars was incident on the 18th, around the 3rd hour after midnight, even though the *Almanach* expected it on the 21st.
2. In the year 1476, March 25, at the 2nd hour of the night, he saw Saturn near the Nebula of Cancer; for Saturn appeared to be separated by two digits to the west, the straight line drawn between the fourth and fifth of Cancer; but it was in the same straight line of Cancer, the fourth, and with the first, or Nebula, equally distant from each. Because this disagrees with the tables, Bullialdus (*Astronomia* VI.5) gathers — as is to be read in the text — the fifth of Cancer; otherwise the observation will not stand: for the first of Cancer, or Nebula, was then in $0^{\circ} 14'$ of Leo, that is, the fourth; the fourth of Cancer in $1^{\circ} 22' 14''$ of Leo, and the Asellus Australis [the Southern Donkey], or the fifth of Cancer, in $1^{\circ} 14'$ of Leo. Thus Saturn was in $0^{\circ} 41'$ of Leo, whose place, however, he computes from his own tables at $0^{\circ} 20'$ of Leo; he subjoins that, on account of the magnitude of the Nebula, Walther's eye could have erred in the position of Saturn.
3. In the year 1477, September 5, in the morning, around the third hour after midnight, he saw that Saturn and Mars were distant from each other by one palm, and Mars was more to the west; from which he concludes a punctual conjunction on that day, so that Mars ought to have eclipsed Saturn — but it is said below, in the Martian observations, on the 6th of October rather, that this conjunction took place on the 5th of September of this year.
4. In the same year, October 15, from an observation, he detects an error in the tables of one degree and $36'$, as to the position of Saturn and Mars.
5. In the year 1478, September 24, 40 minutes before sunrise, he saw the conjunction of Saturn with the Moon, such that the Moon ... was seen to be in $6^{\circ} 42' 18''$ of Cancer, with southern latitude $19^{\circ} 27'$. But Saturn was occulted much earlier by the splendor of the Moon than by the body [itself].

6. In the year 1479, October 30, he saw the conjunction of Saturn and Mars, as to longitude, such that Saturn was more to the north by almost one degree; but Mars was very near the sixth of Virgo.
7. In the year 1481, October 22, around an hour before sunrise, he saw Saturn and Mercury in the same latitude, but Mercury more to the east than Saturn, by one diameter of the Moon; from which he concludes that their conjunction preceded that observation. Particularly, since on the 23rd day he saw Mercury more to the east than Saturn by about three diameters of the Moon.
8. In the year 1482, at the hour $2\frac{1}{4}$ before sunrise, the Moon eclipsed Saturn — since at the hour $2\frac{3}{4}$ before sunrise Saturn had been more to the east in southern latitude, and the Moon was distant from it by two Moons [i.e. two lunar diameters]; but when the Moon had emerged, it was distant from the northern horn of the Moon by two digits — gradually; afterwards they passed the middle of the heaven; but the Moon, at the time when the middle of the eclipse is reckoned, was seen to be at 23° of ... [Saturn at] 13° ...
9. In the year 1504, March 28, in the morning following the night, he saw Saturn more to the west and more to the north, by $2\frac{1}{4}$ of an hour [?] but more distant in latitude than in longitude; on the following night he saw Saturn much nearer to the aforesaid star; therefore he concludes that the conjunction of Saturn took place then. Hence Bullialdus likewise (*Astronomia* VI.6) reckons that conjunction to be made on the 29th of March, at the 2nd hour after midday.

Observations of Saturn made with the Radius [the cross-staff]

The second class has the distances of Saturn taken with the Astronomical Radius, and indicated by the first and second Sine — which, in order that they may be found, are multiplied by 1200; and divided by the first Sine, and produced by the second Sine, as often emerges in the question, in the Gnomonic Table of Purbach [Purbachii], constructed to the same number of 1200, exhibiting the degrees and minutes of the distance sought.

For example: Saturn is said to be distant from Algomisa [Algomisa, i.e. Procyon], so that the first Sine is 210, and the second Sine 489 particles. Therefore, multiplying the parts of the Gnomonic Table 1200 by 210, you get 252000; which, divided by 489, yields as often as $515\frac{1}{3}$; which number, sought in the aforesaid Table under the column of 500 parts, in the region of the number 15, of the left

side, and computed by the proportional part, exhibits $23^{\circ} 13' 53''$. Therefore Saturn stood distant from Algomisa by $23^{\circ} 13' 53''$ — unless the parallax of the eye [parallaxis oculi] of this kind should indicate that such distances need correcting, because the angle at the center of the Astronomical Radius is greater than the angle made at the bottom of the eye.

Table of distances of Saturn taken with the Radius (1475):

Y r.	M o.	D H . . M.		Dist. of ♄ from the Fixed Stars	Sin e 1	Sin e 2
1 1 1 4 7 5	Se pt.	1 2 30 6	p.m. noct., in the morning [manè]	Algomisa	210	489
				Cap. seq. Gemin. [the following one of the Twins]	210	573
				Saturn & Mars	20	949
1 2	Se pt.	1 2 30 7	p.m. noct.	Saturn & Mars	10	667
1 3	Se pt.	2 3 (abo 1 ut)	p.m. noct., in the morning [manè]	Algomisa	210	480
				Cap. seq. Gemin.	210	560
				Saturn & Mars	20	679
1 4	Oc t.	1 2 30 3	p.m. n.	Quarta Leonis [the fourth of Leo]	160	810
				Octava, or the heart of Leo [Octava, seu cor ♌]	210	771
1 5	Oc t.	1 2 30 7	p.m. n., in the morning [manè]	Quarta Leonis	190	907
				Octava Leonis	210	770
				Saturn & Mars	210	807
1 6	No v.	3 3 (abo ut)	p.m. n., in the morning [manè]	Quarta Leonis	190	100 1
				Septima ♌ [the seventh of Leo]	210	872

Y r.	M o.	D . .	H M.	Dist. of ♄ from the Fixed Stars	Sin e 1	Sin e 2
				Octava ♄ [the eighth of Leo]	210	793

Caput II (continued) — Saturn observations made at Nuremberg by Bernhard Walther, from 1475 to 1504

[The chapter's second class of observations continues. This page presents the remainder of Walther's tabulated Saturn observations, recording for each the year, month, day, hour and minute (a.m. / morning or p.m.), the distance of Saturn from named fixed stars, and two computed sines.]

Table — Walther's Saturn observations (continued), Nuremberg.

Columns: row index | Ann. M. D. H. M. (Year, Month, Day, Hour, Minute) | Dist. ♄ à Fixis (Distance of Saturn from the fixed stars) | Sinus 1. | Sinus 2.

#	Year, Month, Day, H. M.	Distance of ♄ from fixed stars	Sinus 1	Sinus 2
1	1475 Nov. 12 — 2 30 p.m.n. / 7 morning	Sixth of Leo [♄]	210	708
		Eighth of Leo [♄]	210	798
1	Nov. 29 — 4 nearly p.m.n. / 8 morning	Fourth of Leo [♄]	170	901
		Sixth of Leo [♄]	210	695
		Eighth of Leo [♄]	210	784
1	Dec. 1 — 3 nearly p.m.n. / 9 morning	Fourth of Leo [♄]	170	887
		Sixth of Leo [♄]	210	692
		Eighth of Leo [♄]	210	779¾
2	Dec. 29 — 3 0 p.m.n. / 0 morning	Fourth of Leo [♄]	180	869
		Eighth of Leo [♄]	210	698
2	1476 Feb. 12 — 2 0 n. seq. 1 (the following night)	Fifth of Cancer [♋]	20	1022
		Cap. seq. of Gemini [♊]	210	675½

#	Year, Month, Day, H. M.	Distance of ♄ from fixed stars	Sinus 1	Sinus 2
		Fourth of Leo [♌]	170	671
2	Feb. 19 — 2 0 n. seq.	Fifth of Cancer [♋]	10	620
2		Cap. seq. of Gemini [♊]	210	695
		Eighth of Leo [♌]	210	554⅓
2	Nov. 14 — a little before	Eighth of Leo [♌]	20	944½
3	sunrise ☉			
		Sixth of Leo	130	961
2	Nov. 17 — a little before	Eighth of Leo	20	937
4	sunrise ☉			
		Sixth of Leo [♌]	130	964
2	Nov. 18 — before sunrise ☉	Eighth of Leo [♌]	20	937
5				
		Sixth of Leo [♌]	130	972½
2	Nov. 21 — before sunrise ☉	Sixth of Leo [♌]	130	972
6				
		Eighth of Leo [♌]	20	937
2	1477 Oct. 16 — 4 30 p.m.n. /	Eighth of Leo [♌]	170	945
7	morning			
		Sixth of Leo [♌]	190	840
		Saturn & Mars	50	874
2	1478 Apr. 19 — a little after	Heart of the Lion [Regulus]	90	892
8	sunrise ☉			
		Sixth of Leo	140	882
2	1479 Nov. 16	Seventh of Virgo [♍]	60	859
9				
		Tenth of Virgo [♍]	130	884
3	Nov. 24 — more carefully	Sixth of Virgo [♍]	30	796
0	than the earlier one			
		Seventh of Virgo [♍]	40	667
		Tenth of Virgo [♍]	90	632
3	1481 Dec. 30 — 3, before	Spica of Virgo	90	544

#	Year, Month, Day, H. M.	Distance of ♄ from fixed stars	Sinus 1	Sinus 2
1	sunrise ☉, carefully			
		Twenty-first of Virgo [♍]	110	535
3	1482 Jan. 19 — 3, before	Spica of Virgo	90	512
2	sunrise ☉, carefully			
		Twenty-first of Virgo [♍]	110	520

33. The third class contains observations made by means of zodiacal armillae, that is, observations verified or corrected against Aldebaran, or the Heart of the Lion, or other stars; but among these the certainty is not below about ten minutes. For Walther himself says, under the year 1503, September 16: *Ten minutes are to be added, on account of the motion of Aldebaran [recorded] for all the stars observed by means of it, all the way up to 13 October; and on 12 December he says: I have again observed these with delay, and most diligently. Yet I see that nothing closer than ten minutes can be captured with precision by the instrument, or thereabouts.* Again, under the year 1504, he has this: *I have again corrected the motion of Jupiter and of Saturn, adding ten minutes on account of the variation in the place of Aldebaran from 1 September of the year 1503; through the Heart of the Lion they fall short by ten minutes. Nonetheless I have selected not a few of these as they stand in Walther, choosing every sixth one.*

[The second, parallel table occupies the right-hand column of folio 282. It tabulates, for the later Walther observations (numbered 34–70), the computed quantities: the *mean motion in longitude* (Mediab. Caelu — read as *Medium ab Capite/Caelo*, the mean reckoned in the heavens), Saturn's longitude, and its latitude.]

Table — Walther's reduced Saturn positions (continuation), Nuremberg.

Columns: row index | Ann. | M. | D. | Mediab. Caelu (Gr. degrees / Sign. sign) | Saturn. Longit. (Sig. sign / G. degrees / ' minutes) | Latitudo (G. degrees / ' minutes)

Y e a		D		a		Mean		Longitude:		G		Lat.	
#	r	Month		y	motion:	Gr.	Sign	Sig.		.	'	G.	'
3	1	Sept.		2	15		Tauri	♉		1	0	0	1

Y e a # r	Month	D a y	Mean motion: Gr.	Sign	Longitude: Sig.	G . '	Lat. G. '
4 5 0 3		2				7	5 A
3 5		2 15 8		Tauri	☉	1 0 0 7	3 0 A
3 6	Nov.	4 17		Canc ri	☉	1 2 0 7 5	1 0 A
3 7	Dec.	1 6 1		Arieti s	☉	1 3 0 5 0	1 8 A
3 8	Dec.	1 5 4		Arieti s	☉	1 5 0 5	2 2 A
3 1 9 5 0 4	Januarij	5 3		Tauri	☉	1 1 0 3 5	1 5 A
4 0	morning	1 11 0		Tauri		1 4 0 2 5	1 5 A
4 1	morning	1 10 9		Tauri		1 2 2 3	
4 2	n.s. [following night]	2 13 0		Tauri		1 1 0 2 0	5 A
4 3	morning	2 27 4		Tauri		1 5 1 3	
4 4	n. seq.	2 30 5		Tauri		1 4 0 1 5	8 A
4 5	n. seq.	2 24 6		Tauri		1 4 1 5	

Y e a # r	Month	D a y	Mean motion: Gr.	Sign	Longitude: Sig.	G . '	Lat. G. '
4 1 6 5 0 4	Febr.	3	23	Gemi n.	☿	1 2 1 2	0 0
4 7	n. seq.	4	3	Gemi n.		1 2 1 2	0 0
4 8	n.s.	5	5	Gemi n.		1 2 1 3	0 0
4 9	n.s.	6	22	Gemi n.		1 2 1 3	0 0
5 0	n.s.	8	11	Gemi n.		1 1 1 8	0 2 A
5 1	n.s.	9	7	Gemi n.		1 8 1	
5 2	n.s.	1 2	22	Gemi n.		1 5 0 2	
5 3	n.s.	1 4	22	Gemi n.		1 5 0 7	
5 4	n.s.	1 5	14	Gemi n.		1 5 0 7	
5 5	n.s.	1 6	14	Gemi n.		1 5 0 7	
5 6	n.s.	2 0	18	Gemi n.		1 0 1	
5 7	n.s.	2 6	25	Gemi n.		1 4 0 5	
5 1 8 5 0 4	Martij	2	2	Canc ri	☿	1 4 0 5	0 0
5 9	n. seq.	3	2	Canc ri		1 4 0 5	0 0

Y e a # r	Month	D a y	Mean motion: Gr.	Sign	Longitude: Sig.	G . ' G.	Lat. G. ' A
6 0	n. seq.	1 1	14	Canc ri		1 4 0 8	
6 1	n. seq.	1 7	23	Canc ri		1 5 0 1	2 2 A
6 2	Apr. n.s.	2 4	24	Virgi nis	☿	1 3 3 0	
6 3	n. seq.	3 0	24	Virgi nis		1 4 3 5	
6 4	Maij n.s.	9	19½	Libr æ	☿	1 3 5 0	[0?] [1 ?]
6 5	n. seq.	2 2	23	Libr æ		1 4 0 5 7	3 0 B
6 6	n. seq.	2 3	26	Libr æ		1 0 6	
6 7	n. seq.	2 4	1	Scorp ij		1 0 0 6	5 B
6 8	n. seq.	2 5	4	Scorp ij		1 1 6 0	
6 9	n. seq.	2 8	5	Scorp ij		1 2 6 8	
7 0	n. seq.	2 9	14	Scorp ij	☿	1 4 6 5	

CAPUT III.

Saturn observations of Copernicus, Pitati, Ristori, and Giuntini, from the year 1514 to 1563.

The reader is forewarned, from Rheticus's preface to the Ephemerides of the year 1551, that Copernicus was sufficiently satisfied if in his observations and computations he did not depart from the truth by ten minutes. Moreover, he

made no mention of any correction for refraction, and he fixed the altitude of the pole at Frauenburg [Frombork] at a value just over three minutes too large, by the testimony of Tycho Brahe (*Progymnasmatata*, ch. 1). In the observations that follow, no certainty greater than these limits is to be required.

1. In the year 1514, on the sixth before the Kalends of May [26 April], at the fifth hour after midnight, Copernicus saw Saturn in a straight line with the second and the third [stars] of the forehead of Scorpius — that is, at an elongation of 209 degrees from the first star of Aries. So he himself states (*De Revolutionibus* V, ch. 9).
2. In the same year, on the third before the Nones of May [5 May], at the first hour and 12 minutes before midnight, Copernicus observed Saturn in opposition to the Sun — that is, with Saturn placed at the mean position of the Sun, Saturn being in [text continues on the facing page]

degree 205, 24' from the first star of Aries (Copernicus, *De Revolutionibus* V, ch. 6).

3. In the year 1520, on the third before the Ides of July [13 July], from an observation of Copernicus, Saturn was in opposition to the mean place of the Sun at the very meridian of Frauenburg, or Cracow, Saturn holding a degree of 272, 25' from the first star of Aries. So Copernicus himself (*De Revolutionibus* V, ch. 6).
4. In the year 1524, in nearly the same February, Saturn, Jupiter, and Mars were in conjunction in Pisces at 10 degrees — about which Kepler too writes in Book V on the new star, ch. 29.
5. In the year 1527, on the sixth before the Ides of October [10 October], at the sixth hour and 24 minutes after midnight, the opposition of Saturn to the mean place of the Sun was observed by Copernicus, with Saturn distant from the horn of Aries by 7 minutes, at 4 degrees (*De Revolutionibus* V, ch. 6).
6. In the year 1536, Pietro Pitati [Pietro Pitati], from his observation, judged that Saturn had been in conjunction with Mars on 22 May; but Julian Ristori of Prato, Doctor of Sacred Theology and an excellent mathematician, the teacher of Giuntini [Francesco Giuntini], on 19 June at the first hour of the night, saw Saturn nearly covered by Mars, as had been the conjunction predicted in the preface to his tables; and yet Stöffler, in his Ephemeris together with the Alphonsine Tables, had assigned that [conjunction] to 25 May.

7. In the year 1542, on 29 January, at the ninth hour following, of the night, Saturn and Mars were observed in conjunction, as predicted by Ristori, at Giuntini's [place], as above.
8. In the year 1563, on the ninth before the Kalends of September [24 August], at the fourteenth hour, 30', after midday, the conjunction of Saturn and the more boreal of the two Joves [Jupiter and Saturn] at Orange showed Saturn to be somewhat more southerly, virtually grazing it, in Cancer at 28 degrees — as the foretold conjunction is narrated in the preface of the tables. And yet the Alphonsine [tables] put off this conjunction to 25 September, in Leo at 4 degrees, 12'.

CAPUT IV.

Saturn observations after Tycho's manner, in which the days are noted in the Old Style of the Calendar.

1. In the year 1582, on 21 August, at the second hour after midday, there was an opposition of Saturn to the true place of the Sun in Pisces at 7 degrees, 26'; but [taken] from the Tychonic observation, [Saturn being] reckoned from the tables. So Longomontanus in his *Astronomia Danica* II, *Theorica* ch. 1.
2. In the year 1583, on 6 September, at the third hour and 1', there was a true opposition of Saturn to the Sun in Pisces at 19 degrees, 50', from observation; the Tychonic [value], but reckoned by Danish calculation, [is] 19 degrees, 48' $\frac{1}{3}$. Longomontanus, as above.
3. In the year 1584, on 15 September, at the sixth hour and 30', there was a true opposition of Saturn to the Sun in Aries at 2 degrees, 34'; [taken] from the Danish tables at 2 degrees, 35' $\frac{3}{4}$. Observed by Tycho. Longomontanus, as above.
4. In the year 1585, on 28 September, at the first hour and 30', there was a true opposition of Saturn to the Sun in Aries at 15 degrees, 39'; but [taken] from the Danish tables at 15 degrees, 39' 15". Longomontanus, as above.
5. In the year 1586, on 12 October, at the eleventh hour, the true opposition of the Sun to Saturn was in Aries at 29 degrees, 2'; Tycho observing, but [taken] from the Danish tables at 29 degrees 4'. Longomontanus, as above.

6. In the year 1587, on 9 January, at the ninth hour, 45', after midday, Tycho at Uraniborg observed Saturn in Aries at 26 degrees, 8', with southern latitude 2 degrees, 28' — yet the Alphonsine calculation would place that [planet] at 28 degrees, 8' with latitude 2 degrees, 30'; Copernicus, however, [puts it] at 25 degrees 58', with latitude 2 degrees, 32'. He used this Boulliau observation, *Astronomia Philolaica* VI, for his own purposes, and the places of Saturn's nodes are to be investigated. See Tycho's letter, p. 56.
7. In the same year, on 14 January, at the fifth hour, 50', after midday, Tycho observed Saturn in Aries at 26 degrees, 21', with southern latitude 2 degrees, 26'. The Alphonsine [value] for it was 28 degrees, 21'; but Copernicus [puts it] at 26 degrees, 12'; the latter has latitude 2 degrees, 30'. Tycho, where above.
8. In the same year, and month, on 15 [January], at the fifth hour, 45', after midday, Tycho observed Saturn in Aries at 26 degrees, 4', with southern latitude 2 degrees, 25'. The Alphonsine [value] there was 28 degrees, 24'; but Copernicus [puts it] at 26 degrees, 27'. Lansbergen, in his *Thesaurus*, collected from this observation, by adding refraction at 26 degrees 23', 28", and a latitude of 2 degrees, 26'.
9. In the year 1587 likewise, on 26 October, at the ninth hour after midday, there was a true opposition of the Sun to Saturn in Taurus at 12 degrees 46', [taken] from a Tyconic observation, rather than from the Danish tables. By which occasion it is to be noted that the *Longomontanus* II, *Theoricae* ch. 2, [says] that the Danish tables, taken from the *Thesaurus*, were corrected, but in such a way that the mean place of Saturn is short by 10 minutes from its apogee, with Saturn at 3 degrees of eccentricity, but elsewhere by adding the prosthaphaeresis, the fiftieth part.
10. In the year 1588, on 8 November, at the tenth hour, 10', there was a true opposition of the Sun to Saturn in Taurus at 26 degrees, 44'; Tycho observing, [the value taken] from the Danish [tables] at 26 degrees, 44' also. Longomontanus, as above.
11. In the year 1589, on 22 November, at the fourth hour, 30', there was a true opposition of the Sun to Saturn in Gemini at 10 degrees, 55'; Tycho observing, [taken] from the Danish [tables] at 10 degrees 53'. Longomontanus, as above.

12. In the year 1590, on 8 February, at the eighth hour, 8', in the evening, Tycho observed Saturn at Uraniborg in Gemini at 7 degrees, 32'; the same year too, at about an hour into the night, [observed] in degree 7, 38½. Geminus, with latitude southern 1 degree, 30'. Longomontanus II, *Theoricae* ch. 2, and Boulliau VI, *Astronomia* ch. 1, & 2.
13. In the year 1590, on 7 September, at the twelfth hour, Tycho observed Saturn in Gemini at 28 degrees, 6', with southern latitude 1 degree, 11'. So Boulliau, *Astronomia* VI, ch. 1, & 2.
14. In the same year, on 6 December, at the tenth hour, 20½, after midday, there was a true opposition of the Sun, with Saturn being in Gemini at 5 degrees, 10', as Tycho observed. But [taken] from the Danish tables at 5 degrees 8½. Longomontanus II, *Theor.* ch. 2.
15. In the year 1591, on 17 March, at the seventh hour, 30½, in the evening, Saturn was observed by Tycho at Uraniborg in Gemini at 22 degrees, 24½. Longomontanus, as above, ch. 3.
16. Likewise in the year 1591, on 1 December, at the eighth hour after midday, there was a true opposition of the Sun, with Saturn placed in Cancer at 9 degrees, 24½; Tycho observing. But [taken] from the Danish table at 9 degrees, 23'. Longomontanus, as above, ch. 2.
17. In the year 1595, on 30 January, at the twenty-first hour after midday, there was a true opposition of the Sun, with Saturn placed in Leo at 21 degrees, 15½; Tycho observing. But [taken] from the Danish [tables] at 21 degrees, 18½. Longomontanus, as above.
18. In the year 1600, on 13 January, at the seventh hour, 30', after midday, Tycho, at the citadel of Benatky [Benatky Castle] near Prague, observed Saturn distant from Venus at 5 degrees, 29'; for Saturn approached the station, observing its meridian altitude at 31 degrees, 7', and its distance from Spica at 11 degrees, 12', 1", and [its distance] from the boreal Lance [scale of Libra] at 16 degrees, 7½, having crossed [the meridian] somewhat earlier than Spica; the meridian altitude of the other being 30 degrees, 41'. Hence Tycho concluded that on the preceding day Saturn had been in Gemini at 28 degrees, 18', 44", with northern latitude 2 degrees, 43'. But on day 25 it was found in degree 28, 30', 44", with northern latitude 2 degrees, 34½. So Snel in his observations. Tychonic.

19. In the year 1600, on 2 April, at the twelfth hour, 21', after midday, Tycho, in the citadel of Prague, observed Saturn's meridian altitude to be 32 degrees, 28½, & at the twelfth hour, 43', observed the same [planet] distant from the boreal Lance at 19 degrees, 14½. So Snel, as above.
20. In the same year, on 9 April, at the eleventh hour, 21', 37½, Tycho likewise observed Saturn distant from Spica at 8 degrees, 9½, & at the eleventh hour, 46', distant from the boreal Lance at 19 degrees, 45', & at the twelfth hour altitude, observing its meridian altitude at 32 degrees, 40'.
21. In the year 1601, on 6 July, in the evening, at the ninth hour, 39', after midday, Tycho likewise there observed Saturn distant from Antares [Heart of the Scorpion] at 32 degrees, 1', & from the boreal Lance at 11 degrees, 42½. Hence the place of Saturn in Scorpio [was found] at 3 degrees, 50½; the latitude of the same [being] boreal at 2 degrees, 20½. But our calculation (says Tycho at Uraniborg, as above) gives the longitude at 3 degrees, 43', 23", & the latitude at 3 degrees, 19', 26".

If anyone should desire that the foregoing observations be brought into accordance with the Gregorian-Calendar style, let him add to them ten days; and they were from the year 1582.

The remaining observations of Tycho or of Longomontanus, which we shall set forth below in Caput XI, the *Catalogue*, we have taken partly from Tycho's *Epistolae*, page 56.

partly from Longomontanus's *Astronomia Danica*, Book II, *Theoricorum* ch. 2 & 13; partly from a Tychonic manuscript, [obtained] from Father Albert Curtz of the Society of Jesus, who, since he was appointed by the Emperor for the editing of the Tychonic observations, very generously and most liberally transcribed them for me; and from these I have selected only a few, just to test the agreement, or disagreement, of the Astronomical Tables.

CAPUT V.

Saturn observations of Jost Bürgi, from the Hessian observations of Snel; and likewise of Lansbergen, Hortensius, Gassendi, and Boulliau, from the year 1592 to 1640.

Bürgi's observation of Saturn at Kassel, by the days of the Old Style.

Table — Bürgi's Saturn observations at Kassel (Old Style).

Columns: row index | Ann. (Year) | Mens. (Month) | Dies (Day) | Hor. Min. ant. vel post merid. (Hour, Minute, before or after midday) | Distantia Saturni à Fixis (Distance of Saturn from the fixed stars: Gr. degrees / M. minutes / star)

Y e a r	Mont h	Day	Hour, Min., before/after noon	G r M . .	from the star
1 5 9 2	Octob .	14	4 before noon	2 23 7	from Regulus
				5 57 2	from Aldebaran
1 5 9 3	Janua rij	3	6 30, after noon	8 46	from the head of Pollux [cap. Pollucis]
				3 12 4	from the right shoulder of Orion [humer. dext. Orion.]
1 5 9 4	Janua rij	2	8 p.m.	2 52 1	from the head of Pollux
				2 49 4 $\frac{1}{3}$	from Sirius
1 5 9 5	Nove mb.	24	5 0, before noon	1 46 3	from Regulus
			[thence] Boulliau I.6.c.2	1 50 2 $\frac{1}{4}$	from the back of Leo [dorso α]
			elicits the place of β	7 57 $\frac{1}{2}$	Virgo [$\mathfrak{M}$]
1	Maij	5	9 0, after noon	7 17	from Regulus

Y e a r	Mont h	Day	Hour, Min., before/after noon	G r M . .	from the star
5 9 6					
			[thence] Boulliau, as above	1 8 3	from the back of Leo [dorso ♀]
			elicits the place of h	1 29	Virgo [♊]
1 5 9 6	Maij	7	9 0, after noon	1 10 0	from the neck of Leo [ceruice ♀]
				1 52 7	from the tail of Leo [cauda ♀]
1 5 9 7	Marti j	27	8 30, after noon	2 35 1 ½	from Regulus
				1 2 0 ½	from the tail of Leo [cauda ♀]
1 5 9 5	Febr uarij	18 — <i>ought to be placed after the year 1594</i>	8 after noon	8 24	from the mane of Leo [iuba ♀]
				4 32	from Regulus

If, among Gassendi's observations — which are now being printed at Lyon, under the press — there shall have been other observations pertinent here, and they shall have come into our hands, they are to be added, and to be understood here as supplied.

15. In the year 1640, on 12 October, by the New Style, at the eighth hour & a few minutes after midday, Boulliau observed Saturn in the Meridian, distant from a star of the fourth magnitude, which belongs to the haunches of Aquarius, by 26'; but Saturn was more boreal than that vertical [star]; so

[it is in] Boulliau, *Astronomia* ch. 3, who, subjoining the observation, makes that star to have been in Aquarius at 23 degrees, 47'; with southern latitude 23 degrees, 55', 39", [recte: latitude] southern at 1 degree, 35' ½; so that Saturn was in Aquarius at 23 degrees, 55', 39"; with southern latitude 23 degrees, 24', 0", 8", with southern latitude 1 degree, 36', ¾; but the Rudolphine [tables give it] at 24 degrees, 5', with southern latitude 1 degree, 38'.

16. In the year 1630, on 19 June, with Michele Florenzio Langreno of Brussels observing, & [Saturn] culminating at the degree of the Equator 241, 5', 52", Saturn began to be occulted by the Moon, & from the moment at which it emerged; the foot of Virgo, for which Tycho gives the longitude at Libra 28 degrees, 57', latitude 2 degrees, 57', ¾, & likewise [for] star 22. The star of Virgo lay hidden beneath the obscure boreal part of the Moon; with the culmination at degree of the Equator 253, 42'.

CAPUT VI.

Observations of Saturn near the perigee of the eccentric, made at Majorca by D. Vicenç Mut [Vincentius Mutus], a man most skilled in astronomy, recorded on days of the New Style, all of them around the ninth hour after midday, and most generously communicated to us by letter, together with the place of Saturn derived from observation and from a fivefold calculation.

The first table records observations made at Majorca in 1650 (with two further observations from 1654). For each entry it gives the date, the measured distance of Saturn from the fixed stars (in degrees and minutes), the observed place of Saturn (sign, degrees, minutes), and then, under the heading *Difference of the Tables*, the discrepancy in minutes between this observed place and the place computed from the Prutenic, Danish, Rudolphine, Lansbergen, and Boulliau tables respectively.

Y e a r	M o n t h	Distance of Saturn from the fixed stars	Observed place of ♄ (Sig.)	Prute n. (')	Dani c. (')	Rodu l. (')	Lans b. (')	Bullia l. (')
1 6 5 0	Ja n u a r y	from the preceding star, the topmost in the foot of	♊	10	16	18	2	12

Y M e o a nt r h	Distance of Saturn from the fixed stars	Observed place of ♄ (Sig.)	Prute n. (°)	Dani c. (°)	Rodu l. (°)	Lans b. (°)	Bullia l. (°)
	♄ (lat. N. 1 11)						
Ja n.	from the same	♄	13	16	18	10	12
F e br	from the same	♄	20	16	17	11	11
.							
F e br	from the same	♄	20	16	16	12	10
.							
M ar c h	from the same	♄	23	16	16	11	10
	from the same	♄	25	16	15	10	9
	from the same	♄	28	16	13	7	8
A pr il	from the same	♄	28	17	13	5	7
	from the same	♄	28	18	14	4	8
	and from the nearest [star]	lat.					
M a y	from the heel of ♄ following	♄	24	20	15	3	9
M	from the	♄	22	21	16	2	10

Y e a r	M o n t h	Distance of Saturn from the fixed stars	Observed place of ♄ (Sig.)	Prute n. (°)	Dani c. (°)	Rodu l. (°)	Lans b. (°)	Bullia l. (°)
	a y	preceding [star] in the foot of ♊ following						
(latit. 0 46)								

The second table gives two further observations from 1654, with the place of Saturn computed from the Danish, Rudolphine, Lansbergen, Ptolemaic [*Almagestum*], and *Novum* (Riccioli's own) reckonings:

Y e a r	M o n t h	H o u r	Distance of Saturn from the fixed stars	Observed place of ♄ (Sig.)	Dan ic. G.	Rod ul. G.	Lan sb. G.	Al ma g. G.	N o u .
1 3 5 4	Febr uary	1 9 0		♌	23	1 23 8	1 22 5	5 23 9	1 1
(latit ude)									
	Febr uary	1 9 5		♌	20	5 20 7	5 20 0	4 20 6	4 5

The observations of this year 1654 were made with Saturn very nearly acronychal [at opposition, rising as the Sun sets].

14. Earlier, in the year 1651, on June 5 at the 8th hour, he had observed Saturn in the same latitude as a star which is in the belly of the southern Twin [Gemini], but more easterly by 7 minutes; from which he concluded that on June 4 their partial conjunction had occurred.
15. Likewise, in the year 1643, on September 23, he had observed Saturn's meridian altitude as 53° 38', it being in a straight line with the Head of Algol [Caput Algol] and the northern star following in the Horn of Aries.

16. Likewise, in the year 1644, on September 30 at the 9th hour, he observed Saturn to be more westerly by 5' than the star preceding it after the bend of the Three of Pisces [the asterism *flexum trium Piscis*], and more northerly by 30".

CAPUT VII.

Observations made: 2 by Tycho [Tycho Brahe], 4 by the Fathers of the Society of Jesus at Innsbruck [Oenipontum], and 22 by the Marchese Cornelio Malvasia [Cornelius Malvasia] at Modena [Mutina].

In the year 1582, on August 21 at hour 10:02, Saturn was distant from the left shoulder of Aquarius $22^{\circ} 29'$; but at hour 10:39 it was distant from the right shoulder of Aquarius $16^{\circ} 5'$; and at hour 11:57¼ — or, more correctly, at hour 12:1¼ — it had a meridian altitude of $23^{\circ} 23'$.

In the same year, on August 23 at hour 9:57, Saturn was distant from the lower Horn [of Capricorn] $70^{\circ} 39\frac{3}{4}$, and at hour 10:5¼ it was distant from the left shoulder of Aquarius $22^{\circ} 20'$.

Observations made at Innsbruck [Oenipontum] by our Fathers, and transmitted to me by P. Michael Staudacher of the Society of Jesus.

In the year 1636, on July 10, with Arcturus raised toward its setting at $39^{\circ} 14'$ and Saturn at its rising at $18^{\circ} 40'$, Saturn itself was observed to be distant from the Head of Ophiuchus $41^{\circ} 17\frac{1}{2}$, and from the bright star of Aquila [Altair] $32^{\circ} 46\frac{2}{3}$.

On July 13, with Arcturus raised toward its setting at $44^{\circ} 25'$ and Saturn at its rising at $16^{\circ} 50'$, Saturn was seen to be distant from the bright star of Aquila $32^{\circ} 53\frac{1}{2}$, and from the Heart of Scorpius [Antares] $35^{\circ} 39'$.

On July 23, with Aquila raised high toward its rising at $40^{\circ} 54\frac{3}{4}$ and Saturn at $17^{\circ} 12'$, Saturn was distant from the Head of Ophiuchus $40^{\circ} 54\frac{3}{4}$, and from the bright star of Aquila $33^{\circ} 10' 50''$.

Finally, on July 25, with Aquila raised toward its rising at $34^{\circ} 30'$ and Saturn at $18^{\circ} 18'$, Saturn was observed to be distant from the Head of Ophiuchus $40^{\circ} 51' 50''$, and from the bright star of Aquila $33^{\circ} 18' 30''$.

Observations of the most illustrious Marchese Cornelio Malvasia, made at Modena [Mutina].

These observations survive in the *Ephemerides* of the same Marchese Cornelio, published at Modena in the year 1662, given to me most generously by the author himself, at fol. 187, where he states that he observed the altitude of the Pole of Modena to be $44^{\circ} 38'$; whereas, when we observed it, we found it $44^{\circ} 38' 50''$. He there assumes the longitude of Modena to be $34^{\circ} 5'$ — very close to that which we determined in the *Geographia Reformata*, namely $34^{\circ} 6' 30''$. With these settings, he proceeds.

In the year 1662, on May 30, around hour 1 of the afternoon, using a wooden sextant exhibiting single minutes, and with the assistance of D. Geminiano Montanari [Geminianus Montanarius], Doctor of Laws and a most expert astronomer, he observed Saturn to be distant from Spica $42^{\circ} 17'$, and from the Heart of Scorpius [Antares] $7^{\circ} 46'$. Antares 10° , Spica 35° — from which, ordered by means of the Refraction Table of Cassini [*Tabula Refractionum Cassinica*], which appears in the same volume at fol. 173, he found the Refraction of Saturn to be $3' 7''$. Antares $5' 42''$, Spica $1' 25''$; from which there come out, as the corrected distances of Saturn from Antares $7^{\circ} 43'$, and from Spica $42^{\circ} 16' 45''$ — or, if it be first rounded, $42^{\circ} 17'$. From this, assuming from the Tychonic latitudes that Antares is $4^{\circ} 27'$ and Spica $1^{\circ} 59'$, and the difference of their longitudes $45^{\circ} 57'$, and the longitude of Spica in $\sphericalangle$ $19^{\circ} 8' 12''$, they gathered by trigonometry the longitude of Saturn in $\sphericalangle$ to be $1^{\circ} 13' 8''$, and its northern latitude $2^{\circ} 14' 6''$. With Lansbergen's calculation giving it as $1^{\circ} 22' 29'' \sphericalangle$ — and this, $2^{\circ} 16'$.

By this method of observing and of calculating, he collected from the evening observations the longitudes and latitudes written below, together with the excess over the Lansbergian Tables noted by him, employing the distances of Saturn from Spica, and either from Antares or from Arcturus.

1662 — D. Jun.		Observed (Sig.)	G			Lüsberg G.	'	Excess (')
			.	'	"			
3	Lo	$\sphericalangle$	0	5	0	1	6	9
	ng.			7				
	Lat.	Bor. 2	1	4		2	16	2
			3	0				
5	Lo	$\sphericalangle$	0	4	4	0	58	9
	ng.			8	0			

1662 — D. Jun.		Observed (Sig.)		G . ' "			Lüsberg G. ' "		Excess (')	
6	Lat.	B. 2		1	3		2	16	3	
				3	0			$\frac{1}{2}$		
	Lo	↗ ng.		0	4	0	0	54	10	
7	Lat.	B. 2		1	3		2	15	2	
				3	0			$\frac{1}{2}$		
	Lo	↗ ng.		0	3	3	0	50	11	
8	Lat.	B. 2		1	0		2	15	$1\frac{1}{2}$	
				4				$\frac{1}{2}$		
	Lo	↗ ng.		0	3	0	0	45	9	
	Lat.	B. 2		1	0		2	13	1	
				4						

The observations continue in the right column, for July:

1662	Observed (Sig.)		G.	'	Lüsberg G. ' "		Excess (')	
9	Lon	↗ g.	0	31	0	42	11	
10	Lat.	B. 2	14	2	15	1		
	Lon	↗ g.	0	27	0	38	11	
	Lat.	B. 2	14	2	$14\frac{1}{2}$	$\frac{1}{3}$		
11	Lon	↗ g.	0	22	0	33	$11\frac{1}{2}$	
12	Lat.	B. 2	14	2	$15\frac{1}{2}$	$1\frac{1}{2}$		
	Lon	↗ g.	0	18	0	29	$11\frac{1}{2}$	
	Lat.	B. 2	12	2	14	2		
14	Lon	↗ g.	0	10	0	21	11	
15	Lat.	B. 2	12	2	14	2		
	Lon	↗ g.	0	8	0	19	11	

1662	Observed (Sig.)		G.	'	Lüsberg G.	'	Excess (')
	g.						
	Lat.	B. 2	11½	2	14	2½	
16	Lon	✕ ⁷	0	5½	0	15	9½
	g.						
	Lat.	B. 2	11⅓	2	13	2	
23	Lon	ℳ	29	37	29	49	12
	g.			½		½	
	Lat.	B. 2	11	2	13	2	
24	Lon	ℳ	29	34	29	47	12½
	g.						
	Lat.	B. 2	10	2	12	2	
25	Lon	ℳ	29	30	29	42	12
	g.						
	Lat.	B. 2	9½	2	11½	2	
Jul. D.							
1	Lon	ℳ	29	15	29	27	12
	g.						
	Lat.	B. 2	11	2	13	2	

Moreover, on July 3, from the distance of Saturn from Spica, and from the middle star in the neck of Ophiuchus, corrected, and from the Tychonic stars, the same Marchese derived the longitude of Saturn in Scorpius $29^{\circ} 9' 8''$, and its northern latitude $2^{\circ} 7' 46''$. But because, through the optical tube fitted with a lattice of silver wire for determining smaller intervals, as is described in the same volume at fol. 196, a certain small star was seen to be distant from the eastern limb of Saturn imperceptibly [*insensibiliter*], the apparent semidiameter of Saturn being neglected, he established the place of that fixed star to be the same as that of Saturn; so that by the following days' Saturnine distances from the same fixed star, the place of Saturn could be more certainly defined. And so, on day 4 in the evening, Saturn was found distant from that fixed star $2' 35''$, of the kind of which the whole tube took in $41\frac{1}{4}$; and therefore in Scorpius $29^{\circ} 6' 30''$. Therefore, by a similar method, he set out for us the Saturnine longitudes and latitudes written below, but selected by me.

Die Iulij h		Observed (Sig.)	G		Lüsberg G.	'	Excess (')
			.	'			
7	Lon	ℳ	2	5	29	13	14½
	g.		8	9		½	
	Lat.	Bor. 2	7	2	9	2	
11	Lon	ℳ	2	5	29	4¾	14¾
	g.		8	0			
	Lat.	B. 2	6	2	8	2	
14	Lon	ℳ	2	4	28	58	15½
	g.		8	3		½	
	Lat.	B. 2	5	2	7	2	
22	Lon	ℳ	2	2	28	47	19
	g.		8	8			
	Lat.	B. 2	4	2	6	2	
August.							
5	Lon	ℳ	2	2	28	45	21
	g.		8	4			
	Lat.	B. 1	5	2	0½	1½	
				9			

This is a specimen of the said observations, from which it is clear that Lansbergen's tables at this period exceed the true place of Saturn by about 15 minutes; for

[The discussion of Lansbergen's excess concludes:] from a more exact reckoning we are unable to establish anything here, the more so because the most illustrious Marchese Cornelio uses the Tyconic stars, whose needed little correction we have shown in Book 4, and the distances of Saturn from the fixed stars adjusted by the Cassinian Refraction, about which, however, we have indicated in Book 1, Chapter 1, number 9, what we doubt.

But in the year 1663, the same illustrious Marchese Pansano [Pansanus] [?], from the observations of many days and from the distances taken with a very large sextant, concludes a Great Conjunction of Saturn, Jupiter, and the fixed stars to have occurred on October 16, at hour 7:34 after midday, in Sagittarius 13° 2' 46", and the northern latitude of Saturn 1° 16'; Jupiter 0° 16' ⅗. We, however, taking it around hour 8 p.m. of the same day, [find it] in 13° 3' ⅗, with the same latitude.

CAPUT VIII.

Select observations of Saturn, out of many, which Father Giovanni Battista Riccioli [Io. Baptista Ricciolus] and Father Francesco Maria Grimaldi [Franc. Maria Grimaldus] carried out at Bologna [Bononia] in the College of St. Lucy [Collegium S. Luciae], together with others as assistants, whenever there was need, of the Society of Jesus.

1. In the year 1641, on the night following the 20th day of August, at the hour acquired from the fixed stars after midday 13:59, the altitude of Saturn above the western Horizon was observed to be $21^{\circ} 23'$.
2. In the same year, on the night following August 31, an hour after midnight at 3:25' 37", the altitude of Saturn, acronychal, above the Horizon was seen to be $19^{\circ} 35'$.
3. In the same year, on the night following October 14, Markab of Pegasus [Markab Pegasi] crossed the middle of the Heavens, and Saturn at the perpendicular [*ad perpendicularum*] by $8^{\circ} 45''$; M. C. [the meridian crossing] of Saturn followed, whose altitude was then seen to be $31^{\circ} 6'$. It was estimated that at that time the meridian altitude was $10^{\circ} 50'$ — but the meridian reckoning was incorrect.
4. On the same day of the same month, in the night following the transit of the star Fomahant [Fomalhaut], when by the same [method] Saturn's transit was counted, the time turned out to be smaller [i.e. shorter]. The meridian altitude of Saturn was seen to be $34^{\circ} 50'$.
5. Likewise, in the year 1642, on June 6, in the morning, with the altitude of the bright star of Aquila falling westward at $51^{\circ} 15'$, and the times reckoned up to the altitude of Saturn at $25^{\circ} 52'$, [and] minutes of time $8^{\circ} 55''$, and on day 7, in the morning, about one hour before the rising of the Sun, the bright star of Aquila obtaining a western altitude of $52^{\circ} 40'$, the times being reckoned up to it $5^{\circ} 22''$, by means of a perpendicular, [and] then at once the western altitude of Saturn captured at $22^{\circ} 12'$.
6. In the year 1642, on July 16, in the morning, with the altitude of the bright star of Aquila falling westward, the times being reckoned by the same [method], $6^{\circ} 40''$, after which the meridian altitude of Saturn was observed to be $41^{\circ} 57'$.

7. In the same year, on September 13, in the night following, Saturn's acronychal meridian altitude was seen to be $39^{\circ} 59'$; after which, with the transit numbered to the perpendicular at $13' 45''$, the altitude of the bright star in the Tail of Cetus [*lucida caudae Ceti*, Deneb Kaitos] was captured at $24^{\circ} 56'$, and thence, from the transit of the same star by M. C. [meridian crossing], numbered $18' 35''$.
8. In the year 1642, on September 28, around the third part of the night [$\frac{3}{8}$ *noctis*], with the distance of Saturn captured by sextant from the bright star of Aries [Hamal], it was $19^{\circ} 34' 30''$; from the Lower Jaw [*Mandibula*] of Cetus, which is of the second magnitude, $43^{\circ} 46'$.
9. In the same year, on October 14, around the second hour of the night, Saturn was seen to be distant from Fomalhaut $26^{\circ} 51'$, and from the bright star in the Tail of Cetus $20^{\circ} 2'$, and again from Jupiter $10^{\circ} 31'$.
10. In the year 1643, on January 20, in the night following, the altitude of Saturn seen from the west was $31^{\circ} 23'$, and its azimuth $39^{\circ} 40'$; thence, after $4' 40''$ had elapsed, the rising altitude of Aldebaran was $48^{\circ} 50'$.
11. In the year 1643, on June 28, in the morning, the western altitude of the bright star of Aquila was $46^{\circ} 2'$; thence, after minutes of time had been counted, Saturn was nearest to the Sun by the Sextant [recte: at the next Solar Sextant, i.e. the 60° aspect]; the observation was carried out, distant from the foot of Andromeda $42^{\circ} 54'$; then, after 4 minutes of time, distant from the bright star of Aries $28^{\circ} 1' 30''$ — most exactly.
12. In the year 1643, on July 15, in the morning, the rising altitude of the bright star of Aries was $46^{\circ} 50'$; thence, after 32 minutes had elapsed, the distance of Saturn from the bright star of the Sextant was $27^{\circ} 45'$; and after 4 minutes of time it was distant from Aldebaran $35^{\circ} 7'$; and after a further 4 minutes of time distant from Jupiter to the east [*Ioue orientiori*] $15^{\circ} 50'$.
13. In the same year, on July 26, the captured oriental altitude of the bright star of Aries was $59^{\circ} 10'$; the perpendiculars counted were $6'$; after which the distance of Saturn from the Sextant was $27^{\circ} 43'$; from the same, after a further 6 minutes of time, it was distant from Aldebaran $56^{\circ} 58\frac{1}{2}'$.
14. In the same year, on July 30, in the morning, the captured rising altitude of the bright star of Aries was $58^{\circ} 27'$; the minutes elapsed, 4; Saturn distant from the bright star of Aries $27^{\circ} 50'$; and after 10 minutes it was distant

from Aldebaran $57^{\circ} 2'$ — for at that time Saturn was retrograde, and nearest to the Sextant of the Sun.

15. In the same year, on August 31, in the morning, Aldebaran shining in the East, distant at the vertex $34^{\circ} 10'$; after which, the time being counted, 10 minutes, Saturn was distant from the same $58^{\circ} 25'$; thence, after 2 minutes of time, it was distant from the Lower Jaw of Cetus $40^{\circ} 2'$ — but it was not verified, since [the reading is] suspect; therefore only the distance of Saturn from the bright star of Aries $6^{\circ} 12'$ [is given] — nearest.
16. In the year 1643, on September 27, in the night following, Saturn, acronychal, crossed [the meridian] by M. C., its meridian altitude being captured by a double quadrant at both points, $44^{\circ} 48'$; but its rising altitude, counted as the minutes of the meridian, $13' 41''$, was observed — the rising altitude of the bright star of Aries $62^{\circ} 24'$.
17. Likewise, in the year 1643, on December 25, under the first hour of the night following, the fourth from sunset, Saturn at the Quadrant of the Sun, near the Head of Andromeda, distant at the vertex $25^{\circ} 15'$.
18. In the year 1644, on June 28, with the bright Head of Aries having an altitude, seen at the vertex, of $20^{\circ} 30'$, Saturn was observed [recte: was seen]; its distance from the bright star of Aries by the Sextant $13^{\circ} 53\frac{1}{2}'$; then, after 8 minutes of time, the distance of Saturn from the bright star of the girdle of Andromeda was $29^{\circ} 6\frac{1}{2}'$. It was nearly Italic [Italian-reckoned hours]; and the refraction of the bright star of Aries was such that Saturn was very nearly at par with it, and so the distance scarcely has any need of correction.
19. In the same year, and in the same month, on day 9, Saturn was observed to be distant from the bright star of Aries $36^{\circ} 9'$; and after 7 minutes the time observed [gave] the distance of Saturn from the bright star of the foot of Andromeda $36^{\circ} 9'$.
20. In the year 1644, on July 11, in the night following, Saturn was distant from the bright star of Aquila falling westward at the Italic sixth hour, very nearly, and halved [i.e. about $6\frac{1}{2}'$], or [from] the bright star of Aquila toward its setting, $17^{\circ} 24\frac{1}{2}'$; and after 9 minutes it was distant from the bright star of the foot of Andromeda $18^{\circ} 13'$. The foot of Saturn itself, [from] the bright star of Andromeda, was distant $18^{\circ} 48'$ — as often [done] in other observations.

21. In the same year, on July 22, in the morning, at the Italic civil hour 17:15, Saturn was seen to be distant from the bright star of Aries $43^{\circ} 56' \frac{1}{2}$.
22. In the year 1644, on August 1, in the morning, with the bright star of Aries prepared [for measurement], distant at the vertex $33^{\circ} 15'$; Saturn was distant from Aldebaran $11^{\circ} 1'$, who in another instrument had been distant a half-hour before from Capella $60^{\circ} 15'$.
23. In the year 1644, on August 13, in the morning, in clearest weather, with Aldebaran distant toward the East at the vertex $44^{\circ} 53'$, Saturn was seen to be distant from Aldebaran $44^{\circ} 53'$; thence, the distance of Aldebaran being $43^{\circ} 36'$ from the vertex, Saturn was distant from Aldebaran $17^{\circ} 18'$ — for at this time Saturn was distant from the shoulder of Orion that precedes it $56^{\circ} 4'$ — and it was then nearest to the Sextant of the Sun.
24. In the year 1644, on October 8, in the night following, at hour 3 Italic, Saturn, acronychal, was distant from the bright star of Aries $17^{\circ} 51'$, and at the southern foot of Andromeda $36^{\circ} 3'$ — for it was more westerly than each star. But on day 9, the meridian distance of the Sun from the vertex was $29^{\circ} 8' 40''$; and in the night following that same day, at the Italic civil hour $2\frac{1}{2}$ [recte: $2\frac{3}{4}$], Saturn.

Saturn was distant from the bright star of Aries by $19^{\circ} 54'$, and from the southern foot of Andromeda by $36^{\circ} 6'$.

26. [Margin: $\square$ (quadrature)] In the year 1644, on November 17, on the following night, Rigel of Orion was observed rising toward the east, Saturn being distant from it by $63^{\circ} 56'$; and after 3 minutes Saturn was distant from Aldebaran by $49^{\circ} 57'$; and after another 3 minutes it was distant from the bright star of the jaw of Cetus by $26^{\circ} 13'$.

27. In the year 1645, on July 26, in the morning, when Saturn was distant from the bright star of Aries by $33^{\circ} 50'$ — the time having been counted out after 2 minutes — Saturn was observed once, and again, after another minute, distant from Capella by $48^{\circ} 56' \frac{1}{3}$; and after three minutes it was distant from Aldebaran by $30^{\circ} 59'$. [Margin: $\square$ (quadrature)] At that time it was near the quadrature [$\square$] of the Sun, whose meridian distance on the 27th was seen from the vertex to be, by the greatest quadrant [the large quadrant], $25^{\circ} 19' 20''$; but by the smaller quadrant, $25^{\circ} 19'$.

28. [Margin: $\oslash \oslash$ (conjunction with Mars)] In the year 1646, on June 23, in the morning, after the conjunction of Saturn with Mars, when the bright star of Aries

was distant from the vertex by $63^{\circ} 56'$, Saturn was distant from Capella by $40^{\circ} 32'$; but from the bright star of Aries it was distant from the vertex by $62^{\circ} 46'$. Saturn was distant from the bright star on the side of Perseus by $34^{\circ} 31'$.

29. [Margin: $\square$ (quadrature)] In the year 1646, on August 10, with the bright star of Aries distant from the vertex toward the east by $39^{\circ} 40'$: Saturn at the quadrature [$\square$] of the Sun, and near to it, was distant from Capella by 38° , precisely; but when the bright star of Aries was distant from the vertex by $38^{\circ} 22'$, Saturn was distant from Aldebaran by $17^{\circ} 26'$. It was itself then at an altitude of about 31° .

30. In the year 1647, on February 2, on the following night, at the $3\frac{1}{4}$ civil hour, Saturn was seen to be distant from the bright star of Aries by 15° ; and after observations were repeated most precisely, after 7 minutes it was distant from Aldebaran by $23^{\circ} 27'\frac{1}{2}$.

31. In the year 1647, on November 16, about the second hour, with half an hour after sunset, Saturn was seen to be distant from Capella by $30^{\circ} 48'$; and from the northern horn of Taurus by $25^{\circ}\frac{1}{2}$, when Saturn was at an altitude of $21^{\circ} 50'$; and from the northern horn by $17^{\circ} 16'$.

32. [Margin: $\circ$ (opposition)] In the year 1647, on November 20, on the following night, at about the 4th Italian hour, Saturn was observed acronychal [rising at sunset], distant from Capella by $31^{\circ} 7'$, and from the northern horn of Taurus by $20^{\circ} 50'$; but at the end of the observation Saturn was at an altitude of $40^{\circ} 45'$, and Aldebaran was distant from the vertex toward the rising point by $55^{\circ} 15'$.

33. In the year 1647, on November 25, on the following night, about the 3rd Italian hour, we saw Saturn distant from Capella by $31^{\circ} 17'\frac{1}{2}$, but from the northern horn of Taurus by $21^{\circ} 10'\frac{1}{2}$. These observations are to be set out below at nos. 53 and 54.

34. [Margin: $\circ$ (opposition)] In the year 1648, on December 2, when Saturn was approaching the perigee of its epicycle and drawing near to opposition [$\circ$], around the third hour of the following night Saturn was observed distant from the vertex toward the rising point by $57'$; and observed again, and more often, distant from Aldebaran by $7^{\circ} 40'$, and from Capella likewise at repeated observations by $24^{\circ} 52'\frac{1}{2}$.

35. In the year 1649, on July 27, in the morning Saturn was at an altitude of 23° , and distant from Capella by $25^{\circ} 24'\frac{1}{2}$, and from Aldebaran by $20^{\circ} 56'\frac{1}{2}$.

36. In the same year, on July 31, in the morning Saturn was seen at an altitude of $27^{\circ} 20'$, and then distant from Aldebaran by $21^{\circ} 27'$, but from Capella by $25^{\circ} 30' \frac{1}{2}$.

37. In the year 1651, on the very 1st of January, about the third Italian hour of the following night — that is, when Aldebaran, rising toward the east, was distant from the vertex by $38^{\circ} 56'$ — Saturn itself was then seen to be distant from Aldebaran by $36^{\circ} 21'$, and from the bright shoulder of Orion, or the following one, by $22^{\circ} 57'$.

38. [Margin: $\odot$ (opposition)] In the year 1652, on January 15, of the following night, at about the fourth Italian hour — that is, when the bright shoulder of Orion, rising toward the east, was distant from the vertex by $34^{\circ} 51'$ — Saturn was seen to be distant from the aforesaid shoulder of Orion, and soon after from Procyon, by $16^{\circ} 39' \frac{1}{2}$; and at Rigel by $51^{\circ} 33'$. Saturn was then at an altitude of about 36° , and not far from opposition [$\odot$] with the Sun.

39. In the same year, on May 29, on the following night, about the first hour after sunset, when the head of Pollux was at an altitude of $20^{\circ} 55'$, Saturn was seen to be distant from the bright star of the mane of Leo by $30^{\circ} 12' \frac{1}{2}$, but from Regulus by $29^{\circ} 27'$, when Saturn was at an altitude of $20^{\circ} 33'$.

40. In the same year, on November 19, in the morning about the 13th Italian hour, Saturn, near to retrogradation, was distant from the Dog Star, or Procyon, by $26^{\circ} 57'$; and a little after from the heart of Leo by $12^{\circ} 26'$, when Regulus itself was nearly on the meridian.

41. In the year 1653, on January 30, after the opposition with the Sun already celebrated [observed], but because of clouds unobservable on the following night, when Procyon was distant from the vertex by $60^{\circ} 40'$, Saturn was distant from the bright shoulder of Orion, and on the following day soon after from Procyon, by $24^{\circ} 23' \frac{1}{4}$.

42. In the same year, on March 7, when on the following night the bright foot of Gemini was culminating, we observed Saturn distant from Procyon by $22^{\circ} 40'$, but from the following shoulder of Orion by $45^{\circ} 15'$.

43. Likewise in the year 1653, on April 27, on the following night, almost 2 hours after sunset, we observed Saturn distant from the following head of Gemini by $18^{\circ} 30'$, and from the heart of Hydra by $28^{\circ} 14'$.

44. Also in the year 1653, on December 6, in the morning, with the sky most serene and most dry, Saturn was distant from Procyon by $38^{\circ} 47' \frac{1}{2}$, and from the southern head of Gemini by $38^{\circ} 2'$; and soon after Saturn was distant from the

vertex by $37^{\circ} 14'$; and after 2 minutes the azimuth of Saturn from the vertex was $37^{\circ} 14'$, observed toward the west. The distance of Saturn from the vertex was $38^{\circ} 36'$. On December 22, in the morning, at the $13 \frac{1}{4}$ civil Italian hour, Saturn was seen to be distant from Procyon, being then at an altitude of $18^{\circ} 23'$. Soon after it was distant from the head of Pollux by $37^{\circ} 50'$; but on account of refractions the distance of Saturn from Procyon is to be set at $38^{\circ} 36'$.

45. In the year 1654, on February 10, just under the Italian hour of night $2 \frac{1}{2}$, Saturn was at an altitude of $27^{\circ} 15'$, and was distant from Procyon by $35^{\circ} 53' \frac{1}{2}$; and from the bright star of the quadrilateral of Ursa Major — the one which shines on the haunch, or the one nearest among the Seven Triones [the Wain] — it was distant by $49^{\circ} 18' \frac{1}{2}$. [Margin: $\oslash$ Perig. (opposition; perigee)]

46. In the same year, on February 12, at very nearly the $6 \frac{2}{3}$ Italian hour by the civil clock, Saturn passed across the meridian; and its meridian distance from the vertex was $29^{\circ} 6' \frac{1}{2}$. Then, after a perpendicular had been let fall, the transit of Regulus was counted by M. C. [Margin: M. C.] and its meridian distance from the vertex was $30^{\circ} 51'$.

47. Also in the year 1654, on April 25, about the 3rd hour after sunset, Saturn was distant from Procyon by $32^{\circ} 53'$, raised at an altitude of $19^{\circ} 30'$; but from the head of Pollux by $31^{\circ} 13' \frac{1}{2}$.

48. In the same year, on April 29, about the $1 \frac{1}{2}$ hour after sunset, when Procyon was at an altitude toward the west, Saturn was distant from it by $32^{\circ} 56'$; and from Pollux by $31^{\circ} 17'$.

49. In the year 1655, on May 8, in the evening, after the high altitude of Procyon — 6 minutes having been counted — and then at once, Saturn was seen to be distant from Procyon by $44^{\circ} 52'$; but from the more easterly head of Gemini by $44^{\circ} 25' \frac{1}{2}$.

50. In the year 1655, on May 27, at about the 2nd hour after sunset, we observed Saturn distant from Regulus by $8^{\circ} 22'$, but from the bright star of the mane of Leo by $10^{\circ} 56'$.

51. In the same year, on June 5, at the 2nd hour after sunset, Saturn was distant from Regulus by $8^{\circ} 45'$, and from the bright star of the mane of Leo by $11^{\circ} 14' \frac{1}{2}$.

52. Again, in the year 1655, on July 10, on the following night, Saturn in azimuth, at precisely 90 degrees, was distant from the vertex by $74^{\circ} 17'$. Thence, with $6^{\circ} 50'$ counted off in minutes, the distance of Saturn at the time from the vertex from Spica was precisely 65° ; and at both [stations] the star was in the western region.

53. In the year 1656, on January 9, in the morning at the Italian hour of dawn at the $12\frac{1}{4}$ civil hour, Saturn, being retrograde, was distant from Regulus by $27^{\circ} 44' \frac{3}{4}$, and from the bright star of the mane of Leo by $28^{\circ} 33' \frac{3}{4}$.

54. In the year 1656, on March 3, just under the fourth hour of the following night, Saturn, tending toward conjunction [♌] with the Sun, was distant from Regulus by $24^{\circ} 49'$, and from the heart of Hydra by $36^{\circ} 26' \frac{1}{2}$.

55. In the same year again, and in the same month, on day 11, on the following night, at the 2nd hour, we saw Saturn distant from Regulus by $24^{\circ} 12'$, but from the heart of Hydra by $35^{\circ} 57' \frac{1}{6}$.

56. In the year 1656, on May 30, on the following evening, with the tail of Leo at an altitude of $41^{\circ} 23'$, to whose azimuth Saturn — marked out by the wire of the [filar] triangle [reticle] — was carried, it was distant from the vertex by $52^{\circ} 50' \frac{1}{2}$; and from its [the star's] arrival, with $2^{\circ} 20'$ counted off perpendicularly, Regulus was distant from the vertex by $62^{\circ} 33' \frac{1}{2}$. But all these stars were toward the west, just as Saturn was.

57. Likewise in the year 1656, on July 13, half an hour after the true [sunset], Saturn was observed by us to be distant from us — from the more eastern Spica — than Saturn was, by $30^{\circ} 48' \frac{1}{2}$; and from the bright star of the loins of Leo, which was setting, by $17^{\circ} 4' \frac{3}{4}$.

58. In the year 1657, on March 22, on the following night, at the 4th Italian hour, Saturn, near to opposition with the Sun, was distant from Regulus by $37^{\circ} 4' \frac{1}{2}$, and from Arcturus by $32^{\circ} 43'$.

59. In the same year, on June 24, on the following night, the distance of Spica was $57^{\circ} 22' \frac{1}{2}$; and after three minutes of time the distance of Saturn from the vertex was $54^{\circ} 20'$; and at once Saturn was distant from Spica by $20^{\circ} 21' 15''$.

60. [Margin: ♌ (opposition)] In the year 1648 — which was to be noted above — on February 21, at the 1st hour after sunset, Saturn was distant from Aldebaran by $8^{\circ} 54' \frac{1}{2}$; but Regulus from the horn of Orion by $33^{\circ} 1'$.

61. Likewise in the year 1648, on February 26, on the following night, about the 1st Italian hour, Saturn was distant from Aldebaran by $9^{\circ} 39'$, but from Rigel by $32^{\circ} 56'$.

62. [Margin: ♌ (opposition)] In the year 1650, on December 22, in the morning at sunrise, the distance of Saturn from the vertex was observed toward the rising point by $80^{\circ} 10'$, both in altitude and in azimuth; on the night of the same day,

with Scheat of Pegasus placed at an altitude in the quadrilateral of Pegasus, it was distant from the vertex by $39^{\circ} 2'$ toward the rising point. But after the observation, the distance of Saturn from the heart of Hydra was captured from the vertex, the rising being $55^{\circ} 47'$. Meanwhile, with $10^{\circ} 50'$ counted off perpendicularly, and because Saturn was in opposition with Mars on that day, the conjunction was believed to have occurred; and therefore the conjunction of Saturn with Mars is to be consulted below in the Mars observation at chapter 42 [recte: book on Mars, Cap. 42], at no. 7 of the chapter.

63. In the year 1650, on April 16, at noon on day 2, Saturn was observed at the meridian, distant from three certain Fixed stars very near to it, and at the same passage [transit], with Saturn seen stationary, with the Saturn motion stationary; and likewise direct, by that very method which is contained in the Ephemeris of Argoli [Andrea Argoli], and nearly so of Lansbergen [Philips van Lansbergen], in that the term of the station was between the 21st and 22nd of February.

64. In the year 1657, on December 14, in the morning, Saturn was observed on the very meridian, distant from the vertex by $48^{\circ} 57' 8''$; thence, with $50''$ counted off in seconds, it passed across Spica by the same meridian.

Observations otherwise promised from Gassendi above, at Cap. 5, no. 14.

Distances of Saturn from the Fixed stars, observed by the [astronomical] radius [cross-staff].

Year	Day	Gr. [°]	'
1633	6 March, in the morning, from Antares	8	$24 \frac{1}{2}$
	to the top of the forehead of Scorpius	12	$5 \frac{1}{3}$
1633	27 May, in the evening, from Antares	6	50
	to the top of the forehead of Scorpius	8	55
1634	13 April, in the morning, from the heart of Scorpius	17	$48 \frac{1}{2}$
	to the top of the forehead of Scorpius	23	$14 \frac{3}{4}$
	10 June, in the evening at the $8 \frac{1}{2}$ hour, from Antares	14	$46 \frac{2}{3}$
	at an altitude of 14° , to the top of the forehead of Scorpius	20	2
1635	24 April, in the morning, from Aquila	36	18

Year	Day	Gr. [°]	'
	to the Heart of Scorpius	28	30
	22 June, in the evening, from Aquila	38	27 ½
	to the top of the forehead of Scorpius	31	25
	20 Aug., in the evening, from the left knee of Ophiuchus	24	27
	from the right thigh of Ophiuchus	14	49
1636	1 May, in the morning, from Aquila	31	5 ⅔
	from the left shoulder of Sagittarius	7	45 ⅓
1638	24 July, in the morning, from Aquila	30	40
	from the mouth of Pegasus	31	57

CAPVT IX.

Various methods are set out — 20 of them — for observing the positions of Saturn and of the remaining lesser planets, so that judgment may be made about observations by their effect [test] and certainty.

1. The First Method of all, in my judgment the most outstanding, is when the planet is near a Fixed star of known longitude and latitude, so that both can be seen together through the telescope, and an estimate be made by eye, joined with a Capacity of Minutes [a micrometer measure], by which it may be determined how the telescope grasps and fixes the longitude and latitude of the planet. For through the telescope, with the star uncovered of those rays which — whether from the atmosphere, or from the deceptiveness of the eyes — represent the stars as if they were larger and nearer than they really are. But this felicity is very rare. Yet we have some examples of it in Saturn, indeed at Chapter 5, Observation 15, and at Chapter 6, Observation 16. And in Jupiter we shall give from our own [observations], and from those of D. Vicenç Mut [Vicenç Mut], a most splendid example, in Book 1 of the *Almagestum Novum*, Section 6, Cap. 10, and in others below, where we shall treat of the individual planets.

2. The Second Method, nearer to the preceding, is observation made with the naked eye when a planet touches [draws close to] some Fixed star, of which the longitude and latitude are known; or, if it does not touch it, is yet so near it that an estimate can be taken by eye, with a paucity of digits in breadth, by which the planet is distant from the Fixed star, or in latitude. For an Astronomical Digit, raised in the sky, is equivalent to Minutes 2 ½ at most; and this method here is

liable to that deceptiveness of splendor of which we spoke in the first method, whence it comes about that the planet and the Fixed star seem nearer to one another than they themselves really are.

Examples of such observations, besides those which we adduce concerning the other planets in their places, are — for Saturn — above at Cap. 1, Obs. 2; Cap. 2, Obs. 5; Cap. 6, Obs. 10; Cap. 6, Obs. 14. Yet I do not wish, in Obs. 1 of Cap. 1, to set out that whole difference, namely between the Ptolemaic computation, the Longomontanian [Longomontanus], the Bullialdian [Ismaël Boulliau], and Our own; we ascribe the aforesaid deceptiveness, since the greater part arises from the place of the Fixed star, taken at that time from diverse Tables, and so also from the other examples. Yet I should believe that even by this method one can — provided only the arrivals [approaches] of either of the five [planets] to the Fixed star, and perhaps more, in some first scruples [minutes] — go astray.

3. The Third Method, akin to the preceding, but much more fallacious, is by the conjunction of a planet with the Moon, as it appears to the eye, especially to the naked one. For besides the danger of hallucination, from the splendor of either, the danger of the arrival is incurred in the intricacies of the Moon's parallaxes [parallaxis Lunarium]; that is, the planet does not indeed come near the Moon in true [position], but appears [to], and very near it, so that it can be estimated by eye how great a part of the Lunar diameter the planet is distant from the horns of the Moon, or from its edges.

Examples of such observations for Saturn I have indicated above at Cap. 1, Obs. 6; Cap. 2, Obs. 5; and Cap. 5, Obs. 11 and 16.

4. The Fourth Method, used by the Ancients, was by Zodiacal Armillae [armillary rings] — celestial circles analogous to those of Longitude and Latitude — or by Astrolabes equivalent to them, such as Ptolemy describes in [*Almagest*] Book 5, Cap. 1, with great syntax; and as Egnatius Danti [Egnazio Danti] describes in his *Astrolabe*. But such instruments Tycho [Tycho Brahe] deservedly held in lower esteem than others, in his *Mechanica* [*Astronomiae Instauratae Mechanica*], folio 19, where he describes these very Armillae; but he confesses that they are liable to an error of at least two minutes.

The Ancients indeed scarcely attained the certainty of even ten minutes by the Armillae. And so Waltherus [Bernhard Walther] himself, who frequently employed them, not rarely detected in them themselves a defect of ten minutes, as is shown by Observation 33, Cap. 2, reported above. See also what Tycho says

against the Torquetum used by the Arabs, in the place cited, and in Tome 1, *Progymnasmata*, page 141.

5. The Fifth Method is carried out by Equatorial Armillae, which Tycho substituted for the Zodiacal ones, and which he describes in the *Mechanica*, folios 20, 22, and 23, and in Tome 1 of the *Progymnasmata*, Cap. 2, folio 141. For by these the Declination, and the Difference of Right Ascension between the planet and the Fixed star of known Right Ascension, are obtained to within one minute or another. But with all respect to Tycho, I judge that they err by not rarely four or five minutes, on account of causes which I shall set out in my *Liber Organicus*. Meanwhile let it suffice as an argument that there is difficulty in seeing the error in the Quadrants themselves, as the Sextants, much more simply built, are seen, and so on. Yet still, that they have one or another minute of certainty in observing them: provided there be given the Declination of the planet and its Right Ascension, the same one then investigates its Longitude and Latitude through the Problems set out above, the obliquity of the Ecliptic being supposed, or the Distance of the Poles of the Equator and of the Ecliptic — how this is carried out, we taught in Book 10 of the *Almagestum Novum*, Section 2, Problems 48 to 52, and in our *Primum Mobile*.

6. The Sixth Method, more secure than the preceding, is completed by the Meridian Altitude of the planet, with a great Quadrant or Sextant, taken in the same moment together with the planet at some Fixed star, whose preceding Right Ascension be known; for then, from the Altitude of the planet compared with the Altitude of the Fixed star, its Declination is made known, and the Right Ascension is the same; and as the Fixed star crosses the Meridian, so afterward the Longitude is investigated, and the Latitude through the Problems set out above. For at the moment when the star is most precisely observed at the plane of the Meridian, perpendicular to it [the meridian line], some determined point is fixed in the same plane as the center, by means of which the thread is marked; as is taught in *Almagestum Novum* Book 5, Cap. 15, Problem 8, where the description of the instrument is also given.

7. The Seventh Method, near to practice [most practicable], is if the moment be observed at which the planet crosses the Meridian, by the wire of the triangle [filar reticle]; and at the same moment one companion [assistant] takes the meridian altitude of the planet; and a third companion begins to count the seconds of time of the oscillations perpendicularly, as we set out in *Almagestum Novum* Book 2, Cap. 20. Or whenever some Fixed star crosses the same Meridian; or, if you observe the transits of the Fixed star at the same time, taking the

meridian altitude of the planet: for the Time embraced, both converted into the Right Ascension of the star, subtracted or added — that is, in the transit through the middle of the Sky [the meridian] — gives the Right Ascension of the planet. But the meridian altitude of the planet, compared with the Equator, gives the Declination, from which, through the Problems already indicated, are sought the Longitude and Latitude of the planet. Provided that the brief interval of time, in which the transit of the planet, or of the star, takes place, the smaller the danger of erring in the just time of the Primum Mobile, congruent with the quantity, if indeed every four seconds of time bring in one minute of the Equator.

You have an example of this practice in our observations relating to Cap. 8, namely Obs. 3, 4, 8, 46, and 64; from which let it please to weigh no. 64: in the year 1657, on December 14, in the morning, Saturn's meridian distance from the vertex of our Observatory was captured at $48^{\circ} 57' 8''$; and thence to the transit across the Meridian we counted $50''$, and so we deduced Saturn's both Declination and Right Ascension.

The Right Ascension and Declination of Saturn, and its distance from the vertex on December 14, 1657, are computed as follows:

	Gr. [°]	'	''
Meridian distance of Saturn from the vertex	48	57	8
Therefore, Meridian Altitude of Saturn	41	2	52
Altitude of the Equator at our Observatory	45	29	50
Therefore, Southern Declination of Saturn	4	26	58
Right Ascension of Spica at that time for us	196	48	36
Parts of the Equator for the $50''$	0	12	30
Therefore, Right Ascension of Saturn	196	36	6

But the Longitude and Latitude of Saturn will thus be investigated by the adjoined Diagram, in which let the Equator be AB, and [the diagram follows].

Diagram. A circle representing the celestial sphere, used to derive Saturn's longitude and latitude from its declination and right ascension. Within the circle a network of great-circle arcs is drawn: the Equator, the Ecliptic, the Solstitial Colure, and the circle of declination through Saturn, meeting at the marked points. The Saturn glyph (♄) appears near the center, with a second small glyph beside it.

- P (top): the Boreal Pole of the Equator [Aequatoris Polus Borealis], at the top of the circle.
- Z (interior, near P): the Pole of the Ecliptic [Eclipticae Polus], distant from P by the arc PZ (= $23^{\circ} 30' 20''$, the obliquity).
- A (left): one end of the Equator AB; in the text the Equator is AB.
- B (right): the other end of the Equator AB.
- C (upper left): on the Ecliptic CYK — the point where the Ecliptic crosses; the Ecliptic runs C–Y (Aries)–K. C marks the beginning of Cancer.
- K (lower right): the common point of the Solstitial Colure APK and the Ecliptic CYK; K marks the beginning of Capricorn.
- Y (Aries) and $\varnothing$ (Libra): the Equinoctial points, marked on the Ecliptic.
- h (center): Saturn's place; with the small adjacent glyph.
- S (center, below h): the point in which Saturn's place is designated, reached from the Pole P by the arc PS along the circle of declination.
- O (bottom center): foot of the arc ZSO on the Ecliptic / Latitude circle.
- T (center): intersection point of the arcs near Saturn.

The text: "The Solstitial Colure is APK, and the Ecliptic is CYK, in which the beginning of Cancer is C and of Capricorn K; the Equinoctial points are Y and $\varnothing$. Further, let the Boreal Pole of the Equator be P, and of the Ecliptic Z, their distance being PZ, which for us is $23^{\circ} 30' 20''$. Since indeed it is recognized from the Ephemerides that Saturn was then around the 16th degree of Libra, with a Boreal latitude of about 2° , and the Southern declination observed was $4^{\circ} 26' 58''$ — therefore Saturn's place is designated in S, to which, from the Pole P of the World, by the circle of Declination, the Arc PS, consisting of the Quadrant PI and the Southern declination IS, will be drawn; for the whole Arc PS is $94^{\circ} 26' 58''$. But from the Pole Z of the Ecliptic, draw to S, by the circle of Latitude, the Quadrantal Arc ZSO. For in the spherical Triangle PSZ, the two Sides PZ, of $23^{\circ} 30' 20''$, and PS, of $94^{\circ} 26' 58''$, are given; and from these the Angle SPZ comprehended, of $73^{\circ} 23' 54''$, from the Right Ascension of Saturn: For from the given degrees $196^{\circ} 36' 6''$ subtract 90° from A to $\varnothing$ [recte: from Y to $\varnothing$], that is, the arc of the Equator from the beginning of Cancer, there will remain from the beginning of Cancer to the term I of Saturn's Ascension, the Arc CI; and so the Angle API, of $106^{\circ} 36' 6''$; and this subtracted from 180° leaves the Angle SPZ of $73^{\circ} 23' 54''$. From these three given — by the Canons of Logarithms for spherical Triangles — the remaining Arcs are obtained, namely the base SZ, and, the degrees 90° having been subtracted, the Boreal latitude of Saturn OS will be the known [recte: the mark]. We obtain likewise the Angle PZS, which measures the arc CO of the Ecliptic,

counted from the beginning of Cancer, whence the Longitude of Saturn will be known to us; which therefore will be of Libra 17° 0' 8", and the Boreal Latitude 2° 15' 42". By which observation, as accurate as could be, and on account of the time elapsing between the transit of Saturn and of Spica, in no way liable to error, we conclude much more that the Lansbergian Tables are distant from the truth than the Tychonic, or Danish; for from these tables is given the Longitude and Latitude written below:"

	Saturn (♄) Latitude	Longitude			Gr. [°]	'	"
		Gr. [°]	'	"			
Danish	2	2	3	♌	16	5	3
			6			5	0
Lansbergian	2	2	3		16	1	2
			0	6		4	5
Ours, from Observation	2	2	4		17	0	8
			5	2			

8. The Eighth Method, more secure than the preceding, and less troublesome — inasmuch as it is dispatched by one and the same observer with one and the same moment, through three observations — is, if at some moment the plane of the [filar] Triangle's wire, placed at the Meridian, glides to the center of the planet, the observer of this transit gives a signal to two other companions, who have already at hand prepared the instruments. And one [continues].

LIBER V — DE SATURNO (continued)

Caput IX. (*continued*) — The twenty methods of observing the positions of Saturn and the other lesser planets

(Methods 8–20)

Let one observer take the planet's meridian altitude, while another takes the rising or setting altitude of a fixed star — so set up that it stands a good many degrees off the meridian, yet not so far off that the uncertainty of refraction makes the result doubtful. From this rising or setting altitude, provided its declination and right ascension are known, the star's right ascension can be derived. For if the planet's altitude, once it has been reduced to the equator's altitude, is greater than that of the equator, it will give the planet a southern

declination; if it is less than the equator's, it will leave the planet a northern declination. The right ascension we shall hunt out as follows.

In the diagram opposite, let the planet pass across the meridian HVR; let its altitude AF be given, and from the horizon HR its altitude will be had, since it lies at vertex V; and given the distance VF, run the arc of declination PD through F from the pole of the world P. Then in the triangle FPV we have the complement of the star's declination FP, drawn to the quadrant, and VP, the complement of the altitude of the pole, which is PR. With these three sides given, then, trigonometry will yield the angle FPV, the star's distance from the meridian measured along the equator. If this is added to the right ascension of the western fixed star, it will give the right ascension of the mid-heaven [Medium Coeli], that is, the right ascension belonging to whatever point is then culminating, namely the point through which the meridian passes at that moment. And as for how the planet's longitude and latitude are then derived from its right ascension and declination, that is plain from Problem 5 [*Modo* 5] indicated above — and indeed I have already given one worked example of the preceding method.

Diagram. A circle (the local sphere) carries the meridian as the horizontal diameter HR, with the zenith V at top and the nadir at bottom. Inside, points P (the celestial pole), F (the fixed star), B, and A are marked, with arcs drawn between them forming the spherical triangle FPV described in the text.

- V (top): the zenith / vertex
- P (upper interior): the pole of the world
- B (upper right interior): auxiliary point
- F (center): the fixed star
- A (lower interior): auxiliary point on the meridian
- H (left, on horizon line): horizon point
- R (right, on horizon line): horizon point

9. — The Ninth Method

[Marginal number: 9]

The Ninth Method works exactly as in [Method] 8, except that the altitude of the fixed star is taken instead, and in its place a fixed star of known azimuth is observed by means of the other [side] of the filar triangle [*Filaris Trianguli*] lying flat toward the center of the fixed star. For, as in the preceding scheme of the triangle, the azimuth will give the angle FVP from the sides VP and FP, as above;

and from the angle FPV and the rest, the procedure is carried through exactly as in the preceding method.

10. — The Tenth Method

[Marginal number: 10]

The Tenth Method. If the planet is set outside the meridian, its altitude is observed, together with that of a fixed star appearing at exactly the same moment in the same azimuth; or else, if that azimuth is of known magnitude, in any other way, provided only that — besides the altitude of the pole — the declination and right ascension of the fixed star are known. For in the third diagram here, let HVR be the meridian and HAR the horizon, and round about, let VA be the quadrant of the vertical circle, in which the planet appears at P and the fixed star at F, and from the pole of the world B let circles of declination be drawn through both, giving the arcs BP and BF.

First, if the magnitude of the azimuth AH, that is, of the angle AVH, is known, its complement to 180° will be the angle PVB. With this, and with the complement of the altitude BV, and with the planetary altitude — the complement of which is PV — in the triangle PVB the base BP will be given by the triangle canons. If this turns out to be a quadrant, there is no planetary declination; if it is less than a quadrant, you will have the planet's northern declination [*Declinationem Planetæ versus Polum conspicuum*]; if greater than a quadrant, then subtracting the quadrant, the planet's declination toward the other pole will remain.

Diagram. A circle representing the local sphere, with the horizontal diameter as the horizon HR and the vertical line through the zenith V. The points P (planet) and B are marked in the upper interior, F near the center, A at the bottom of the vertical, forming the spherical triangle PVB of the text.

- V (top): the zenith / vertex
- P (upper interior): the planet
- B (upper right interior): the pole of the world
- F (center): auxiliary point
- A (bottom interior, on vertical): the foot of the vertical circle
- H (left, on horizon): horizon point
- R (right, on horizon): horizon point

11. — The Eleventh Method

[Marginal number: 11]

The Eleventh Method is this: when the planet's altitude has been observed on some determined vertical [circle], you watch for a fixed star to come to the same vertical, and meanwhile, by means of the perpendicular, you note the intervening time; then, as soon as the star reaches that vertical, you take its altitude. Or, the other way round, you may first take the fixed star and then watch for the planet to be carried onto the same vertical; or the quantity of time may be noted, as the procedure of the preceding method explained.

First, then, if the angle PVB in the triangle BVP is known, you acquire it as in the first step of the preceding numbered method; the side BP will reveal the other side of the planet [PV]. But if the azimuth is not known, then — as I said — in the triangle FVB, by the second step, the side BP will be had. Then, in the triangle FBP, you ask for the angle FBP, just as in the preceding numbered method, by its third step; and through that you have the difference of right ascension of the fixed star and of the planet, and likewise its right ascension; and afterward you must correct it for the intervening time, converting the time into parts of the equator. For if the planet comes to the vertical before the fixed star, the said time must be subtracted; if afterward, added. And so you have the planet's absolute right ascension, and from it, by the usual methods, the longitude and latitude.

You have examples of this kind of observation above, in Chapter 8, at observations 56 and 61. Although in these two were employed for verifying the azimuth-quantity, and the declination of Saturn, and another for the time, and from it the right ascension was to be gathered — out of which arises Method 12.

12. — The Twelfth Method

[Marginal number: 12]

The Twelfth Method is carried out thus. With the plane of our filar triangle [*Trianguli nostri Filaris*] turned toward the center of the planet, take the planet's own distance from the vertex; and, to verify its azimuth, if some fixed star cannot be received at the same moment in the same region of the sky at an equal distance from the vertex, count the time until such a star is at a convenient distance from the vertex to be taken. Once this is captured, you then watch for the other star to reach the same quadrant of the vertical circle in which the planet stood, and at the same distance from the vertex; and watch for the distance of this star from the vertex. For if the declination and right ascension of either fixed star are known, you will obtain the planet's longitude and latitude, derived from the prior star's longitude and right ascension and from these, in the usual way, the longitude and latitude. This is what was designated above by the

meridian and horizon scheme; and we shall teach it by the example of our observations in Chapter 62, more briefly and clearly.

Anno 1657. Octobris 22. [Year 1657, October 22] In the morning, near sunrise, with Saturn standing on the eastern vertical, at an altitude of $80^{\circ}10'$, but corrected for refraction at $80^{\circ}15'$ — since it stood less than $10'$ in time after sunrise — and with that distance of the eastern star known to us outside the [twilight] clouds, refractions not having interfered, we took the Heart of the Hydra [*Cordis Hydrae*, α Hydrae] Y, at a distance from the vertex VY of $55^{\circ}47'$, with its [azimuth] in the same [region] and with the complement of the altitude of the pole, drawn to the quadrant — that is, the southern declination of the Heart of the Hydra, $7^{\circ}11'$, added to the quadrant; this gives the arc BY of $97^{\circ}11'$. By trigonometry I derived the angle VBY of $19^{\circ}18'$.

On the following night, in the eastern region, [Pegasi] Scheat [β Pegasi] P came onto the same vertical, at a distance from the vertex PV — observed — of $39^{\circ}2'$; with that same arc and with BV $45^{\circ}29'50''$ and with the northern declination of Scheat, $26^{\circ}14'40''$, the complement of which BP is $63^{\circ}45'20''$, I found the azimuthal angle BVP of $102^{\circ}31'$. Then in the triangle BVS, with the said angle (which is the same as angle BVS), and with the altitude BV $45^{\circ}29'50''$ and the distance of Saturn SV $80^{\circ}15'$, by the logarithmic canons I find the base BS of $92^{\circ}16'55''$; and thus, with the southern declination of Saturn $2^{\circ}16'55''$ taken, with the angle SBV $74^{\circ}18'$, from which I subtracted the angle VBY $19^{\circ}18'$ found above, there remains the angle YBS of $55^{\circ}0'$. This would be the difference of right ascension between the Heart of the Hydra and Saturn, if at the same moment in which Saturn's distance from the vertex was taken, the distance of the Heart of the Hydra had also been taken. But because that distance of the Heart of the Hydra was taken later, when Saturn had now descended somewhat, therefore the difference must be diminished by $2^{\circ}42'30''$, answering to the intervening time of $10^{\circ}50''$. And so there remains a difference of $52^{\circ}17'30''$.

Now the right ascension of the Heart of the Hydra was then $137^{\circ}40'$, and Saturn was more eastern, therefore Saturn's right ascension was $189^{\circ}57'30''$; and its declination, from what was said above, $2^{\circ}16'55''$ southern. Therefore, by the Problems of the *Primum Mobile* and the most subtle logarithmic canons of Vlacq, the longitude of Saturn was then Libra $10^{\circ}2'26''$, and its northern latitude $1^{\circ}51'32''$. So, from this observation, the Lansbergian tables depart more than the Danish, as is plain from the following little table.

Ex Tabulis [From the Tables]	h Longitudo — Sig.	G r			h Latit. Bor. — Gr.		
		.	'	"		'	"
Danicis [Danish]	♌	1	3	1 2		1	0
		1	2	9		4	
Lansbergij	—	1	7	3 2		9	2
[Lansbergian]		1		0			0
Ex Observat. [From the Observed]	—	1	2	2 1		5	3
		0		6		1	2

I confess, however, that because of the rather large interval of time between the observation of Saturn and that of the Hydra, and because from the morning observation of Saturn to the evening observation of Scheat the plane of the filar triangle could be moved somewhat from its former position, this observation serves rather as an example of the problem than for the certainty of the truth.

13. — The Thirteenth Method

[Marginal number: 13]

The Thirteenth Method is this: if, to a determined and known degree of azimuth designated by the filar triangle, you watch for the planet's arrival, and at its arrival take its distance from the vertex; and at the same moment let a fixed star of some known distance from the vertex be observed, or at least, as soon as possible, with the intervening time meanwhile counted between the two observations. This scheme will become clear by the numbered scheme of the preceding [method], and by the example of observation 52 in Chapter 8.

Anno itaque 1655. die 10. Iulij nocte sequenti [So in the year 1655, on the 10th day of July, on the following night], in the western azimuth of exactly 90°, with the filar triangle set up, Saturn S being at a distance from the vertex VS [continues].

[The worked example here closes with the comparison table:]

Ex Tabulis [From the Tables]	h Longitudo — Sig.	G r			h Latit. Bor. — Gr.		
		.	'	"		'	"
Danicis [Danish]	♍	6	5	4 1		5	0
			7	0		0	
Lansbergianis	—	6	3	2 1		3	6

Ex Tabulis [From the Tables]	h Longitudo — Sig.	G r			h Latit. Bor. — Gr.		
		.	'	"		'	"
[Lansbergian]			7	5		8	
Ex Observatis [From the Observed]	—		7	9 4 2		1	4
				0		0	0

14. — The Fourteenth Method

[Marginal number: 14]

The Fourteenth Method, somewhat more laborious than the preceding, requires four observers: one, who is to watch for the determined and known azimuth to expect the center of the planet; another, who at that very moment is to take the distance [of the planet] from the vertex; the remaining two, who are to take at the same moment the distance of the planet from a fixed star of known declination and right ascension. With these acquired, inspect the diagram in which, with the designated horizon HR and meridian HVR, the planet P is given, distant from the vertex by PV; and from the azimuth, the angle PVB, in the triangle PVB, in which there is also given the complement of the altitude of the pole BV.

For trigonometry will not hide the side BP, which indicates the planet's declination. For if BP comes out 90°, there will be no declination; if it exceeds 90°, the excess gives a southern declination; if it falls short, it gives a northern declination. Furthermore, let the fixed star be at F, or at O, with the distance PF or PO certain; and from the star's declination, the side BF or BO, and from the common BP — as above — once these three sides are known, the angle FBP or PBO, namely the difference between the right ascensions of the fixed star and the planet, will be revealed by these. This difference of right ascension is to be added in the eastern quadrant, if the star was at F, that is, higher than the planet P, and subtracted in the western [quadrant]; on the contrary, in the eastern quadrant, if the star was at O. Once you have the planet's right ascension, with the declination — as above — already acquired, you will gain, in the usual way, the planet's longitude and latitude.

Diagram. A circle (the local sphere) with the horizontal diameter as the horizon HR and the vertical through the zenith V. In the upper interior, points P, F, O, and B are marked, with B the pole of the world (upper right). Arcs connect them, forming the triangles PVB, FBP, and PBO described in the text. A is at the foot of the vertical.

- V (top): the zenith / vertex
- B (upper right interior): the pole of the world
- F (upper-left interior): a fixed-star position
- P (interior, below F): the planet
- O (interior, below P): an alternative fixed-star position
- A (bottom interior, on vertical): foot of the vertical circle
- H (left, on horizon): horizon point
- R (right, on horizon): horizon point

[Method 14 carries no comparison table on the page; the prose runs straight into Method 15.]

15. — The Fifteenth Method

[Marginal number: 15]

The Fifteenth Method is accomplished by [taking] the distance of the planet from two more eastern fixed stars, or two more [continues].

western ones; especially if the distance of those [stars] from one another is known. An example may be taken from Chapter 8, our observation 41.

Anno 1653. Ianuarij 30. [Year 1653, January 30] On the night following the Opposition of Saturn with the Sun, we took P. Grimaldi [Grimaldi], and I, Saturn distant from the shoulder of Orion [*Orionis humero lucidiori*, the brighter shoulder = Betelgeuse], that is, from the following one, by $47^{\circ}34'$; and likewise from Procyon by $24^{\circ}23\frac{1}{4}'$, both of them; and the fixed star was more western than Saturn. Let, then, for this observation, the diagram be this, in which let EC be a portion of the ecliptic, and B the southern pole [*Polus Australis*]; let the semicircle ASB be drawn through the center of Saturn S, and the semicircle AOB through the shoulder of Orion O; and let Procyon be at P, from which to the pole A the complement of latitude AP is drawn — for the southern latitude of the shoulder of Orion is $16^{\circ}6'15''$, and that of Procyon $15^{\circ}57'10''$; and so AO is $73^{\circ}53'45''$, and AP $74^{\circ}2'50''$.

Now the distance OP of the fixed stars between themselves, by our frequent observations, is $26^{\circ}2'50''$. Finally, from the fixed stars to Saturn the arcs of distance are drawn, PS and OS. With these set down:

First, in the triangle OPS, with the three sides given — OP $26^{\circ}2'50''$, OS $47^{\circ}34'$, and PS $24^{\circ}23\frac{1}{4}'$ — by trigonometry the angle OPS is given, $142^{\circ}21'40''$.

Second, in the triangle OAP, with three sides likewise given — AP 74°2'50" and AO 73°53'45", and OP, as above — the angle OPA is given, 86°5'20"; which, with OPS, makes 228°27'; and subtracting these from 360°, there remains the angle APS of 131°33'. With this in the same triangle APS, and with AP as above 74°2'50", and PS 24°23¼', the angle ASP is found, 18°7'10", and the base AS 90°58'20". Hence the southern latitude of Saturn [*Saturni Latitudo Borealis*] was 58'20". [recte: *Australis* — the text says AS is 90°58'20", exceeding the quadrant by 58'20", giving a southern latitude; but it prints *Borealis*. Transcribed as printed.] And because the longitude of Procyon was 20°59'45", if you add the difference of longitude PAS — since Saturn will be more eastern — Saturn's longitude was Leo 9°6'55", and its northern latitude [*Latitudo Borealis*] 58'20".

[Margin / parenthetical:] What [say] here the Danish and Lansbergian tables? Namely:

Ex Tabulis [From the Tables]	h Longitudo — Sig.	G r				h Latit. Bor. — Gr.			
		.	'	"		.	'	"	
Danicis [Danish]	♌	9	2	1	0		5	2	
			5	0			3	0	
Lansbergij	—	9	2	3	0		3	1	
[Lansbergian]				0			7	5	
Ex Observatis [From the Observed]	—	9	6	5	0		5	2	
				5			8	0	

Diagram. A spherical-triangle figure (curved arcs within an implied sphere) for the Method-15 worked example. The southern pole B is at upper right; arcs descend to E and C along the ecliptic at lower left/right, with S (Saturn), G, O (shoulder of Orion), and P (Procyon) marked in the interior, and A at the lower vertex.

- B (upper right): the southern pole [Polus Australis]
- S (interior, upper): Saturn
- G (right of S): auxiliary point on an arc
- O (left interior): the shoulder of Orion [Betelgeuse]
- P (lower interior): Procyon
- A (bottom vertex): the pole vertex (foot of the latitude complements)
- E (left, on ecliptic line): point on the ecliptic EC
- C (right, on ecliptic line): point on the ecliptic EC

16. — The Sixteenth Method

[Marginal number: 16]

The Sixteenth Method is accomplished by [taking] the distance of the planet from fixed stars of known longitude and latitude, especially if the distance of the fixed stars from one another is now foreknown — one of them being more eastern than the planet, the other more western; otherwise, from the complement of the latitudes, the difference of longitude would have to be investigated in advance.

Let the example be taken from Chapter 8, observation 58. **Anni 1657. Martij 22. nocte sequenti** [In the year 1657, March 22, on the following night], when we — P. Grimaldi and I — saw Saturn distant from Regulus [*Regulo*] by $37^{\circ}4'45''$, then from Arcturus the distance of the fixed stars often observed by us was $59^{\circ}49'$, and the northern latitude of Regulus was $0^{\circ}26'20''$, and Arcturus' was $31^{\circ}0'40''$. Let, then, this diagram be congruous with this observation, in which let EC be the portion of the ecliptic, and B the northern pole [*Polus Borealis*]; and from it let the two quadrants of latitude be drawn — one BS through Saturn S, the other BC through Arcturus A. Let Saturn be at S, through which the arc of distance BO is drawn; the distance, moreover, between Arcturus AR and Saturn RS, between Regulus and Saturn.

First, then, in the triangle RSA, with the three sides given — AR $59^{\circ}49'$ and AS $32^{\circ}43'$ and RS $37^{\circ}4'45''$ — the angle is given by the triangle canons [continues at top of right column:] RAS, $36^{\circ}39'20''$.

Second, in the triangle RBA, the three sides are likewise given — AR $59^{\circ}49'$ and BR, the complement of the latitude of Regulus, which is $89^{\circ}33'40''$, and AB, the complement of the latitude of Arcturus, which is $58^{\circ}59'20''$. Therefore, by trigonometry, the angle BAR is given, $109^{\circ}50'$; which, with the angle RAS, makes the angle BAS, $146^{\circ}29'20''$. Third, then, with this angle in the same triangle BAS, and with the complement of AB $58^{\circ}59'20''$, and AS $32^{\circ}43'$, the base BS is found, $87^{\circ}19'$; and so the northern latitude of Saturn [*Borealis Latitudo Saturni*] is $2^{\circ}41'$; and the angle ABS, $17^{\circ}22'45''$, which, subtracted from the longitude of Arcturus — which was then $19^{\circ}27'30''$ — leaves Saturn's longitude in Libra at $2^{\circ}4'45''$. (As for the others, see below.)

Diagram. A spherical-triangle figure for the Method-16 worked example. The northern pole B is at the apex (top); the curved sides descend to E and C along the ecliptic at the bottom, with A (Arcturus), R (Regulus), S (Saturn), and O marked in the interior.

- B (apex, top): the northern pole [Polus Borealis]
- A (right interior): Arcturus
- R (left interior): Regulus
- S (center): Saturn
- O (lower interior, below S): point on the latitude quadrant through Saturn
- E (lower left, on ecliptic): point on the ecliptic EC
- C (lower right, on ecliptic): point on the ecliptic EC

Ex Tabulis [From the Tables]	Longitudo — Sig.	G r			Latit. Bor. — Gr.		
		.	'	"		'	"
Danicis [Danish]	♄	2	4	1	2	4	3
			0	0		0	5
Lansbergij	—	2	1	2	2	3	0
[Lansbergian]			8	0		4	
Ex Observatis [From the Observed]	—	2	4	4	2	4	0
				5		1	

17. — The Seventeenth Method

[Marginal number: 17]

The Seventeenth Method is this: if the planet's meridian altitude is measured, and it is observed whether it is in a straight line with some known fixed stars — see Chapter 6, observation 15.

18. — The Eighteenth Method

[Marginal number: 18]

The Eighteenth Method is this: if the planet is in a straight line with two fixed stars, so that the planet's longitude can be estimated through them — as we did in Chapter 3, observation 1; or if from here it is in a straight line with two fixed stars, and then in another straight line with two other known fixed stars — see what we said in Book 10 of the *Almagestum Novum* [the *New Almagest*], pages 563 and 564, Problems 131 and 132.

19. — The Nineteenth Method

[Marginal number: 19]

The Nineteenth Method suits only those planets which are visible for a long time together with the Sun — such as Venus, and rarely Jupiter, since the Sun is too deeply depressed [below the horizon], and refractions make it doubtful. For if at the same moment the [altitude] of both is taken — namely, of the Sun and of Venus — and the azimuth of the latter, or its distance from the Sun, then from the Sun's declination and right ascension can be found also Venus' declination and right ascension, and from these the longitude and latitude.

20. — The Twentieth Method

[Marginal number: 20]

The Twentieth Method does not always serve for acquiring the planet's longitude and latitude, but only for forming a judgment as to whether the planet is stationary, direct, or retrograde — and whether some one of the three superior [planets] is in opposition to the Sun. For if, at the very moment of midnight, it passes across the meridian, that is a sign that the planet is then opposite the Sun, since the place of the planet opposite the place of the Sun can be recognized. Likewise, if on some days around the stations the planet's distance from the nearest fixed stars is observed, it can easily be judged whether it remains in the same longitude, or whether, made retrograde, it has become direct again. Even if its place is not known with respect to the ecliptic, [it can be judged]. Thus we, from our observation 63, judged in the year 1650, from the 16th of February to the 2nd of March, by continued observations with the aid of the telescope, that Saturn's stations had fallen between the 21st and 22nd of February, and that from then on it was direct.

CAPVT X.

On the limits of the certainty within which the positions of Saturn could be represented up to now — or could be represented in future — as much by observations as by astronomical tables, and on their disagreement.

Granted that observations of celestial phenomena are the foundation of astronomical tables, it is nonetheless certain that one must not seek out just any and every kind of observation, but rather many and very accurate ones. As regards Saturn in particular, Tycho [Tycho Brahe] aptly notes in the preface to his *Astronomical Observations* that observations of thirty, or at the very least twenty-four, years are required — and not only that, but observations in every position [of Saturn] in its acronychal risings [observationes Acronychiae], and beyond

these, observations also of the intermediate positions, so that the conclusions about the planet's arrangements and motions may be established by examination, properly worked out through the tables. He says that Ptolemy [Ptolemy], Copernicus [Copernicus], and the rest could not have done this. He thinks, indeed, that the ancient astronomers were so often led astray from the heavens — because, in his judgment, they were content with the three acronychal observations of each of the superior planets, and afterwards (as he puts it) joined to these others taken at random and not without latent error — that he believed this error was at once obvious. And he holds that this can be said without doing the ancients an injustice; indeed, it stands as their own confession.

2. For concerning Hipparchus [Hipparchus] in particular there exist these words quoted in Ptolemy, *Almagest* IX, ch. 2 [recte: *Magnae Constructionis* lib. 9, cap. 2]: that Hipparchus — a most truth-loving man, by reason of the difficulties at least, and because he did not have at hand the exquisite observations of the ancients — undertook this negotiation of the planets to the extent that he himself shows in his commentaries: that is, he gathered them into a better order and showed that they did not agree with the hypotheses of those times. But, with few [observations] interposed, he adds in the same place: nevertheless he demonstrated none of these things fully; others, too, did not arrive at the end. So it has come about that they do not agree with themselves, men who have cultivated these mathematical disciplines so exquisitely, and who would have advanced [the matter], had any one of them done what the rest did, in undertaking something whose outcome they did not foresee. [Margin: Hipparchi lans. (Praise of Hipparchus.)]
3. Ptolemy from this book confesses (ch. 2 — much is said in it) the aforesaid difficulties to be present, and among many such things he professes these in particular: *one must do whatever one can in this matter. For the business is one of many and most difficult causes; and these have not yet been rightly considered by my predecessors, nor [can they be] in their consideration: it can happen, by observing through an instrument, that some error arises, until in a later, more sensitive observation an earlier one is corrected, when a later observation is made. Now time, from which we have such things recorded, is so very long that the comparison may make it [the result] sure.* But by the very same dishonesty he confesses an abuse beyond reason for some — those who, with circles fashioned and feigned in the plane of the ecliptic, as though by nothing at all, through mere congruence, commodity, and the absence of clear evidence and right-angled triangles, on account of

obliquity, as though if error should arise therefrom it ought to be negligently disregarded. Finally he thinks that one must attend to the oppositions of the planets, taken from the place of the Sun itself, and prefer the true place of Tycho. [Margin: Ptolemæi excusatio circa Planetas minores. (Ptolemy's excuse concerning the minor planets.)]

4. As for al-Battānī [Albategnius], we need say no more about the business of Ptolemy and of al-Battānī, who almost necessarily followed Ptolemy, [a matter] which others have treated — why heaven itself would not openly fall away from the truth. That great conjunction of Saturn and Mars, which Stoefflerinus [Johannes Stöffler] had predicted from the Alphonsine tables would occur in the year [continues below]

mini 1536, on the 25th of May; yet it took place on the 20th, with Pietro Pitato [Pietro Pitati] observing — or on the 19th, with Giuliano Ristori [Iulianus Ristorius] of Prato, teacher [praeceptor] around hour 2, observing — by which Saturn was found to be 2 nodes [removed] from Mars at that time. And in the same year, 1542, on the 29th of January of the following night, that conjunction of Saturn with Mars took place for many days before the Alphonsine reckoning [abacum Alphonsinum]. But in the year 1563, the conjunction of Saturn and Jupiter [continues] on the 24th of August, hour 14, 30' after midday, with Boreali Jupiter covering Saturn somewhat more Australian in the end of degree 28 of Cancer [Cancrī] — whereas the Alphonsine calculation [Alphonsinus calculus] places that syzygy as distant by 1 whole month: thus on the 25th of September, and Leo's [Leonis] degree 4. 12'. The cause of this was, [according] to Regiomontanus [Regiomontanus] and to the Prutenic [Prutenicus] canons afterwards. Yet Tycho touches on both calculation-errors in the *Mechanica*, folio 39, on the other side. By this most manifestly intolerable he detected the error: which I said at the outset, and that great conjunction of the year 1563, of which I spoke from the beginning, in the motion of Saturn — and a place sufficiently outstanding: if indeed Alphonsus's numbers failed by a whole month, Copernicus by some little [time], who erred only by a few [units]. But Maestlin [Maestlin] testifies that he himself observed at Leipzig [Lipsiae] in the year 16 [recte: 1563] of his age, complete, that conjunction around the end of Cancer and the beginning of Leo; and on folio 43 of the same tables he adds, speaking [of them]: *whence it comes about that the planets are sometimes Australian in the heavens, when their number exhibits them Boreal — and the contrary*. In the *Epistolae*, moreover, page 56. & in *Progymnasmatum* tome 1, page 648, he erred somewhat in degree 2. In the Alphonsine [tables], as regards Saturn's place, he detected a discrepancy; not otherwise, as Longomontanus [Longomontanus], at chapter 13,

affirms in the year 1591, on the 17th of March, at 7 hours 3' after midday at Uraniborg [Vraniburgi], observed Saturn distant from Aldebaran [Aldebara] by 19. 11'. ½. & from Pollux [Pollux] by degrees 25. 54'. ½: with septentrional declination of degrees 22. 23', from which he gathers the inscribed place of Saturn below, compared with the Alphonsine and the Prutenic.

Saturn (An. 1591. Mart. 17)	Longitude, &		Latitud e		
	Sig. Gr.	'	"	Gr.	'
Observed p. m., hour 7 ½	II 22	43		0	56 ½
Alphonsina	25	7		0	56
Prutenica	22	23		1	35
Danica	22	45 7 ½	[?]		

[Margin: Alphonsinorum errores in Planetis superioribus. (Errors of the Alphonsine [tables] in the superior planets.)]

Finally, Maginus [Magini] in his *Epistola ad Richardum Fasterum*, which he has in the *Directiones*, page 95, says that the Alphonsine reckoning errs more widely in the minor planets than the Prutenic.

- Now Copernicus, having strictly examined the hypotheses which we just now indicated on the occasion of the Alphonsine [tables] — no wonder if both with the Ptolemaic and his own ternary of acronychal observations, and that too in opposition with the mean place of the Sun, he was confident — and (as Joachim Rheticus [Rheticus] testifies) thought he had done quite enough for himself, if it had not come to 10 minutes, that is, the sixth part [sextans] of a degree, that his observations could lead him astray, and that he departed no further from the truth — as Rheticus admits in the preface to the *Ephemerides*. Kepler [Kepler], moreover, at chapter 18 of the *Mysterium Cosmographicum*, says that Copernicus, neglecting the quadrants of degrees, that is, fifteen minutes in the motions of these planets, reckons it [thus]. *In reprehensionem incurrere iure videretur, nisi consulto fecisset, eo quod praestaret imperfectam habere Astronomiam, quam nullam.* (He would rightly seem to incur reproach, had he not done it deliberately, on the ground that it is better to have an imperfect Astronomy than none.) *For difficulties of this kind occur, while the stars run their course; which to anticipate, and to aspire to a constitution of knowledge with the least loss, that is the part of a brave man; to despair through cowardice,*

and timidly to shun all this care, is the part of a coward. Just as in this matter, recently reviewed, [Saturn] disassembles itself, and that not without shame, he admits. By the example of Ptolemy, of the ancients, he frees himself; the difficulty of observing such a [planet]. Soon, at chapter 18 of the same *Mysterium*, having been born in the year 1594, on the 12th of November, in his new style, he says that Saturn stood between the neck [cervicem] and the Heart of Leo [Cor Leonis], where it ought to be according to the Prutenic calculation on the 31st of October: a discrepancy of nearly 27' in minutes. Indeed, sometimes the slightest error of the Prutenic [tables] mounts to 40' [continues] [Margin: Coperniti errores in Planetis, & excusatio. (Errors of Copernicus in the planets, and his excuse.)]

advert it. Tycho, page 39 of his *Mechanica*, where he speaks of Copernicus concerning Saturn and Jupiter, says: *His restitution in these two planets is not so far removed from the celestial norm as to digress, especially as regards Saturn, which he never errs by more than half a degree, well — to the very highest [degree] —, Copernicus could not elude the calculation in heaven, he observes.*

6. Longomontanus, therefore, following Tycho, and relying on his own observations, so used [them], that he need not despise the Prutenic numbers, but emends them in some places: for he professes, in *Theoricorum* chapter 2, that he has constructed Danican tables of Saturn out of the Prutenic, by subtracting 20' from the mean longitude of Saturn; from its apogee, moreover, by subtracting 3'; by subtracting [from?] some part five-sixths — notwithstanding the Author of the *Astronomicus* book, who is inscribed [as author of] *Urania Propitia*, edited in the year 1650 at Bicini in Silesia, page 85. He asserts frequently, faithfully, and with diligent observations of Saturn, but [that he] selected 29 [observations] in various eccentricities, & compared the points of commutation detected, that the Danican and the Lansbergian tables sin much more than the Rudolphine; that he, however, in the first commutation, departs from the place of Saturn by a semicircle, by minutes $4\frac{1}{3}$. [Margin: Iudicium de Danicis, ac Rudolphinis circa Saturnum. (Judgment concerning the Danican and the Rudolphine [tables] regarding Saturn.)]
7. Kepler nonetheless thought that so great an error of minutes was not contained in his own tables; for in the *Explanatio fundamenti Ephemeridum*, page 14, he says thus: *Quantum vero ad superiores Planetas, ausim spondere, non facile differentia Ephemeridis a Caelo occurruram, quae oculis notari possit; si vel instrumentis exquisitissimis attenderint Astronomi*

exercitati, vel insidiati fuerint congressibus illorum inter se, & cum Fixis clarioribus, quarum loca etiam certe fidis observationibus, & accurato calculo fuerint constituta. (As regards the superior planets, I would venture to promise that no difference between the Ephemeris and the heavens will easily occur that could be noted by the eye; provided that practised astronomers attend with the most exquisite instruments, or lie in wait for the conjunctions of those [planets] with one another, and with the brighter fixed stars, whose positions have been established by surely trustworthy observations and accurate calculation.) But in the *Mysterium Cosmographicum* he said, at chapter 19: Saturn furnishes the easiest cause of an enormous distance [discrepancy] in observation, an error nonetheless even great in distance, a smaller [error] in opinion is begotten in the prosthaphaeresis [in prosthaphaeresi].

8. Let us now hear the most distinguished astronomer Vincenzo Mutus [Vincentius Mutus], who in the year 1654, among others then made from the Majorca [Maioricae] observations, in an epistle of the 26th of March, which he sent to me, recounts these acronychal [risings] of Saturn, which he reached on the 11th of February, and on the 15th of March at hour 9 after midday, with the calculation adjoined from the more celebrated tables.

Anno 1654, hour 9 p. merid.		Gr			
Saturn's Longitude per D. Mutum		Sign.	.	'	'
11 Feb. Observed with latitude		$\varnothing$	22	51	
		Bor.	1	28	
Computed from the Tables:	Lansbergen.		22	59	exc. 8
	Danicis		23	18	exc. 27
	Rudolph.		23	15	exc. 24
	Almagest.		23	11	exc. 20
15, hour 9 Observed		$\varnothing$	20	31	
March:	Lansbergen.		20	46	exc. 15
	Danicis		20	57	exc. 26
Computed from:	Rudolph.		20	50	exc. 19
	Almagest.		20	45	exc. 14

D. Mutus appends in the same epistle: *Not yet for certain, but I almost dare to affirm, that the distances of the planets from the Earth have nothing in common*

with the diameters of their orbs, hitherto held established; nor that the elongation from the [Sun's] World can be deduced from the prosthaphaeresis of the orbs. A notable example I observe these months in Venus, Mars, Saturn, and Jupiter — at the days elapsed. All which things, together with the observations, after the work is completed, I shall gladly communicate.

9. Bullialdus [Ismaël Boulliau], that highest and outstanding effort in emending the Rudolphine [tables] in the *Astronomia Philolaica*, book 6, where indeed at chapter 5, he reconciles those tables with the most ancient observation of Saturn made in the year 519 of Nabonassar [Nabonassari], and with another of the year of Christ 503, he recognizes that the aphelion [Aphelium] is to be drawn back into the preceding [signs] by degrees there 48. 50'. 56"; here [it is] at degree 46. 10'. 46". — or [its] motion is to be advanced.

[Margin: Bullialdi sup. (Boulliau's emendation.)]

medium [of the] Rudolphine [tables] 36'. The aphelion, moreover, from ♄ degree 26. drawn back to ♀ degree 28. From the observations he gathers; yet he collects some discrepancy of minutes 9'. has chapter 6. In examining his observations of the year 1640, he sets forth a motion of Saturn's Node [Nodi Saturni] taken from the Rudolphine tables, [for] the Moon [Lunam] could not [have been] in the year of Christ 503. Feb. 21. hour 4. To the Athenians [Athenis] Saturn occult at the same time, which truth he confirms by history. But his Saturni tables, the Philolaican [Philolaicas], from the places of Saturn through Tycho, and Longomontanus, observed not to recede beyond 3'. vel 4. minutes, [whereas] Vualtheri [Bernhard Walther], by his own observation, makes [it] greater than he expends [from] chapter 5. & ex qua colligit place ♄ in ♊ degree 41. — therefore the Philolaican [place] of degree 6. & 19. He has a suspected [reading], so that the place is nude, almost twofold made. & on account of the latitude of the Nebula of Cancer [Nebulae Cancrī], on the 21st of February, deduces the place of ♄ in ♊ degree 6. 20'. The Philolaican, moreover, at degree 6. 12'. 51". — Concerning the rest, in the observations of Copernicus, Tycho, Longomontanus, and his own, which he compares from the tables, he adds nothing unless [a difference of] a semicircle exceeding in the place of Saturn by minutes 4 ½.

10. So far it is given to gather from the opinion of others, nor do we have observations sufficiently many, immune from every sensible error, or [free] from all human industry — diffusible [error], nor anything of antiquity dissolves [it], for these tables, although exact, did not [yet] decades of minutes, or sextants of a degree, scarcely attain; nor are the

tables so exact but that some scruples of dubious minutes may be suffered, as in Saturn rarely indeed by 34', not rarely by 14'. or 16, the Rudolphine [tables], the Lansbergian, moreover, as the Philolaican [by] 15'. or by 12. and these often by less. From which it follows that we do not know how to discern, sometimes in the disagreement between the observations and the tables, the vice of these [tables], whether of the one or the other — yet this discrepancy, in a great part, whether the observations or the tables, among the most accurate ascertained, are wont to satisfy, within 5'. circiter; minute, [yet] I do not doubt but that a great part of the discord proceeds either from the observations, especially if they have been held from the ancients, or [from] the mode chosen in observing — more operations, & whose suppositions not so scrupulously involved.

11. Among the Modes, then, reviewed in chapter 9, the first degree of certainty merits those which require only the Declination of a single fixed [star], or the Right Ascension and the Altitude of the planet; for in these can be exercised the astronomer with instruments suited [for] no error exceeding 3'. & a minute, of which kind are Modes 1. 6. 8. To these are akin 2. 5. 7. 9. 10. 11. 12. 13. 15. 16., in which the five circular elements concur to determine the place of the planet, so that an error may be feared of 5'. or 6'. circiter, of minutes. Modes 4. 14. & 17., then, I judge to be liable to an error of 8'. or 10'. of minutes; while 3. & 18. [are liable] even to an error of 20'. of minutes. Therefore, in whatever way astronomy advances, I reckon that we cannot hope for observations, or tables, which in three respects are superior to the [other] planets, certainly and evidently excluding doubt, [free] from a threefold scruple of error, & by which a good part rests within 5'. or 6'. for some places of the planetary orbit do not exceed 10'. Let this be commodious, so that the least [error] of either part labors under the vice. It remains, as in the following chapter, as in a mirror, I may set forth selected observations of the places of Saturn, with parallel, subjoined likewise, [from] the more celebrated tables. From this it will be established that no tables [are such] by which they can be supported, [no] observations by which they can be opposed, so that scarcely can it be discerned, in the discrepancy, whether the whole is to be ascribed to the observations or to the tables, in whole or in some part.

CAPVT XI.

Selected positions of Saturn from the preceding observations, and collated with the positions computed through the more celebrated tables.

The following characters [Characteristicae] indicate the tables, namely: **Da.** the Danican; **La.** the Lansbergian; **No.** Our own [Nostras]; **Ph.** the Philolaican; & **Ru.** the Rudolphine; **Pru.** the Prutenic — before which are noted the observers of the places of Saturn. On the left side, moreover, are indicated repeatedly the aspects of Saturn with the Sun, exactly indeed, where nothing is added; nearer, however, where the letter **C.** indicates *Circiter* (approximately).

Left table — Saturn's positions, ancient through 1514:

Ann. Mens. D. / H. p. m.	Observ. & Tab.	h Loca — Sig. G. ' "	Differ. ' "
229 ante Chr. / Mart. 1. H. 8. / $\odot$ C.	Prisci	$\mathfrak{M}$ 9 30 0	
	Logom.	9 3 0	
	Bullial.	8 43 0	
	Mihi	8 51 0	
	Lat.	a 2 55 0	
Tabb. Anni Christi	Ru.	$\mathfrak{M}$ 9 2 40	11 40
	Ph.	8 41 0	10
	No.	8 42 50	12 50
127 Mart. 27 / Ho. 6 / $\odot$ media	Ptolem.	$\underline{\alpha}$ 1 13 0	
	La.	1 5 0	8
	Ru.	1 32 30	19 30
	Ph.	1 32 19	19
	No.	1 25 24	12 24
133 Iunij 3 / H. 4	Ptolem.	$\mathfrak{M}$ 9 40 0	
	La.	9 34 0	6 0
	Ru.	9 52 30	12 30
	Ph.	9 39 0	1 0

Ann. Mens. D. / H. p. m.	Observ. & Tab.	h Loca — Sig. G. ' "	Differ. ' "
	No.	9 39 29	0 31
136 Iulij 9 / H. 7	Ptolem.	♄ 14 14 0	
	La.	14 3 0	11 0
	Ru.	14 32 0	18 0
	Ph.	14 34 0	20 0
	No.	14 20 0	6 0
138 Dec. 22 / H. 8	Ptolem.	♄ 9 15 0	
	La.	9 17 0	2 0
	Ru.	10 1 6	46 6
	Ph.	10 5 0	50 0
	No.	10 30 0	15 0
503 Febr. 21 / H. 4	Athen.	♄ 6 20 0	
	La.	6 45 0	25 0
	Ru.	6 32 0	12 0
	Ph.	6 12 0	8 0
	No.	6 14 0	6 0
1503 Dec. 11 / H. 7 / ♂ C.	Valther.	♄ 15 30 0	
	La.	14 6	84 0
	Ru.	14 41 20	48 40
	Ph.	15 0 30	29 30
	No.	15 5 0	25 0
1514 Febr. 23 / H. 17	Copern.	♄ 25 13 0	
	La.	25 4 0	9 0
	Ru.	25 4 15	8 45
	Ph.	25 1 4	11 56
	No.	25 3 0	10 0

Right table — Saturn's positions, 1527 through 1587:

Ann. Mens. D. / H. p. m.	Observ. & Tab.	h Loca — Sig. G. ' "	Differ. ' "
1527 Oct. 10 / H. 18 24' / $\circ$ media	Copern.	Υ 26 40 0	
	La.	27 22 0	42 0
	Ru.	26 48 40	8 40
	Ph.	27 4 40	24 40
	No.	26 59 0	19 0
1563 Aug. 24 / H. 14 30' / $\circ$ h & $\sphericalangle$	Iunctin.	$\S$ 28	
	La.	28 29 0	
	Ru.	28 1 15	
1582 Aug. 21 / H. 2 / $\circ$	Tychon.	$\times$ 7 26 0	
	(Lat.)	Lat. 2 2 a	
	Pr.	$\times$ 7 26 0	0 0
	Da.	7 22 0	4 0
	Ru.	7 28 0	2 0
	Phi.	7 23 0	3 0
	No.	7 25 0	1 0
1583 Sept. 7 / H. 12	Tychon.	$\times$ 20 19 0	
	(Lat.)	Lat. 2 2 a	
	Pru.	20 34 0	15 0
	La.	19 13 0	66 0
	Rud.	19 33 0	46 0
	Phi.	20 12 0	7
	No.	20 14 0	5
1583 Sept. 13 / H. 1	Tycho.	$\times$ 19 50 0	
	Pru.	20 4 0	14
	La.	$\times$ 19 1 0	49
	Da.	19 48 0	2
	Rud.	19 10 0	40
	Phi.	19 48 0	2

Ann. Mens. D. / H. p. m.	Observ. & Tab.	h Loca — Sig. G. ' "	Differ. ' "
	No.	19 49 0	1
1584 Sept. 25 / H. 6 30'	Tychon.	Υ 2 34 0	
	(Lat.)	Lat. 2 24 a	
	Pru.	Υ 2 44 0	10
	La.	1 26 0	68
	Da.	2 36 0	2
	Rud.	1 54 0	40
	Phi.	2 33 0	1
	No.	2 34 0	0
1585 Octob. 8 / H. 19 30'	Tychon	Υ 15 39 30	
	(Lat.)	Lat. 2 48 a	
	Pru.	Υ 15 43 0	4
	La.	14 17 0	82
	Da.	15 39 0	0 30
	Ru.	14 52 0	47
	Phi.	15 38 20	1
	No.	15 36 27	2 0
1586 Oct. 22 / H. 11	Tychon.	Υ 29 2 0	
	(Lat.)	Lat. 2 46 a	
	Pru.	Υ 29 3 0	1
	Da.	29 14 0	12
	Ru.	28 18 0	44 0
	Phi.	29 4 0	2
	No.	29 4 0	2 0
1587 Ianu. 19 / H. 9 45'	Tycho.	Υ 26 8 0	
	(Lat.)	Lat. 2 28 a	
	Pru.	Υ 25 58 0	10
	Ru.	26 45 0	37
	Ph.	26 15 22	7 22

Ann. Mens. D. / H. p. m.	Observ. & Tab.	h Loca — Sig. G. ' "	Differ. ' "
	No.	26 13 0	5 0
1587 Ianu. 25 / H. 5 45' / $\circ^{\circ}$	Tychon.	Υ 26 24 0	
	Pru.	26 15 0	9
	Ru.	27 0 0	36
	Phi.	26 30 0	6
	No.	26 28 0	4

Caput XI (continued)

Selected Positions of Saturn, Compared with the Tables (continued)

The comparison of observed Saturn positions against the six principal sets of tables continues. Each block gives the date and equated hour of an observation (with its aspect symbol), then the observed or tabular source, the longitude of Saturn (zodiac sign, degrees, minutes, seconds), and the difference in minutes and seconds against the leading entry of the block. The table-sigla are: *Tycho.* / *Tychon.* (Tycho's or Tychonic observation), *Byrgius* (Bürgi), *Lansb.* (Lansbergian observation), *Hortes.* (Hortensius), *Nos.* (Ours), *Mutus* (Mut), *Bullial.* (Boulliau); and the tabular columns *Pru.* (Prutenic), *Da.* (Danican), *Ru.* (Rudolphine), *Ph.* / *Phi.* (Philolaic), *No.* (Ours), *La.* (Lansbergian). "Lat." rows give the latitude (B. = boreal/northern, a = austral/southern). "C." marks the configuration with respect to the Sun (opposition $\circ^{\circ}$, quadrature $\square$, trine $\triangle$, conjunction with Mars σ , etc.).

Saturn's Positions [Saturni Loca] — Table (continued; observations of 1588–1660).

The columns are: **Ann. Mens. D. / H. p. m.** (Year, Month, Day / equated hour); **Obs. & Tab.** (Observation source and Table); **h Loca: Sig. G. ' "** (Saturn's position: sign, degrees, minutes, seconds); **Differ. ' "** (Difference: minutes, seconds).

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Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1588 Nov. 5, H. 9	$\circ^{\circ}$	Tycho.	Υ	1	4	0		

Year, Month, Day / Hour	Asp ect	Source / Table	Si gn	°	'	"	Diff. '	Diff. "			
1588 Nov. 18, H. 10 10'	♍	Pru.	♄	2	6						
				1	4	0	4				
		Da.		2	2						
				1	4	0	0	0			
		Ru.		2	6						
				1	4	0	2	0			
		Ph.		2	4						
				1	5	4	6	49			
		No.		2	2	9					
				1	4	4	0	17			
		1588 Nov. 18, H. 10 10'		♍	Tycho.	♄	2	5	3		
							2	4	0		
Pru.	6		4								
	2		3		0		5				
Da.	6		9								
	2		4		0		1				
Ru.	6		5								
	2		5		0		13				
Phi.	6		7								
	2		4		4		1	48			
1588 Nov. 18, H. 10 10'	♍		Tycho.		♄		6	5	8		
							2	4	4	1	46
		Pru.	6	5		6					
			1	5		0					
		Da.	0	3							
			1	4		0	8				
		Ru.	0	5							
			1	5		0	1				
		Ph.	0	4							
			1	5		0	3				
		1589 Dec. 2, H. 14 30'	♍	Tycho.		♄	0	0			
							1	3	3	13	30
Pru.	0			9	0						
Da.											
Ru.											
Ph.											

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
		No.		1	4	0	11	0
				0	2			
1589 Dec. 16, H. 20 30'	♂	Tycho.	II	2	1	0		
				5	0			
		(Lat.)		1	1	a		
				3				
		Pru.	II	2	2	0	8	
				5				
		Da.		2	8	0	2	
				5				
		Ru.		2	1	0	9	
				5	9			
		Ph.		2	1	4	0	40
				5	0	0		
		No.		2	1	5	0	50
				5	0	0		
1591 Mar. 27, H. 7 30'	♂	Tycho.	II	2	4	0		
				2	3			
		(Lat.)		0	5	a		
				6				
		Pru.	II	2	2	0	23	0
				2	0			
		Ru.		2	1	0	33	0
				3	6			
		Ph.		2	4	1	3	15
				2	6	5		
		No.		2	4	0	1	0
				2	2			
1591 Dec. 31, H. 1	♂	Tychon.	♄	9	2	3		
				4	0			
		Pru.		9	1	0	6	30
				8				
		Da.		9	2	0	1	30

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "				
1593 Jan. 8, H. 11 30'	♋	Ru.	♄	3			10	30				
				9	3	0						
		Ph.		5			2	50				
				9	2	5						
		No.		6 0			2	30				
				9	2	3						
		Tychon.		6 0			0					
				2	5	3						
		(Lat.)		3 8			a					
				0	8							
		Pru.		♄			2	5	0	1	0	
							3	7				
1593 Jan. 14, H. 9		Ru.	♄	2 1			0	48	0			
				3	0							
		Ph.		2 2			4	4	4			
				4								
		No.		2 0			0	2	0			
				4								
		Lansb.		♄			2	1	0			
							3	2				
		Pru.					2	2	0	14	0	
							3	6				
		La.					2	1	0	0	0	
							3	2				
Ru.				2	3	0	33	0				
				2	9							
Ph.				2	3	3	19	34				
				3	1	4						
No.				2	3	0	18	0				
				3	0							
1594 Jan. 24, H. 11		Tychon.	♄	7 4			0					
				5								
		Pru.		7	5	0	5	0				

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1595 Feb. 9, H. 21	♌	Ru.	♍	0			4	0
				7	4	0		
		Ph.		9			6	50
				7	5	5		
		No.		1 0			5	0
				7	5	0		
		Tycho.		0			3	
				2	1			
		Pru.		1 5 0			10	30
				2	2	0		
		Da.		1 6			2	30
				2	1	0		
		Ru.		1 8			12	30
				2	2	0		
Ph.	1 8			4	40			
	2	2	1					
1595 Dec. 4, H. 17		Byrgius	♎	1 0 0			6	40
				2	2	4		
		Pru.		1 1 0			3	
				7	5			
		Ru.		7 0			19	30
				8	1	0		
		Ph.		7			5	30
				8	3	0		
		No.		0 5			27	15
				7	3	1		
1596 Feb. 8, H. 9		Tycho.	♎	0 5			14	0
				7	3	0		
		(Lat.)		3			1	
				5	5			
		Pru.		2 7			18	0
				1	5	B		
				6 .				
				6 1 0			23	43

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1596 May 15, H. 9				6				
		Ru.		6	1	0	18	43
				1				
		Ph.		5	5	2	7	3
				9	0			
		No.		5	5	0	4	43
				7				
		Byrgius	♄	1	2	0		
				9				
		Pru.		1	1	0	14	0
1597 Mar. 12, H. 12				5				
		Ru.		1	4	0	11	0
				0				
		Ph.		1	2	3	1	30
				7	0			
		No.		1	2	0	1	0
				8				
		Tycho.	♄	1	2	0		
				7	5			
		(Lat.)		1	5	B		
1599 Mar. 26, H. 12				6	.			
		Pru.	♄	1	5	0	26	0
				7	1			
		Ru.		1	3	0	14	0
				7	9			
		Ph.		1	3	0	9	0
				7	4			
		No.		1	3	0	6	0
				7	1			
		Tycho.	♅	1	3	0		
1599 Mar. 26, H. 12				3	7			
		(Lat.)		2	5	B	0	
				0	.			

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1600 Apr. 17, H. 12		Pru.	♌	1	1	0	36	0
				4	3			
		Ru.		1	4	0	8	0
				3	5			
		Ph.		1	3	3	2	30
				3	9	0		
		No.		1	3	0	1	0
				3	8			
		Tycho.	♌	2	4	2		
				5	7	3		
		Pru.		2	3	0	9	23
				5	8			
1608 July 19, H. 3	♍	Ru.		2	1	0	34	0
				5	3			
		Ph.		2	5	0	11	0
				5	8			
		No.		2	5	0	9	0
				5	6			
		Longom.	♍	2	5	0		
				6	3			
		Pru.		2	2	0	35	0
				7	8			
		Da.		2	5	0	4	
				6	7			
1609 July 31, H. 13	♍	Ru.		2	4	0	9	
				6	4			
		Ph.		2	5	4	2	40
				6	5	0		
		No.		2	5	9	2	9
				6	5			
		Longom.	♍	8	3	0		
				1				
		Pru.		8	5	0	22	0

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1610 Aug. 12, H. 22 30'					3			
		Da.		8	3	0	0	0
					1			
		Ru.		8	3	0	2	0
					3			
		Ph.		8	2	0	2	0
					9			
		No.		8	3	0	1	0
					0			
		Longom.	≈	2	1	0		
1611 Aug. 25, H. 16	∞				0	0		
		Pru.		2	3	0	26	
					0	6		
		Da.		2	1	0	4	
					0	4		
		Ph.		2	1	0	3	
					0	3		
		No.		2	1	0	2	
					0	2		
		Longom.	✕	2	1	0		
1628 July 3, H. 12					2			
		Pru.		2	3		18	0
					0			
		Da.		2	1		1	0
					3			
		Ru.		2	1		7	0
					9			
		Ph.		2	1	1	1	15
					3	5		
		No.		2	1	4	0	45
1628 July 3, H. 12					2	5		
		Hortes.	⊖	4	5	3		
					7			

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
		Pru.		4	5	0	1	47
					9			
		La.		5	4	0	6	47
		Ph.		5	6	0	8	47
		No.		5	4	0	6	

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Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1640 Oct. 12, H. 8 10'		Bullial.	♊	2	5	4		
					3	5	0	
		(Lat.)		1	3	a		
					5			
		Pru.	♊	2	1	0	5	20
					4			
		Ru.		2	5	0	9	20
					4			
		Ph.		2	0	0	4	20
					4			
		(Lat.)		1	3	0	2	
					7			
		No.		2	5	0	3	20
					3	9		
1642 Sept. 13, H. 12	♌ C.	Nos.	♋	2	3	2		
					1	6	0	
		Pru.		2	4	0		
					1	7		
		La.		2	2	0	11	
					1	3		
		Da.		2	4	0	13	
					1	8		
		Ru.		2	5	0	12	

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1643 June 27, H. 17	□ C.	Ph.	Υ	1	3			
				2	4	0	17	
				4	4			
		No.		2	3	1	80	
				1	6	5		
		Nos.		7	3	0		
				0				
		Pru.		7	4	0	14	
				4				
		La.		7	0	0	30	
		Da.		7	2	0	6	
				4				
		Ru.		7	3	0	5	
				5				
1643 July 29, H. 17	△ C.	Ph.	Υ	7	2	0	1	
				9				
		No.		7	2	0	1	
				9				
		Nos.		7	4	0		
				0				
		Pru.		8	3	0	23	
				La.	7	1	0	22
				8				
		Da.		7	4	0	7	
				7				
		Ru.		7	5	0	16	
				6				
		1643 Aug. 30, H. 16			Ph.	Υ	7	4
7								
No.	7		4		1		7	15
	7		5					
Nos.	6	2	0					

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1644 June 5, H. 15					2			
		Pru.		6	3	0	13	0
					5			
		La.		6	0	0	22	0
		Da.		6	3	0	9	0
					1			
		Ru.		6	3		1	0
					3			
		Ph.		6	2	0	4	0
					6			
		No.		6	2	3	2	30
					4	0		
		Nos.	Υ	1	1	0		
					8	6		
		Pru.		1	2	0	12	0
					8	8		
1644 June 8, H. 16		La.		1	5	0	21	0
					7	5		
		Da.		1	2	0	4	0
					8	0		
		Ru.		1	2	0	9	0
					8	5		
		Ph.		1	3	0	19	0
					8	5		
		No.		1	3	0	16	0
					8	2		
		Nos.		1	3	0		
					8	6		
		Pru.		1	4	0	8	0
					8	4		
		La.		1	1	0	26	0
					8	0		

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1644 Oct. 8, H. 8 30'	♂	Da.		1	3	0	1	0
				8	5			
		Ru.		1	4	0	4	0
				8	0			
		Ph.		1	5	0	14	0
				8	0			
		No.		1	4	0	12	0
				8	7			
		Nos.	γ	1	4	0		
				7	5			
1646 June 22, H. 6	♂ ♀ C.	Pru.		1	3	0	11	0
				7	4			
		La.		1	1	0	28	0
				7	7			
		Da.		1	4	0	1	0
				7	6			
		Ru.		1	3	0	8	
				7	7			
		Ph.		1	3	1	6	0
				7	9	0		
		No.		1	3	5	6	
				7	9	5		
		Nos.	ϕ	1	1	0		
				4	4			
		Pru.		1	2	0	6	0
				4	0			
		La.		1	5	0	17	0
				3	7			
		Da.		1	2	0	7	0
				4	1			
		Ru.		1	2	0	9	0
				4	3			

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1647 Feb. 2, H. 8		Ph.		1	2	0	9	0
				4	3			
		No.		1	2	3	7	30
				4	1	0		
		Nos.	☿	1	3	0		
				1	0			
		Pru.		1	1	0	17	0
				1	3			
		La.		1	4	0	11	0
				1	1			
1647 Nov. 20, H. 9 30'	♌ C.	Da.		1	4	0	13	0
				1	3			
		Ru.		1	4	0	17	0
				1	7			
		Ph.		1	4	0	10	0
				1	0			
		No.		1	3	4	7	40
				1	7	0		
		Nos.	☿	2	2	0		
				8	4			
		Pru.		2	2	0	0	0
				8	4			
		La.		2	3	0	6	0
				8	0			
		Da.		2	4	0	24	0
				8	8			
		Ru.		2	5	0	18	0
				8	2			
		Ph.		2	4	3	16	30
				8	1	0		
		No.		2	4	5	16	50
				8	1	0		

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1648 Feb. 26, H. 8		Nos.	♄	2	1	0		
				6	0			
		Pru.		2	3	0	34	0
				5	6			
		La.		2	8	0	2	0
				6				
		Da.		2	1	0	3	0
				6	3			
		Ru.		2	1	0	6	0
				6	6			
		Ph.		2	1	0	7	0
				6	7			
		No.		2	1	3	6	30
				6	6	0		
1649 July 26, H. 16		Nos.	♄	2	3	0		
				5	8			
		Pru.		2	0	0	22	0
				6				
		La.		2	4	0	8	0
				5	6			
		Da.		2	7	0	29	0
				6				
		Ru.		2	4	0	4	0
				5	2			
		Ph.		2	4	3	3	30
				5	1	0		
		No.		2	4	2	3	27
				5	1	7		
1650 Jan. 6, H. 9		Mutus.	♄	2	1	0		
				5	9			
		(Lat.)		1	1	a		
				1				

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1650 Jan. 28, H. 9		Pru.	II	2	1	0	8	0
				5	1			
		La.		2	2	0	2	0
				5	1			
		Da.		2	3	0	16	0
				5	5			
		Ru.		2	3	0	17	0
				5	6			
		Ph.		2	5	0	12	0
				5	1			
		No.		2	2	0	10	0
				5	9			
1650 Jan. 28, H. 9		Mutus.	II	2	5	0		
				3	7			
		Pru.		2	4	0	12	0
				3	5			
		La.		2	7	0	10	0
				4				
		Da.		2	1	0	16	0
				4	3			
		Ru.		2	1	0	18	0
				4	5			
		Ph.		2	9	0	25	0
				4				
1650 Feb. 12, H. 9 9½'		No.		2	7	0	10	0
				4				
		Mutus.	II	2	3	0		
				3	2			
		Pru.		2	1	0	20	0
				3	2			
1650 Feb. 12, H. 9 9½'		La.		2	4	0	11	
				3	3			

Year, Month, Day / Hour	Aspect	Source / Table	Si g n	°	'	"	Diff. '	Diff. "
1650 Feb. 24, H. 9 (Directus)		Da.		2	4	0	16	
				3	8			
		Ru.		2	4	0	17	
				3	9			
		Ph.		2	4	0	10	
				3	2			
		No.		2	4	0	8	
				3	0			
		Mutus.	II	2	2	0		
				3	3			
		Pru.		2	3	0	20	0
				3				
1650 Mar. 8, H. 9		La.		2	3	0	12	0
				3	5			
		Da.		2	5	0	36	0
				3	9			
		Ru.		2	3	0	16	0
				3	9			
		Ph.		2	3	0	10	0
				3	3			
		No.		2	3	1	7	50
				3	1	0		
		Mutus.	II	2	3	0		
				3	5			
		Pru.		2	1	0	22	0
				3	3			
		La.		2	4	0	11	
				3	6			
		Da.		2	5	0	16	
				3	1			
		Ru.		2	5	0	16	
				3	1			

Year, Month, Day / Hour	Aspect	Source / Table	Si gn	°	'	"	Diff. '	Diff. "
		Ph.		2	4	0	10	
				3	5			
		No.		2	4	0	9	
				3	4			

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Year, Month, Day / Hour	Aspect	Source / Table	Si gn	°	'	"	Diff. '	Diff. "
1650 Mar. 14, H. 9 C.		Mutus.	II	2	4	0		
				3	7			
		Pru.		2	2	0	24	0
				3	3			
		La.		2	5	0	10	0
				3	7			
		Da.		2	3	0	16	0
				4				
		Ru.		2	2	0	15	0
				4				
		Phi.		2	5	0	9	0
				3	6			
		No.		2	5	0	8	0
				3	5			
1650 Mar. 20, H. (?)		Mutus.	II	2	4	0		
				4				
		Pru.	✕	2	3	0	27	0
				3	7			
		La.		2	1	0	7	0
				4	1			
		Da.		2	2	0	16	0
				4	0			
		Ru.		2	1	0	13	0
				4	7			

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1650 Apr. 3, H. (?)		Phi.		2	1	0	8	0
				4	2			
		No.		2	1	1	6	15
				4	0	5		
		Mutus.	II	2	5	0		
				4	3			
		Pru.		2	2	0	29	0
				4	4			
		La.		2	5	0	5	0
				4	8			
		Da.		2	1	0	17	0
				5	0			
		Rud.		2	6	0	13	0
				5				
1650 Apr. 18, H. 9 (A.)		Phi.		2	0	0	7	0
				5				
		No.		2	5	0	6	0
				4	9			
		Mutus.	II	2	5	0		
				6				
		Pru.		2	3	0	28	0
				5	7			
		La.		2	9	0	4	0
				6				
		Da.		2	2	0	18	0
				6	3			
		Ru.		2	1	0	14	0
				6	9			
1650 May 2, H. 9		Phi.		2	1	0	8	0
				6	3			
		No.		2	1	3	5	30
				6	1	0		
		Mutus.	II	2	2	0		

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1650 May 12, H. 9				7	4			
		Pru.		2	1	0	23	0
				7				
		La.		2	2	0	3	0
				7	7			
		Da.		2	4	0	20	0
				7	4			
		Ru.		2	3	0	15	0
				7	9			
		Phi.		2	3	0	9	0
				7	3			
		No.		2	3	2	7	35
				7	1	5		
		Mutus. / Nos.	II	2	3	0		
				8	0			
		Nos.		2	3	0		
				8	8			
		Pr.		2	9	0	31	0
				9				
		La.		2	3	0	6	0
				8	2			
		Da.		2	5	0	13	0
				8	1			
		Ru.		2	4	0	8	0
				8	6			
		Ph.		2	4	0	2	0
				8	0			
1654 Feb. 11, H. 9; ♂ H. 19 C.		No.		2	3	0	1	0
				9	9			
		Mutus.	♂	2	5	0		
				2	2			
		Pru.		2	6	0	14	0
				3				

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1654 Mar. 15, H. 9		La.		2	5	0	7	0
				2	9			
		Da.		2	1	0	26	0
				3	8			
		Ru.		2	1	0	23	0
				3	5			
		Ph.		2	1	0	21	0
				3	3			
		No.		2	1	0	19	0
				3	1			
		Mutus.	♌	2	3	0		
				0	1			
		Pru.		2	4	0	9	0
				0	0			
1655 May 27, H. 9 ☐ C.		La.		2	4	0	15	0
				0	6			
		Da.		2	5	0	26	0
				0	7			
		Rud.		2	5	0	19	0
				0	0			
		Phi.		2	4	0	17	0
				0	8			
		No.		2	4	0	15	0
				0	6			
		Nos.	♍	3	2	0		
				0				
		La.		3	3	0	14	0
				4				
		Da.		3	5	0	32	0
				2				
		Ru.		3	3	0	16	0
				6				
		Phi.		3	3	0	18	0

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1656 Jan. 8, H. 17, R	No.			8				
				3	3	0	17	0
	Nos.		♌	7				
				2	2	0		
	La.			2 7				
				2	3	0	7	0
	Da.			2 4				
				2	1	0	49	0
	Ru.			3 6				
				2	7	0	40	0
1656 Mar. 3, H. 18	Ph.			3				
				2	4	5	13	50
	No.			2 0 0				
				2	4	0	14	0
	Nos.		♌	2 1				
				1	4	0		
	(Lat.)			9 7				
				2	8	B		
	La.			2 8 B				
				1	5	0	10	0
1656 Mar. 11, H. 8	Da.			9 7				
				2	2	0	33	0
	Ru.			0 0				
				2	1	0	24	0
	Ph.			0 1				
				2	0	3	13	3
	No.			0				
				2	0	0	13	0
	Nos.		♌	0				
				1	1	0		
	La.			9 0				
				1	2	0	11	0
	Da.			9 1				
				1	4	0	32	0

Year, Month, Day / Hour	Aspect	Source / Table	Sign	°	'	"	Diff. '	Diff. "
1656 July 13, H. 7 20'				9	2			
		Ru.		1	3	0	23	0
				9	3			
		Ph.		1	3	0	26	0
				9	6			
		No.		1	3	0	24	0
				9	4			
		Nos.	♄	1	3	0		
				8	8			
		La.		1	5	0	12	0
				8	0			
		Da.		1	9	0	31	0
1657 Mar. 22, H. 11 30; ♂ C.				9				
		Ru.		1	2	0	24	0
				9				
		Ph.		1	5	1	15	10
				8	3	0		
		No.		1	5	1	15	15
				8	3	5		
		Nos.	♅	2	1	0		
				5				
		(Lat.)		2	4	0		
				1				
		La.		2	1	0	3	0
				8				
		Da.		2	4	0	25	0
				0				
		Ph.		2	3	0	17	0
				2				
		No.		2	3	2	17	20
				2	0			

COROLLARIVM [Corollary]

It follows from the preceding Table that there is no set of tables among the more celebrated astronomers whose canons are not supported by some observations, and against which some others do not tell — assuming the observations are taken as they stand. Yet more observations stand in favor of Our Tables, and next of the Philolaic, which the Rudolphine and Danican most closely approach; while in the third rank stand the Lansbergian and the Prutenic. To let the reader review the numbers, and the number of instances in which the tables satisfy the observations within 5' or within 10', the figures are given in the little table set out below.

The Tables that Satisfy the Observations of Saturn [Satisfaciunt Observationibus Saturni].

Table [Tabula]	Within 5' — instances [Vicibus]	Within 10' — instances [Vicibus]
Prutenic [Prutenica]	12	21
Lansbergian [Lansbergiana]	12	25
Danican [Danica]	17	21
Rudolphine [Rudolphina]	8	21
Philolaic [Philolaica]	25	54
Ours [Nostra]	32	58

This always allowing for a more accurate computation, in case any error has crept in upon us, as upon any other human being, in this matter.

CAPUT XII.

On the Hypothesis and Theory of the Motions of the Five Lesser Planets, whether Geometric, or Arithmetic, and especially on Saturn.

Where, regarding the Progress made in this branch of Astronomy, and the Defect still hidden within it.

To take up the present occasion offered first by Saturn — yet matters that are common to the other four lesser planets as well — I shall treat them together, first setting out a few Suppositions.

I. SUPPOSITIO.

[Margin: 7. Species of motion.]

Among the five Lesser Planets, seven kinds of motion have been observed up to now. The **first** is the daily revolution from the same to the same meridian in a span of about 24 hours; this is called the *motion of the Primum Mobile*, or the *Common motion*, from East toward West. The **second** is the *Proper*, or *Secondary motion*, from West toward East, by which the planets appear to move contrary to the motion of the Primum Mobile. The **third** is the *motion of Declination from the Equator*, admitted alongside the second motion — since the motion of the planets does not in fact take place upon the Equator, but rather is described about the poles and the axis of the Ecliptic, near the poles and axis of the Zodiac. The **fourth** is the *motion of Latitude*, because the proper orbit of these planets is inclined to the plane of the Ecliptic, and cuts it in two nodes, beyond which they are found to depart from the Ecliptic. The **fifth** is the *motion of Altitude*, by which at fixed times they recede higher from the Sun and from the Earth, until at the greatest distance they reach their *aphelia* [Apogees]; and from there gradually descending they draw nearer again, and approach the Earth and the Sun, until at the least distance they pass out at their *perihelia* [Perigees]. The **sixth** is the *motion of Wandering* about its own body's centre — namely, the Telescopic motion, not yet sufficiently confirmed. The **seventh** is the *motion of Libration*, which is a twofold Telescopic motion. The remaining differences of motion do not constitute a diversity of kind, but are diverse affections of the same motion, in respect of quantity and of anomaly, distinctly considered: as when they are called Direct, Stationary, Retrograde, or, by a twofold Anomaly, are moved by one resolved motion (which they call the *First inequality*, or *Eccentric*); the other being tied to it (which they call the *Second inequality*, or *Epicycle*, or *Commutation*). And the first inequality displays itself most in the line of the Apsides, which passes through the centres of the Sun and the Earth; and this happens at the true conjunctions and oppositions of the planets with the Sun, and then they appear under the same Ecliptic, or Zodiacal point, whether viewed from the Earth or from the Sun. Beyond these cases this second inequality also occurs, by as much as the place of the supreme heaven, under which they are viewed from the Sun, differs.

II. SUPPOSITIO.

[Margin: 2. Fluidity of the planetary heavens.]

To explain the aforesaid motions of the planets, the solidity of the celestial orbs — together with their multiplicity, as the ancients held, whether absolutely or at least as a bare Hypothesis — is asserted, and by us refuted as not only without foundation but in the highest degree improbable; and it is rejected, in common with the more recent Astronomers after Copernicus: as we have shown at length (*Almagestum Novum*, sect. 1, cap. 2, qu. 2).

So too (*Almagestum Novum*, sect. 2, cap. 7), speaking of the heavens of the planets in particular. For that the sphere of the Fixed stars is solid is held to be more probable, and perhaps above I granted that another sphere is given, by whose rapid sweep of the Primum Mobile the whole sphere of the Fixed stars is carried round daily, except for these motions of the Fixed stars themselves — provided only that we understand them to be accomplished without any solidity of the spheres, by the bare impulse of the Intelligences, namely the Angels.

III. SUPPOSITIO.

Although none of the motions thus far indicated is the *Primum mobile* among the suppositions, yet not one of them — that is, no celestial Phenomenon among the planets — could be saved without manifest error, whether speaking Mathematically and apart from any cause, or explaining it Physically. The *First motion*, or *Common motion*, is nonetheless attributed to the very Stars, or to the Earth, and is examined by experiments of Physics, and by the rules of Mathematics: that the Earth is not moved with a Daily motion, much less with an annual motion of both kinds — this part of the proposition we have demonstrated with the whole effort of our talent, and with the greatest erudition we could muster from all quarters, gathering and setting forth arguments at length (*Almagestum Novum*, sect. 3, cap. 3 & 4). For the present, however, it suffices for the Reader at last to read through cap. 11 of this same book attentively, and apart from prejudice — which we beg to be done, attentively, and apart from prejudice.

[Margin: 4]

These things supposed, we now expound how, and by how far, the more recent Astronomy has progressed beyond the point to which it had hitherto advanced. **First**, it has learned that the line of the Apsides passes through the centres of the Sun and of the Earth at once; and that consequently the planets are carried away unequally by their own motion — not, as the old Astronomy supposed, by means of equal distances; but, as the truth has it, with the true Oppositions and Conjunctions of the Sun, and with the orbit of the planets, and apart from so

many librations toward the poles — that, by a simpler inclination to the Ecliptic, they display the varieties of latitude; but that all the aforesaid motions are accomplished freely in a fluid aether, and apart from that farrago of solid orbs which the ancients devised.

[Margin: 5]

It has gained, **next**, this further point, by which it profits the more recent Astronomy: that beneath that *Optical* inequality which appears in the motion of the planets, there lies a subordinate *real* inequality — neither wholly Optical, nor merely Apparent with respect to the Earth, which is not the centre of the planetary motion, viewed; and which inequality, as it were, if they were viewed from their own proper orbit's centre, they would appear to be moved equally and uniformly: yet what is in fact contained in those heavenly bodies, as nearly divine, as the Ethnic philosophers said, so persuaded the Astronomers, even down to Longomontanus inclusively, that they made it an axiom — namely, that *the celestial motions of the bodies of the heavens are equal*. Therefore, by others and others, eccentric Circles, Epicycles, and the like, they tried to explain the motion which, viewed from their own circles' centre, is equal, viewed from the Earth is unequal — as we have explained, fittingly enough, by the figures (*Almagestum Novum*, sect. 1, cap. 2 & 3). But Kepler first of all noted that that inequality is partly Optical, and partly — as the Apparent inequality is to us dwellers on Earth — Physical and Real: for in the orbit of the planet there are two foci, of which, since the one is not the centre, in the other the centre of the orbit itself, the planet is really and unequally moved. For if the planet be supposed to move equally about the centre of its own orbit, and the whole Eccentricity by which that centre is distant from the Earth's centre, we measure from the base of a triangle measuring the Angle of Prosthaphaeresis, the mean — that is, the equal — motion can never be reduced to truth, nor satisfy exactly the places of the planet observed. But if the Eccentricity be bisected, three points are set down in the line of the apsides: one is our Earth, the other is the centre of the planetary orbit, and the third in the middle, which is the centre of the planetary orbit; and the third, distant from the Earth by an equal amount, as is the Earth distant from the planet, the planet would be moved more justly: a far juster outcome arises — the Equation being compounded of a Physical part, whose basis is the distance of the centre of equal motion from the Sun's centre, and an Optical part, whose basis is the distance of the centre of the Orbit from the Earth's centre.

[Margin: 6]

But because the Ellipse has this property — that in its diameter there are three points equally distant from one another, namely the centre of the Ellipse, and two hence indeed the foci, or umbilici; and that those points coalesce by a radius reflexed from the periphery, and a physical virtue dispersed through it; therefore Kepler, by his own sagacity, perceived that the Orbits of the planets are not circular, but Elliptical, and that the causes of the planetary motion are Physical — for from the Ellipse there is yielded a reason why the planet at the extremities of the greater diameter is there at its Aphelia, here its Perihelia, and Perigees, and why its motions are dispensed as they appear. Yet he constructed the Mode in the Ellipse of the Prosthaphaereses, and in investigating the Aphelion, or Apogee, did not demonstrate it Geometrically (Kepler being the discoverer).

[Margin: 7]

Kepler was succeeded by Ismaël Bullialdus [Ismaël Boulliau], who in his *Astronomia Philolaica* (cap. 13 & lib. 11) not only attempted to demonstrate the motion of the planet, so that it might be accomplished through diverse circles upon the surface of a single cone, yet describes an Ellipse: a thing solvable nonetheless by equipollence into several circles. But he also investigated the very places of the Aphelia in the Ellipse by the same method of Vieta [François Viète]: yet not so exactly and subtly that he did not leave to Sethus Vuardus [Seth Ward] the task of emending the place, and then of investigating it more exactly in the Ellipse than Bullialdus, and of inquiring out the places of the Aphelia more exactly in the Ellipse. But Comes Paganus [Blaise Pagan] used the Elliptical figure happily enough in demonstrating the planetary motions, and the same; and our most friendly Io. Dominicus Cassinus [Giovanni Domenico Cassini] labours at it.

[Margin: 8]

Thus far recent Astronomy has progressed; but it still seems to me that progress must be made all the way until we recognize that the motion of the planets is not from a part only, but as a whole, to be unequal and uniformly non-uniform; and this not so much because the celestial bodies are deformed, but most especially because they are congruent to the limits intended by God the supreme Maker: for those equalities, which seem to us beautiful, are not beautiful; but those inequalities are more beautiful, which constitute a regular harmony of the World — as I have set forth elsewhere with many examples in the *Opificium Dei*. Besides, I consider that the motion is not only resolvable into several circles by the Ellipse, but also through Eccentrics and the Copernican Epicycles, or the Danish ones, no rarely more exactly to represent the observed places of the planets — which is an

indication that we do not yet hold that genuine figure, that very measure, which the motion of the planets requires.

[Margin: italic] Moreover, the aforesaid Authors suppose, who by a single Ellipse expound the motion of the planet, that the Earth is moved with the First motion from East to West; otherwise it is not saved: by the fluidity of the heaven of the planets, of which in Supposition II. nor can the First motion be reconciled with the Second by a single Ellipse, and with the remaining Suppositions enumerated; and yet that the Earth is so moved is false from the things said (Supposition III.). It remains therefore for the Astronomers to expound how the aforesaid motion is accomplished, and apart from Physical repugnance is continued by the planet itself in its passage.

[Margin: 9]

Now indeed, if what the inventors of their own inventions held — too dear to me, but seen to be absurd — the Astronomy will be at last recalled by way of restoration to the ancient, and only this will be recognized: that the planets describe a Conical surface from East to West, and other and other, sometimes broader, sometimes narrower spires, just as the five prior motions of Supposition I. require — easily not only is the First motion reconciled with the Second, but at the same time with the remaining three; and at once the planets will appear, not as stationary in fact, Direct, or Retrograde, but as perpetually carried round toward the West about the Earth; and then it will be seen that they make no progress in the Zodiac, when at the same moment they come to the same Meridian, when together with some one of the Fixed stars. They will be Direct, however, when they return a little more slowly to the same Meridian than the same Fixed star; Retrograde, however, when they revert there more quickly than the Fixed star, than they had been the day before at the same Meridian.

[Margin: 10]

Nor indeed does it become Astronomers to be so narrow of breast that they do not comprehend this spiral motion, because it cannot be done by a single simple figure, easily drawn with the pen, especially since it revolves about Conical spires; still less by the gypsum cone of this art, designated as a spiral figure, through which it may at last be cut off by a section of the cone, if not exactly Elliptical, yet nearest approaching the Elliptical — though by this very orbit the planet is not really moved.

[Margin: 11]

Finally, Astronomy ought to make progress in observing

[Continued.] the places of the planets most exactly by mutual congresses, or with the Fixed stars by the aid of the Telescope, or by application with the Fixed stars at the Meridian: that all the parts of the planetary Revolution may, by every means, be noted as to their places, apart from the error of many minutes; then indeed a far more certain knowledge will be had from measurement, whether of a single Ellipse, or of figures described by spires equivalent to an Ellipse — and so, from the foundation of constituting the planetary motions, for constructing tables still more certain. Retaining in the meantime the Ellipse, whether really or equivalently, we suppose in Saturn these things, which follow.

[Table: Saturn — mean motions. The first column gives the kind of motion (Diurnal / Annual). Numbers run: Sig. (signs) | G. (degrees) | then four further sexagesimal subdivision columns headed I, II, III, IV, V.]

Mean motion from ♄		Sig.	G.	I	II	III	IV	V
Apogei	Diurnus	0	0	2	0	35	1	3
							3	8
	Annus	0	1	1	3	17	5	3
			2	3	4		4	2
Nodi Bo-	Diurnus	0	0	0	0	18	4	1
							5	4
	Annus	0	0	1	5	5	1	1
					4		2	0
rei	Diurnus	0	0	0	0	4	1	3
							5	6
	Annus	0	0	0	2	54	5	4
					5		1	3

[i.e. the Diurnal and Annual mean motion of Saturn, of the Apogee, and of the Northern Node.]

Epoch of Christ at the meridian of the last day of December, in the Meridian of Bologna.

	Sig.	Gr.	I	II
Mean motion	2	13	5	45
Apogee	7	5	15	25

	Sig.	Gr.	I	II
Node Ω	3	8	59	18

Pro Hypothesi autem Figurae Geometricae.

(For the Geometric Figure of the Hypothesis, however.)

The Ellipse being chosen in the meantime, whose nearest traces the planet's diurnal motion — made toward the West by some, by others, and other — designates as quasi-circular spires about a cone, let the measures written below be chosen.

Of such parts as the Radius, or Solar Semidiameter of the Ellipse, is 100000, its bisected Eccentricity is 1740. Of such parts is it.

Semidiameter Maior Ellipsis Saturni

(Greater Semidiameter of the Ellipse of Saturn) If the Radius of the Annual Orbit $\odot$ be 100000.

Or its mean distance from the Sun	954198
Lesser Semidiameter of the Ellipse	946965
Whole Eccentricity from the Sun	110190 $\frac{4}{5}$
Half of the Eccentricity	55095 $\frac{2}{5}$

	Distantia (Distance)	
With the Sun at Apogee, Saturn at Aphelion	from the Sun	1009293
	from the Earth	1111033
With the Sun at Apogee, Saturn at Perihelion	from the Sun	899103
	from the Earth	797363
With the Sun at Perigee, Saturn at Aphelion	from the Sun	1009293
	from the Earth	1007553
With the Sun at Perigee, Saturn at Perihelion	from the Sun	899103
	from the Earth	800843

For the remaining distances, see Volume 2, Table 97.

		Gr	I	I
		.	I	I
Inclination of the Orbit to the Ecliptic		2	3	0
			0	
	⊙ Apog. ♄ at Aphelion, in ♈	2	1	1
			6	2
	⊙ Apog. ♄ at Aphelion, in ♏	2	4	4
			6	8
Latitudo Maxima Saturni (Greatest Latitude of Saturn)	⊙ Apog. ♄ at Perihelion, in ♈	2	1	4
			4	4
	⊙ Apog. ♄ at Perihelion, in ♏	2	4	1
			9	8
	⊙ Perig. ♄ at Aphelion, in ♈	2	1	4
			6	0
	⊙ Perig. ♄ at Aphelion, in ♏	2	1	8
			6	
	⊙ Perig. ♄ at Perihelion, in ♈	2	1	1
			5	2
	⊙ Perig. ♄ at Perihelion, in ♏	2	4	4
			8	

The figures described and explained you have (*Almagestum Novum*, sect. 2 & 3), but for the Ellipse read Circle, or little circle, and their use.

[Continued from the right column of the preceding page.] re-read in this Volume Book One, and its cap. 11 with the Appendix, or read the *Astronomia Geometrica* of Seth Ward, published at London in the year 1656, in which he teaches to investigate, as much by the circle as by the Ellipse, the inequality of the planets, the Nodes, the Inclinations, &c., whether the eye be placed in the Sun, or in the Earth, or in some other planet, from which the Sun would be seen. But in that work it requires Observations somewhat too delicate, and tied to certain definite moments of time, which cannot be reduced to a near approximation with ease, on account of the subtlety with which it can perhaps be done — who would have thought it? — and on occasion their handling not rarely, whether from clouds, or otherwise subtracted. If, however, the Astronomers shall with long-suffering have persisted in this study, it may at last be done, that such things — by so many observations adopted, and by the benefit of Geometry demonstrated by Ward — may perfect Astronomy. But always it lies upon them to reconcile the diurnal

motion of the Primum Mobile, which at the end we show cannot be attributed to the Earth, with the Sun, with the proper motion of the Stars.

BOOK SIX, CONTAINING THE OBSERVATIONS OF THE PLANET JUPITER, AND THE HYPOTHESIS OF ITS MOTIONS.

CHAPTER I.

Ancient Observations of Jupiter, from the year 241 before Christ down to the year 807 of the same era.

1. In the year 45 (according to Dionysius, on the 10th day of the month Parthenon, that is to say in the year 83 from the death of Alexander the Great), on the 17th, on the day of Epiphany, the next morning at 10 in the morning, Jupiter touched the southern Ass — the one situated in the Nebula of Cancer. Ptolemy [*Almagest* XI, ch. 3] judges that this star had been one degree from Jupiter; Longomontanus [*Theorica* II, ch. 7], 33'; and Bullialdus [Boulliau, *Astronomia* ch. 7]. And he reckons that this had been a year before Christ, falling on the 3rd of September, [?] at the 16th hour after noon at Uraniborg; and that at that time the star was distant from Jupiter [?] grad. [Bullialdus] gr. 7, and 33'; or, as Longomontanus has it, by no fewer than 6'; or, as Bullialdus has it, with the southern latitude, 25'. But Lansbergius [Lansbergen] in his *Thesaurus* of observations records it as having been in the year 507 of Nabonassar, the 17th of Epiphi, and at that hour, the Goat at 14°20', and of the Ass, the longitude of Jupiter [?] and of Cancer at gr. 7, 32', by observation — but at gr. 34°26'' from his Tables. Truly it was the 3rd of September; and that fixed star was in Cancer gr. 7, 11', with southern latitude 3', 30''.

2. In the 17th year of the Emperor Hadrian, on the 1st of Epiphi, at the 1st hour before the middle of the following night, Ptolemy at Alexandria gathered from his own observation that the acronychal opposition of Jupiter had occurred with the mean place of the Sun, Jupiter being in Scorpio gr. 23, 11'. So he himself [*Almagest* XI, ch. 1], and Copernicus [*De Revolutionibus* V, ch. 10]. That year was 133 of Christ, and the 18th day of May.

3. In the 21st year of Hadrian, on the 13th of Paophi, at the 2nd hour before the middle of the following night, Ptolemy at Alexandria, reckoning, judged that the acronychal opposition of Jupiter with the mean place of the Sun had been made

in Pisces gr. 7, 54'. So he himself [*Almagest* XI, ch. 1] and Copernicus, as above. The year was 136 of Christ, and the 31st of August.

4. In the first year of the Emperor Antoninus, on the 20th of Messori — the next being Athyr — on the 5th hour after midnight, Jupiter was opposite the mean place of the Sun in Aries gr. 14, 23', by observation and by Ptolemy's reasoning [*Almagest* XI, ch. 1]; and indeed in Greek the day is so designated: ἄθὺρ κ' εἰς τὸν κ' καὶ [Greek: Athyr 20, into the 20th and (?) — the Egyptian calendar date] [?]. That is to say Athyr 20, into the 21st: thus Copernicus [*De Revolutionibus* V, ch. 10]. By error they had placed the day at 15. It was the year 137 of Christ, the 7th of October.

5. In the second year of Antoninus, on the 26th of Messori, the next day, at about the fifth hour, equal time, after the middle of the night — Ptolemy being at Alexandria — comparing Jupiter with the bright star of the Little Manger [Praesepe], he judged it to be in gr. 15, 45' of Gemini. So he himself [*Almagest* XI, ch. 2].

Lansbergius in his *Thesaurus* of observations records that Jupiter — observation 2 — refers this to the year 139 of Christ, July 20, hour 17, after the meridian of Alexandria, and that Jupiter accompanied the bright star of the Hyades in gr. 15, 30' of Gemini. So Longomontanus [*Astronomia Danica* II, ch. 7]. Therefore the first year of Antoninus was 136, the second 139, and it really was the day 10 of July, the next being the 11th, the year 139.

6. In the year of Christ 508, that is to say of Diocletian 224, on the 30th of the month Thoth — that is, the 28th of September — in the morning at Athens, Jupiter was seen very near the Heart of the Lion [Cor Leonis, Regulus]; three digits from it, that is, minutes $7\frac{1}{4}$, distant toward the north. So Bullialdus [*Astronomia* ch. 7] from a manuscript of the Library of the Most Christian King, adding that at that time the Heart of the Lion had been in gr. 8, 49', 54"; and in the same manuscript it is indicated that the conjunction of Jupiter and Mars was observed, in the year of Diocletian 214, on the 6th day of Pachon, the year coming round, under the 5th hour after midnight.

In the year of Christ 807, on the day before the Kalends of February, on the 17th of the Moon, the star of Jupiter was seen to have passed almost beneath the Moon, as is found in the *Annals of the Franks*, and in the *Life of Charlemagne*.

CHAPTER II.

Observations of Jupiter made by Johannes Regiomontanus [Regiomontanus] and Bernhard Walther, from the year of Christ 1471 to 1504.

The First Class is of observations made by ocular estimation.

1. In the year 1471, March 15, Regiomontanus at Strasbourg saw Jupiter almost in a straight line between the brighter star of the middle of the left wing of Virgo, and the darker one around the eye, toward Leo; and distant in obscurity by two-fifths of the spaces between the said stars; but on August 9 at Nuremberg in the evening he saw Jupiter and Venus distant from one another by $1^{\circ}13'$, using also the Cross-staff [Radius]; granted that the calculation of Alphonsus would require gr. 4, 33'.
2. In the year 1478, Bernhard Walther observed as much on the 22nd of August as on the 30th of September that Jupiter was in a straight line with the two eyes of Taurus, almost 3 parts after midnight, and from the more western eye it was distant by half the distance of the eyes of Taurus.
3. In the year 1488, October 8, Jupiter being in M.C. gr. $13^{\circ}\frac{1}{2}$, was observed by Walther in gr. 13, 20' of Pisces, with the southern latitude of one degree. Bullialdus [*Astronomia* ch. 7] says that Jupiter had been in gr. 14, 16' of Pisces; if the place of Aldebaran be corrected, it was in Π [Gemini] $2^{\circ}36'$; but this observation looks to the armillaries, concerning which see below.
4. In the year 1497, February 15, in the morning at hour 4 after midnight, the Moon, Mars, and Jupiter were distant by a diameter of the Moon, says Walther; but the distance was about half from the side of the latitude. Mars, however, was more western than Jupiter and more meridional, granted that, according to the *Almanac*, their conjunction — which was still to come — had passed.
5. In the year 1503, September 8, in the morning at hour 4 after midnight, I saw, says Walther, Jupiter near the star which is the eighth of Gemini, on the right side of the preceding, and they were at almost the same conjunction in longitude, such that if you imagine an arc through the Pole of the Zodiac, and the star, it would touch the western edge of Jupiter; but the latitude truly held itself beyond it toward Boreas in the manner of two transverse digits. Now the said star is placed distant from the Ecliptic toward the north by gr. 2, 40'; granted that, observed by the armillaries by Walther, it scarcely had any latitude — from which Lansbergius in the *Thesaurus* gathers that Jupiter had been in gr. 12, 2' of Cancer,

as from the Tables gr. 11, 56'; and the southern latitude. But the said fixed star, which he says had 12 minutes 11', the fixed star moreover had been in ♋ [Cancer] gr. 11, 55', lat. Bor. gr. 2, 56¼'. But the fixed star was in ♋ gr. 11, 27', lat. 15'.

6. In the year 1503, October 6, I have indicated, says Walther, the ocular conjunction of Jupiter and Mars according to longitude; but Mars was more northern than Jupiter by one part, the Moon almost rising before the Sun by two hours.

7. In the year 1504, February 9, Walther notes the conjunction of Jupiter with Mars; April, however, the 29th, the conjunction of Jupiter with the eighth of Gemini after the meridian, according to longitude, Jupiter existing more northern by half a part; but Bullialdus [*Astronomia* VI, ch. 7] affirms that Walther was as much deceived here as in the observation of the year 1503. September 8 — and that he was deluded in reading Ptolemy's catalogue, in that he ought to have taken the twelfth star of the eighth of Gemini under the left thigh of the following Gemini, and that the observation had occurred at the time when Jupiter was in gr. 11, 33' of Cancer, with southern latitude of at least 13'; but from the Tables he gathers the place of Jupiter in gr. 12, 0', 25" of Cancer.

8. The Second Class contains only two observations made by the Cross-staff [Radius], on whose use see Walther's observations of Saturn, no. 10.

I have already touched on the first observation, no. 1; the other was made in the year 1478, August 24, in the morning, when the first interval of distance between Jupiter and the right eye of Taurus was 70, and the second interval 811; but between Jupiter and the left eye of Taurus the first interval was 30, the second 942.

The Third Class is of Observations made by the Zodiacal Armillaries, concerning whose uncertainty within 10 minutes, see Walther's observations of Saturn, no. 33, above.

The following table of armillary observations of Jupiter (observations 9–52) spans the foot of page 304 and the head of page 305. Columns: the observation number; the year, month, and day [Ann. Mens. D.]; the observed place of Jupiter [☿ Locus observ.] in Sign, Degrees, Minutes [Sign. Gr. M.]; and the Mid-Heaven [Med. cœlum] in Degrees and Sign [Gr. Sig.]. Interspersed "Latit." rows give the ecliptic latitude (A. = southern/austral; B. = northern/boreal). The note "n. s." (post meridiem / next-day specification) and "manè" (morning) appear with several dates.

N o.	Year, Month, Day	☿ Place: Sign	G r.	M . Mid-Heaven: Gr.	Sign
9	1487 Oct. 7, n.s.	Pisces	1 3	2 13 0	Capric.
1 0	Dec. 9, n.s.	Pisces	1 7	4 1 5	Piscium
		Latit. A.	1	4 5	
1 1	1503 Sept. 11, manè	Cancer	1 2	0 hor. 4 p.m.n.	
		Latit. B.	0	1 5	
1 2	Sept. 16, manè	Cancer	1 2	1 h. 2½ p.m.n. 5	
		Latit.	0	0	
1 3	Sept. 22, manè	Cancer	1 3	0 15	Cancri
		Latit.	0	0	
1 4	Sept. 28, manè	Cancer	1 3	4 15 5	Tauri
		Latit.	0	0	
1 5	No. 16, p.m.n.	Cancer	1 4	4 16 5	Arietis
		Latit. A.	0	1 7	
1 6	Dec. 12	Cancer	1 0	5 21 3	Ariet.
1 7	Dec. 14	Cancer	1 0	5 4 0	Ariet.
1 8	1504 Ian. 5, manè	Cancer	7	5 1 0	Arietis
1 9	Ian. 10, manè		7	0 7	Tauri
		Latit. B.	0	1 5	

N o.	Year, Month, Day	☿ Place: Sign	G r.	M . Mid-Heaven: Gr.	Sign
2 0	Ian. 19, manè		6	2 10 5	Libræ
2 1	Ian. 20		6	8 9	Tauri
		Latit. B.	0	1 5	
2 2	Ian. 22		6	0 7	Gemin.
		Latit. B.	0	1 5	
2 3	Ian. 24, n.s.		5	4 23 0	Tauri
2 4	Ian. 25, n.s.		5	3 25 0	Tauri
		Latit. B.	0	1 5	
2 5	Ian. 26, n.s.		5	2 19 2	Tauri
2 6	Febr. 11, n.s.	Cancer	5	1 11 5	Gemin.
		Latit. B.	0	2 0	
2 7	Febr. 4, n.s.		5	7 1	Gemin.
2 8	Febr. 5, n.s.		5	0 5	Gemin.
		Latit. B.	0	2 2	
2 9	Febr. 6, n.s.		4	5 19 3	Gemin.
3 0	Febr. 8, n.s.		4	4 9 8	Gemin.
		Latit. B.	0	1	

N o.	Year, Month, Day	☾ Place: Sign	G r.	M . Mid-Heaven: Gr.	Sign
				8	
3 1	Febr. 9, n.s.		4	5 3 0	Gem.
3 2	Febr. 12, n.s.		4	4 15 5	Gem.
3 3	Febr. 13, n.s.		4	4 10 5	Gem.
3 4	Febr. 14, n.s.		4	4 20 7	Gem.
3 5	Febr. 15, n.s.		4	4 15 5	Gem.
3 6	Febr. 16, n.s.		4	4 15 5	Gem.
3 7	Febr. 20, n.s.		4	5 15 3	Gem.
		Latit. B.	0	2 5	
3 8	Febr. 26, n.s.		4	4 2 5	Cancri
3 9	Martij 3, n.s.	Cancer	5	0 2	Cancri
4 0	Mart. 11, n.s.		5	2 14 3	Cancri
4 1	Mart. 17, n.s.		5	5 23 0	Cancri
		Latit. B.	0	7	
4 2	Mart. 27, n.s.		6	5 19 0	Leonis
4 3	April 24, n.s.		1 1	0 15	Virginis
4 4	April 29, n.s.		1 1	2 20 0	Virginis
4	April 30, n.s.		1	4 21	Virginis

N			G	M		
o.	Year, Month, Day	☿ Place: Sign	r.	.	Mid-Heaven: Gr.	Sign
5			1	0		
		Latit. B.	0	2		
				0		
4	1504 Maij 9, n.s.	Cancer	1	1 4		Libræ
6			3	8		
4	Maij 18, n.s.		1	2 19		Libræ
7			5			
4	Maij 23, n.s.		1	5 26		Libræ
8			5	3		
4	Maij 24, n.s.		1	0 1		Scorpij
9			6			
		Latit. B.	0	2		
				0		
5	Maij 25, n.s.		1	1 4		Scorpij
0			6	3		
5	Maij 28, n.s.		1	5 5		Scorpij
1			6	3		
5	Maij 29, n.s.		1	3 14		Scorpij
2			7			

[At the foot of page 304 the year-marker "1504" is printed beneath the table.]

The next table (page 305, compares three computed places of Jupiter — by Observation, by the Alphonsine [Alphons.], and by Copernicus [Copern.] — for three armillary observations.

N				G	M	Latitudo:	
o	Date [Ian. H. M.: D.,	Source	Longit. Iovis: Sign	.	.	G.	M.
.	hours post mer.]						
1	9, 15, 0	Obser	Cancrī	7	5	0	9
		v.			2		B
		Alpho		7	3	0	6
		ns.			5		A
		Coper		7	3	0	32
		n.			2		A

N

o	Date [Ian. H. M.: D., hours post mer.]	Source	Longit. Iovis: Sign	G MLatitude:	
				. . G.	M.
2	14, 8, 0	Obser	Cancrī	7 1 0	8
		v.		9	B
		Alpho		7 7 0	5
		ns.			A
		Coper		7 1 0	32
		n.			A
3	15, 6, 10	Obser	Cancrī	7 1 0	8
		v.		5	B
		Alpho		7 1 0	5
		ns.			A
		Coper		6 5 0	32
		n.		6	A

Lansbergius in his *Thesaurus* of observations, examining the Tyconic observation of Jupiter — observation 4, of day 14 — gathers from his own Tables the place of Jupiter in gr. 7, 19', 19" of Cancer, with northern latitude 9'.

Longomontanus, moreover, in his *Astronomia Danica* [II], in the chapter on the *Theorica*, exhibits eight acronychal places of Jupiter — five indeed from Tycho's [observations], but the last three from the place of Jupiter computed from his own Prutenic Tables, yet corrected, by adding 4 $\frac{2}{3}$ ' to the mean longitude, and 40' to the apogee. The Prosthaphaeresis, moreover, of the part of the eccentric everywhere a twenty-fourth part [vigiesimam quartam], and they are of this kind, by the old-style Calendar.

The following table (page 305, gives, for eight acronychal observations, the date [Ann. Mens. D.], the hour and minute after the meridian [H. M. p. mer.], the observed longitude [Lōg. observ.] in Sign, Degrees, Minutes [Sig. G. M.], and the supputted (computed) longitude [Lōg. supputata] in Degrees and two further columns of minutes [Gr. I, II].

N N

o	o	Year, Month, Day	H M. p. mer.	Observed Long.: Sign	G MComputed Long.:		I
					. . Gr.		I I
4	1	1583 Sept. 6	2 10 0	♋ Pisces	2 3 23 3 3		3 4 8 0

N	N						
o	o	Year, Month,	H M.	Observed Long.:	G M	Computed Long.:	I
.	.	Day	. p.mer.	Sign	. . Gr.		I I
5	2	1584 Oct. 13	7 20	♉ Taurus	0 2 0		2 1
					2		2 5
6	3	1591 April 23	1 0	♊ Pisces	1 1 13		9 0
			9		3 0		
7	4	1595 Sept. 12	6 10	♊ Pisces	2 5 28		5 4
					8 6		4 5
8	5	1596 Oct. 18	1 0	♉ Taurus	5 4 5		3 0
			2		0		5
9	6	1607 Sept. 17	1 10	♈ Aries	4 1 4		8 1
			1		0		0
1	7	1610 Dec. 30	1 40	♋ Cancer	1 3 19		3 1
0			4		9 6		8 0
1	8	1613 Mart. 1	2 0	♍ Virgo	2 4 21		4 4
1			2		1 5		2 5

From the foregoing acronychal observations, Bullialdus [*Astronomia* VII] of the years 1583, 1584, 1591, and 1596 — consult chapters 1 and 2.

There follow the last Tyconic observations, made at the fortress of Benatek near Prague, in the year 1600; or at Prague in the house of Curtius, in the year 1601, by the new style — consigned by Snellius [Snell] in the observations published at Leiden [Lugdunum Batavorum], in the year 1618.

12. In the year 1600, February 3, when the bright star of Hydra was distant from the meridian toward its rising by about one degree, and the head of Hydra crossed the meridian before it by about one hour, Tycho observed Jupiter distant from the head of Pollux by gr. 29, 51 $\frac{1}{3}$ '; and corrected for refraction gr. 29, 52 $\frac{1}{3}$ '; and from the bright star of the feet of Gemini gr. 44, 11 $\frac{1}{3}$ '; but corrected gr. 44, 11', 50".

13. In the year 1600, February 4, by the new style, on the following night, the meridian altitude of Jupiter was observed at gr. 56, 29 $\frac{1}{3}$ '; and at once the meridian altitude of the more southern [star] in the head of Leo was taken, which was gr. 51, 23 $\frac{1}{4}$ '; and of the following [star] in the other foot of Leo, which was gr. 65, 15 $\frac{2}{3}$ '; and at that time Jupiter had withdrawn from the meridian by as much as was the diameter of its own body.

14. In the year 1600, April 12, by the new style, at hour 9, 46', after the meridian, Jupiter was distant from the bright star of the feet of Gemini gr. 39, 0'½'; and at hour 9, minutes 53', it was distant from Regulus gr. 12, 30'.

15. In the year 1601, July 16, by the new style, on the following night, at hour 9, 22', Jupiter, high at gr. 10, 40', was seen to be distant from Arcturus gr. 41, 26'; and at hour 9, 29', high at gr. 9, 31', distant from Saturn gr. 45, 18'.

There follow observations of Jupiter completed by Tycho from the year 1583 down to 1599 at Uraniborg, and the rest in Bohemia, which R. P. Albertus Curtius S.J. selected from a manuscript of Tycho's, and transmitted to us — once chosen out for publication, among the Tychonic observations, by the Emperor, formerly his patron, and consigned in the old style.

CHAPTER III.

Copernican Observations of Jupiter, from the year of Christ 1520 to 1530.

It must be noted that Copernicus numbers the longitudes of the planets from the first fixed star preceding the horn of Aries, which in the year 1525 he places as distant from the Vernal Equinox by gr. 27, 21' [recte: per his text]; from which the longitude is thereafter derived. [The page reads "gr. 20, 40'."]

1. In the year 1520, on the 12th of the Kalends of March, in the morning at the 6th hour before the meridian, Copernicus, by an instrument for distances, most diligently observed Jupiter to precede gr. 4, 31' the first Star — the one which is in the forehead of Scorpio, the more splendid one, whose place he says had been in the parts of Scorpio gr. 16, 48'. So Copernicus [*De Revolutionibus* V, ch. 14].

2. In the year of Christ 1520, on the day before the Kalends of May, in the middle of the preceding night, at the 11th hour, Copernicus, as he himself asserts, most diligently observed Jupiter acronychal in gr. CC, 10°57' [scrup. XVIII] of the sphere of the Fixed [stars], namely in Scorpio gr. 10, 57'. So he himself [*De Revolutionibus* V, ch. 11].

3. In the year of Christ 1526, on the 4th of the Kalends of December, at the 3rd hour, in the middle of the night, Copernicus observed Jupiter acronychal in the parts of the Sphere of the Fixed [stars] XLVIII, scrup. 33, namely in Gemini gr. 9, 16'. So Copernicus [*De Revolutionibus* V, ch. 11].

4. In the year of Christ 1529, on the Kalends of February, the matter being settled, at the 19th hour, in the middle of the night, Copernicus observed Jupiter

acronychal in gr. CXIII, scrup. XLIV of the Fixed [stars] — that is in Leo gr. 14, 28'. So Copernicus [*De Revolutionibus* V, ch. 11].

CHAPTER IV.

Tychonic Observations of Jupiter.

Tycho himself, in the *Epistles to the Landgrave of Hesse*, page 56, sets down the following observations of Jupiter made at Uraniborg in the year 1587; and, noted by the old style, computes them by the Alphonsine, the Prutenic, and the Copernican Tables.

Liber VI — De Iove (Book 6, Jupiter)

Caput IV — Tycho's Jupiter observations (continued)

[This page continues the table of Tycho Brahe's observed Jupiter positions begun on the preceding page. The table is laid out in two parallel halves on the folio (page 306 left, page 307-side right). Columns: observation number; Year; Month; Day; Hour and Minute past noon [*post meridiem*]; Jupiter's observed longitude [*Long. ꝓ observata*] in Sign, Degrees, Minutes; Jupiter's observed latitude [*Latit. observata*] in Degrees, Minutes; and a final unlabeled column carrying the letters **A** or **B**. The longitude column repeats the zodiacal sign only when it changes; intervening rows take the sign from the row above.]

No	Ye ar	Month	D a H M. y . (p.mer.)			Long. ꝓ (Sign G. M.)	Lat. (Gr. M.)	A / B
1	15	August	5	1	0	♋ 27 14	1 30	A
6	83			2				
1		Septem ber	2	1	0	24 49	1 36	A
7			8	2				
1			5	1	0	♋ 23 45	1 36	A
8				2				
1		Decemb	6	1	0	23 38	1 36	A
9				2				
2			1	1	0	23 7	1 37	A
0			0	2				
2			1	8	30	20 59	1 18	A

No	Year	Month	Day	Hour	Minute (p.mer.)	Long. λ (Sign G. M.)	Lat. (Gr. M.)	A / B
1		er	1					
2	15	August	2	1	0	γ 5 22	1 14	A
2	84		0	0				
2		October	1	9	30	0 22	1 30	A
3			3					
2	15	March	9	7	15	γ 6 44½	0 58	A
4	85							
2	15	January	3	1	23	η 15 43 1/16	1 47	B
5	89		0					
2		Februar	2	0	30	η 13 2	1 30	B
6		y	1					
2	15	January	2	4	26	$\underline{\alpha}$ 17 45	1 28	B
7	90		4					
2		March	1	1	16	13 56	1 36	B
8			5	0				
2			2	1	20	13 11½	1 36	B
9			1	2				
3			2	9	50	12 39½	1 36	B
0			5					
3		April	1	1	16	9 54¾	1 34	B
1			7	6				
3		July	1	9	51	11 19⅔	1 19	B
2			1					
3	15	April	1	1	0	$\approx$ 14 16⅙	1 23	B
3	91		4	1				
3			2	2	22	13 38½	1 20	B
4			0					
3			2	1	52	13 15⅔	1 21	B
5			2	1				
3			2	1	52	13 7¾	—	B
6			3	1				
3			2	1	41	12 58	1 20	B

No	Ye ar	Month	D a y	H .	M. (p.mer.)	Long. $\sphericalangle$ (Sign G. M.)	Lat. (Gr. M.)	A / B
7			4	1				
3			2	9	44	12 44	1 20	B
8			6					
3			2	1	40	12 22 $\frac{4}{5}$	1 21	B
9			9	1				
4			3	1	46	12 15 $\frac{5}{8}$	1 20	B
0			0	1				
4	15	May	1	1	45	$\nearrow$ 15 33 $\frac{1}{3}$	0 37	B
1	92		6	2				
4			1	1	50	15 21 $\frac{1}{6}$	0 37	
2			8	1				
4			2	1	45	14 46	0 38	
3			2	1				
4			2	1	34	14 3	0 38	
4			8	1				
4			3	1	17	13 47	0 36	
5			0	1				
4			3	1	7	13 39 $\frac{1}{2}$	0 36	
6			1	1				
4	15	August	4	1	35	$\approx$ 22 31	1 8	A
7	94			1				
4			8	1	45	22 23	1 8	A
8				1				
4		October	2	6	34	18 43 $\frac{5}{6}$	1 2	A
9			8					
5	15	Septem	7	0	30	$\times$ 29 4 $\frac{4}{5}$	1 39	A
0	95	ber						
5			1	0	15	29 17 $\frac{1}{2}$	1 28	A
1			0					
5			1	0	10	29 10	1 39	A
2			1					
5		October	2	—	—	24 20	1 32	A

No	Year	Month	Day	Hour	Min. (p.mer.)	Long. $\sphericalangle$ (Sign G. M.)	Lat. (Gr. M.)	A / B
3			7					
5		November	1	—	—	24 5 $\frac{3}{5}$	1 21	A
4			3					
5		December	6	6	0	25 16 $\frac{2}{3}$	1 21	A
5								
5	15	January	1	5	42	Υ 1 7 $\frac{4}{5}$	1 9	A
6	96		6					
5			2	5	30	3 1 $\frac{1}{2}$	1 4	A
7			6					
5			2	5	48	3 42 $\frac{2}{3}$	1 0	A
8			9					
5		February	2	6	25	9 7 $\frac{1}{3}$	0 59	A
9			3					
6			2	7	47	10 43 $\frac{2}{3}$	0 57	A
0			9					
6		March	1	6	40	12 4	0 59	A
1			6					
6		July	2	1	0	$\sphericalangle$ 9 40	1 14	A
2			5					
6		August	8	3	0	10 32	1 18	A
3								
6		October	1	1	0	$\sphericalangle$ 7 59	1 27	A
4			1					
6			9	1	0	6 54 $\frac{2}{3}$	1 27 $\frac{1}{2}$	A
5			1					
6			1	1	0	6 30 $\frac{2}{3}$	1 27 $\frac{1}{2}$	A
6			2	1				
6			1	1	30	6 6 $\frac{5}{6}$	1 27	A
7			5	0				
6			2	1	0	5 8 $\frac{2}{3}$	1 26	A
8			2	1				
6			2	1	0	4 52 $\frac{1}{3}$	1 26	A

No	Year	Month	Day	Hour	Min. (p.mer.)	Long. λ (Sign G. M.)	Lat. (Gr. M.)	A / B
9			4	1				
7			2	1	0	4 45 $\frac{1}{6}$	1 26	A
0			5	1				
7		Decemb	5	7	56	γ 0 55 $\frac{5}{6}$	1 16	A
1		er						
7			1	7	30	0 46 $\frac{1}{4}$	1 14	A
2			2					
7			1	7	0	0 45 $\frac{1}{4}$	1 14	A
3			3					
7			2	6	30	0 53	1 9	A
4			0					
7	15	January	8	6	0	γ 1 44 $\frac{2}{3}$	1 6	A
5	97							
7		March	1	8	0	12 9 $\frac{5}{6}$	1 10	A
6			5					
7	15	January	9	1	8 $\frac{1}{2}$	ϵ 13 8 $\frac{1}{2}$	1 15	A
7	99			3				
7			2	—	—	11 5 $\frac{3}{4}$	0 17	A
8			6					
7		October	2	—	—	δ 18 10 $\frac{1}{3}$	0 39	B
9			0					
8		Decemb	3	—	—	20 0 9/10	0 0	
0		er	1					
8	16	January	1	—	—	δ 20 50	0 52	B
1	00							
8		Februar	3	—	—	17 4 $\frac{1}{2}$	0 49	
2		y						
8		March	1	—	—	12 33 $\frac{1}{3}$	1 7	
3			5					
8		April	7	—	—	11 45	1 2	
4								
8		April	2	—	—	12 25	0 59	

No	Year	Month	Day	Hour	Minute	Long. α (Sign G. M.)	Lat. (Gr. M.)	A / B
5			7					
8	May		2	—	—	12 45	0 59	
6								

After this table the running text resumes (page 306, right column, below the table):

Once the typographic printing of Tycho's observations had been begun, there was sent to me a specimen of the subjoined observation, made in Bohemia in the year 1600, which runs as follows.

[The following is a second, more detailed table — a single fully worked-out observation set. Columns: observation number; Month and Day [*Mens. Dies*]; the object or reference from which the distance was measured, under the heading **Distance from the fixed stars** [*Distantia à Fixis*]; and Jupiter's measured value [*Iouis*] in Degrees [*Gr.*], minutes [*I* = first minutes], seconds [*II* = second minutes/seconds]. Explanatory phrases run across the left of the table.]

No	Month / Day	Distance from the Fixed Stars	G r.	'	"
8	January 6, with Jupiter high	from the Heart of the Lion [<i>à</i>	2	5	4
7	on the meridian, degree 44 6'1/8	<i>corde</i> α , Regulus]	7	7	0
		Repeated twice	2	5	4
			7	7	0
		corrected nonetheless	2	5	4
		[<i>correcta tamen</i>]	7	5	0
		from Spica [<i>à Spica</i> $\mathfrak{M}$]	2	1	0
			6	6	
		Repeated	2	1	0
			6	6	
		corrected	2	1	0
			6	4	
8	January 9	from the Heart of the Lion [<i>à</i>	2	0	4
8		<i>corde</i> α]	8		0
		Repeated twice	2	0	4

Nº	Month / Day	Distance from the Fixed Stars	G r.	'	"
			8		0
		corrected	2	4	4
			7	8	0
		from Spica [<i>à Spica ♍</i>]	2	1	0
			6	9	
		Repeated twice	2	1	0
			6	9	
		corrected	2	1	0
			6	7	
	The meridian altitude of		4	1	4
	Jupiter [<i>Altitudo Meridiana</i>		4	4	0
	<i>Iouis</i>]				

[Between rows 88 and 89 the source inserts a prose remark spanning the description column:] Jupiter was in a straight line with Arcturus and Vindemiatrix, and by nearly the diameter of its own body it declined to the south from a line drawn through the Heart of the Lion [Regulus], and a third [reference].

Nº	Month / Day	Distance from the Fixed Stars	G r.	'	"
8	February, last day of the	from the Heart of the Lion [<i>à</i>	2	2	0
9	following night [<i>ultima die</i>	<i>corde Leonis</i>]	4		
	<i>noct. seq.</i>]				
		Repeated	2	0	0
			5		
		Repeated twice	2	5	0
			3	9	
		then [<i>pone</i>]	2	5	3
			3	9	0
		corrected	2	5	0
			3	7	
		from Spica of the Virgin [<i>à</i>	3	1	3
		<i>Spica Virg.</i>]	0	7	0
		Repeated	3	1	0

№	Month / Day	Distance from the Fixed Stars	G		
			r.	'	"
			0	8	
		Repeated	3	1	0
			0	9	
		Repeated	3	1	3
			0	9	0
		then [<i>pone</i>]	3	1	3
			0	8	0
		corrected	3	1	0
			0	6	

[Prose remark spanning the description column:] This discrepancy of the observation was caused by useless [instruments], by the excessive height of the pedestal, and by the unsteadiness of the fork on which the sextant is hung; but the meridian altitude of Jupiter was at that time —

| | | by the Quadrant [*Quadrante*] | 46 | 2 | 20 | | | better, by the Sextant [*Sextante melior*] | 46 | 5 | 0 |

№	Month / Day	Distance from the Fixed Stars	Gr		
			.	'	"
90	March 3, h. 11 30'	Longitude of Jupiter ♃ in ♎	18	12	30
		[<i>Longit.</i> ♃ ♎]			
		Southern latitude [<i>Latitudo Austr.</i>]	1	33	30

[Prose remark spanning the description column:] Since from the altitude of the Sun observed on the same day — which ought to have been 32° 5' 14" — it is gathered that the Quadrant gave readings smaller than the true value by 3 minutes, these altitudes [of Jupiter], with that [correction] added to the altitude of Jupiter, were thus corrected — and it was —

| | On the same day, distance [*Eodem die distantia*] | 46 | 5 | 20 | | | from the Heart of the Lion [*à Corde Leonis*] | 23 | 34 | 0 | | | Repeated | 23 | 35 | 30 | | | Repeated | 23 | 34 | 0 | | | from Spica of the Virgin [*à Spica Virginis*] | 30 | 42 | 30 | | | Repeated twice | 30 | 42 | 30 | | | Meridian altitude of Jupiter ♃ [*♃ Altit. Merid.*] | 46 | 9 | 50 |

[The table continues at the top of the next folio (page 307, left column), under the same heading layout — № 91 of the Bohemia observation set.]

№	Month / Day	Distance from the Fixed Stars	G		
			r.	'	"
9	March 4, near the opposition	from the Heart of the Lion [à	2	2	0
1	[<i>iuxta</i> ☿] of Jupiter ♃ with the	<i>Corde</i> ♏]	3	5	
	Sun ☉				
		Repeated twice	2	2	3
			3	5	0
		from the bright mane of the	2	3	3
		Lion [à <i>lucida iuba</i> ♏]	4	9	0
		Repeated twice	2	4	0
			4	0	
		from the third [star of the]	1	0	0
		wing of Virgo [à <i>tertia ala</i> ♍]	7		
		Repeated twice	1	0	4
			7		0
		Meridian altitude of Jupiter ♃,	4	1	1
		by the Quadrant [♃ <i>altit.</i>	6	1	0
		<i>merid. Quadr.</i>]			
		by the brass Sextant [<i>Sextante</i>	4	1	0
		<i>orichal.</i>]	6	3	
		Distant from Spica ♋ [<i>Distat à</i>	3	4	3
		<i>Spica</i> ♋]	0	9	0
		Repeated twice	3	5	0
			0	0	
	℞ at hour 11 30', longitude of		1	4	3
	Jupiter in ♏ [<i>Iouis longitudo in</i>		7	7	0
	♏]				
		northern latitude [<i>latitudo</i>	1	3	4
		<i>Borea</i>]		1	
	For this day, March 4:		6	1	4
	Declination of Jupiter [<i>Ad diem</i>			7	0
	<i>hanc 4. Mart. Declinatio Iouis</i>]				
		distance corrected from the	2	2	1

N ^o	Month / Day	Distance from the Fixed Stars	G		
			r.	'	"
		Heart of the Lion [<i>Dist. correctà à Cord. ♏</i>]	3	3	0
		hence the right ascension follows [<i>hinc prodit Asc. R.</i>]	1 6 9	1 4	4 4
		distance from the third [star of the] wing of Virgo, corrected [<i>Distantia à tertia alæ ♍ correctà</i>]	1 6	5 8	2 0
		hence the right ascension of Jupiter [<i>hinc Asc. Recta Iouis</i>]	1 6 9	1 3	5 0
		distance of Jupiter from the bright star of the neck of the Lion, corrected [<i>Distantia Iouis à lucida colli ♏ corr.</i>]	2 4	3 7	3 0
		hence the right ascension of Jupiter [<i>hinc Asc. Recta Iouis</i>]	1 6 9	1 4	1 7
		distance of Jupiter ♑ from Spica ♏, corrected [<i>Distantia ♑ à Spica ♏ correctà</i>]	1 6 9	1 5	3 7
		right ascension limited from every side [<i>Asc. recta vndiq; limitata</i>]	1 6 9	1 4	0
		hence again the longitude of Jupiter in ♏ [<i>hinc rursus longit. Iouis ♏</i>]	1 7	3 8	3 0
		northern latitude [<i>latitudo Bor.</i>]	1	3 0	5 0

Thus far from the autograph of Tycho [*Hactenus ex Authographo Tychonis*].

Caput V

Jupiter's observations made at Kassel by Jost Bürgi [Iusto Byrgio], instrument-maker [*Organopæo*] to the Landgrave of Hesse, selected from Snel [Snellio] among the Hessian observations, together with the Keplerian and Longomontanian [observations].

[This chapter opens with a table of observations from the Kassel (Cassel) observatory program. Columns: observation number; Year, Month, Day, Hour, Minute, old style, past noon [*Ann. Mens. D. H. M., stylo veteri, post mer.*]; and **Distance of Jupiter from the fixed stars** [*Distantia Iouis à Stellis Fixis*] in Degrees [*Gr.*] and Minutes [*M.*], with the named reference star. Most entries carry two distance measurements (to two different stars).]

N ^o	Year	D H M G					from star
		Mo.	.	.	.	r. M.	
1	1590	Dec	5	1	1	2 0	from Spica [à Spica]
		.		3	8	2 8 20	from the Northern Scale [à Lance Borea]
2	1591	Jan.	2	1	3	2 13 ½	from Spica
			9	6	0	9 8 2½	from the Northern Scale
3		Jun	8	9	1	2 37 ½	from Spica
		e			0	0 3 21	from Arcturus [ab Arcturo]
4	1593	Apr	7	1	0	4 28	from Antares [ab Antare]
		.		5		7 2 10	from the bright star of the Eagle [à lucida Aquilæ]
5	1594	July	2	1	0	4 31 ⅓	from the bright star of the Eagle
			3	0		0 5 48	from the head of Andromeda [à cap. Andromedæ]
6		Sep	1	8	3	3 1	from the bright star of the

N ^o	Year	D H M G					from star
		Mo.	.	.	.	r. M.	
		t.	6	0	7		Eagle
					4	52	from the leg of Pegasus [à crure Pegasi]
					6	$\frac{1}{3}$	
7	1597	Sep	1	1	4	1	from Aldebaran [ab Aldebara]
		t.	3	4	5	3	
					1	53	from the bright star of the right shoulder of Orion [ab lum. dext. Orió.]
					6	$\frac{1}{2}$	
8		Oct.	1	1	1	1	from Aldebaran
					3	1	3
					2	47	from Capella [à Capella]
					3		
9	1595	Sep	1	1	0	3	from the third star of Aries [à tertia Arietis]
		t.	1	1		3	$\frac{1}{2}$
					3	9	from the leg of Pegasus [à crure Pegasi]
					3		
		this ought to have been placed above [<i>debut hæc poni supra</i>]					

Below the table (page 307, left column):

Boulliau [Bullialdus], in *Astronomia Philolaica* book 7, chapter 3 [*l. 7. c. 3.*], using the observation of the year 1591, January 29, gathers the place of Jupiter as Scorpio 17° 9' 22", with northern latitude 1° 21' 14"; and for the year 1597, September 13, the place [of Jupiter as] Π [Gemini] 16° 14' 11", with southern latitude 0° 35' 29".

Caput VI

Jupiter's observations made by Pierre Gassendi [Petro Gassendo], Ismaël Boulliau [Ismaele Bullialdo], Martin Hortensius [Martino Hortensio], [Philip] Lansbergen [Lansbergio], Johannes Hevelius [Ioanne Heuelio], and Vicenç Mut [Vincentio Muto], from the year of Christ 1620 to 1650.

1. In the year 1620, on November 4, new style, at hour 8 after noon, at Aix [Aquis Sextiis], Pierre Gassendi observed with a cross-staff [*Radio*] the distance of Jupiter from the head of Medusa [à *capite Medusæ*] as 23° 58', and presently as 6° 35' from Aldebaran; and 18° 30', or 31°, [from] the foot of the eastern [star] of Orion,

and its right shoulder [*humerum dexterum*] as $18^{\circ} 34'$ — which Tychonically is $18^{\circ} 35'$. Hence he deduced Jupiter in Taurus $16^{\circ} 25'$, with northern latitude $1^{\circ} 18'$. So he reports in his *Life of Claude Fabri de Peiresc* [*in vita Claudij Fabricij Peireskij*].

2. In the same year, on November 5, at hour $7\frac{1}{2}$, Gassendi there [*ibidem*] saw Jupiter distant from the head of Medusa $24^{\circ} 4'$, then $3'$, then $5'$; and from the bright star of the Pleiades [*à lucida verò Pleiadum*] $9^{\circ} 55'$; then $55\frac{1}{2}'$. From this he inferred the longitude of Jupiter in Taurus $16^{\circ} 16'$, with southern latitude $1^{\circ} 16\frac{1}{2}'$. The same [is found] in the life [of Peiresc] of which I spoke above.

3. In the year 1620, on November 7, at Aix, the same [Gassendi] observed the opposition of Jupiter with the Sun, as we have it in the records [*in schedis*] sent to me by Dom. Dominicus Cassinus [Giovanni Domenico Cassini] himself from Bologna.

4. In the year 1623, on October 12, at hour 17 [*hor. 17.*], at Loudun [*Loduni*] in France, Boulliau observed Jupiter farther advanced in longitude than Regulus by 3 minutes, and more northerly by 8 minutes; from which he deduced Jupiter to be in ♌ [Leo] $24^{\circ} 40'$, with northern latitude $35'$. So he himself [reports] in book 7 [of the] *Astronomia Philolaica*, chapter 3.

5. In the year 1627, on April 25, old style, at hour 1 after noon, at Leiden [*Leydæ*], Martin Hortensius [Martinus Hortensius] observed Jupiter more to the west than the topmost star of the forehead of Scorpio [*supremâ frontis Scorpj*], by almost 5 minutes. So Lansbergen [Lansbergius], in the *Thesaurus*, records it as 5 in longitude [5. *Iouiali*], affirming that that star [*Stellam illam*] was in Scorpio $28^{\circ} 6'$, with northern latitude $1^{\circ} 4'$; and accordingly Jupiter in $28^{\circ} 1'$, with northern latitude $1^{\circ} 3'$; but from his own tables [it would be] $28^{\circ} 1' 47''$ Scorpio, with northern latitude $1^{\circ} 5'$.

6. In the year 1629, on October 20, old style, Jupiter was observed at Middelburg [*Middelburgi*] in a straight line with two stars preceding it [*præcedentis*] in the horn of Capricorn [*cornu Capricorni*]; so Lansbergen in the *Thesaurus* records, on the observation of Jupiter, who concludes from this that Jupiter was in Aquarius $0^{\circ} 17'$, with latitude $44'$.

7. In the year 1633, Pierre Gassendi diligently observed the opposition of Jupiter with the Sun, on December 14 in the evening, near the hour 9 of the night. For he saw Jupiter distant from Aldebaran $22^{\circ} 21'$, and from the left shoulder of Orion [*ab humero sinistro Orionis*] $19^{\circ} 35'$; but in the daytime [*die autem*] on the 17th, [it was] distant from Aldebaran $21^{\circ} 56'$, while from the same left shoulder [of Orion] $19^{\circ} 19'$; in the observations sent to me from Bologna by Dom. Cassini.

8. In the year 1633, on December 17 in the evening, Gassendi at Digne [*Diniæ*] saw Jupiter retrograde near Propus of Gemini [*Retrogradum Propodi Geminorum*], so that from the margin it could scarcely be discerned as moving, were it not that — by the telescope [*Telescopio*] — it was seen to be separated [from Propus]. The arrangement of the Medicean stars [*Mediceorum siderum situs*, i.e. Jupiter's moons] indicated the star [Propus] left behind to the north [*ad Boream*]. On the 18th in the evening, at hour 8½, it was being hidden to the naked eye [*nudo oculo*] under the rays of Jupiter, but the telescope showed it standing apart from Jupiter's diameters [*Iouis diametris*], and to the north. On the 19th in the morning, at hour 4½, it was nearer, and still to the north; nor can the angles be made out with certainty, since the line drawn through the Mediceans was distant from Jupiter by 4 diameters. On the same [day], in the evening, at the same hour 8, it was nearer, and Jupiter was to the east, and distant from it — as far as it had been in the morning to the east — but the angle, since in the centre of Jupiter it made [it] sharper [*acutior*] toward the east than it had been in the morning toward the west. For the rest, the line of Jupiter's satellites is perpetually inclined to the ecliptic, and can, near a conjunction of Jupiter and Propus, be reduced [to] the middle time, or to [the moment] under the meridian on the 19th. So [it is reported] from Gassendi in the *Epicurus*, *Meteorology* page 906.

9. In the year 1634, Gassendi observed the station of Jupiter, comparing it by the telescope with the little fixed star [*Stellula Fixa*] to which Jupiter was approaching, on February 15, after hour 10 in the evening; it stood [*stitit*] almost normal [perpendicular] with respect to the line of the Mediceans, distant from the said star to the south [*ad Austrum*] by three of its own diameters; and in the same arrangement it appeared on the 16th. As it was on the 17th, so it was on the same [day]; but it was in contrary directions [*in contrarias plagas*], although it was distant from the said star by three diameters on the 17th. The arrangement was alike on the 18th. But on the 15th and 16th it was distant from Aldebaran 17° 17'; and from the right shoulder of Orion 16° 16'; to a finer minute, and the latitude to the north 0° 8'. So Gassendi above.

10. In the year 1634, Jupiter [being] now direct [*iam Directus*], on April 11: nearest to Propus, and the acute angle with the line of the Mediceans toward the west, distant by 10 [diameters?] from Propus toward the north, by the diameters of itself [Jupiter], the telescope showing [it]; while on the 12th the angle was nearly equal, [as] before; for which reason the conjunction of Jupiter and Propus took place around the intermediate time. So from Gassendi in the *Epicurus* page 906.

11. In the year 1634, on April 12, at hour 8½, at Paris, Boulliau, with an optical tube [*optico tubo*], observed Jupiter separated from Propus toward the north by 9 minutes, while toward the 10th, and as to azimuth scarcely toward the west [*occidentaliorem*], yet judged the position toward the zodiac; [he] had now passed beyond the place of Propus, which was in Π [Gemini] $25^{\circ} 56'$; Jupiter then in Π $25^{\circ} 53'$, with northern latitude $14'$. So [he reports] in book 7 of the *Astronomia Philolaica*, chapter 3.

12. In the year 1634, on December 4, at hour 19 [*hor. 19.*], at Loudun [*Loduni*], Boulliau with a tube observed Jupiter distant $17'$, or $18'$, [to within] the smallest minutes, to the north from the small ass [*ab Aselo*], to the north of Jupiter [*Boream versus*]; the position as to azimuth toward the eastern parts [*ad Azimuthum partes orientales*]. From this he judged Jupiter to obtain the same place with the said star in Π [Gemini], with northern latitude $14'$.

13. In the year 1635, on January 18, the opposition of Jupiter with the Sun [was] determined by Gassendi; to which [agree] the records from Aix on the 16th, in the evening, [where] he saw Jupiter distant from Procyon $18^{\circ} 41'$, and from Castor $16^{\circ} 16'$; but on the morning of the 17th, at hour 5, he saw [it] distant from Castor $16^{\circ} 58'$; and from Pollux $12^{\circ} 42'$; and from Regulus $25^{\circ} 27\frac{1}{2}'$. So [it is reported] in the observations sent to me from Bologna by Dom. Cassini.

14. In the year 1636, on February 19, Gassendi notes, in letters [sent] to Cassini, the opposition of Jupiter with the Sun; because at Digne, on the 20th in the evening, he saw Jupiter distant from the neck [of the Lion] $9^{\circ} 18'$, and from Regulus $5^{\circ} 10'$.

15. In the year 1637, on July 16, Boulliau saw with the tube Jupiter applied to a star, which is the sixth in the Wing of Virgo [*sexta in Astro Virginis*], preceding it; and four of them [*quatuor*], which is on its left [*in alia eius sinistra*]. At hour 1, it was distant from that [star] by 12 minutes; and at hour 4½ and 9, but more to the west [*occidentior*] by $12\frac{1}{2}$ minutes; therefore I reckon Jupiter to have preceded the star by 12 minutes; and so it lingered [*versari*] in Virgo $29^{\circ} 38'$, with northern latitude $1^{\circ} 18'$. So [he reports] in book 7 [of the *Astronomia Philolaica*], chapter 3.

16. In the year 1639, [near] the opposition of Jupiter with the Sun (it is ascribed to the day of May 20 [*diei 15. Maij*]) it was observed at Aix; in the records sent to Cassini, [in which] Aix [*Aquis Sextiis*] saw Jupiter distant from the Southern Scale [*à Lance Austrina*] $21^{\circ} 5'$, but to the north $18^{\circ} 21\frac{1}{3}'$.

17. In the year 1639, on August 31, at hour 8, at Paris, Jupiter returned again [*denuò rediit*] to the bright star of the forehead of Scorpio [*ad lucidam frontis*]

Scorpij]; [it] was distant by about 24', or somewhat more, in azimuth [by] six minutes toward the east; for which reason it scarcely [departed] by one [minute], or by a scruple [*scrupulo*], surpassed [*superaverat*] the star in longitude, whence — by other surrounding circumstances — Boulliau reckoned Jupiter to be in ♄ [Scorpio] 28° 5', with northern latitude 42'. So [he reports] in book 7 [of the *Astronomia Philolaica*], chapter 3.

18. In the year 1646, Dom. Vicenç Mut [D. Vincentius Mutus], at Majorca [*Maioricæ*], observed through several days, in the month of February, the opposition of Jupiter, by a foot preceding [the star] of Gemini [*ad præcedentem pedem Geminorum*]; and on the night of the 19th day he found Jupiter in total station [*in totali statione*], and from this most southern star [*à Stella occidentaliorem*] [distant] 5', and more northerly by 9', with 10', as in the letters from him given to me.

19. In the year 1646, on December 24, new style, in the evening, Hevelius at Danzig [*Dantici*] observed Jupiter covered [*tectum*] by the Moon, which page 477 of the *Selenographia* narrates [as] its emergence from the Moon at hour 8 39½'; observing the occultation of [the star] Regiomontanus of Prussia [*Regiomontano Prussiæ*, a lunar crater] at hour 7 53'; observing [the crater] Albertus Linemann [*Albertum Linemannum*], and so at Danzig at hour 7 45' 33"; as Hevelius reckons.

20. In the year 1647, on January 20, Gassendi at Paris, at hour 14 10', saw the northern margin of the Moon, [where] the southern margin of Jupiter was distant by half a spot of Caspia [*per semissem maculæ Caspiæ*], by the telescope used; at hour 14 17', the Moon touched the margin of Jupiter, and after a half-minute he began to emerge; at hour 15 0' 30" he [Jupiter] withdrew to the western margin of the Moon; but the arc of the lunar limb between the points of Immersion and Emersion was 72 degrees. So [it is reported] in the *Epicurus* page 901.

Hevelius too, on the same day, on the 20th, has it [on] page 480 of the *Selenographia*; [the same] observed the transit of Jupiter as above. On the Moon at hour 15 57'. So I reckon that Jupiter was at the very limb of the Moon, while it still lingered at the same hour 7.

21. In the year 1647, on April 12, new style, in the evening, Hevelius at Danzig [*Gedani*], observing Jupiter passing beneath the Moon, noted its conjunction with the Moon, [so far] as he noted in longitude, at hour 11 14' 50" after noon, [Jupiter being in] high Arcturus 13° 10'; and then Jupiter, at the northern cusp of the Moon, was seen to be cut into a dichotomy [*dichotomâ*] by 6', as he himself reports in the *Selenographia*.

The same phase Gassendi observed at Paris, when — the Moon being less perceptible [*insensibilior*] — the greater dichotomy appeared at the northern cusp [being] under the Moon, when Jupiter, seen by the telescope, touched the limb of the Moon, [it] scarcely seemed to be obscured, but truly began to be obscured by little intervals; and indeed at hour 10 4'; and the half precisely [*dimidium præcisè*] was wanting to Jupiter, and it was reckoned a pleasant sight that Jupiter, divided in half [*dimidio sui*], and afterward even less, than the half was unequally illuminated by the Moon, [it] standing out [*prætenuiret*] for a whole hour of demonstration; at hour 9½, the whole emerged distinctly; from the cusp, [it was] less than a quarter [*dodrantem*] in the longitude of the spot Caspia [*Caspiæ maculæ*].

In the same year likewise, and on the 12th of April, Dom. Vicenç Mut [D. Vincentius Mutus] at Majorca observed Jupiter eclipsed by the Moon, when Regulus was occulted to the west [*occidentalis*], the second altitude being 57° 18'; that is, at hour 9 56'; he began to be occulted at the northern cusp of the Moon, and egressed from the high Regulus 49° 12'; but to the north [it was] 10° 48', so that he lay hidden under that [Moon] by 52'. In another letter sent to me by him, on the 12th, [the same is] observed; that, from my [calculation of] the altitude of the latitude of the city of Majorca 39° 35'; therefore from the diversity of the parallax, the Moon — Jupiter being nowhere else than [elsewhere], [it] touches nothing of Jupiter — [is] elsewhere of them.

22. In the year 1647, through several days of December, Dom. Vicenç Mut, observing Jupiter with the shapeless star from the belly of Leo [*cum informi Stella sub ventre Leonis*], detected the total station of Jupiter to have occurred on the 27th, at hour 14, at Majorca; when Jupiter was still occidental [*occidentalis*] from that star by 3', and more southerly by 9', or 10'. To examine this observation, and to scrutinize the radius of the orbit of the world [*Radium orbis Mundi*], the Sun being in perigee, and because the variety of station can hence be gathered, the quadrature with the Sun is possible.

23. In the year 1650, the same Vicenç Mut [Vincentius Mutus], on 18 April, at hour 10 at Mallorca [Maioricæ], using a special instrument and a very large one, observed Jupiter to be distant from the star in the southern foot of Virgo by 3° 26'. From this, and from the observed latitude, he concludes that Jupiter was in Scorpio 5° 22'. To this the Lansbergian tables agree, with a deviation of 1' Danish; the Prutenic by 2', the Boulliau [Bullialdici] by 3', the Rudolphine by 11'. So he himself, in a letter to me.

24. In the same year, likewise on 21 April, from the latitude of Jupiter and a distance of $5^{\circ} 18'$ from the southern Balance [Lance Austr.], he inferred that it was in Scorpio $5^{\circ} 0' 40''$, with deviations as above, the Tables being named.
25. Likewise in the same year, there on 2 May, he saw Jupiter distant from the southern Balance by $6^{\circ} 41'$, and from the lowest southern star of the three forming the fringe of Virgo by $4^{\circ} 20'$; therefore it was in Scorpio $3^{\circ} 37'$, which agrees with the Prutenic, but with deviations: Danish $2'$, Boulliau $3'$, Lansbergian $4'$, Rudolphine $11'$. On 16 May, it was very nearly in the same longitude, being distant from the southern star in the foot of Virgo by $53'$; from which Jupiter's latitude was northern $1^{\circ} 24'$.
26. In the same year there, on 24 May, at hour $8\frac{1}{2}$, while D. Vicenç Mut was observing, a line drawn from the lowest, southern, of the three forming the fringe of Virgo to the star in the southern foot of Virgo grazed the western limb of Jupiter; thereupon Jupiter was distant from the aforesaid lowest by $2^{\circ} 15'$. From this he deduced Jupiter's longitude as Scorpio $1^{\circ} 12'$, and its northern latitude as $1^{\circ} 23\frac{1}{3}'$, with deviations from the longitude observed by the Boulliau Tables of $3'$, the Prutenic and Danish of $4'$, the Lansbergian of $8'$, the Rudolphine of $11'$. So he himself, in the same letters.
27. In the year 1649, again there, on 11 May, he observed Jupiter to be more easterly than the four stars preceding in the wing of Virgo by $2'$, or at most $1^{\circ} 30'$, and distant a little less than the two adjacent in the second Hyad. But on 9 June Jupiter was more westerly than that same star by one of its diameters exactly, and more northerly by scarcely more than its semidiameter. On the 10th, however, it was now more easterly in the same hour, so that in 24 hours it had completed three of its own diameters.

CAPUT VII.

Appendix of observations of Jupiter from the Tychonics recently published at Vienna, from the press of David Hautt, from which we have selected a few, and from *The Author of Urania Propitia* and from the Fathers of Innsbruck [PP. Oenipontanorum].

1. In the year 1582, on 30 March, in the morning at hour 4 $10'$, Jupiter stood distant from the mouth of Pegasus by $24^{\circ} 24\frac{2}{3}'$, and after 6 minutes of time from the Eagle [Aquila] by $35^{\circ} 32'$.

2. In the same year, on 7 April, in the morning at hour 3 36', Jupiter was distant from the mouth of Pegasus by $24^{\circ} 10\frac{1}{3}'$ — but too near the horizon — and at hour 3 50' was distant from the Eagle by $36^{\circ} 16\frac{1}{4}'$.
3. In the same year, on 2 November, at hour 5 54' 55", Jupiter was on the meridian at an altitude of $16^{\circ} 34'$, and at hour 6 was distant from the extremity of the tail of Capricorn by $3^{\circ} 48'$. But on account of the excessive nearness of the stars it could not be exactly observed. At hour 8 19' it stood, by repeated measurement, distant from the Vulture's bright star [Iucida Vulturis, i.e. Vega] by $35^{\circ} 2\frac{1}{2}'$, and at hour $8\frac{1}{3}$ was distant from the first star of Pegasus's wing once, and again by $38^{\circ} 34\frac{1}{2}'$; but on the following noon the clock, which he had used, was found to run slow by 15' 40".
4. Likewise in the year 1582, on 12 November, Jupiter was observed by the radius [Radium], which we trust little.

From The Author of Urania Propitia, Part 2, chapter 14, or from page 90.

5. In the year 1627, on 6 May, the said author in Silesia, with a telescope of an aperture capacity of 14 minutes, observed Jupiter to be more easterly than the topmost of the front of Scorpio by $3\frac{1}{2}$ minutes; and thus, in Tychonic terms, in Scorpio $28^{\circ} 2'$. This was on 16, new style.
6. In the year 1629, the same author from 17 October to 29, by several observations, saw the place of Jupiter to exceed the Rudolphine place by about 9'.
7. In the year 1649, the same author, on 11 May in the evening, through the aforesaid telescope noted Jupiter with a single minute more easterly than the little star 1 of the wing of Virgo; and thus, in Tychonic terms, in Virgo $29^{\circ} 56'$ — though nonetheless the Rudolphine calculation gives $29^{\circ} 46'$.
8. Add to these the conjunction of Jupiter and Mars observed at Prague in the year 1604, on 8 and 9 October, from which Kepler [Keplerus] concluded that it occurred a little before midday on the 9th. [Margin: ♂ ♀ &c / ♂]
9. Add also the distance of Jupiter, which D. Vicenç Mut, in the year 1659, on 30 March at hour 8, observed more westerly by 25' — at the nebulous Praesepe [Nebulosâ Præsepe], as he wrote to me. [Margin: 2]

Select observations of Jupiter made at Innsbruck [Oeniponti] by the Fathers of the Society of Jesus, and transmitted to me by Father Michael Staudacher.

10. In the year 1635, on 9 September, in the morning, between hour 4 and 5, the Moon covered Jupiter, which was then in longitude $15^{\circ} 5'$, and at an altitude of $15^{\circ} 5'$. Aldebaran [Aldebata] was at an altitude of 31° . The remaining observations stand as follows:

An. 1635. Mens. D.	(time)	Distantia $\sphericalangle$ à Fixis	Altitudo ab Horiz. Fixarū G.	Horiz. Iouis G. '
		(star)	Gr. '	
Sept. 19	manè	Canicula	36 25 45 40	7 50
		Pollucis cap.	36 42 20 $1\frac{1}{2}$	
Octob. 2	manè	Canicula	39 44 45 $1\frac{1}{2}$	28 15
		Iuba $\sphericalangle$	7 30 15 11	
7	manè	Canicula	39 46 30 53	32 55
		Iuba $\sphericalangle$	8 30	
Martij 18	1636 vesper e	Regulo	2 47 18 18	48 6
		Iuba $\sphericalangle$	7 54 45 59	
31	vesp.	Regulo	1 51 40 18	51 30
		Iuba $\sphericalangle$	7 40	
April. 16	vesp.	Regulo	0 55 40 54	56 30

An. 1635. Mens. D.	(time)	Distantia ♀ à Fixis	Altitudo ab Horiz. Fixarū G. '	Horiz. Iouis G. '
		Canicula	38 2	
Maij 30	vesp.	Iuba Leon.	8 16	Reguli 31 40
		Cauda ♀	22 1	30 25
Iulij 10	vesp.	Arcturo	52 17	55 35 10 23
		Dubhe	52 31	
Dec. 24	vesp.	Regulo	39 27	Spica Me rid .
		Arcturo	32 50	32 45 42 16 ½
Januar. 21	1637	Arcturo	32 20	29 0
		Lyræ lucid.	91 4	54 27
Martij 14		Regulo	36 25	48 55 18 44
		Cauda ♀	17 51	36 33
Martij 21		Regulo	35 30	55 31 30 40
		Arcturo	34 26	27 25

CAPUT VIII.

Select observations of Jupiter chosen from those which the Fathers Giovanni Battista Riccioli [Io. Bapt. Ricciol.] and Francesco Maria Grimaldi [Franc. Maria Grim.], of the Society of Jesus, carried out together with other companions of the same Society of Jesus in the College of S. Lucia at Bologna.

With some observations added at the end by the most illustrious Marquis Cornelio Malvasia [Marchion. Cornelij Maluasias].

1. In the year 1642, on the night following the 5th of September — on which the opposition of Jupiter with the Sun was celebrated — the meridian distance of Jupiter from the Sun was $22^{\circ} 31' 30''$. Saturn was at a meridian altitude of $49^{\circ} 50'$. From the meridian altitude of Jupiter, and from the transit of the bright star in the southern tail of the Whale [cauda Ceti australis] by the meridian-line [per M. C.], there were computed, by the aid of a perpendicular, $7' 10''$; from the transit of that same Tail [we obtained] Saturn's distance to be $8^{\circ} 0'$.
2. In the year 1642, on 18 September, about the first hour of the following night, Jupiter was distant from the brightest star of Aries [lucissima Arietis] by $53^{\circ} 29'$, and from the bright star in the bridle of Aries [Mandibula] by $25^{\circ} 34'$.
3. In the same year, on 1 October at the following night, the western altitude of the Eagle [Aquila] flowed by $53^{\circ} 11'$ over $5' 45''$ of time; at which time Jupiter was distant from the bright star of the Eagle by $50^{\circ} 47'$; and then, a few minutes afterward, it was distant from Scheat of Pegasus by $23^{\circ} 1'$.
4. In the year 1643, on 10 February at the following night, hour 2, Jupiter was seen at an altitude of 6° , and distant from Scheat of Pegasus by 30° ; from the head of Andromeda [capite Andromedæ], $31^{\circ} 44\frac{1}{2}'$.
5. In the same year, on 11 February, hour 3, in Italian civil reckoning, Jupiter was at an altitude of 9° ; it was distant from Scheat of Pegasus by $32^{\circ} 13'$; at Markab of Pegasus, $20^{\circ} 37'$; and a hundredth part of that observation was made more accurately.

6. In the year 1643, on the night of the 23rd, hour 1, on 23 February, Jupiter was at an altitude of 9° , and distant from the girdle of Andromeda [cingulo Andromedæ] by $39^{\circ} 52'$; from the bright star of Aries by $39^{\circ} 1'$.
7. In the year 1643, on 18 June at the following night, the western occidental altitude of the Eagle, which was $46^{\circ} 2'$, was measured over $21\frac{1}{2}'$ of time; and Jupiter was distant from the bright star of Aries by $15^{\circ} 42'$. Then, after 2 minutes of time, it was distant from Saturn by $13^{\circ} 10'$ — at which time the place of Saturn, related to the same place, was sought from the observation.
8. In the year 1643, on 15 July in the morning, the altitude of the bright eastern stars of Aries was taken, and after an elapse of 6 minutes of time it was taken from the Sextant; the distance of Jupiter from the same bright star of Aries, repeated, was $46^{\circ} 50'$; from the bright star, twice, by $14^{\circ} 29'$; but after this minute of time, by repeated observation, it was distant from Aldebaran by $41^{\circ} 21'$, when Aldebaran was at 19° ; and Jupiter about [hour] 1 [□ = in quadrature?] with the Sun.
9. In the same year, when both the altitude was taken at hour 10 in the morning, against the eastern stars of Aries by $58^{\circ} 27'$, and after 7 minutes of time it was distant from the bright star of Aries by $13^{\circ} 56'$, and after 6 minutes of time it was distant from Aldebaran by $44^{\circ} 13'$; after the sesqui-quadrant of the hour it was distant from Saturn once, and at that time Jupiter [□] with the Sun at hour 17, precisely.
10. In the year 1643, on 3 August in the morning, the bright star of Aries was at an altitude at rising of $48^{\circ} 48'$; the numbers taken are 1, after we had seen Jupiter distant from Capella by $56^{\circ} 7\frac{1}{2}'$, and after 6 minutes of time it was more distant from Aldebaran by $40^{\circ} 2\frac{1}{2}'$.
11. In the same year, on 8 August in the morning, another was at rising: Aldebaran by $44^{\circ} 40'$, the elapse thence of 7 minutes of time. Jupiter was distant from the same Aldebaran twice by $39^{\circ} 51'$; and after 5 minutes of time distant from Capella by $55^{\circ} 59\frac{1}{2}'$.
12. In the year 1643, on 9 August, in the morning, another altitude: Aldebaran from rising $45^{\circ} 16'$; thence after 7 minutes Jupiter was distant from Aldebaran by $39^{\circ} 51'$, and again by $39^{\circ} 50' 7\frac{1}{2}''$; and after 4 minutes of time it was distant from Capella by $55^{\circ} 59'$; and besides, just now, $20''$ — just now $40''$.

13. Again in the year 1643, on 11 August, in the morning, another Aldebaran from rising $47^{\circ} 55'$; thence after 5 minutes it was distant; Jupiter was distant from Aldebaran by $39^{\circ} 51'$; and by repeated observation after 6 minutes of time it was distant from Capella once by $55^{\circ} 58\frac{1}{3}'$; again after by $55^{\circ} 58'$.
14. On the following day, on the 12th, in the morning, another Aldebaran from rising by $42^{\circ} 37'$; after 6 minutes of time, Jupiter was distant from Aldebaran by $39^{\circ} 51'$; and the same again, as often; and after 5 minutes of time it was distant from Capella by $55^{\circ} 59'$.
15. The day after, that is on 13 August, in the morning after the altitude of Aldebaran at rising $41^{\circ} 24'$, there were numbered 5 minutes of time, while Jupiter was distant from Aldebaran by $39^{\circ} 51'$; again after 5 minutes $50\frac{1}{2}'$, and at Capella by $55^{\circ} 59'$.
16. The following day, on the 14th of the same month, almost an hour before sunrise, Jupiter was distant from Aldebaran by very nearly $39^{\circ} 52'$; and from Saturn in the morning by $17^{\circ} 50'$. Then after 1, nearly the quadrant, Jupiter crosses the meridian, its meridian distance from the vertex being $36^{\circ} 9\frac{1}{2}'$; at a high distance it appears at $50'$; the distance of Jupiter seen from the center of the Sun, taken by the hemicycle, was $116^{\circ} 41'$. Earlier, it had really stood distant by [the] light, of Aries by $13^{\circ} 43'$.
17. In the year 1643, on 15 August, in the morning in the dawn, on the most fortunate Assumption of the Blessed Virgin, on which day it was an Italian feast: Jupiter crossed the meridian, its distance from the vertex being one quadrant, which was $36^{\circ} 9\frac{1}{3}'$; in the other two days by $36^{\circ} 10'$. After this transit, there were numbered 16 minutes; Jupiter was distant from the bright star of Aries by $13^{\circ} 43'$; and it stood at the same distance from Aldebaran by $39^{\circ} 53' 15''$; again it really was distant by $39^{\circ} 53' 10''$; and after 6 minutes of time it was distant twice from Capella by $56^{\circ} 0' 15''$. At its rising, Jupiter was twice seen distant from the center of the Sun by $116^{\circ} 34'$; but refraction was diminishing the distance.
18. In the year 1643, on 21 August, Aldebaran was at rising $53^{\circ} 9'$; and after 3 minutes of time Jupiter was distant from Aldebaran by $39^{\circ} 52\frac{1}{3}'$; after 6 minutes of time it was distant from Capella by $56^{\circ} 2\frac{1}{3}'$.
19. In the same year, on the 24th, in the morning Aldebaran was distant from the vertex toward rising by $34^{\circ} 10'$; and after 13 minutes of time it was

distant from Jupiter by $40^{\circ} 18\frac{1}{2}'$; and after three minutes it was distant from the bright shoulder of Orion [lucido humero Orionis] by $60^{\circ} 2'$.

20. In the year 1643, on 12 October at the following night, Jupiter, approaching opposition with the Sun on the meridian, was distant from the vertex by $38^{\circ} 5'$; and then Aldebaran was distant from the vertex at rising by $47^{\circ} 54'$. [Margin: 8]

21. In the year 1644, on 1 January in the evening, Jupiter was eastern and at an azimuth precisely 11 degrees, at the same moment at which Father Giovanni Battista Riccioli [P. Io. Baptista Ricciolius] observed; it was distant from the bright star of Aries at rising from the vertex by $39^{\circ} 15\frac{1}{3}'$.

22. In the year 1644, on 17 July, in the morning, after the western altitude of the Eagle of $38^{\circ} 30'$. The horizon sounds the hour 2 Italian; thence after 4 minutes of time Jupiter was nearest to the Sun in Virgo by $31^{\circ} 42\frac{1}{3}'$ & $\frac{1}{3}$; and after 24 minutes it was distant from the northern horn of Taurus [cornu Boreo Tauri] by $19^{\circ} 48'$.

23. In the year 1644, on 1 August, in the morning, the bright star of Aries was distant from the vertex by $44^{\circ} 50'$; thence after half an hour Jupiter was distant from Capella by $30^{\circ} 12'$; distant from Saturn by $36^{\circ} 45'$; but at Italian civil hour $7\frac{1}{3}$; Jupiter was distant from Mars by $3^{\circ} 12'$. [Margin: ♂]

24. In the year 1644, on 21 August, when Jupiter was tending toward [the Sun in quadrature, □], in the morning Aldebaran was distant from the vertex by 44° ; immediately Jupiter was distant from Capella by $28^{\circ} 50\frac{1}{2}'$; and after 10 minutes of time it was distant from the bright star of Aries by $39^{\circ} 26'$.

25. In the same year, on the 22nd of the same month, after one minute of the subsequent time, the distances of Jupiter from the stars were taken — the altitude of Aldebaran having been taken first, $50^{\circ} 12'$ — in the morning.

Min. Temp. M.	Distant. Iouis G. '	à Stellis
4	29 23	à Lucida Υ
2	28 54	à Capella
4	46 14	à Π capite præcedeti
2	48 37	à Π cap. sequenti
4	13 46	à Π pede lucido
4	39 36	à Saturno

Insert here Observations 59, 60, 61, 62, to be placed below.

36. In the year 1648, on 25 May, hour 1 of the following night — that is, Jupiter was seen distant from the head of Castor [Castoris capite] by $42^{\circ} 43\frac{2}{3}$; at.
37. In the year 1649, on 2 June, about hour 2 of the following night, when the head preceding Gemini, distant from the vertex by $52^{\circ} 2'$, Jupiter was distant from Regulus by $34^{\circ} 44\frac{1}{2}$; and from the bright mane of Leo [iubæ Leonis] by $35^{\circ} 34\frac{1}{2}$.
38. Again in the year 1649, on 9 June at the following night, Jupiter was seen more westerly than that star of Virgo which precedes the four stars of the left wing [quatuor alæ sinistræ], or whose longitude was $29^{\circ} 59'$ — of Virgo — and northern latitude $1^{\circ} 25'$. But on the 10th, Jupiter in the same hour was seen more easterly than the aforesaid star, so that it was seen on the day before, distant from the vertical of the aforesaid star, orthogonally, by $4\frac{1}{2}$ Semidiameters of its own; on the day after the aforesaid orthogonal Semidiameters 4 precisely. But on the eleventh [day], the Jovian Semidiameters were $10\frac{1}{3}$. Therefore, since the diurnal motion was then less, of three [Semidiameters], and since Jupiter on the 10th had been in [Libra] grade $0. 2''$; it had been more southerly than the aforesaid star by very nearly one diameter of its own. But how from this is deduced the apparent diameter of Jupiter — it has been said in book 7 of the *Almagestum Novum*, section 6, chapter 10; and again below, see the discourse.
39. In the year 1649, on 22 June, a little after Jupiter's [conjunction] with the Sun, observation having been made more westerly than the setting of the Sun, again, and as Jupiter was often distant from Regulus by $35^{\circ} 42'$; and from the bright mane of Leo by $36^{\circ} 33'$.
40. In the year 1650, on 24 April, about Jupiter's [conjunction] with the Sun at the following night, Jupiter was distant from the vertex by $19^{\circ} 54'$; distant from Spica of Virgo by $15^{\circ} 59'$; and just now Arcturus was distant from the vertex by $47^{\circ} 52'$.
41. In the year 1652, on 30 June at the following night, from the setting of the Sun, Jupiter was distant from the vertex by $79^{\circ} 13'$; and just now Antares was distant from the vertex by 33° precisely; thence it was high at Aquila by 30° ; and from the vertex by $78^{\circ} 22'$; but it had stood, on the preceding day, [in conjunction] with the Sun.

42. In the same year, on 4 July, hour likewise 1, from the setting of the Sun, Jupiter was high by $19^{\circ} 46'$; distant from the bright star of Aquila by $34^{\circ} 47'$; thence high by $13^{\circ} 10'$; distant from Antares by $52^{\circ} 29'$.
43. In the same year, on 1 August at the following night, from the setting of the Sun, Jupiter was distant from the bright star of Aquila by $25'$, about distant from the vertex by $36^{\circ} 41'$; thence high from Pegasus by $35^{\circ} 57\frac{1}{2}'$.
44. In the same year, on 24 August at the following night, the bright star of the Eagle being distant from the vertex by $40^{\circ} 39'$, toward eastern rising Jupiter was distant from the same by $37^{\circ} 9'$; and a little afterward it stood from the same Pegasus by $57^{\circ} 2\frac{1}{3}'$; just now, Pegasus was nearest by $\triangle$.
45. Finally, in the same year, on 14 November, about an hour after sunset, when Fomalhaut was seen distant from the vertex by $77^{\circ} 10'$. Jupiter was seen distant from the same by $50^{\circ} 54'$; but at the vertex it was distant by 75° about; near Pegasus by $49^{\circ} 45'$.
46. In the year 1653, on 22 May, in the morning, Markab of Pegasus, at rising, was distant from the vertex by $55^{\circ} 31'$; and Jupiter was distant from the vertex by $67^{\circ} 34'$; and from the head of Andromeda by $57^{\circ} 5'$; just now, Jupiter was distant from the vertex by $66^{\circ} 50'$; at Pegasus the most by $47^{\circ} 43'$.
47. In the year 1653, on 28 November at the following night, hour very nearly 2, from the setting of the true Sun, Jupiter stood at Fomalhaut by $25^{\circ} 52'$; from the vertex really by $64^{\circ} 55'$. Fomalhaut was distant from the vertex toward rising by $76^{\circ} 2'$; but a little afterward it stood from Cetus by very nearly the [same] distance, $50^{\circ} 42'$; with Stella distant from the vertex by $69^{\circ} 42'$. Consult the ephemerides for the discourse to be placed below, whether in the conjunction of Mars with Jupiter it has erred.
48. In the year 1653, on 23 December, hour after midday $5\ 7\frac{1}{3}$; expecting Jupiter at the precise Azimuth of 30 degrees; it was distant from the vertex by $66^{\circ} 28\frac{1}{3}'$; from which moment there were numbered $12\frac{1}{3}$; the bright star of Aquila was distant from the vertex by $61^{\circ} 41\frac{1}{3}'$.
49. In the year 1654, on 2 November at the following night, Jupiter and Direction tending in its own way (hitherto in its retrograde course) was distant from the bright star of Aries by $50^{\circ} 15\frac{2}{3}'$; and just now from the bright star of the tail of the Whale [Caudæ Ceti] by $23^{\circ} 40\frac{1}{3}'$; and then it was hour 4 Italian, with the half [hour].

50. Again in the year 1654, on 6 November at the following night, it crossed Fomalhaut by the meridian-line [per M. C.], and the perpendicular being numbered, minutes 23' 40". Jupiter reached the meridian by M. C., distant from the vertex by 52° 16' 40"; the hour was Italian 5½.

51. Again in the same year, on 11 November at the following night, about the hour. ...by 3½ Italian hours. Jupiter, nearest the meridian, stood [?] from the bright star of Aries by 50° 15', and from the tail of Cetus by 23° 39' ½.

51. In the year 1655, on 21 August, in the morning, when Jupiter was now retrograde and in mid-heaven, it stood from the zenith by 34° 13' ½; then after 3' 40" of time. The following shoulder of Orion stood toward the west from the zenith by 59° 56'.

52. In the year 1655, on 17 October, on the following night, Jupiter — approaching its opposition with the Sun — stood on the meridian from the zenith by 36° 4'.

53. In the same year, on 12 March 1656, at 1 hour of the night, Jupiter stood from the bright star, that is, the following shoulder of Orion, by 53° 55' ¼, and from Rigel by 48° 46' ½.

54. In the same year, on 16 August, in the morning, two hours before sunrise, Jupiter stood from Capella by 26° 56', and from the northern horn of Taurus by 15° 3' ¼.

55. Lastly, in the same year, on 27 October, two and a half hours after sunset, Jupiter — being eastern — stood from Capella by 26° 43' ⅔, and from the northern horn of Taurus by 14° 30' ½.

56. In the year 1657, on 10 February, on the following night, Jupiter stood on the meridian from the zenith by 25° 32' 50"; then after 35' 10" of time Aldebaran crossed [the meridian: M.C.].

57. In the same year, on 18 March, Jupiter was in the same azimuth as Venus on that day — which I discuss among the observations of Venus — and Jupiter then stood from the zenith by 52° precisely; in the same azimuth Aldebaran stood from the zenith by 58° 17'.

58. In the year 1647, on 18 April, on the following night, Jupiter was observed standing from Capella by 46° 48' ½, and from the heart of Hydra by 32° 2' 40". Arcturus, then to the east, stood from the zenith by 47° 40'.

59. In the year 1648, on 20 February, on the following night, around 3½ hours after sunset, that is, with Procyon standing from the zenith by 38° 48'. Jupiter,

high up by $34^{\circ} 30'$, stood from the same Procyon by $46^{\circ} 43'$, and from the tip of the tail of Ursa Major by $54^{\circ} 34' \frac{1}{2}$.

60. Likewise in the year 1648, on 21 February, one hour after sunset, with the Sun [?] $3\frac{1}{2}$, Jupiter stood from Procyon by $46^{\circ} 35'$, and from the tip of the tail of Ursa Major by $54^{\circ} 50'$.

61. Again in the year 1648, on 26 February, on the following night, 3 hours after sunset, Jupiter — being eastern — stood from Procyon by $46^{\circ} 1' \frac{1}{2}$, and from the last star of the tail of Ursa Major by $54^{\circ} 58'$.

62. In the year 1649, on 9 June, from an observation that I shall report on another occasion (Book 10, Cap. 3, nos. 5 and 6), Jupiter was in Virgo at $29^{\circ} 56' 25''$, with northern latitude $1^{\circ} 25' 49''$; and it was then near its station.

This observation was memorable.

64. [Margin: ☿ ♂ ♃ et 8 — i.e. Mercury, conjunction of Jupiter, and opposition] In the year 1657, on 26 December, on the following night, Jupiter stood on the meridian itself from the zenith by $21^{\circ} 11' 33''$; and $6' 40''$ of time after its transit, Sirius crossed the same meridian.

But on 27 December, on the following night, Jupiter stood on the meridian from the zenith by $21^{\circ} 10' 43''$; and $7'$ precisely of time later, Sirius crossed the same meridian. Hence Jupiter's declination on the 26th was $23^{\circ} 18' 37''$, and on the 27th it was $23^{\circ} 19' 27''$.

Selected Observations from the *Ephemerides* of the Illustrious Marquis Cornelio Malvasia [Marchionis Cornelij Malvasiæ], f. 203.

In the year 1662, from his own astronomical observatory at Modena [Mutinensi], he observed the distances of Jupiter from the fixed stars written below, but corrected them by means of Cassini's Table of Refractions; and, taking the positions of the fixed stars from Tycho, he derived from them by trigonometry — set out below — the longitudes and latitudes of Jupiter, and compared these with those that the Lansbergian calculation yields.

[The table that follows gives, for each date in June, July, and August 1662: the day; the hours after sunset; the corrected distance of Jupiter from each of two reference stars (Spica, Boötes [the bright star of Boötes / Arcturus], the southern Claw [of Scorpio], etc.) in degrees and minutes; the observed position of Jupiter (Longitude and Latitude, here B[orealis]?); and the excess or defect relative to Lansbergen.]

J u n e	Hrs after sunset ☉	☿ Corrected distance from A.	A. G. '	Observed position of ☿ (long./lat.)	G. '	Lansbergen: Excess or Defect
						'
.						
5	1 15	Spica / Boötes	16 8 / 33 6	Lo. / La. B.	4 55 / 1 20	Exc. 10 / Def. 4
7	2 8	Spica / Lūc. Aust.	16 0 / 5 37	Lo. / La. B.	4 47 / 1 18	Exc. 10½ / Def. 3
9	0 35	Spica / Boötes	15 52 / 32 56	Lo. / La. B.	4 39 / 1 18	Exc. 11 / Def. 3½
1 4	1 30	Spica / Boötes	15 35 / 32 51	Lo. / La. B.	4 22 / 1 17½	Exc. 11 / Def. 4
2 2	0 52	Spica / Boötes	15 17 / 32 45	Lo. / La. B.	4 4 / 1 15	Exc. 13 / Def. 4
2 5	1 15	Spica / Arcturo	15 14 / 32 44	Lo. / La. B.	4 2 / 1 13	Exc. 12 / Def. 3
J u l y		A.				
1	1 47	Spica / Arcturo	15 12 / 32 43	Lo. / La. B.	3 59 / 1 13	Exc. 13 / Def. 4
4	0 30	Spica / Arcturo	15 12 / 32 45	Lo. / La. B.	4 0 / 1 11	Exc. 13⅓ [?] / Def. 3
7	0 52	Spica / Arcturo	15 15 / 32 46	Lo. / La. B.	4 3 / 1 10	Exc. 13 / Def. 3
1 0	1 20	Spica / Arcturo	15 20 / 32 49	Lo. / La. B.	4 8 / 1 7	Exc. 13 / Def. 2
1 3	0 30	Spica / Arcturo	15 26 / 32 53	Lo. / La. B.	4 14 / 1 7	Exc. 13 / Def. 2½
1 6	1 9	Spica / Arcturo	15 32 / 32 58	Lo. / La. B.	4 22 / 1 7	Exc. 13 / Def. 3
2 2	0 55	Spica / Arcturo	15 52 / 33 8	Lo. / La. B.	4 41 / 1 6	Exc. 14 / Def. 3

J u n e	Hrs after sunset ☉	☿ Corrected distance from	A. G. '	Observed position of ☿	G. '	Lansbergen: Excess or Defect
2 4 A u g .	1 36	Spica / Arcturo A.	16 1 / 33 12	Lo. / La. B.	4 49 / 1 9	Exc. 14 / Def. 2½
5	1 28	Spica / Arcturo	17 3 / 33 42	Lo. / La. B.	5 54 / 1 1	Exc. 13 / Def. 2
1 1	1 52	Lūc. Aust. / Arcturo	3 45 / 34 2	Lo. / La. B.	6 34 / 1 0	Exc. 12 / Def. 2
1 7	0 32	Lūc. Aust. / Arcturo	3 14 / 34 20	Lo. / La. B.	7 13 / 0 59	Exc. 13 / Def. 2½
2 4	1 22	Lūc. Aust. / Arcturo	2 15 / 34 50	Lo. / La. B.	8 12 / 0 58	Exc. 12 / Def. 2
2 9	1 24	Lūc. Aust. / Arcturo	1 31 / 35 12	Lo. / La. B.	8 57 / 0 57	Exc. 11 / Def. 2½

But you should bear in mind that the positions of the fixed stars in Tycho's catalogue stand in need of correction, and that a correction of distances relying on Cassini's Refractions is not free of doubt, as I have already pointed out in Book 1.

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CAPUT IX.

On a selection of observations concerning Jupiter, compared with a calculation derived from our Tables.

1. From what was said in Book 5, Cap. 9, 10, and 11, on the methods of observing the positions of the planets, on the difficulty of avoiding errors of several minutes, and on the verification of the Tables from a smaller number of more reliable observations rather than from a larger number of less certain ones, it is plain — [Margin: On the Danish Tables.] Tycho [Brahe] judged, in his preface to

the *Astronomical Letters*, that the motion of Jupiter cannot be corrected unless it be observed at its individual oppositions in single signs of the zodiac, over a span of 12 years. [Margin: And on the Rudolphine.] Yet Longomontanus, in Book 2 of his *Astronomia Danica* [Astronomiæ Danicæ], Cap. 5, undertook to construct the Danish Tables — adhering in part to those eight oppositions of Jupiter observed against the true place of the Sun [Acronychias], in part to Tycho — and in Cap. 7 brought forward another observation for hunting out the place of Jupiter's apogee [Apogæi Iovialis locum].

Kepler [Keplerus], moreover, in the explanation of the foundations of his *Ephemerides* on which he built the Rudolphine Tables (p. 14), affirms that his Tables, in respect of the three superior planets, cannot be noted as departing from the heavens by even a single minute. Elias Leonicus [?] [Eliās Leonicus], who is himself the author of a work in Bicini [?] published in Silesia and entitled *Praxa Propitia* [?] (p. 89), says that the Rudolphine Tables wander from observations in Jupiter by as much as 13' in the second semicircle of the commutations; for in the first they so depart from the very defects of the Rudolphine men [?] that, where they supposed Kepler to be in error, the same thing turns out in the second. He adds, moreover, that with Kepler the Theory of Jupiter labours under some fault — namely the Mean motion, the place of the Aphelion, and the proportion of the radius of the orbit to the interval between the Sun and the Earth.

Finally, Boulliau [Bullialdus], that most diligent investigator of astronomical truth, [Margin: And on the Bullialdan, and his unreliability.] in correcting the Rudolphine men (*Astronomia Philolaica*, p. 9), shows that they err by 48'; he attaches to this the position of Jupiter near Regulus, which the observation made in Cap. 1, no. 6, requires as exceeding the Tabular place of Jupiter. But we have made bold to bring forward five only of his Tables, on the faith of his own Tables, but here and there indeed unreliable, as in Cap. 8 [?], p. 170. The Treasures of the conjunction of Jupiter and Mars, which Kepler observed at Tübingen along with Mästlin [Mæstlino] (*Astronomia Optica*, p. 305), I have set before me; and on the occasion of these I shall draw upon his Tables, as more fully in Book 7, Cap. 8, on the occasion of Mars.

[Margin: Order of the observations.] We have, accordingly, selected out of so many of the observations narrated above 20 of note — the conjunctions of Jupiter and of Mars, and 15 conjunctions of Jupiter with the fixed stars, observed for the most part with a telescope [Tubospecillo]; and we have added one Tychonic

observation made by means of distances from two fixed stars. These we shall report below in the order of the times.

1. [Margin: ♂ ♄ of the Asellus Australis (southern Donkey)] In the year 141 before Christ, as I reported in Cap. 1, on 3 September, at hour 16 after midday at Bologna, Jupiter was seen to cover the Asellus Australis of Cancer, which was for me, and from the positions of the fixed stars corrected in Book 4, was then in Cancer at $7^{\circ} 11' 7''$, with southern latitude $3^{\circ} 30''$ [?]. On account of the borrowed light of the small stars, stars appear nearer to one another to the naked eye than they really are; so that, if Jupiter, touching a fixed star with the naked eye, were viewed through a telescope, it would stand off from it by a good many minutes, and sometimes by 8 Jovian diameters. Jupiter could have stood off from the southern Asellus by just as many scruples, and so be in Cancer at 7° and about 3' from the minute.

The Tables then exhibit Jupiter as follows:

		Sig.	G . ' "		
Jupiter is then exhibited by the Tables	Lansbergij	☿	7	34	26
	Lat. a.	0	1	0	
			0		
	Danica in	☿	7	33	0
	Philolaica	☿	7	6	0
	Lat.	0	2	0	
			5		
	Noftra	☿	7	4	30
	Lat.	0	2	10	
			4		

2. [Margin: ♂ ♄ / ♂ ♂] In the year of Christ 498, as I shall report in the observations of Mars, the two were seen in the morning around the 9th hour of the first day of May. Jupiter and Mars were so closely joined that they seemed in no perceptible way to differ. For Boulliau, and almost for me, Mars was then in Virgo at $0^{\circ} 13' [?] 56''$, with northern latitude $1^{\circ} 14'$. But Jupiter for me came out in Virgo at $0^{\circ} 15' 34''$; yet, on account of the borrowed rays, they seemed to differ scarcely at all.

	Sig.	G.	'	"
♂	♂	0	13	56
♂	♂	0	15	34

3. [Margin: ♂ ♂ / ♂ ♂ of Regulus] In the year of Christ 508, on 27 September, at hour 17 after midday at Athens, but 16 at Bologna, Jupiter was seen nearest to Regulus as to longitude, and from it toward the north by 3 digits, that is by 7' ½ of arc [minutis 7' ½]. For me, Regulus was then in Leo at 8° 51' 57"; but for Boulliau at 8° 49' 54".

		Sig.	G		
			.	'	"
And by the Tables Jupiter was then	Rudolphinis	♂	9	35	33
	Philolaicis		8	58	43
	Noftris		8	56	30

4. [Margin: ♂ ♂ / ♂ ♂] In the year of Christ 509, on 13 June, at hour 9 at Athens, Jupiter was seen more eastern than Mars by 1 digit, that is by 2' ½ of arc; but at any rate by more, on account of the added rays. And by the Tables written below they were then as follows:

	♂ Sig.	G			♂ Sig.	G		
		.	'	"		.	'	"
Rudolphinis	♂	1	58	0	♂	1	50	0
		1				1		
Philolaicis	♂	1	57	43	♂	1	54	10
		1				1		
Noftris	♂	1	56	40	♂	1	52	2
		1				1		

5. [Margin: Astronomia Optica, p. 305.] [Margin: ♂ ♂ / ♂ ♂] In the year of salvation 1591, Kepler, at Tübingen with Mästlin, saw Jupiter covered over by a ruddy Mars, on 9 January in the morning, as Lansbergen has it; and so it suffices that it struck 12 by the civil clock, whence the day had then begun. But for me it was Jupiter at hour 13 in Scorpio at 14° 59' 12". Mars was in Scorpio at degree 14° 58' 53".

		Sig.	G	.	'	"
On day 13 [die H. 13], after midday	♈ in	♌	1	59	12	
			4			
	♊ in	♌	1	58	53	
			4			

6. In the year 1587, Tycho, in his *Letters*, writes that Jupiter was observed by him in Cancer at 7° 19', on 14 January, 8 hours after midday.

	Sig.	G.	'	"
Therefore ♈ Observed position	♌	7	19	0
Position computed by me		7	18	16

7. [Margin: ♂ ♈ / ♂ ♊] In the year 1604, Kepler, from the observations made at Prague, concludes that a conjunction of Jupiter and Mars fell on 9 October, a little before midday. For me, from my Tables at hour 23, 50' after midday on the 8th, the positions, reduced and abridged, come out:

	Sig.	G.	'	"
♈ in	♌	19	15	37
♊ in	♌	19	15	38

8. Boulliau relates that in the year 1623, on 12 October, 17 hours after midday, at Loudun in Poitou — that is, at hour 18 at Bologna — it was observed

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— that it was covered by the tube, in a conjunction just before completed, namely Jupiter's conjunction with Regulus in Leo at 24° 40'; but my Tables exhibit Jupiter then in Leo at 24° 46'. [Margin: ♂ ♈ & of Regulus]

9. [Margin: ♈ with the brow of Scorpio] In the year 1627, on 25 April by the old style, Hortensius [Hortensius], at Leiden, at hour 11 — which is hour 11 28' at Bologna — observed with a telescope [tubospecillo] Jupiter more western than the topmost star of the brow of Scorpio by scarcely 1'. But this star, the most northerly, was for me then in Scorpio at degree 27° 54' 55". Therefore Jupiter was in Scorpio at degree 27° 54'.

10. On 22 April of the same year, Elias à Leonibus [Elias à Leonibus], at Uraniburg Propitia [Vraniæ Propitiæ], had seen Jupiter at hour 1 25' after midday, in Silesia, distant in consequence by 18' from the topmost star of the brow of Scorpio; and so in Scorpio at 27° 37'.

	Sig.	G.	'	"
For me, Jupiter came out on day [die]				
22	♄	27	41	0
25	♄	27	46	53

11. [Margin: ♂ ♀ of Propus] In the year 1633, Petrus Gassendus [Pierre Gassendi], from various observations made with the telescope, reckoned the conjunction of Jupiter with Propus [Propode] to have fallen under the meridian of the day on 19 December, at Digne [Diniæ]. For me, Propus was then in Gemini at 25° 47', and on the meridian Jupiter was in Gemini at 25° 54'. Hence, before the meridian, the conjunction took place, and Jupiter was retrograde.

12. [Margin: ♂ ♀ of Propus] In the year 1634, Petrus Gassendi, at Digne, at hour 12 after midday on the 11th of April — which is hour 12 12' at Bologna — reckoned by telescope that Jupiter was then in a direct conjunction with Propus of Gemini as to longitude, and more northern than Propus by about 8'. But Boulliau, who was lying in wait at Paris for Jupiter's conjunction with Propus, saw by telescope on the following day, that is 11 April, at hour 8 30' after midday — which was hour 9 10' at Bologna — Jupiter more northern than Propus by 9', and as to longitude more eastern than Propus by 3'. Since, then, Propus was for me at degree 25° 46' 22" of Gemini, and the diurnal motion of Jupiter was 9', it follows that on the next day, the 11th, at hour 12 12', Jupiter was more western than Propus by 6 minutes or so, but not in conjunction with Propus. So, dividing thus the hours of both observations, Jupiter will have been on the 11th day, at hour 12 22', in Gemini at 25° 43' 30". Our Tables give Jupiter in Gemini at 25° 41' 27".

Jupiter's position	Sig.	G.	'	"
Observed	♄	25	43	30
Computed		25	41	27

13. [Margin: ♂ ♀ & of the Asellus Australis] In the same year 1634, on 4 December, at hour 10 after midday at Loudun in Poitou — but hour 10 [?] at Bologna — Boulliau reckoned by telescope that Jupiter was a little more eastern than the southern Asellus, which was for me then in Leo at 3° 34' 9". Therefore Jupiter was in degree 3° 36'; but our Tables give it further on, at degree 3° 40' 13".

Jupiter's position	Sig.	G		
		.	'	"
Observed approx.	♄	3	36	0
Computed		3	40	13

This observation is notable for tracing out the Mean motion of Jupiter, since it returned to the Asellus Australis with which it had once been joined — by the said observation, no. 1 — after 1874 Julian years, that is, 105 [years], 14 hours 50'.

14. In the year 1637, on 16 July, at hour 9 at Paris — but at hour 9 40' at Bologna — Boulliau saw Jupiter by tube more western by 7' of arc, and more southern by 8' ½, than the sixth star of the left wing of Virgo, which precedes the four stars of the left wing of Virgo. For me, from my fixed stars, that star was then in Virgo at 29° 47', with northern latitude 1°. Therefore Jupiter was in Virgo at 29° 40', with latitude 1° 16'. Our Tables give Jupiter then more western by less than three minutes.

Jupiter's position	Sig.	G.	'	"
Observed	♄	29	40	0
Computed		29	37	7

15. In the year 1639, on 31 August, the same Boulliau, at Paris at hour 8 after midday — namely at hour 8 40' at Bologna — with a telescope ...observed Jupiter, in a conjunction completed a little before, with Regulus, Jupiter being in Leo at 24° 40'; but my Table gives it in Leo at 24° 46'.

16. [Margin: ♂ ♄ with the brow of Scorpio] In the year 1646, on 19 February, D. Vincenzo Mutus [Vincentius Mutus] of Majorca, on the following night contemplating with the telescope Jupiter at its station, noticed that it was near Propus of Gemini by 5', more western by minutes [?], and 9' ½ more northern; Propus was for me then in Gemini at 25° 56' 24", with southern latitude 13' 30". Therefore Jupiter's position is as below.

[Margin (right): pio noted Jupiter more eastern by one or another minute than the northern star of the brow of Scorpio, which was for me then in Scorpio at 28° 5' 10". Therefore Jupiter in Scorpio at 28° 6'. — this belongs with the running text of the right column]

♃ position		Sig.	G	'	"
	Observed	♄	2	51	24
			5		
Computed by Tables	Noftris		2	54	20
			5		
	Prutenicis		2	15	0
			5		
	Lansbergianis		2	1	0
			6		
	Philolaicis		2	56	36
			5		

Jupiter's position		Sig.	G.	'	"
	Observed	♃	28	7	0
	Computed		28	7	10

17. [Margin: ♂ ♃ with the left wing of Virgo] In the year 1649, on 11 May, at hour 1 after midday — but 8 at Majorca — D. Vincenzo Mutus saw Jupiter by tube more eastern than the star of the left wing of Virgo by 1' ½ or 2'. But Elias à Leonibus in Silesia saw it more eastern by a single minute at the same moment of time, whence it is indeed notable and reliable. That star was then in Virgo at 29° 57' 10". Therefore Jupiter was in Virgo at 29° 58' 40", and perhaps at 29° 59'. What of the Tables?

♃ Position		Sig.	G.	'	"
	Observed	♃	2	58	40
			9		
Comput. by Tab. or			2	59	10
			9		
	Prutenic.		2	45	0
			9		
	Lansbergij	♄	0	0	40
	Danicis	♃	2	58	0
			9		
	Rudolph.		2	46	0

☿ Position	Sig.	G.	'	"
		9		
Philol.	☿	0	1	10
Noftris		0	0	50

18. [Margin: ☿ ☿ Direct, with the wing of Virgo] In the same year 1649, on 9 June, when Jupiter had now turned direct, Father Francesco Maria Grimaldi [Grimaldus] and I saw with the telescope, at hour 1 after sunset, Jupiter manifestly more western than the preceding star of the left wing of Virgo, by however much on the 10th we saw it more eastern; or rather, on the 10th, at the same hour, somewhat less eastern than it had been the previous night; whence we estimated that Jupiter's conjunction with that star took place on the 9th, at hour 21 after midday, according to the trigonometric calculations I have set out (*Almagestum Novum*, Book 9, sect. 6, c. 10). That star was then in Virgo at 29° 57' 16".

☿ Position	Sig.	G.	'	"
Observed	♃	29	57	16
Pruten.		29	40	0
Comput. by Tab.	☿	0	0	52
Danicis		0	1	0
Noftris	♃	29	59	6

19. In the year 1650, D. Vincenzo Mutus of Majorca, on 18 April, at hour 10 — namely Bologna 10 37' — observed Jupiter by tube in Scorpio at degree 5° 22'.

☿ Position	Sig.	G.	'	"
Observed	♃	5	22	0
Computed by Tables		5	25	0
Pruten.		5	22	0
Lansbergen.		5	21	0
Danicis		5	33	0
Rudolph.		5	21	0
Philolaic.		5	23	30
Noftris				

20. Likewise in the year 1650, the same D. Vincenzo Mutus of Majorca, on 24 May, at hour 8 30' after midday — which at Bologna is ...

[The no. 20 comparison from the preceding pages concludes here:] At Bologna it was 9°7'. With the telescope he noted Jupiter in Scorpio, between degrees 1 and 12.

Jupiter — Position [♃ Locus]

		Sig.	G		
			.	'	"
Computed from the Tables [<i>Comput. ex Tab.</i>]	Observed [<i>Observatus</i>]	℥	1	1	0
				2	
	Prutenic [<i>Pruten.</i>]		1	1	0
				8	
	Lansbergian [<i>Lansbergen.</i>]		1	2	3
				1	0
	Danish [<i>Danicis</i>]		1	1	0
				6	
	Rudolphine [<i>Rudolph.</i>]		1	3	0
				1	
	Philolaic [<i>Philolaic.</i>]		1	1	0
				5	
	Ours [<i>Nostris</i>]		1	1	4
				4	0

Now that we have tested the excellence of our Tables against twenty observations this exact and this carefully selected, so that any part of the discrepancy may not improbably be ascribed to the observations rather than to the Tables, we have judged it superfluous to pile up still further comparisons here, made with other observations — not without weariness and at excessive length. Therefore, although we have examined eight acronychal positions as well [*loca 8. Acronychia*], which Longomontanus alone examined, we still do not so trust them as not to suspect that an error of six minutes or more may lurk in them, on account of a doubtful motion of the Sun [*motum Solis Tychonicum*] — Tycho's, but a false one — and on account of other quantities assumed in the Prutenic Tables for fixing the exact moment and the place of the true opposition with the Sun.

CAPVT X.

De Hypothesi Arithmetica, et Geometrica Motuum Iovis.

[*On the Arithmetical and Geometrical Hypothesis of the Motions of Jupiter.*]

The matters to be selected are those we stated in Book 5, chapter 12, inasmuch as they are common to the five lesser planets. The remaining matters proper to Jupiter are written out below.

Motion of Jupiter [*Motus ♃*]

		Sig. G.	I . II.	III.	IV . V	
Mean from Aries [<i>Medius ab ♈</i>]	Daily [<i>Diurnus</i>]	0 0	4 5	15	5	3
			9		8	3
	Annual [<i>Annuus</i>]	1 0	2 3	11	9	7
			0 2			
Of the apogee [<i>Apogei</i>]	Daily [<i>Diurnus</i>]	0 0	0 0	14	3	1
					8	1
	Annual [<i>Annuus</i>]	0 0	1 2	2	1	1
			9		5	8
Of the nodes [<i>Nodi ♊</i>]	Daily [<i>Diurnus</i>]	0 0	0 0	4	2	5
						2
	Annual [<i>Annuus</i>]	0 0	0 2	37	2	0
			4		8	

The epochs of the motions are set to the beginning of the Common Era of Christ, at the last meridian [i.e. midnight] of the preceding December, on the Meridian of Bologna.

♃	Sig.	G.	'	"
Mean motion from Aries [<i>Motus medius ab ♈</i>]	5	29	49	45
Of the apogee [<i>Apogei</i>]	4	28	25	24
Of the nodes [<i>Nodi ♊</i>]	2	27	40	25

For the Geometrical Hypotheses, see what was said in Book 7 of the *Almagestum Novum* [*Alm. Novi*], sections 2 and 3, and here in Book 5, chapter 12 toward the end. But choosing for the present an ellipse, whose traces about the cone seem to mark out the planet's daily motion through various spirals and other paths directed toward the west, let there also be selected the measures written out below, in parts of which the Radius of the orbit of the Sun's annual circle — that is, the greater semidiameter of the Sun — is the unit.

	Si Radius Orbis ☉ sit [<i>If the Radius of the Sun's orbit be</i>]	
Let the ellipse be [<i>Ellipseos sit</i>]	10000	100000
	0	
And the bisected eccentricity of the Sun [<i>Et bissecta Solis Excentricitas</i>]	1740	

	Value
The greater semidiameter of Jupiter's ellipse, or its mean distance from the Sun, is [<i>Semidiameter maior Ellipsis ꝓ seu eius à Sole media distantia est</i>]	522521
The smaller semidiameter of the ellipse [<i>Semidiameter minor Ellipsis</i>]	521794
The whole eccentricity from the Sun [<i>Excentricitas tota à Sole</i>]	50736
The bisected eccentricity [<i>Excentricitas bissecta</i>]	25368

Distance [*Distantia*]

			Distance
Sun at apogee & Jupiter [<i>Sole Apogeo & ꝓ</i>]	At aphelion [<i>Aphelio</i>]	from the Sun [<i>à Sole</i>]	547889
		from the Earth [<i>à Terra</i>]	649629
	At perihelion [<i>Perihelio</i>]	from the Sun [<i>à Sole</i>]	497153
		from the Earth [<i>à Terra</i>]	395413
Sun at perigee & Jupiter [<i>Sole Perigeo & ꝓ</i>]	At aphelion [<i>Aphelio</i>]	from the Sun [<i>à Sole</i>]	547889
		from the Earth [<i>à Terra</i>]	646149
	At perihelion	from the Sun [<i>à Sole</i>]	49715

		Distance
	[<i>Perihelio</i>]	3
	from the Earth [<i>à Terra</i>]	398893

	Gr.	I.	II.
Inclination of the orbit to the Ecliptic [<i>Inclinatio orbitæ ad Eclipticam</i>]	1	42	20

Of the maximum variations of latitude [*Varietas latitudinum maximarum*]

			G r	I I	I I
			.	.	.
Sun at apogee & Jupiter [<i>Sole Apogeo & ☌</i>]	At aphelion [<i>Aphelio</i>]	in conjunction [<i>in ☌</i>]	1	8	30
		in opposition [<i>in ☌</i>]	1	4	205
	At perihelion [<i>Perihelio</i>]	in conjunction [<i>in ☌</i>]	1	7	50
		in opposition [<i>in ☌</i>]	1	4	520
Sun at perigee & Jupiter [<i>Sole Perigeo & ☌</i>]	At aphelion [<i>Aphelio</i>]	in conjunction [<i>in ☌</i>]	1	9	20
		in opposition [<i>in ☌</i>]	1	3	490
	At perihelion [<i>Perihelio</i>]	in conjunction [<i>in ☌</i>]	1	8	18
		in opposition [<i>in ☌</i>]	1	4	515

For the remaining distances, see in the second volume, Table 97. [*Reliquas Distantias vide in 2. Volumine Tab. 97.*]

LIBER SEPTIMVS

IN QVO SVNT

MARTIS PLANETÆ OBSERVATIONES

Et Hypothesis Motuum.

[BOOK SEVEN, in which are the Observations of the Planet Mars, and the Hypothesis of its Motions.]

CAPVT I.

Martis Observationes Antiquæ ab Anno ante Christum 357. usque ad Annum Christi 509.

[Ancient Observations of Mars, from the year 357 before Christ to the year of Christ 509.]

1. Aristotle, in Book 2 *On the Heavens*, chapter 12, text 60, reports as follows: "We have seen the Moon, half-full [*dichotomam*], coming up to the star of Mars, which is the star occulted by the dark part of the Moon; and Mars emerged from the bright and clear side." From this observation it follows that this happened at the Moon's first quarter; but Kepler, in his work on Mars, chapter 69, affirms that it could not have happened at any other time than 357 before the common era of Christ, on April 4, in the evening, with the Sun in degree 10 of Taurus, and the Moon with Mars in degree 3 of Leo, when Aristotle, twenty-one years of age, was a hearer of Eudoxus.
2. In the year 13, according to Dionysius, on day 25, which was the 52nd year after the death of Alexander, and the 476th year of Nabonassar, on day 20 of Athyr (the following [day], the 21st), in the morning, the star of Mars appeared overlying the Boreal front of Scorpio [*Boreali frontis Scorprij*], which was then with Mars in Scorpio degrees 2, minutes 15. So Ptolemy, Book 10, chapter 9. Hence Lansbergius, in his *Thesaurus*, Observation 1 of Mars, supposes the supreme star in the front of Scorpio to have been in Scorpio degrees 1, minutes 42, seconds 12, with northern latitude degree 1, minute 13; and he commends his Tables, which exhibit Mars in Scorpio degrees 0, minutes 53, seconds 12, and with latitude degree 1, minute 13. But Bullialdus [Boulliau], in his *Astronomia*, chapter 18, says it was in degree 1, minute 17, after the meridian of Rudolphine reckoning; he

gathers that the fixed star [*Fixam*] itself was then in Scorpio degrees 2, minutes 34, and Mars in Scorpio degrees 2, minutes 33, minutes 41. But Kepler, in *On Mars*, chapter 69, says the year was 272 before Christ, January 18, in the morning, and in chapter 70 he admits that his calculation differs from the observation by degree 1, minute 31, second 28; for this reason he supposes that Ptolemy erred in Scorpio, taking the first [degree] for the fifth, because the observer called it the more Boreal of the front of Scorpio, of which the fifth was the more Boreal, and Tyconic reckoning placed it as more remote from Regulus by degrees 94, minutes 46½ — whence Mars, distant from this same Regulus by degrees 94, minutes 49½, or minutes 51½; these things Bullialdus [Boulliau], in Book 8, chapter 13. But Longomontanus, in Book 2 of his *Theorica*, chapter 10, contends that the first reading is to be retained.

3. In the year 15 of Hadrian [*Adriani*], Ptolemy from his own observation found that Mars was in opposition to the Mean place of the Sun on day 26 of Tybi, hour 1, equally after midnight, when Mars was in degree 21 of Gemini. So he himself, Book 10, chapter 7; and from him Copernicus, Book 5, chapter 15. But Kepler, in *On Mars*, chapter 69, calls this observation into doubt on suspicion of an error in time, in the Refractions, in the places of the Fixed stars, and for Gemini degree 21 he reckons degree 30; or at least degree 21, minute 4. It was the year of Christ 130, and day 14 of December.
4. In the year 19 of Hadrian, Ptolemy observed an opposition of Mars to the Mean place of the Sun on the 6th [of the month], following [*sequente*] day 7, hour 3, before midnight, in Sagittarius degree 28, minute 50. So he himself, Book 10, chapter 7, and from him Copernicus, Book 5, chapter 15. Kepler however, in *On Mars*, chapter 69, says it was in degree 29 of Leo, or degree 29, minute 31. It was the year of Christ 135, and day 21 of February.
5. In the year 2 of the Emperor Antoninus [*Antonini Imperatoris*], on the day of Epiphi 12, the following [day] 13, hour equal 2, before midnight, Mars was seen in opposition to the mean place of the Sun, existing in Sagittarius degrees 2, minutes 34. So Ptolemy, Book 10, chapter 7, and from him Copernicus, Book 5, chapter 15. Kepler, in *On Mars*, chapter 69, says it was in Sagittarius degree 1, minute 36, or rather degree 0. It was the year of Christ 139, day 27 of May, following day 28.
6. In the same year 2 of Antoninus, on the 15th of Epiphi, the following [day] 16, hour 2, equal, before midnight, the heaven [*cælum*] was in degree 20 of Libra; and with the Sun according to the Mean motion existing in degree 5,

minute 17 of Gemini, Ptolemy observed Mars by comparison with Spica [*Spicam*] to be in Virgo degree 1, minute 36. Lansbergius, however, in his *Thesaurus*, Observation 2, says that Mars was in the year of Christ 139, May 30, hour 9, after the meridian, in Virgo degree 1, minute 34, minute 38. But Kepler, in *On Mars*, chapter 70, with his own Tables, gathers Virgo degree 1, minute 43, adding [that] the instruments...

of Ptolemy admit an error of 10 minutes; and indeed it was the 30th of May, the following day 31.

7. In the year 498 of Christ, as Bullialdus [Boulliau] reports in Book 8 of his *Astronomia*, chapter 13, and from a manuscript of the Royal Library of Paris [*Bibliothecæ Regiæ Parisinæ*] that is not named, the observer says: "I saw, after the setting of the Sun, in the year of Diocletian 214, [on] Pachon the 6th, in the seventh hour of the night, Mars joined to Jupiter [*Martem iunctum Iovi*], so that it was distant from it by no interval at all, but they were touching." Bullialdus [Boulliau] adds that it was the year of Christ 498, May, day 1, hour 9; and that Mars was then by his own Tables together with Jupiter in Virgo degrees 0, minutes 13, minutes 57, with northern latitude degree 1, minute 13.
8. In the year of Christ 509, as Bullialdus [Boulliau] narrates in Book 8, chapter 13, this observation lies hidden in the same Royal manuscript: "In the year 225 of Diocletian, [on] Payni 19, after the setting of the Sun, the star of Mars touched the star of Jupiter, so that by that very distance it was seen in the preceding [degrees] of one [sign]; but in the Austral direction by digits 2, as far as the canon of numbers and the *Magna Syntaxis* show the two Planets to have been in the same direction, distant from each other by digits 2; on the said day [*dicti mensis*], on which they were seen very close to one another mutually." Bullialdus [Boulliau] adds that in that year of Christ 509, June 13, hour 9, after the meridian of Uraniborg [*Vraniburgi*], Jupiter was by his own Tables in Leo degrees 11, minutes 57, minutes 43. Mars indeed, by the Rudolphine [Tables], in Leo degree 11, minutes 50, minutes 50, when it ought to have been in degrees 11, minutes 55. He adds that Mars was with Regulus in the year 508, September 27, in the morning.

CAPVT II.

Martis Observationes ex Opusculo observationum Io. Regiomontani.

[Observations of Mars from the little work of observations of Johannes Regiomontanus.]

1. In the year of Christ 1461, at the beginning of the night of December 2, Johannes Regiomontanus [Regiomontanus] at Rome saw Mars in a straight line with two Stars of the head of Capricorn, distant between themselves by degrees 2, and 2 from Mars itself, the very same distance — that is, by degrees 2 from Mars — which stars Alphonsine calculation [*Alphonsinus calculus*] placed as conjoined. On day 5 of December he saw them conjoined, but, clouds intervening, he could not note the hour. At the beginning of the sixth night he saw that Mars had passed Saturn already by degrees 1, minute 2 [$1\frac{1}{2}$]; because their distance was nearly the half-and-half [*subsesquialtera*] of the distance of the two Stars of the head of Capricorn. Hence Lansbergius, in his *Thesaurus*, Observation 3, asserts his trust in his Tables, as regards this observation, on day 2 of December.
2. In the year 1461, on December 14, at the beginning of the night, Regiomontanus saw Mars joined, as regards longitude, to the brighter [star] in the tail of Capricorn, which he says was then in Aquarius degrees 14, minutes 29. Alphonsine calculation placing Mars in Aquarius degrees 17, minutes 20, he doubts whether it was in the place of the Fixed star.
3. In the year 1462, September 15, in the morning, at hour 10, the same [Regiomontanus] saw Mars almost in a straight line with the seventh and eighth Stars of Leo, and equidistant; toward the north from the eighth — that is, from the heart of Leo through a true diameter [*per veram diametrum*]. Bullialdus [Boulliau], Book 8, chapter 13, says the seventh star of Leo was, namely, the austral one of the triangle on the neck, of the third magnitude, in Leo degrees 20, minutes 21, minutes 41, with latitude north degrees 4, minutes 51; the eighth in Leo degrees 22, minutes 18, minutes 41, with latitude north minutes 26. Therefore, since the Tables exhibit degrees 1, minute 17, accordingly Mars is shown to have differed from Regulus toward the north by minutes 51, and to have been in Leo degrees 21, minutes 58. See the rest in Bullialdus.
4. In the same year 1462, September 19, he saw Regulus, Mars, and Venus in a straight line, so that toward the Austral direction Venus was below Regulus, just as Mars was Boreal; the distance of Mars from Regulus being one and a quarter [*sesquiquarta*] the distance of Venus from the same.
5. In the year 1462, October 16, in the morning, at the night of October 12 [*sic*], Mars, says Regiomontanus, was not yet [*nondum*] within the twenty-fourth part [*vigesimam quartam partem*] of Leo, since the space between itself and the said Star was reckoned equal to four diameters of Venus; and

they suspected then that Mars was conjoined with the twenty-fifth [part] of Leo. But on day 17 of October, in the morning, at hour 11, he saw Mars already...

having passed the said Star, and that it was distant from it by a space one-and-a-half-times [*sesquialtero*] as much as yesterday's distance; and Mars was more southerly.

6. In the year 1464, December 11, hour 13, after the setting of the Sun, Regiomontanus at Rome saw Mars in a straight line with Star 22, and 23 of Virgo, but Mars was more Boreal, since it was distant from those Stars by degrees 2, and 3, by double the distance; from the said comparison the Alphonsine calculation differs in latitude by half-degrees.
7. In the year 1465, June 19, about midday, Regiomontanus saw Mars almost in a straight line with the first and second Stars of Sagittarius, a little more Boreal, and distant from the first by one-and-a-half-times the interval, and from the second...
8. In the year 1468, April 26, at the beginning of the night, the same saw Mars passing little over the straight line, in which it had been; and on the tail of the Little Bear [*caudâ Vrsæ minoris*], and because Jupiter was at the beginning of Cancer, and rather contrary to their conjunction; and on day 29 of April, Jupiter saw Mars, and Saturn the thirteenth of Gemini, in nearly a straight line with the Boreal head of the Twins; it was however more remote from Mars than Jupiter, but more Boreal, as the distance of Jupiter from the rest [of the] distance was between itself and that Star the thirteenth.
9. In the year 1471, July 26, in the morning, hour 3, after midnight, Regiomontanus at Nuremberg saw Mars in a straight line with the eyes of Taurus, and more Eastern by a little, off the straight line by 3 — about minutes — and distant from the eastern eye of Taurus, by how much they are distant between themselves by the tenth part, the third, and the fourth part of Taurus.
10. In the same year 1471, September 9, Regiomontanus by the radius observed the distance of Mars from the right shoulder of Orion to be in the first sign [*Sinum primum*] 210, and second [*secundum*] 674; but for the distance from the head of Castor [he found] the first sign 210, and the second 662.

11. In the year 1474, March 7, Regiomontanus at Nuremberg saw Mars more Eastern than the Boreal Ass [*Asino Boreali*] by the diameter of the Moon, it appeared; suddenly it was approaching that Star, but it was now beginning to be directed [*dirigi*].

CAPVT III.

Martis Observationes Norimbergæ habitæ à Bernardo Vualthero ab anno 1475. Christi ad 1504.

[Observations of Mars made at Nuremberg by Bernhard Walther [Bernhard Walther], from the year of Christ 1475 to 1504.]

The First Class is of the observations made by estimation of the eye. [Prima Classis est observationum oculari æstimatione peractarum.]

1. In the year 1475, September 17, in the morning, between the third [hour] and the fourth, after midnight, Mars and Saturn stood apart between themselves by nearly five minutes, as far as longitude, from which Walther [Walther] judged them to be conjoined without doubt on day 18; and indeed on day 19 Mars was seen to be more Eastern than Saturn, by however much Saturn had been to the west of Mars on day 17. Let this Almanac of conjunctions [*Almanach coniunctionum*] be distant up to day 21.
2. In the year 1477, September 5, in the morning, hour nearly the third after midnight, Walther [observed] Saturn more Western than Mars, distant by one palm-breadth [*palmum*], in the same latitude, whence he concluded for the day on which Saturn should be eclipsed by Mars. On day 5 of September, things to be read out for [up to] day 6 of October, since he could afterward find nothing in these matters from his Tables. At Walther's, however, the *Fifth of September* is held, just as Snellius [Snell] has it in his observations of Walther; nevertheless Walther truly subjoins day 15 of October, [that] in the morning he had observed Mars more Eastern than Saturn by degrees 2, minute 47 — but it is to be seen whether it was Retrograde.

LIBER VII — DE MARTE (Book Seven — On Mars)

Caput III (continued) — Mars Observations made at Nuremberg by Bernhard Walther, from the year 1475 to 1504

[The numbered observations continue from the prior page. The left column carries Walther's narrative observations (nos. 3–16, 51–56); the right column carries a tabulated set of observations (nos. 17–50) giving the distance of Mars from fixed stars, with the two computed sines.]

3. In the year 1478, on March 16, in the morning at the second hour after midnight, he saw Mars together with the sixth star of Virgo, which lies midway among the three stars of the left wing, in nearly the same longitude, but more than half a foot more to the south.
4. In the year 1479, on October 30, he saw the same — Mars and Saturn — in conjunction as to longitude, with Saturn the more northerly, and they were nearly one degree apart; but Mars was very close to the sixth star of Virgo. Lansbergius [Philips van Lansbergen], in his *Thesaurus*, gathers from his own Saturn tables, for the fourth hour of the morning, that Saturn was in Virgo at $27^{\circ}4'$ with a northern latitude of $2^{\circ}1'$, and Mars in Virgo at $27^{\circ}56'$ with a latitude of $1^{\circ}22'$.
5. In the same year, on November 7, he saw Mars more than one degree more to the south than the seventh star of Virgo, but conjoined with it as to longitude — which Boulliau [Ismaël Boulliau], in Book 8, Chapter 13, says was at the same time as Mars at $2^{\circ}51'$ of Libra, and the northern star at $2^{\circ}50'$. [Margin: Boulliau, lib. 8, cap. 13.]
6. In the year 1484, on November 28, at about the third hour of the following night, the Moon — says Walther — was eclipsing Mars.
7. In the year 1486, on September 7, in the morning at the fourth hour after midnight, he saw Mars between the two horns of Taurus, in the same straight line with them, distant from the southern horn by about two lunar diameters.
8. In the year 1488, on October 3, in the morning, he saw Mars and the two heads of Gemini in one straight line, Mars lying toward the east relative to the following head of Gemini, at a distance of nearly twice the separation of the two heads.
9. In the year 1490, on September 18, he saw Mars somewhat more to the south, and more to the west than the nebulous star of Cancer [Praesepe]; in the morning

at the fourth hour after midnight, he saw the same star now somewhat more to the east than the nebula — more so than on the preceding day, when it had been more to the west — so that the conjunction with the nebula occurred at some intermediate time.

10. In the same year, on September 21, in the morning at the third hour after midnight, he saw Mars distant from the fifth star of Cancer by a lunar diameter, and distant by a hand's breadth from a line drawn through the fourth and fifth stars of Cancer, but nearer the fifth.

11. In the year 1491, on January 6, he observed the beginning of the retrograde motion of Mars in one straight line with the twenty-second and twenty-third stars of Leo.

12. In the same year, on March 13, in the morning at the second hour and two-thirds after midnight, Mars was seen in one straight line with the sixth and eighth stars of Leo, distant from the eighth by two-fifths of the interval between the sixth and eighth.

13. In the year 1492, on September 27, in the morning at about the fifth hour after midnight, Mars was nearly in a straight line with the sixth and seventh stars of Leo, and more to the south, the seventh lying midway between the sixth and Mars; but Mars was more to the west, nearly by a finger's breadth, off that line.

14. In the same year, on March 25, Mars was more to the east than the seventh star of Virgo, by a little more than a lunar diameter, at about the same latitude; but on the 27th it was more to the east by four fingers, and on the 29th it was more to the west than the seventh star of Virgo by a lunar diameter.

15. In the year 1497, on February 15, in the morning at the fourth hour after midnight, Mars was distant from Jupiter by a diameter; in such a way, however, that the half of this distance reckoned to the latitude, and Mars was more to the south than Jupiter, and more to the west — although, according to the *Almanac* of these men, the conjunction had already passed.

16. In the year 1504, on March 27, Mars was also seen by armillae [armillary instruments] in Cancer at $17^{\circ}45'$, with Aldebaran placed at $2^{\circ}45'$ of Gemini. From this Boulliau, in Book 8 of his *Astronomy*, Chapter 13, says that Mars was at $17^{\circ}48\frac{2}{3}'$ of Cancer, because Aldebaran was more to the west in Gemini at $2^{\circ}48\frac{2}{3}'$. [Margin: Boulliau, lib. 8, Astron. cap. 13.]

The Second Class contains observations made with the radius [cross-staff] using the first and second sines, on the use of which see under the Waltherian observations of Saturn, no. 10.

Table — Walther's Mars observations (Second Class): distance from fixed stars

Columns: observation number | Year, Month, Day, Hour (*Ann. Mens. D. H.*) | Distance from fixed stars (*Distantia à Fixis*) | First sine (*Sinus prim.*) | Second sine (*Sinus secūd.*)

N o .	Year, Mo., D., H.	Distance from fixed stars	Sinus prim.	Sinus secūd.
1 7	1475 Sept. 1, 3 (post mid. night)	from the preceding [star] of Gemini's head	210	772
1 8	Sept. 3, 3 (p.m.n.)	from the following [star] of Gemini's head	180	950
1 9	Sept. 4, 3 (p.m.n.)	from the preceding [star] of Gemini's head	210	725½
		from the following [star] of Gemini's head	210	1006½
		likewise from Algomisa [Procyon]	210	623
2 0	Sept. 5, 2½ (p.m.n.)	from the preceding [star] of Gemini's head	210	705
		from the following [star] of Gemini's head	210	960
		likewise from Algomisa [Procyon]	210	614½
2 1	Sept. 6, 3½ (p.m.n.)	from the preceding [star] of Gemini's head	210	685
		from the following [star] of Gemini's head	210	920
2 2	Sept. 7, 2½ (p.m.n.)	from the preceding [star] of Gemini's head	210	662½
		from the following	210	883½

N o .	Year, Mo., D., H.	Distance from fixed	Sinus	Sinus secūd.
		stars	prim.	
		[star] of Gemini's head		
2	Sept. 16, 2½ (p.m.n.)	from the preceding	210	638
3		[star] of Gemini's head		
		from the following	210	844
		[star] of Gemini's head		
2	Sept. 17, 2½ (p.m.n.)	from the preceding	210	611
4		[star] of Gemini's head		
		Algomisa [Procyon]	210	493
2	Sept. 21, sub 3 (p.m.n.)	from the following	210	523
5		[star] of Gemini's head		
		Algomisa [Procyon]	210	448
2	Sept. 23, 2½ (p.m.n.)	from the following	210	495
6		[star] of Gemini's head		
2	Sept. 26, 2½ (p.m.n.)	from the heart of Leo	210	824
7		[Regulus]		
2	Oct. 13, 2½ (p.m.n.)	from the heart of Leo	210	948½
8		[Regulus]		
		from the sixth [star] of	60	1127
		Leo		
2	Oct. 30, 2½ (p.m.n.)	from the sixth [star] of	140	1036½
9		Leo		
		from the heart of Leo	110	982½
		[Regulus]		
3	Nov. 3, 3 (p.m.n.)	from the sixth [star] of	160	960
0		Leo		
		from the heart of Leo	140	951½
		[Regulus]		
3	Nov. 12, 6 (p.m.n.)	from the sixth [star] of	190	983
1		Leo		
		from the heart of Leo	210	889½
		[Regulus]		
3	Nov. 28, 7 (p.m.n.)	from the tail of Leo	210	878

N o .		Year, Mo., D., H.	Distance from fixed stars	Sinus prim.	Sinus secūd.
2			[Denebola]		
			from the heart of Leo	210	582
			[Regulus]		
3		Dec. 1, 3 (p.m.n.)	from the tail of Leo	180	1010
3			[Denebola]		
			from the heart of Leo	210	549
			[Regulus]		
			from the 27th [star] of Leo	140	797
3		1476 Jan. 3, 6 (p.m.n.)	the seventh [star] of	150	837
4			Virgo		
3		Feb. 5, 4 (p.m.n.)	the fifth [star] of Virgo	60	849
5					
3		Feb. 19, 4 (p. merid.)	the seventh [star] of	170	835
6			Virgo		
3		Feb. 20, 4 (p. merid.)	the fifth [star] of Virgo	50	761
7					
3		Mart. 20, 2 (p. merid.)	the first [star] of Virgo	10	958½
8					
3		Mart. 29, 2 noct. (p.m.)	the twenty-seventh	140	926½
9			[star] of Leo		
4		April 4, 1 noct.	the twenty-second [star]	180	888
0			of Leo		
4		April 7, 1 noct.	the twenty-seventh	130	869
1			[star] of Leo		
4		Sic fuerat die sexta	the twentieth [star] of	190	897½
2		[Thus it had been on the sixth day]	Leo		
4		April 12, 1 noct.	the twenty-seventh	160	897
3			[star] of Leo		
			from the heart of Leo	210	931½
			[Regulus]		

N o .	Year, Mo., D., H.	Distance from fixed	Sinus	Sinus secūd.
		stars	prim.	
		the twenty-seventh [star] of Leo	210	895
		from the heart of Leo [Regulus]	210	960½
		the twenty-seventh [star] of Leo	210	964
		from the heart of Leo [Regulus]	210	960½
		the twenty-seventh [star] of Leo	210	860
		from the heart of Leo [Regulus]	200	901
		a little after, from the same heart [of Leo]	210	947
4 4	1477 Oct. 15, 4½ (p.m.n.)	from the heart of Leo [Regulus]	190	834½
		from the tail of Leo [Denebola]	210	838
4 5	1478 May 19, 1 (post occ. Solis) [after sunset]	Spica	80	941
		the tenth [star] of Virgo	160	941
4 6	1481 Nov. 19, 1 (ante ort. Solis) [before sunrise]	Spica	80	598
		the twenty-first [star] of Virgo	120	588
4 7	1486 Aug. 18, 4 (manè, p.m.n.)	Aldebaran	70	635
		the northern horn of Taurus [<i>Cornu Bor. Tauri</i>]	110	587

N o .	Year, Mo., D., H.	Distance from fixed stars	Sinus prim.	Sinus secūd.
4 8	Aug. 20, 3 (manè, p.m.n.)	Aldebaran	70	559
		the northern horn of Taurus	100	580
4 9	Aug. 26, 4 (manè, p.m.n.)	Aldebaran	100	571
		the northern horn of Taurus	70	535
5 0	Aug. 31, 4 (manè, p.m.n.)	Aldebaran	120	547
		the northern horn of Taurus	60	541

The Third Class has observations made by means of the zodiacal armillae, on whose uncertainty — to within 10 minutes — see the Waltherian Saturn observations above, no. 33. For that reason we have chosen few of these, and only those for which Walther assigns the hour, omitting those for which he notes the culmination of the heavens without an explicit hour.

Table — Walther's Mars observations (Third Class): observed place of Mars

Columns: observation number | Year, Month, Day, Hour, Minute (*Ann. Mens. D. H. M.*) | Observed place of Mars (*Locus ♂ observ.*: Sign, Degree, Minute)

No .	Year, Mo., D., H., M.	Place of Mars (Sig., Gr., M.)
51	1489 April 5, 8, 0 (p. merid.)	Cancer 29, 0
52	1503 Aug. 26, 3 (manè, p.m.n.)	Gemini 23, 53
53	Sept. 16, 2, 30 (p.m.n.) — <i>latit. Borea</i> [northern latitude]	Cancer 5, 15 0, 30
54	Sept. 19, 2, 30 (p.m.n.) — <i>latit. Borea</i>	Cancer 6, 45 0, 15

No	Year, Mo., D., H., M.	Place of Mars (Sig., Gr., M.)
55	Oct. 13, 4 (manè, p.m.n.) — <i>latit. Borea</i>	Cancer 17, 0 1, 0
56	1504 Jan. 3, 3 (manè, p.m.n.)	Cancer 10, 45

Table — comparison of three observed Mars positions (Tycho / Alphonsine / Copernican)

[A small inset comparison table, headed by the month "Ianuarij" (January) for the date column and "Lõg. Mart." (longitude of Mars) and "Latitudo" (latitude) for the position columns. Each of the three dated observations gives three rows: the observed value, the Alphonsine-computed value, and the Copernican-computed value.]

Columns: row index | January: Day, Hour, Minute (D. H. M.) | Longitude of Mars (Lõg. Mart.: Sign, Degree, Minute) | Latitude (Latitudo: Degree, Minute) | source

R	o Jan. D. H.	Long. of Mars (Sig. G.	Latitude (G.	
w	M.	M.)	M.)	Source
1	9, 17, 15	♌ Libra 3, 5 0, 43 4, 4	3, 4 B 2, 48 2, 50	observed (<i>observata</i>) Alphonsine (<i>Alphōsina</i>) Copernican (<i>Copernic.</i>)
2	14, 16, 40	♌ Libra 3, 4 1, 25 4, 56	3, 12 B 2, 57 2, 59	observed Alphonsine (<i>Alphons.</i>) Copernican (<i>Copern.</i>)
3	15, 15, 50	♌ Libra 4, 2 1, 32 5, 5	3, 13 B 2, 58 3, 1	observed Alphonsine (<i>Alphons.</i>) Copernican (<i>Copern.</i>)

There follow the acronychal places of Mars [loca Martis acronychii] from the observation of Tycho, as far as concerns the opposition with the true place of the

Sun — with the place of Mars added, computed from the restored tables; both from Longomontanus [Christian Longomontanus], Book 2 of the *Theorica*, and from Kepler [Johannes Kepler], as reduced in his work *On Mars*, Chapter 15 — indeed, as far as concerns the opposition with the mean motion of the Sun, in his *On Mars*, Chapter 8.

Table — *Ex Longomontano* (From Longomontanus)

Columns: row index | Year (*Ann.*) | Month, Day, Hour, Minute (*Mens. D. H. M.*) | Observed longitude (*Longit. observ.*: Sign, Degree, Minute, Second) | Computed longitude (*Lōg. suppu.*: Degree, Minute, Second)

R	o	Ye	Observed long. (Sig. G. M.	
w	ar	Mo. D. H. M.	S.)	Computed long. (G. M. S.)
4	15	Nov. 18, 1, 30	♊ Gemini 6, 27, 30	6, 27, 30
	80			
5	15	Dec. 28, 4, 0	♋ Cancer 16, 54, 30	16, 55, 30
	82			
6	15	Jan. 30, 19, 15	♌ Leo 21, 35, 10	21, 37, 0
	85			
7	15	Mart. 6, 7, 20	♍ Virgo 25, 42, 0	25, 42, 10
	87			
8	15	Apr. 14, 6, 20	♏ Scorpio 4, 23, 0	4, 26, 30
	89			
9	15	June 8, 7, 45	♐ Sagittarius 26, 42, 0	26, 45, 20
	91			
1	15	Aug. 25, 17, 30	♑ Pisces 12, 15, 0	12, 14, 45
0	93			
1	15	Oct. 31, 0, 40	♉ Taurus 17, 30, 40	17, 29, 10
1	95			
1	15	Dec. 13, 16, 0	♋ Cancer 2, 27, 0	2, 26, 0
2	97			
1	16	Jan. 18, 14, 0	♌ Leo 8, 37, 0	8, 37, 10
3	00			

Table — *Ex Keplero cap. 15. Martis* (From Kepler, *On Mars*, Chapter 15)

Columns: row index | Year (*Ann.*) | Month, Day, Hour, Minute (*Mens. D. H. M.*) | Observed longitude (*Longit. observ.*: Sign, Degree, Minute, Second) | Observed latitude (*Latit. obs.*: Degree, Minute)

R o w	Ye ar	Mo. D. H. M.	Observed long. (Sig. G. M. S.)	Observed lat. (G. M.)
4	1580	Nov. 18, 1, 31	♊ Gemini 6, 28, 35	1, 40 B
5	1582	Dec. 28, 3, 58	♋ Cancer 16, 55, 30	4, 6 B
6	1585	Jan. 30, 19, 14	♌ Leo 21, 36, 10	4, 32 $\frac{1}{6}$ B
7	1587	Mart. 6, 7, 23	♍ Virgo 25, 43, 0	3, 41 B
8	1589	Apr. 14, 6, 23	♏ Scorpio 4, 23, 0	1, 12 $\frac{3}{4}$ B
9	1591	June 8, 7, 43	♐ Sagittarius 26, 43, 0	4, 0 A
10	1593	Aug. 25, 17, 27	♑ Pisces 12, 16, 0	6, 2 A
11	1595	Oct. 31, 0, 39	♉ Taurus 17, 31, 40	0, 8 B
12	1597	Dec. 13, 15, 54	♋ Cancer 2, 28, 0	3, 33 B
13	1600	Jan. 18, 14, 2	♌ Leo 8, 38, 0	4, 30 $\frac{5}{6}$ B

Table — *Opposit. mediae ex Kepleri Marte c. 8* (Mean oppositions, from Kepler, *On Mars*, Chapter 8)

Columns: row index | Year (*Ann.*) | Month, Day, Hour, Minute (*Mens. D. H. M.*) | Observed longitude of Mars (*Lōg. ♂ observ.*: Sign, Degree, Minute, Second) | Computed longitude (*Lōg. suppu.*: Degree, Minute, Second)

R o w	Ye ar	Mo. D. H. M.	Observed long. ♂ (Sig. G. M. S.)	Computed long. (G. M. S.)
	15 80	Nov. 17, 9, 40	♊ Gemini 6, 46, 10	6, 50, 40
	15 82	Dec. 28, 12, 16	♋ Cancer 16, 46, 10	16, 51, 26
	15 85	Jan. 31, 19, 35	♌ Leo 21, 10, 26	21, 9, 41
	15 87	Mart. 7, 17, 22	♍ Virgo 25, 10, 20	25, 4, 50
	15 89	Apr. 15, 13, 34	♏ Scorpio 3, 58, 10	3, 54, 33
	15 91	June 8, 16, 25	♐ Sagittarius 26, 32, 0	26, 40, 23
	15 93	Aug. 24, 2, 13	♑ Pisces 12, 43, 45	12, 34, 36
	15 95	Oct. 29, 21, 22	♉ Taurus 17, 56, 15	17, 57, 14
	15 97	Dec. 13, 13, 32	♋ Cancer 2, 28, 0	2, 32, 20
	16 00	Jan. 19, 9, 40	♌ Leo 8, 18, 0	8, 19, 57

CAPVT IV — Copernican Mars Observations (*Martis Observationes Copernicæ*)

1. In the year of Christ 1512, on the Calends of January [January 1], at the sixth hour before noon — that is, in the morning — Copernicus, at Frauenburg [Frombork], saw Mars one-quarter of a degree distant from the bright star, the first of the Claws [first of Chelae, i.e. of Libra], or more to the south, but deflected toward the rising of the summer solstice [northeast]; which was an indication that Mars was separated from it as to longitude by $7\frac{1}{2}'$, and as to northern latitude by $12'$. (*Copernicus, lib. 5, cap. 19.*) He supposes that star to be elongated from the first star of Aries by $191^{\circ}20'$, with a northern latitude of $40'$; and so the place of Mars to be in [Libra] at $191^{\circ}28'$, with a northern latitude of $51'$; and so

Mars to have been at $1^{\circ}53'$ of Scorpio, according to his hypothesis from the first star of Aries. [Margin: Copernic. lib. 5, cap. 19.]

2. In the year of Christ 1512, on the Nones of June [June 5], after the first hour past midnight, at Frauenburg, Copernicus — from his own observation — says he found Mars acronychal [in opposition to the Sun] at $235^{\circ}33'$; that is, in Sagittarius at $15^{\circ}58'$, and opposite to the Sun positioned at $55^{\circ}33'$ from the first star of Aries, that is, in Gemini at $15^{\circ}58'$ minus. (*Copernicus, lib. 5, cap. 16.*) [Margin: Copernic. lib. 5, cap. 16.]

3. In the year of Christ 1518, on the day before the Ides of December [December 12], at the eighth hour after noon, at Frauenburg, by Copernicus's observation Mars appeared acronychal, and in opposition, at $63^{\circ}2'$ from the first star of Aries — that is, in Gemini at [the corresponding] degree, $23^{\circ}40'$. (*Copernicus, lib. 5, cap. 16.*) [Margin: Copernic. lib. 5, cap. 16.]

4. In the year of Christ 1523, on the eighth day before the Calends of March [February 22], at the seventh hour before noon, at Frauenburg, with Copernicus observing, Mars was seen in [Leo] at $123^{\circ}20'$ from the first star of Aries — namely, in Leo at 24° . (*Copernicus, lib. 5, cap. 16.*) [Margin: Copernic. lib. 5, cap. 16.]

CAPVT V — Tychonic Mars Observations from the year of Christ 1580 to 1601

Tychonic Mars Observations from the year of Christ 1580 to 1601, noted in the Old Style [diebus stylo veteri notatis], and made at Uraniborg unless otherwise added, reckoned to hours after noon.

Tycho himself, in his *Letters to the Landgrave of Hesse* [*Epistolae ad Landgravium Hassiae*], page 56, sets down these three [observations] for the year 1587, in January, made with the Alphonsine and Copernican calculation.

[The Tychonic observation tables follow on the next page (the large two-part table of pp. 320). The page-3 tables below, headed by the page-320 narrative, are continuations: they give "other places of Mars" derived from Tycho's observation and computation, marked with the letter K where they appear in Kepler's On Mars, or with the letter C for the Tychonic observations sent to us by Father Albert Curtius, S.J.]

LIBER VII — DE MARTE (page 320)

There follow other places of Mars from the observation and computation of Tycho, derived from his observations, as they appear in Kepler's *On Mars* — which we shall indicate by the letter K — or, among the Tychonic observations sent to us by Father Albert Curtius [Albert Curtz], of the Society of Jesus — which we shall indicate by the letter C.

Table — other places of Mars (Tycho/Kepler/Curtius), nos. 14–124

[A single large table running across the page in two halves: the left half carries observation nos. 14–66, the right half nos. 67–124. The columns are identical in both halves.]

Columns: observation number | Year (*Ann.*) | Month, Day, Hour, Minute (*Mens. D. H. M.*) | Observed longitude of Mars (σ *Lõg. observ.*: Sign, Degree, Minute, Second) | Observed latitude (*Lat. observ.*: Degree, Minute, Second) | Kepler's chapters (*Capita Kepl.*)

Left half (nos. 14–66):

N o . r	Y e a r	Mo. D. H. M.	Obs. long. σ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
14	1580	Nov. 12, 10, 50	♊ Gemini 8, 37, 0	—	K. 10
15	1585	Nov. 11, 18, 45	♋ Cancer 26, 35, 30	—	C.K. 51
16	1586	Nov. 23, 16, 0	♋ Cancer 26, 38, 30	2, 49, 10 B	C.K. 53
17	1587	Dec. 26, 8, 28	♋ Cancer 17, 38, 0	4, 7, 0 B	K. 11
		(Dec. 26,) 8, 30	♋ Cancer 17, 40, 30	4, 7, 0 B	C.K. 53
18	1588	Dec. 28, 12, 16	[♋] 16, 46, 10	4, 6, 0 B	K. 8

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
1 9	(Dec.) 30, 8, 10	[♄] 16, 0, 30	4, 8, 0 B	C.K. 53
2 1 0 5 8 3	Jan. 26, 6, 15	♄ Cancer 8, 20, 30	2, 52, 12 B	C.K. 53
2 1	Apr. 22, 9, 45	♌ Leo 1, 17, 0	1, 50, 40 B	C.K. 13
2 1 2 5 8 4	Nov. 12, 1, 30	♌ Leo 23, 14, 0	2, 12, 24 B	K. 13
2 3	(Nov. 12,) noctis Dec. 21, 14, 0	[♌] 23, 14, [0] ♍ Virgo 1, 13, 30	2, 12, 0 3, 31, 0 B	B. C. C.K. 53
2 1 4 5 8 5	Jan. 14, 16, 0	♌ Leo 27, 29, 0	4, 20, 0 B	C.
2 5	(Jan.) 22, 14, 0	[♌] 24, 47, 0	4, 28, 0	C.
2 6	(Jan.) 24, 9, 0	[♌] 24, 7, 30	4, 31, 0	C.K. 53
2 7	(Jan.) 31, 12, 0	[♌] 21, 18, 11	4, 31, 0	C.K. 10
2 8	Febr. 3, 6, 0	♌ Leo 20, 11, 9	4, 28, 0 B	C.
2 9	(Febr.) 4, 6, 40	[♌] 19, 47, 30	4, 28, 0 B	K. 53
3 0	(Febr.) 17, 10, 0	[♌] 15, 12, 0	4, 16, 0 B	C.
3	Mart. 9, 9, 10	♌ Leo 11, 49, 6	3, 24, 16 B	K. 28

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
1				
3 2	(Mart.) 11, 5, 0	[♌] 11, 45, 30	3, 24, 10	K. 28
3 3	(Mart.) 12, 10, 30	[♌] 11, 46, 0	3, 22, 0	K. 53
	(Mart.) 12, 9, 0	[♌] 11, 45, 0	3, 22, 0	C.
3 4	(Mart.) 16, 7, 0	[♌] 11, 51, 0	3, 13, 0	C.
3 5	(Mart.) 19, 8, 0	[♌] 12, 2, 0	3, 6, 0	C.
3 6	April 15, 9, 50	♌ Leo 17, 37, 0	2, 9, [0] B	C.
	(April 15,) 10, 0	[♌] 17, 37, 30	—	K. 22
3 7	April 26, 9, 42	[♌] 21, 26, 0	1, 49, 15 B	K. 13
3 8	Maij 7, 11, 26	♌ Leo 25, 55, 0	1, 33, 0 B	K. 27
3 9	(Maij) 12, 10, 8	[♌] 28, 3, 30	1, 24, 30 B	K. 27
4 0	(Maij) 18, 10, 30	♍ Virgo 0, 50, 45	1, 19, 30 B	K. 22
4 1 1 5 8 6	Oct. 21, 18, 0	♍ Virgo 0, 7, 0	1, 36, 6 B	C.K. 13
4 2	Nov. 1, 16, 40	[♍] 5, 52, 0	1, 47, 0 B	C.K. 13
4 3	(Nov.) 30, 19, 30	[♍] 20, 4, 30	2, 16, 30 B	C.K. 13
4 4	Dec. 15, 18, 30	[♍] 26, 6, 24	2, 35, 0 B	K. 51

Y N e o a . r		Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
4 1 5 5 8 7		Jan. 25, 17, 0	♌ Libra 4, 42, 0	3, 26, 0 B	C.K. 53
4 6		Jan. 27, 17, 0	[♌] 4, 41, 0	3, 27, 0 B	C.K. 28
4 7		Mart. 4, 13, 24	♍ Virgo 26, 25, 40	3, 38, 0 B	C.K. 53
4 8		Mart. 6, 7, 23	[♍] 25, 45, 0	3, 41, 0 B	C.
4 9		(Mart.) 10, 11, 30	[♍] 24, 5, 15	3, 29, 0 B	C.
5 0		(Mart.) 27, 9, 40	[♍] 18, 21, 0	2, 55, 0 B	C.
5 1		(Mart.) 27, 9, 40	[♍] 18, 21, 45	2, 55, 40 B	K. 27
5 2		April 1, 9, 30	♍ Virgo 17, 11, 0	2, 43, 30 B	C.K. 27
		(April) 21, 9, 30	[♍] 15, 48, 20	1, 48, 0 B	K. 53
5 3 5 8 8	1 5 8 8	Nov. 5, 18, 50	♍ Virgo 23, 16, 0	1, 37, 0 B	C.K. 51
5 4		(Nov.) 19, 18, 30	[♍] 25, 31, 0	1, 36, 45 B	C.K. 13
5 5		Dec. 4, 18, 0	♌ Libra 9, 19, 24	1, 53, 30 B	K. 13
5 6		(Dec.) 14, 18, 10	[♌] 14, 35, 40	1, 54, 0 B	K. 28
5 7 8	1 5 8	Febr. 11, 17, 13	♑ Aquarius 8, 48, 0	2, 9, 0 B	C.K. 27

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
9				
5 8	Mart. 8, 16, 24	♊ Aquarius 12, 16, 50	2, 4, 0 B	C.K. 53
5 9	April 5, 11, 33	♊ Aquarius 7, 31, 10	1, 28, 13 B	K. 51
6 0	(April) 13, 11, 15	[♊] 4, 43, 20	1, 10, 0 B	C.
6 1	(April) 15, 12, 5	[♊] 3, 58, 21	1, 4, 20 B	C.
6 2	Maij 3, 5, 39	♎ Libra 15, 25, 0	1, 28, 0 B	C.
6 3	(Maij) 6, 11, 20	[♎] 27, 7, 20	0, 6, 40 B	C.
6 4	Sept. 15, 7, 15	♐ Sagittarius 16, 47, 20	1, 41, 40 B	C.K. 13
6 5	Nou. 1, 6, 10	♑ Capricorn 20, 59, 15	1, 36, 0 A	C.K. 13
6 6	Dec. 3, 5, 39	♊ Aquarius 15, 25, 33	1, 11, 47 A	K. 51

Right half (nos. 67–124):

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
6 7 9 0	Mart. 4, 7, 10	♈ Aries 24, 22, 56	0, 3, 12 A	C.K. 12
6 8	Oct. 6, 4, 45	♍ Virgo 17, 16, 0	1, 16, 0 B	C.
6	(Oct.) 30, 18, 15	♎ Libra 2, 57, 20	1, 15, 30 B	C.K. 28

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
9				
7 0	Dec. 27, 19, 8	≈ Aquarius 8, 6, 0	1, 14, 0 B	C.K. 27
7 1 1 5 9 1	Jan. 4, 18, 50	≈ Aquarius 12, 44, 24	1, 23, 15 B	C.K. 27
7 2	(Jan.) 21, 19, 0	[≈] 22, 33, 0	1, 0, 30 B	K. 22
7 3	Febr. 19, 5, 30	✂ Sagittarius 7, 24, 0	—	C.
7 4	Maij 13, 13, 40	♊ Capricorn 2, 24, 30	2, 15, 0 A	C.K. 51
7 5	(Maij) 19, 13, 40	[♊] 1, 34, 45	2, 40, 15 A	C.
7 6	(Maij) 21, 13, 13	[♊] 1, 15, 45	2, 52, 0 A	C.
7 7	(Maij) 24, 12, 42	[♊] 0, 40, 20	3, 5, 0 A	C.
7 8	(Maij) 29, 12, 10	✂ Sagittarius 29, 30, 20	3, 25, 0 A	C.
7 9	Iunij 6, 12, 22	✂ Sagittarius 27, 14, 42	3, 55, 30 A	K. 15, 53
8 0	(Iunij) 10, 11, 50	✂ Sagittarius 26, 2, 36	2, 55, 0 A	K. 53
8 1	(Iunij) 12, 11, 50	[✂] 25, 25, 0	4, 44, 0 A	C.
8 2	(Iunij) 28, 10, 24	[✂] 21, 10, 0	4, 45, 0 A	C.
8 3	Iulij 17, 9, 3	✂ Sagittarius 20, 8, 0	4, 50, 0 A	C.

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
8 4	Sept. 26, 7, 10	♑ Capricorn 18, 36, 0	2, 49, 12 A	C.K. 42
8 5	Oct. 16, 6, 30	♒ Aquarius 1, 27, 20	2, 10, 50 A	C.
8 6	Dec. 10, 10, 5	[♒] 10, 3, 0	0, 16, 0 A	C.
8 1 7 5 9 2	Jan. 23, 10, 15	♈ Aries 11, 34, 30	0, 2, 0 A	K. 12
8 8	Febr. 3, 6, 12	♈ Aries 19, 17, 0	0, 6, 0 A	C.
8 9	(Febr.) 29, 8, 0	♉ Taurus 7, 25, 0	0, 29, 0 A	C.
9 1 0 5 9 3	Iunij 29, 13, 30	♊ Pisces 13, 37, 22	4, 37, 0 A	K. 51
9 1	Iulij 21, 14, 0	♊ Pisces 17, 45, 45	5, 46, 0 A	K. 53
9 2	(Iulij) 30, 13, 45	[♊] 17, 39, 30	6, 6, 15 A	K. 42
9 3	Aug. 5, 13, 45	♊ Pisces 16, 7, 30	6, 18, 50 A	K. 42
9 4	(Aug.) 22, 12, 20	[♊] 13, 10, 15	6, 7, 0 A	K. 53
9 5	(Aug.) 24, 10, 30	[♊] 10, 38, 0	6, 5, 30 A	K. 15
9 6	(Aug.) 29, 10, 20	[♊] 11, 14, 0	5, 52, 0 A	K. 53
9 7	Oct. 3, 8, 0	♈ Aries 3, 6, 50	0, 7, 9 A	K. 26

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
9 8	Dec. 10, 7, 0	♊ Aries 4, 44, 0	0, 1, 15 A	K. 61
9 1 9 5 9 4	Ianu. 3, 6, 12	♊ Aries 18, 36, 0	0, 27, 57 A	C.
1 0 0	Nou. 29, 6, 40	♋ Aquarius 18, 31, 0	0, 19, 30 B	C.
1 1 0 5 1 9 5	Ianu. 3, 19, 10	♐ Sagittarius 13, 36, 40	0, 3, 46 B	C.K. 12
1 0 2	Iulij 21, 14, 40	♉ Taurus 4, 11, 10	2, 30, 0 A	K. 51
1 0 3	Sept. 3, 16, 0	♉ Taurus 26, 6, 0	1, 26, 0 A	C.
1 0 4	Sept. 17, 16, 45	♉ Taurus 26, 7, 12	1, 42, 0 A	K. 53
1 0 5	Oct. 12, 9, 0	♉ Taurus 23, 52, 0	0, 51, 0 A	C.
1 0 6	(Oct.) 25, 8, 10	[♉] 19, 39, 25	0, 12, 41 A	K. 26
1 0 7	(Oct.) 27, 12, 20	[♉] 18, 51, 15	0, 6, 0 A	K. 53
1 0	(Oct.) 28, 12, 0	[♉] 18, 29, 0	0, 4, 30 A	C.K. 61

Y N e o a . r	Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
8				
1 0 9	(Oct.) 31, 0, 39	[♊] 17, 31, 40	0, 8, 0 B	K. 15
1 1 0	Nou. 3, 12, 0	♊ Taurus 16, 18, 30	0, 17, 0 B	C.
1 1 1	(Nou.) 23, 9, 30	[♊] 11, 6, 0	1, 40, 0 B	C.
1 1 2	Dec. 6, 8, 55	♊ Taurus 10, 26, 16	1, 29, 0 B	K. 51
1 1 3	(Dec.) 17, 7, 6	[♊] 11, 31, 27	1, 40, 44 B	K. 51
1 1 4	(Dec.) 18, 7, 40	[♊] 11, 41, 0	1, 40, 0 B	C.
1 1 5 5 9 6	Ianu. 26, 5, 15	♊ Taurus 24, 20, 28	1, 53, 0 B	C.
1 1 6	Febr. 3, 6, 15	♊ Taurus 27, 56, 40	1, 50, 0 B	C.
1 1 7	Mart. 5, 14, 0	♊ Gemini 13, 37, 40	1, 47, 0 B	C.
1 1 8	(Mart.) 9, 8, 0	[♊] 15, 49, 0	1, 49, 40 B	K. 13

Y N e o a . r		Mo. D. H. M.	Obs. long. ♂ (Sig. Gr. M. S.)	Obs. lat. (G. M. S.)	Capita Kepl.
1 1 9		(Mart.) 9, 7, 40	[II] 15, 49, 12	1, 47, 40 B	K. 51
1 2 0		(Mart.) 15, 8, 0	[II] 18, 29, 50	1, 45, 0 B	C.
1 1 2 5 1 9 7		Nou. 7, 17, 0	♄ Cancer 12, 30, 0	1, 36, 24 B	K. 51
1 1 2 5 2 9 9		Oct. 20	♄ Leo 1, 0, 50	1, 18, 0 B	C.
1 1 2 6 3 0 0		Febr. 20, 10, 0	♄ Cancer 29, 14, 56	3, 50, 51 B	Snell.
1 2 4		April 7, 9, 20	♄ Leo 3, 30, 47	2, 33, 0	C.

Of the page-320 narrative below the right table:

There now come to light the remaining Tyconic observations, published at Vienna and edited by Lucius Barrettus — understand by this Father Albert Curtius [Albert Curtz] of our Society, to whom the Emperor Ferdinand entrusted this task, although under an anagram he wished to conceal his own name. As a specimen of these, until they all come into general use, take [the following] for the year 1582.

LIBER VII — DE MARTE (Book 7, Mars)

Caput V (continued) — Tycho's Mars Observations, 1580–1601

[The Tycho/Uraniborg Mars observation table continues. Columns: the entry number; **Year · Month · Day · Hour · Minute** of observation; **Mars's distance** in degrees (Gr.) and minutes (M.); and the reference fixed star (**à Fixis**, "from the fixed stars"). The leftmost numbers are the running observation-entry numbers.]

N

o

.	Year — Month, Day	H M—	Gr. (°)	M. (')	from the fixed star
1582					
1	Nov. 23	8 5 bis	22	32	from the Knee of Castor
2		0			[à Genu Castoris]
5		9 7 ter	39	53½	from the Northern Horn of Taurus [à Cornu Bor. Tauri]
1	25	8 2	22	21⅓	from the Knee of Castor
2		7			
6		8 5 ter	39	43	from the Northern Horn of Taurus
		0			
1	Dec. 3	8 0 quat	21	7½	from the Knee of Castor
2		er			
7		7 5 ter	52	0	from the Eye of Taurus [ab Oculo Tauri]
		2			
		8 1 ter	38	27½	from the Northern Horn of Taurus
		9			
1	17	8 0	6	49½	from the Head of Castor [à cap. Castoris]
2					
8		8 ½	44	41	from Aldebaran [ab Aldebara]

Mars was at almost exactly the same longitude as the Head of Castor, near the apogee [Auge] of its epicycle and close to opposition, together with the Sun. ☉

N

o

.	Year — Month, Day	H M —	Gr. (°)	M. (')	from the fixed star
1	Dec. 27	6 5 b	6	43¼	from the Head of Castor
2		1 is			
9		7 8	36	42¼	from the Heart of Leo [à corde Leonis]
		7 1 b	36	43	from the Heart of Leo
		8 is			
1	29	1 6 b	29	33½	from the Northern Horn
3		1 is			of Taurus
0		1 6	6	16	from the Head of Castor
		9			
1	30	8 1 t	29	13½	from the lower foot of
3		0 e			Erichthonius [ab infer.
1		r			ped. Ericht.]
		8 1	35	27½	from the upper foot of
		8			Erichthonius [à super.
					ped. Erichth.]

We have now passed from Tycho's first observations to his last, made in Bohemia — partly at the castle of Benátky near Prague, partly in Curtius's house at Prague — which Snellius edited at Leiden in 1618, restoring them to the dates of the new calendar.

132. In the year 1600, on January 1 (new style), on the preceding night the meridian altitude of Mars as observed by Tycho was 58° 54', and that of Jupiter was 55° 6'. From this, after two hours, both being at the Pole, they differed from the head of the Pollux [the star], Mars indeed being 29° 45', but Jupiter 33° 35½'. [Reading of these positional figures uncertain in places: 29° 45' / 33° 35½' [?]]

133. On the fifth of January, on the preceding night, one hour before Mars's transit across the meridian, Mars was distant from Pollux's head 29° 3', and soon

after from the Tail of Leo $30^{\circ} 13'$. It then crossed the meridian at an altitude of $59^{\circ} 22'$.

134. In the same year, on March 2 at 10 p.m., Mars was distant from the bright star of Aries [the Ram] $86^{\circ} 33\frac{1}{3}'$, and from Aldebaran $55^{\circ} 47' 1/6$ [?]; therefore, says Snellius, the longitude of Mars was Cancer $29^{\circ} 14' 56''$, with northern latitude $3^{\circ} 50' 51''$.

135. On April 12 at 9 h 37' p.m., Mars was distant from the bright star of the foot of Gemini [the Twins] $32^{\circ} 50'$, and after 14 minutes of time it was distant from Regulus $19^{\circ} 20' \frac{1}{2}$.

136. In the year 1601, October 10, in the morning at 3 h 30', Mars was distant from Pollux's head $25^{\circ} 0' 10''$, from Procyon $27^{\circ} 44' \frac{1}{4}$, and from Regulus $12^{\circ} 2' \frac{1}{2}$.

137. And on October 11, in the morning at 4 h 30', Mars was distant from Pollux's head $25^{\circ} 33' 50''$, from Procyon $28^{\circ} 12'$, and from Regulus $11^{\circ} 23'$.

This was Tycho's last observation: for soon after, suffering from retention of urine when he had drunk too freely at a supper on October 13, he died on the 24th.

The authorities, moreover, who use the aforesaid observations — both the acronychal ones and the others, besides Kepler and Longomontanus — whose places are listed above, are: Boulliau [Bullialdus], *Astronomia* book 8, throughout, and to the end; Lansbergen [Lansbergius], passim, in his observations of the years 1587 (January 15 and 1589, April 15) and 1591 (May 13) and 1595 (October 17, or rather 27).

CAPUT VI.

Observations of Mars made by Justus Byrgius [Jost Bürgi], Longomontanus, Kepler, Fabricius, and Gellius Sascridus, from the year 1590 to 1613.

1. Justus Byrgius's [Jost Bürgi's] observations were made at Kassel [Casellis], and noted on the days of the old style, in hours after noon, by Snellius among the Hessian observations.

[The following table gives, for each numbered observation: **Year · Month · Day · Hour · Minute** of the observation; **Mars's distance** (Martis dist.) in degrees (G.), minutes (M.), seconds (S.); and the reference fixed star (**à Fixis**).]

N
o

.	Year — Month, Day	H MG. (°)	M. (')	S. (")	from the fixed star
1	1590 Dec. 23	1 0 17 3	20	0	from Spica [à Spica]
		11	35	0	from the Northern Scale [à Lance Borea]
2	1591 Jan. 29	1 3 38 9 0	56	30	from Spica
		8	55	30	from Regulus [à Regulo]
3	June 8	9 1 22 0	32	0	from Antares [ab Antare]
		43	39	0	from the bright star of Aquila [à lucida Aquilæ]
4	Sept. 28	7 1 13 5	6	0	from the shoulder of Sagittarius [ab humero Sagittarii]
	(☉ □ — Sun in quartile)	32	37	30	from the bright star of Aquila [ab Aquilæ lucida]
5	1593 Dec. 2	8 0 25	42	0	from the Head of Andromeda [à cap. Andromedæ]
		21	26	15	from the third star of Aries [à tertia Arietis]
6	1594 Jan. 2	8 0 46	28	0	from Aldebaran [ab Aldebara]
		26	18	30	from the Girdle of Andromeda [à cingulo Androm.]
7	March 4	8 0 10 29	39 25	0 0	from Aldebaran from Capella [à Capella]
8	1595 Aug. 8	1 0 25	42	30	from the Head of

N
o

.	Year — Month, Day	H MG. (°)	M. (')	S. (")	from the fixed star
		5			Medusa [à cap. Medusæ]
		20	37	0	from Aldebaran
9	Dec. 13	9 0 24	15	0	from Aldebaran
		40	16	0	from Capella
1	1596 Jan. 28	9 0 11	33	0	from Aldebaran
0		28	53	30	from Capella
1	1597 Sept. 28	1 0 14	26	0	from the following star
1		4			of the Head of Gemini [à cap. seq. Geminor.]
		22	26	30	from Procyon [à Procyone]

12. In the year 1591, January 9 (old style), Michael Mästlin [Michael Mästlin] and Johannes Kepler at Tübingen saw the whole of Jupiter occulted by Mars in an inferior eclipse: the color of Mars was fiery, and its ruddiness proved Mars to be the lower body. Kepler [reports this], page 305 of the *Astronomia Optica* [*Astronomiae Pars Optica*]; and from there Lansbergen, in his *Thesaurus* of these observations, nonetheless setting the day as the eighth, [Margin: *Lansbergii duplex dolus* — "Lansbergen's double trickery"] and the morning, by his own contrivance; but in the calculation he puts the day as the sixth, and the hour as the 18th, by Goad's [reckoning]. [Goëtæ] As if the observation had been made in the morning of the 7th day — quite wrongly, since his own tables do not show this conjunction of Mars with Jupiter except at hour 18 after the midday of the sixth day, by Goad's reckoning, at which time he reckons the place of Jupiter in Scorpio to be at 13° 52', with the true place of Mars in Scorpio at 1° 18'. But Mars's place in Scorpio at 13° 51' — with the latitude 2° 8' 1' 18' — is either faulty, or the figures of Kepler are vitiated; or these are the Tables of Lansbergen. Maginus, in his *Ephemerides*, marks this conjunction from the Prutenic [Tables] for the 9th, at hour 15, 41' after the meridian of Venice.

13. In the year 1591, June 8 (old style), Gellius Sascridus [Gellius], a disciple of Tycho, observing at Padua [Patavii], concluded an opposition of Mars, in opposition to the opinion of Tycho himself, [who held] that Mars was in the place

of the Moon at hour 16 25' after the meridian, when Mars was at that time in the orbit at Sagittarius $26^{\circ} 40' \frac{1}{2}$. Kepler, in *De Marte* [*Astronomia Nova*] chapter 8.

14. In the year 1597, December 10 (old style), David Fabricius [Fabricius] in East Frisia [Ott. Frisia], at hour 12, 10', observed Mars in Cancer $3^{\circ} 40' \frac{1}{4}$, with northern latitude $3^{\circ} 23'$. Kepler in *De Marte* chapter 15.

15. In the year 1602, February 16 (old style), David Fabricius in East Frisia at hour 5, in the morning, observed Mars distant in advance of the bright Southern star of the Wing of Virgo [Virgin] by $20^{\circ} 18'$, and from the Tail of Leo $8^{\circ} 17'$. Kepler, in *De Marte* chapter 15, who from this gathers that Mars was at the Wing of Virgo in Virgo $14^{\circ} 21' \frac{1}{2}$ — from Leo, however, with the tail, in $14^{\circ} 23' 36''$ — taking the mean as Mars at $14^{\circ} 21' 18''$, while computing Fabricius's Sextant [reading] of the distances as too large.

16. In the year 1602, Longomontanus, book 2, *Theoricae* chapter 8, gathers from his own observations an opposition of Mars with the Sun; and that the place of the Sun was, on February 20 (old style), at hour 14, 15', in Virgo $12^{\circ} 24'$ at Copenhagen [Hafniae], although his own Tables give $12^{\circ} 24'$.

17. In the year 1602, February 18 (old style), at Prague, with the help of Matthias Seiffart [Seiffard], Tycho's pupil, using Tycho's instruments, in the evening at hour 10, 30' after the meridian, [the observation continues —]

LIBER VII — DE MARTE (folio 322)

[Continuation of entry 17, top of folio 322:] — observed the distance of Mars from the middle of the Tail of Ursa Major [the Great Bear] $52^{\circ} 22'$; but because this falls between the Heart of Leo and Procyon, the Sextant gave $37^{\circ} 22' 20''$ when it ought to have been $37^{\circ} 19' 40''$; therefore the Sextant exceeds by $2\frac{1}{3}'$. He concludes the distance of Mars from the middle of the Tail of Ursa Major, corrected, to have been $52^{\circ} 19' \frac{1}{2}$. Thus, between Mars and Regulus, he sets $19^{\circ} 20' \frac{2}{3}$; and between Mars and the bright star of Virgo, $21^{\circ} 20'$; he sets $21^{\circ} 17' \frac{1}{2}$; and from this remarkable agreement he establishes the place of Mars in Virgo $13^{\circ} 19' 6''$. Kepler, *De Marte* chapter 15.

18. In the year 1602, on the same night, February 18, at hour 12, 40', Kepler at Prague observed the meridian altitude of Mars: it was $50^{\circ} 19'$, as it should have been with the Tail of Leo; from this he deduced the place of Mars in Virgo $13^{\circ} 19' 30''$, with northern latitude $4^{\circ} 7' 55''$; and from this he recognized that the opposition of Mars with the Sun would be on February 20, at hour 14, 13' after the

meridian, with Mars holding Virgo $12^{\circ} 27' 35''$, with northern latitude $4^{\circ} 10'$. Kepler, *De Marte* chapter 15. 18. 52.

19. In the year 1604, February 27 (new style), Kepler, on a night between the days of Jupiter and Venus, while Cortus observed the middle of the sky, observed Mars distant from Spica $9^{\circ} 44'$, and from the Northern Scale [à Lance Borea] $17^{\circ} 41'$; but using the same instrument he found the distance of Mars from Arcturus $29^{\circ} 13'$, and from Spica $31^{\circ} 57'$. Since these agree with Tycho's data within $1^{\circ} 45'$, he therefore corrected the aforesaid distances, ordering them thus: $9^{\circ} 48' 45''$ — $17^{\circ} 45' 45''$ — $29^{\circ} 17' 43''$. Moreover, he took the meridian altitude of Mars at $32^{\circ} 4'$, and that of Spica at $30^{\circ} 50'$; from the difference of these altitudes, by the declination given under the Pole, he ascertained the altitude of Spica should have been $30^{\circ} 52'$, and that of Mars $32^{\circ} 6'$. He doubts, however, whether the iron rule, being heavy, by its own weight caused a sagging impetus at the points of the pinnules [pinnacidia], in the customary way. Thus Kepler, *De Marte* chapter 11.

20. In the year 1604, April 8 (new style), Kepler, together with Johannes Schulerus [Schuelerus], observing in the evening, found the distance between Arcturus and Spica to be $33^{\circ} 1' \frac{1}{2}$, or $3/4$; from which, having corrected the distances, he acquired the distance of Mars from Arcturus $54^{\circ} 8' \frac{1}{3}$, and from the Heart of Leo $54^{\circ} 8' \frac{3}{4}$. And although one may doubt whether he sometimes took Mars for Spica, he nonetheless gathers an opposition of Mars with the Sun to have been on March 28 (old style), at hour 16 23' after the meridian, with Mars in Libra $18^{\circ} 37' 50''$, with southern latitude $2^{\circ} 26'$. Kepler in *De Marte* chapter 15.

21. In the year 1604, September 27 (new style), at Prague, hour 8, there was an observation of the conjunction of Mars with Saturn; and on October 9, at hour 1 before noon, it was [observed] from the conjunction of Mars with Jupiter. Kepler, book *De Nova Stella in pede Serpentarii* [On the New Star in the Foot of the Serpent-Bearer] chapter 11.

CAPUT VII.

Observations of Mars made by Petrus Gassendus [Pierre Gassendi], Martinus Hortensius [Martin van den Hove], Michael Florentius [Michel Florent van Langren], and Vincentius Mutus [Vicenç Mut], from the year 1617; likewise by the Fathers of the Society [of Jesus] at Ingolstadt and at Innsbruck [Oeniponti].

1. In the year 1621, for the opposition of Mars with the Sun noted in the Ephemerides for May 6, Gassendi at Aix [Aquis Sextiis], on May 3, in the evening

at hour 10, observed Mars distant from the Northern Scale [à Lance Borea] by 8° 19', and from the Southern [Scale] by 5° 17'. But since the Scales [Lances] are 9° 12' apart, so that he might follow Tycho's latitude and longitude, Tycho would have it 9° 8'. Again, on the same day, hour 8, he saw Mars distant from the Northern Scale 8° 18', and from the Southern 5° 6'; and on the 8th day, hour 9, in the evening he saw it distant from the Northern Scale 8° 28', and from the Southern 3° 35'. Thus Gassendi in [his] observations sent also to D. Johannes Dominicus Cassinus [Giovanni Domenico Cassini] at Bologna.

2. In the year 1623, June 26, hour 13 after midday, Gassendi at Digne [Diniae] [observed] the distance of Mars 6° 53' from the left shoulder of Sagittarius, and 13° 3' from the Northern part of the arc of Sagittarius; from this he deduced the longitude of Mars at Capricorn 13° 21' ½, and the southern latitude 6° 37' ⅓ — as is had in his own observations sent in writing to Valois [Valesium], in which are also contained the infrascript [below-written] longitudes and latitudes observed by the same.

[The following table gives, for **Anno 1623: Month · Day · Hour**, then **Longitude of Mars** (Longit. Martis) in **Sign** (Sig.), degrees (G.), minutes (M.), and **Southern Latitude** (Latit. Austr.) in degrees (G.) and minutes (M.). The entry numbers continue from no. 2 above.]

N

o Month —

.	Day	H	Sig.	G. (°)	M. (')	Lat. G. (°)	Lat. M. (')
3	June 28	13	♊ (Capricorn)	12	52	6	31
4	July 1	12		12	4	6	26
		½					
5	5	12		11	4	6	11
		½					
6	6	14		10	48½	6	6½
7	18	11		7	47	5	55
8	19	11		7	33	5	54
9	20	11		7	18	5	54½
1	26	10		6	17	5	54
0		½					
1	27	10		6	11½	5	48
1		½					

N							
o	Month —						
.	Day	H	Sig.	G. (°)	M. (')	Lat. G. (°)	Lat. M. (')
1	August 1	10	♄ (Capricorn)	5	40	5	46
2							
1	2	10		5	39	5	45
3							
1	3	10		5	36	5	43
4							
1	4	9		5	34	5	43
5		½					
1	5	10		5	34	5	41
6							
1	6	10		5	35	5	38
7							
1	8	10		5	37	5	36
8							
1	9	10		5	38	5	35
9							
2	10	10		5	41	5	34
0							

21. In the year 1632, February 5, Michael Florentius Langrenus [Michel Florent van Langren], Cosmographer to the Catholic King [of Spain], at Madrid [Matriti], saw Mars occulted by the Moon when the eastern edge of the Moon was culminating at 178° 38', and emerging from the western edge when 193° 35' was culminating, having been hidden under the [Moon] for 57½ of one hour.

22. The same conjunction (the acronychal conjunction of Mars with the full Moon) Hortensius [Martin van den Hove] observed at Leiden, and Gassendi at Paris at hour 15, 18' after midday; from this Hortensius, in [his] dissertation, says it agrees with the Tables of Lansbergen, and indeed [agrees] with Gassendi; for Lansbergen, in his *Thesaurus* of observations, computing the place of Mars from the aforesaid moment of Mars, [places] the place of Mars in Leo 16° 24' 37", with northern latitude 4° 33' 43". But the true place of the Moon in Leo [he gives as] 16° 42' 31", as seen; with the true latitude 4° 58' 33"; but as seen, 4° 16' 19". Here he adds that, seen through the telescope, Mars was less than one digit more to the

North than the Northern edge of the Moon, and the center of the Moon was seen to be higher toward the West by $38^{\circ} 51'$.

23. Gassendi, moreover, in his *Epicurus* page 900, says that, observing at Paris in the year 1632, on February 6 at hour 3, min. 3, after midnight, the Moon being high toward the West at $44^{\circ} 15'$, the highest faint margin of Mars passed underneath, and just grazing it, it deserted [it] at hour 3, 33', the part of the margin being inclined toward the North; and although Mars was seen by the naked eye much earlier to be occulted by the Moon, nonetheless through the telescope it was seen to immerse the whole [body] later — though he adds that some portion of Mars remained in the middle of the occultation, as if not the whole [body] were then immersed.

24. In the year 1634, the Ephemerides note an opposition of Mars with the Sun on March 12; therefore Gassendi at Digne, on the 8th day, in the evening, with Regulus high, [observed] Mars by the Radius [Astronomical Radius/Cross-staff] distant from Regulus $44^{\circ} 15'$. He saw Mars distant from Regulus $26^{\circ} 41'$, and from the Heart of Hydra $27^{\circ} 57'$; on the remaining days there were clouds, and on the 15th day, in the evening, with Regulus high at 44° , he saw Mars distant from Regulus $23^{\circ} 56'$, and from the Tail of Leo $8^{\circ} 44'$. Thus also to Cassini.

25. In the year 1634, June 8, in the evening, Gassendi at Aix, with the naked eye, judged the last star of the four [stars] of the left Wing of Virgo (which Lynceus's companion Socius saw at the beginning of the night) to be covered by Mars; as far as could be estimated with the naked eye, by how much it might seem distant from Mars, [it was] but [by] half a semidiameter of Mars; but through the telescope Gassendi saw it to be distant from the star by the nearest seven diameters of Mars. [The remainder continues below.]

LIBER VII — DE MARTE (folio 323)

[Continuation of entry 25, top of folio 323:] Then at hour 11, 19', Mars and the star were both at the same altitude, the former [Mars] being lower and the latter higher, with a distance of four diameters. Finally, at hour 12, 34', Mars was seen to be at the same longitude as the star, distant by no more than three diameters of Mars. In the *Epicurus*, page 902, understand the outermost [star] of the left wing, as I shall say in chapter 8.

26. In the year 1636, Gassendi at Aix on March 17, in the evening, with Castor high, by the Radius saw Mars distant from Arcturus $30^{\circ} 29'$, and from Spica 22°

15'; but on the 18th day, with Spica high, [he saw] Mars distant from Arcturus $30^{\circ} 23'$, and from Spica $9^{\circ} 19'$. Thus also to Cassini.

27. In the year 1642, August 15, with Michael Florentius observing at Brussels, the Moon occulted Mars when the Equator was culminating at $300^{\circ} 33'$, and Mars itself culminating at $308^{\circ} 54' 11''$. Thus in his letters to me.

28. In the year 1645, D. Vincentius Mutus [Vicenç Mut], at Majorca [Maioricae], on the 13th day of February, hour 8, saw Mars by three minutes more to the West, and by $33'$ more to the North, than the second preceding star among the unformed stars of Erichthonius; but on the 28th day, at one hour after sunset, he saw Mars distant, as to longitude, by less than $2'$ from the star [of Spica], which is below and to the North of Erichthonius, and by 21 scruples [seconds] more to the North. Thus in his letters to me.

29. In the same year, the same [observer], on the same spot, April 6, hour 7, saw Mars distant toward the East a little more than half [a degree] from the Moon, [and] from the star which is in the upper thigh of Gemini. Likewise in his letters to me.

30. In the same year, 1645, D. Vincentius Mutus at Majorca, hour 8 after midday, saw Mars at almost the same longitude as the extreme foot of Northern Cancer [the Crab], but more to the North by about 24 scruples [seconds]. At length, on the 15th day of May, hour 8, Mars was distant by about 2 scruples [seconds], in respect of longitude, from the Northern preceding [star] in the quadrilateral of Cancer, but it was more to the North by about 5 scruples [seconds]. Likewise in his letters to me.

31. In the year 1649, June 23, hour 9, D. Vincentius Mutus at Majorca saw Mars more to the South, but by about 13 scruples [seconds] more to the West, than the star which is in the outermost left Wing of Virgo; but on the 24th day, hour 9, Mars was seen more to the East than the star which is in the extreme Wing of Virgo; on the 24th day, Mars is a little more than three scruples [seconds] more to the East than it had been on the preceding day toward the West; so that with Mars in conjunction with the said star, the star will have been about the twentieth hour after midday of the 23rd day. Thus from Mut's letters given to me.

Observations of Mars by the Fathers of Our Society at Ingolstadt

At Ingolstadt, moreover, the Fathers of Our Society — as P. Michael Staudacher wrote to me — observed these distances of Mars.

[The following table gives, for **Anno 1617: Month · Day · Hour** (in the evening, *Vesp.*), then **distance of Mars** from Spica (à Spica ♀) in degrees (Gr.) and minutes ('), and from Arcturus (ab Arcturo) in degrees (Gr.) and minutes ('). The "à Spica" reference changes to "ab Antare" partway through, as noted in the cell.]

Month — Day	H (Vesp.)	à Spica ♀ Gr.	'	ab Arcturo Gr.	'
May 25	9¼	44	3 0	51	42
31	9¾	41	5 6	49	12
June 14	10¼	35	1 4	45	12
19	10	32	4 5	43	30
29	10	27	2 4	40	0
July 11	9½	20	4 8	36	27
14	9¼	19	6	35	40
16	9¾	17	5 0	35	10
26	9½	12	1 0	33	4
30	9	9	4 0	32	10
August 6	8½	5	2 6	31	20
7	8½	4	3 6	31	20
		<i>ab Antare</i>		<i>ab Arcturo</i>	
10	8¾	48	3 2	31	8
13	8½	46	3 9	31	5

Observations of Mars by the Fathers of the Society of Jesus at Innsbruck

At Innsbruck [Oeniponti], moreover, the Fathers of the Society of Jesus — by the testimony of the same P. Michael Staudacher — observed the distances written below.

[This table gives, for each date in **An. 1635 / An. 1636 / An. 1637: Month · Day**; the **distance of Mars** (Distantia ♂) from a named star (A.) in degrees (Gr.) and minutes ('); and the **Rising/Setting Altitude** (Altitudo Ortiva / Occidua) of the **Fixed star** (Fixarum) and of **Mars** (Martis), each in degrees (Gr.) and minutes ('). For An.1636 the heading becomes "Altit. Occ." over the distance and "Ortiua" over the altitude; for An.1637 both become "Occid." Where a value reads "occid." or "ortiu." the cell records rising/setting rather than a numeric altitude.]

Yea r	Month — Day	star (A.)	Gr. (°)	'	Fixed-star alt. Gr.	'	Mars alt. Gr.	'
An. 163 5	Sept. 19	Canicula	30	29	31	5	20	3
		[Procyon/the Little Dog]		½				5
		Cap. Polluc. [Head of Pollux]	28	30				
	Oct. 2	Canicula	37	18	42	3	28	2
				½		5		0
		Iuba ∂ [Mane of Leo]	7	22				
				½				
	4	Canic.	38	19	41	5	25	4
				¼		7		6
		Iuba ∂	7	24				
				⅓				
	6	Canic.	39	26	43	3	27	3
						0		5
		Iuba ∂	7	40				
	8	Canic.	40	34	44	4	28	5
						9		7
		Iuba ∂	8	4				
				¼				

Yea r	Month — Day	star (A.)	Gr. (°)	'	Fixed-star alt. Gr.	'	Mars alt. Gr.	'
An. 163 6			(Altit. Occ.)		(Ortiua)			
	May 27	Regulo [Regulus]	53	22	37	3 5	35	2 6
		Cauda ♀ [Tail of Leo]	33	46 $\frac{2}{3}$				
	July 7	Spica ♀	8	38 $\frac{1}{2}$			occid.	
		Arcturo [Arcturus]	33	7 $\frac{1}{2}$	52	1 2	21	2 0
	23	Spica	15	56	15	1 0	18	2 8
		Arcturo	35	57 $\frac{2}{3}$	46	5 0	occid.	
	Dec. 12	Aquila	33	18 $\frac{1}{4}$	37	1 1 $\frac{1}{2}$	21	5 1 $\frac{1}{2}$
		Cygni Lucida [bright star of Cygnus]	62	47 $\frac{1}{2}$				
	27	Aquila	39	58	26	5 2	24	1 2
		Lyræ Lucida [bright star of Lyra]	70	51				
An. 163 7			(Occid.)		(Occid.)			
	Jan. 8	Lyræ Lucida	74	13	25	3 0	24	1 0
		Cygni Lucida	60	53				
	19	Lucid. ♀ [bright star of Aries]	51	50	64	2 2	23	4 6

Year	Month	star (A.)	Gr. (°)	'	Fixed-star alt. Gr.	'	Mars alt. Gr.	'
		Markab. [Markab]	21	20	(ortiu.)		(occid.)	
	Febr. 27	Aldebara [Aldebaran]	53	42 $\frac{1}{3}$	57	2 2	20	2 8
		Orio·hum.luc. [bright star of Orion's shoulder]	73	6	(occid.)		(occid.)	
	March 14	Rigel	56	4 $\frac{1}{3}$	(occid.)		16	5
		Aldebara	42	41	48	4 2	(occid.)	
	20	Rigel	52	43 $\frac{1}{3}$	(occid.)		15	2 5
		Aldebara	38	18 $\frac{1}{6}$	45	5 8	(occid.)	

CHAPTER VIII.

Selected observations of Mars, made at Bologna in the College of St. Lucy by Father Giovanni Battista Riccioli [Giovanni Battista Riccioli] and Francesco Maria Grimaldi [Francesco Maria Grimaldi] of the Society of Jesus.

To which are added the observations of the most illustrious Marquis Cornelio Malvasia [Cornelio Malvasia].

1. In the year 1642, on October 12, in the morning about an hour before sunrise, Mars stood $38^{\circ}24'$ from Regulus, and $19^{\circ}44'$ from Aldebaran; and the same observations were repeated with a great sextant, as the practice was in these and the following ones.
2. In the same year, on October 21, in the morning, by Italian civil reckoning, Mars stood 15° precisely from the bright star of Aries, and $40^{\circ}28'\frac{1}{2}$ from Regulus.

3. In the year 1642, on July 16, in the morning at $7\frac{1}{2}$ hours, Italian reckoning, Mars was $17^{\circ}27'$ from the bright star of Aries, and $28^{\circ}31'$ from the tail of Cetus.
4. In the year 1642, on August 21, in the morning at the forty-first minute after the bright star of Aries had crossed the meridian, Mars stood $25^{\circ}37'$ from it; and 5 minutes of time later it stood $44^{\circ}41'$ from the following shoulder of Orion.
5. In the year 1642, on August 23, in the morning at $9\frac{1}{2}$ hours, civil reckoning, Mars stood $24^{\circ}51'$ from Aldebaran, and 2 minutes of time later it was $41^{\circ}2'$ from it.
6. In the year 1642, on August 25, in the morning, as the bright star of Aries was crossing through the meridian, counting 48 minutes by the pendulum, Mars crossed the meridian, and at that moment the captured altitude of its tail was $57^{\circ}58'$.
7. In the year 1642, on August 28, in the morning, at the crossing of the bright star of Aries through the meridian, counting $51^{\circ}10''$, after which Mars crossed the meridian, the altitude of its tail measured $58^{\circ}18'$.
8. In the year 1642, in September, on the night following, about the fourth hour of the night, Mars stood $38^{\circ}20'$ from Capella, and $17^{\circ}50'$ from Aldebaran.

Here ought to be inserted, in order, the two earlier observations.

9. In the year 1642, on the night following the 31st, after the crossing of the bright star of Aries through the meridian by 31 minutes, and 12 seconds, Mars was tending toward the second hour with the Sun, or it was rising acronychally [acronychus], at the meridian, $16'$. Then after 3 minutes of time Mars was $26^{\circ}12'$ from Aldebaran, and after 3 minutes it stood $42^{\circ}26'$ from Regulus.
10. In the year 1643, on January 5, on the night following the crossing of the bright star of Aries through the meridian, we counted $34^{\circ}36''$; and at that time Mars crossed through the meridian, and the altitude then observed was $60^{\circ}58\frac{1}{2}'$.
11. In the same year, on February 11, on the night following, at the 3rd hour, civil reckoning, Mars stood $22^{\circ}19\frac{1}{2}'$ from the bright star of Aries;

Andromeda was expected to the south at $29^{\circ}29'$; Mars was awaiting the Sun.

12. In the year 1643, on May 3, at the first hour after sunset, Mars stood $21^{\circ}5\frac{3}{4}'$ from Procyon, and $30^{\circ}10\frac{1}{2}'$ from Capella.
13. In the year 1643, on July 11, on the night following, at $1\frac{1}{2}$ hours, Italian civil reckoning, Mars stood $20^{\circ}33\frac{1}{2}'$ from Saturn, the more westerly one; and 5 minutes later it stood $19^{\circ}14\frac{1}{2}'$ from the southern foot of Andromeda; it was now 19° high, the sky being misty.
14. In the year 1644, on August 6, by night, the bright star of Aries was [?] from the vertex toward its rising at $30^{\circ}42'$; from that, counting 6 minutes, Mars stood $7^{\circ}14\frac{1}{4}'$ from the bright star of Aries pulsing seventh with [Florisonio?]; and 2 minutes later it was $30^{\circ}23\frac{1}{2}'$ from Capella.
15. Also in the year 1644, in September, on the 9th, at high Sirius 18° , or about one hour before sunrise, Mars stood $13^{\circ}24\frac{1}{4}'$ from Aldebaara; from the bright star of Aries, indeed, $45^{\circ}48'$; it was awaiting both the Sun and Mars [recte: Sirius?].
16. In the year 1644, in November, on the 17th, on the night following, Mars was $63^{\circ}56'$ distant from the eastern vertex; from this, counting 9' of time, Mars stood $39^{\circ}52'$ from Rigel of Orion; after 3 minutes later it stood $31^{\circ}25\frac{1}{2}'$ from Aldebaran.
17. In the year 1645, on March 22, on the night following, when Mars was in conjunction [□] with the Sun, it was observed to stand $25^{\circ}19'$ from Procyon, and from the bright side of Perseus $25^{\circ}51\frac{3}{4}'$; and then the altitude of Sirius was seen at $7^{\circ}33'$.
18. In the year 1646, on June 23, in the morning, after the conjunction [□] of Mars with Saturn, and from the underwritten bright star of Aries, the distances of these planets from the vertex were taken and are written below:

Bright star of Aries, dist. from vertex	Distance of planets from the fixed stars	
Deg.	Mi n.	G M.
63	56	Saturn from Capella 4 32 0

Bright star of Aries, dist. from vertex		Distance of planets from the fixed stars	
63	44	Mars from Capella	3 11 9 ½
62	46	Saturn from the bright star on the side of Perseus	3 31 4
60	52	Mars from the same side	3 57 2
60	0	Mars from Saturn	1 32

Here is to be inserted the observation that follows, [numbers] 22, 23, and 24.

19. In the year 1647, on April 2, on the night following, at about one hour after sunset, the observation was begun, and completed about one and a half hours; concerning which, just as also concerning the observation of April 4, see our observations of Jupiter at the same time, and Mars 34 and 35 — for at that time the conjunction [□] of these planets was celebrated.
20. In the year 1649, on February 20, on the night following, about 2½ hours, by night, Mars stood 31°23' from the Heart of Hydra, and 49°½ from Procyon.
21. On the 26th of the same month, Mars on the night following was scarcely sensibly more easterly than the Moon with respect to the same Vertical, but was seen to stand 69°23½' from the vertex; the center, however, of the Moon was 68°12'; and after one minute of time, with Mars more easterly, it stood 59°4½' from Rigel; likewise, with Mars more easterly, at the same moment it stood 52°10' from the vertex; then Mars stood 62°ab from the vertex, and 30°11¼' from the Heart of Hydra, and 49°40' from Procyon.
22. In the year 1647, on January 16, on the night following, Mars was 30° high from Procyon; from Procyon also 31°; it stood 25°15¼' from the bright star of Orion; and soon from the bright star of Orion, the horn, 46°18½'.
23. In the same year, on January 23, on the night following, Mars was 33° high from Procyon; it stood 32°20' from the bright star of Orion 44°4'; and after 12 minutes of time it stood 23°49' from Procyon.
24. In the same year, likewise, on January 26, on the night following, Mars stood 43°4' from the bright shoulder of Orion, and 23°12' from Procyon — at that time Mars was about 48° high; from Procyon, indeed, 42°.

25. In the year 1649, on June 2, with the now finished conjunction [□] of Mars with the Sun, on the night following, about an Italian hour and a half, when the bright star of the mane stood 50° from the vertex, Mars stood $16^{\circ}52' \frac{1}{2}$ from Regulus, and $18^{\circ}48'$ from the bright star of Leo.
26. In the year 1652, in November, on the 19th, in the morning, when the bright star of the mane of Leo stood $42^{\circ}50'$ from the vertex, the times were begun to be counted by the pendulum; and after 6 minutes Mars stood $33^{\circ}50'$ from Arcturus, the more easterly one. Then after another 4 minutes it stood $45^{\circ}13'$ from the Heart of Hydra, the more westerly one.
27. In the year 1653, in February, on the 2nd, in the morning, with the bright star of the Eagle $69^{\circ}40'$ distant from the vertex, the more easterly one, Mars stood $24^{\circ}1'$ from Spica, the more westerly one; and soon from the head of Ophiuchus, the more easterly one, $46^{\circ}59'$, than Mars was $46^{\circ}59'$.
28. In the year 1653, on March 15, on the night following, at $1\frac{1}{2}$ hours, after sunset, Mars rising was observed to stand from the vertex 77° [continues]. $77^{\circ}38'$; and from the bright star of the Northern Crown 48° ; and almost 1' later Mars stood $77^{\circ}6'$ from the vertex; it was $36^{\circ}48'$ from Spica.
29. On the following day, that is May 16, with Mars approaching the Sun, since there was an hour and a half after sunset, it was observed to stand $77^{\circ}4'$ from the vertex; and from the head of Ophiuchus $42^{\circ}1'$; soon Mars stood $76^{\circ}24'$ from the vertex; and from Spica of Virgo $36^{\circ}16'$.
30. In the year 1653, on June 19, on the night following, at the second hour after sunset, when Antares appeared, Mars was $19^{\circ}45'$ high; and Mars stood $25^{\circ}37'$ from it; it was seen to be distant from Antares $17^{\circ}53' \frac{3}{4}$; and from the head of Ophiuchus $47^{\circ}33' \frac{3}{4}$; it was tending toward Direction, since it was retrograde.
31. In the year 1653, on June 22, on the night following, when Antares appeared, it was $18^{\circ}16'$ high; but Mars was $26^{\circ}13'$ high; or about one hour after sunset, it was seen that Mars stood from Antares 18° precisely, and from the head of Ophiuchus $47^{\circ}40'$.
32. Likewise in the year 1653, on June 24, one hour after sunset, Mars was $26^{\circ}14'$ visibly high; it was distant from the head of Ophiuchus $47^{\circ}42'$; and soon from the Heart of Scorpio $36^{\circ}18'$; with Antares the same standing $19^{\circ}12'$.

33. In the year 1653, in November, on the 28th, when the conjunction of Mars with Jove [Jupiter] was celebrated, on the night following, Fomalhaut was seen to stand $76^{\circ}2'$ from the vertex; Mars was seen almost in second place, and Mars was distant from Fomalhaut $25'$ precisely; and a little after, from the southern tail of Cetus $47^{\circ}37\frac{1}{2}$; but the tail of Cetus stood $69^{\circ}42'$ from the vertex; Mars, however, 65° .
34. In the year 1653, in December, on the 23rd, on the night following, the bright star of the Eagle stood $61^{\circ}41'$ from the vertex; and therefore one hour after midday $5^{\circ}20'$; after counting [past?] noon by [?] $19^{\circ}12''$, Mars stood from the western Azimuth at 25° degrees, where it was expected; and then, with the distance of Mars from the vertex observed to be $59^{\circ}58'$.
35. In the year 1653, on March 16, on the night following, Mars was expected from the western Azimuth at 85° degrees in that vertex $66^{\circ}41\frac{1}{2}$; then after 5 minutes of time Rigel of the Eagle stood $58^{\circ}32'$ more easterly.
36. In the year 1655, on July 16, on the night following, Mars appeared about as large as Jupiter; it came to the meridian; and then it was seen to stand $70^{\circ}54\frac{1}{2}$ from the vertex; then after $7'40''$ the head of Andromeda stood toward its rising $45^{\circ}3'$ from the vertex.
37. On July 22 (for indeed on the 20th, with a rainy spell of two days having interrupted the observation, the conjunction [□] of Mars with the Sun began) on the night following the crossing of the bright star of the Eagle through the meridian we counted $31^{\circ}10''$; after which Mars came to the meridian, in which the distance of Mars from the vertex observed was $71^{\circ}22\frac{1}{2}$.
38. In the year 1655, in August, on the 21st, on the night following, Mars was expected at the western Azimuth at 20° , and it stood in that vertex $74^{\circ}31\frac{1}{2}$; and after a quarter-hour precisely, or 15 minutes by the pendulum, we counted Mars more westerly than the head of Andromeda, standing $64^{\circ}21'$ from the vertex.
39. In the same year, on August 23, on the night following, after the crossing of the bright star of the Eagle through the meridian by 9 minutes of time, Mars also crossed the meridian; then it is recorded standing $71^{\circ}45\frac{1}{2}$ from the vertex.

40. In the year 1656, on March 11, at the second hour of night following, it was observed that Mars stood from Aldebaran $20^{\circ}17'$ certainly, and from Regulus $40^{\circ}35'$.
41. In the year 1656, on April 29, about three-quarters of the first hour of the night following, the western distance of Mars was captured from the vertex $79^{\circ}55'\frac{3}{4}$ in that Vertical, and from the Azimuth, to which place, on reaching the head of Pollux, or of the following Gemini, it stood $37^{\circ}37'\frac{3}{4}$ from the vertex; and after three minutes of time having elapsed, the more western Procyon stood $55^{\circ}20'\frac{3}{4}$ from the vertex.
42. In the year 1657, in October, on the 21st, before the conjunction [□] of Mars and Saturn, on the preceding day, when the observation of Saturn was made, on the following night the eastern distance of Mars was observed $65^{\circ}41'10''$; designated for the Vertical Azimuth at Triangle 1° , and immediately the times began to be counted; and after 5 minutes, and at the second [count] 25 minutes, the bright star of Aries was captured, standing from the vertex toward its rising $62^{\circ}8'$.
43. In the year 1657, in November, on the 12th, when Mars was nearest to us in retrogradation, and on the night following, after the crossing of the bright star of the south in the tail of Heaven, the minutes of time were counted at $9'\frac{1}{4}$; before which the point itself in the middle of Heaven was seen to stand $36^{\circ}1'3''$ from the vertex.
44. On the 14th, indeed, after the crossing of the bright star of the south in the tail of Cetus, it was counted $9'40''$; the bright star of the middle of Heaven crossed; and its distance from the vertex was $41^{\circ}26'10''$.
45. On the 15th, indeed, in November, on the night following, after the crossing of the bright star of the south in the tail of Cetus, the times counted were $9'40''$; when Mars crossed the middle of Heaven; and its distance, captured from the vertex, was $41^{\circ}21'20''$; from which it is argued that Mars had been beneath the sky at the time of being stationary.
46. In the same year, in November, on the 17th — for on the 16th it had been cloudy weather — after the crossing of the meridian, the bright star of Heaven, and the more easterly one, in the tail of Cetus, and as far as Mars there was a crossing through the M.C. it was counted to be of time $16''$; and then the distance of Mars from the vertex was $42^{\circ}10'20''$.

47. In the same year, in December, on the 4th, on the night following, after the crossing through the middle of bright Heaven, and of the more southerly one, in the tail of Cetus, the times counted were of time 22'45"; and then with Mars in the middle of Heaven, its distance was observed 39°5'24".

48. In the year 1660, in May, on the 18th, D. Vincenzo Mutus [Vincenzo Muti] of Majorca [Maioricae] observed Mars with the breast of Cancer, and with certain little stars distant around Praesepe; but the innumerable ones, nor do we rely on the Tyconic Catalogue, for our affair: with Mars distant beyond 7', and from Praesepe distant about 5'.

Observations made in the Astronomical Observatory of Modena [Mutina] by the most illustrious Marquis Cornelio Malvasia [Cornelio Malvasia], and set forth in his Ephemerides, fol. 215.

Year 1662.	Distance of ♂ from the fixed stars, corrected		Place ☉ Observed	Lansbergen's deficit
H. ab	A.		' ♄	' '
Occas.				
May 30	0	Regulus	3 Long.	3 36
	3		8	4
	0			
		Mane ♄	2 Lat. B.	3 4
			0	1
June 3	1	Regulus	3 Lo.	4 35
	1		2	6
	2			
		Spica ♍	2 La.	2 3
			0	6
June 5	1	Regulus	2 Lo.	5 34
	4		6	2
	0			
		Mane ♄	2 La.	2 5
			5	6
June 8	1	Mane ♄	5 Lo.	3 34
	3		0	2
	8			

Year 1662.		Distance of σ from the fixed stars, corrected	Place $\odot$ Observed	Lansbergen's deficit
		Spica $\mathfrak{M}$	4 La.	2 3
			2	2
June 12	1	Mane $\mathfrak{Q}$	2 Lo.	4 35
	1		8	8
	7			
		Spica $\mathfrak{M}$	2 La.	1 3
			5	9
June 16		Spica $\mathfrak{M}$	1 Lo.	4 34
			0	
		Arcturus	4 La.	1 3
			7	6
June 22	1	Spica $\mathfrak{M}$	4 $\mathfrak{M}$	3 33
	3		0	4
	4			
		Arcturus	1 La. B.	1 3
			1	1
June 25	1	Spica $\mathfrak{M}$	5 Lo.	1 32
	3		6	8
	7			
		Arcturus	4 La.	8 3
			0	
July 1	1	Spica $\mathfrak{M}$	2 Lo.	4 27
	3		5	8
	2			
		Arcturus	5 La.	5 3
July 4	1	Spica $\mathfrak{M}$	3 Lo.	3 26
	3		7	6
	3			
		Arcturus	4 La.	4 4
			7	
July 7	1	Spica $\mathfrak{M}$	4 Lo.	2 26
	3		0	5
	8			

Year	Distance of ♂ from the fixed stars, corrected	Place ☉ Observed	Lansbergen's deficit
1662.	Arcturus	2 La. 6	1 4

But it should be remembered that he used the Tychonic Fixed Stars, which need correction, in accordance with what was said in Book 4. And the Cassinian Fixed Refractions, by which the said distances are corrected, are said by us to be recalled into doubt in Book 1.

CHAPTER IX.

On the Astronomical Tables, to be tested against selected observations made on Mars.

1. Having set forth thus far the reasons for selecting from among so many observations, I have touched on only the most certain of them, in Book 5, chapters 9 and 10, and in Book 6, chapter 9. But indeed Tycho [Tycho Brahe], in the Preface to his *Epistolae Astronomicae* [*Epistolae Astronomicae*], requires 24 years of observations for Mars, so that an acronychal Mars may be opposed to the Sun in each sign of the Zodiac. [Margin: *Longomontanus's opinion.*] Longomontanus, however, in Book 2 of the *Theorica*, chapter 8, brings forward only 14 oppositions of Mars with the Sun, from Kepler's Commentaries on Mars, yet denying that the eccentricity of Mars is the foundation for the construction of Kepler's Ephemerides. [Margin: *And his praise of Kepler.*] Kepler, however, in the explanation of the foundation of the Rudolphine Tables he constructed (page 14 of the Commentaries), states that he departed from his own [findings] on Mars not a nail's breadth, and that the Magnum in the supplement to the Ephemerides most faithfully represented the motions of Mars in the limited Commentaries of those days. And indeed astronomy owes the most in this matter to Kepler. For once, as Pliny [Pliny] testifies (Book 2, chapter 17), the planet Mars was considered unobservable; [Margin: *Errors of the ancients in (Mars).*] and its errors in the ancient Hypotheses could not be forced within the narrowness of two degrees, as Maestlin [Maestlin] in his Preface advised an Ephemeris of the year 1577; indeed, it appeared from the autumnal observations of the year that they had wandered far afield; Kepler, with the truest Hypothesis devised in the year 1625, and with the best use of Tychonic observations, forced the

errors of this planet within a very few minutes — so much so that, as Elias de Leonibus [Elias de Leonibus] asserts in *Urania Propitia*, part 2, chapter 15, the least may have to be changed in the Rudolphine Tables, which is confirmed by the example of the conjunction of Jove [Jupiter] and Mars in the year 1591, about which we said above in Book 5, chapter 9, and which we shall mention again below.

2. Lansbergen [Philips van Lansbergen], moreover, among the other observations of Mars which he brings forward from his *Thesaurus*, the conjunction itself, in the very manner in which he indicates the conjunction of Jove and Mars, which Mestlin observed in January [Margin: *Lansbergen's double trickery.*] Opt. page 305, affirms agrees with Maestlin and with his own Astronomical observations; yet saying nothing of *Mane* [in the morning], he, Lansbergen, made it from his own addition in the morning, and says that Kepler writes the 9th, when he should have written the 8th; nor does this hold, since in the series of the calculation he sets down only January 6, the 18th hour, in order to draw the observation to his own Tables, or as if changed, or otherwise altered at his pleasure, so that for this reason it deservedly invites the reproach of Elias de Leonibus and Boulliau [Ismaël Boulliau], in *Urania Propitia* part 2, chapter 15. Io. Phocylides [Johannes Phocylides Holwarda], and Boulliau — who indeed examined Boulliau's far more profound and prudent investigation of the Rudolphine hypotheses.

Now we proceed to the comparison of the Astronomical Tables, selecting those 10 acronychal Oppositions of Mars with the true place of the Sun, by which especially Kepler in his *Commentaries on Mars* built up the Martial Hypothesis: we add besides four notable conjunctions of Mars — with Jove, and 1 with Saturn, and 6 with the most certain fixed stars — and how far they labor under the least suspicion of error.

10. *The acronychal places of Mars in Opposition, observed against the true place of the Sun according to Tycho, from the Commentary of Kepler, with the computation from the Tables.*

			G		
			Sig.	.	"
Year 1580	Observ.	II	6	28	35
1 Nov. 18 old style	from the Danish		6	27	30
H. 1 30'	from Ours		6	28	13

			Sig.	G · ' "		
	Year 1582	Observ.	⌘	1 6	55	30
2	Dec. 28	Danish		1 6	54	30
	H. 3 58'	Ours		1 6	55	0
	Year 1585	Observ.	⌘	2 1	36	10
3	Jan. 30	Danish		2 1	37	0
	H. 19 14'	Ours		2 1	36	45
	Year 1587	Observ.	⌘	2 5	43	0
4	March 6	Danish		2 5	42	0
	H. 7 23'	Ours		2 5	45	30
	Year 1589	Observ.	⌘	4	23	0
5	April 14	Danic.		4	26	30
	H. 6 23'	Ours		4	24	32
	Year 1591	Observ.	⌘	2 6	43	0
6	June 8	Danic.		2 6	45	20
	H. 7 43'	Ours		2 6	41	0
	Year 1593	Observ.	⌘	1 2	16	0
7	August 25	Danic.		1 2	14	45
	H. 17 27'	Ours		1 2	14	52

		Sig.	G		
			.	'	"
	Year 1595	Observ.	♄	1 31	40
				7	
8	Octob. 31	Danic.		1 29	10
				7	
	H. 0 39'	Ours		1 31	12
				7	
	Year 1597	Observ.	♅	2 28	0
9	Decemb. 13	Danic.		2 26	0
	H. 15 54'	Ours		2 26	40
	Year 1600	Observ.	♆	8 38	0
1	Januar. 18	Danic.		8 37	10
0					
	H. 14 2'	Ours		8 36	45

The part where our Tables disagree from the observations is to be ascribed to the observation of Mars, and to the false Tychonic place of the Sun.

11. In the year 272 before Christ, on January 17, at hour p.m. 17, Mars was seen to lie upon the most northerly forehead of Scorpio, as Ptolemy [Ptolemy] reports from the things said here in chapter 1. [Margin: ♂ *on the forehead of Scorpio.*] Longomontanus, in Book 2 of the Theorica, chapter 10, and Lansbergen in the Thesaurus, contend that this star had been bright of the second magnitude, as observed by Mars [recte: as Mars observed?]. But better do Kepler and Boulliau, in Book 8, teach that the most northerly star had been in the forehead of Scor[pio] [continues].

[Margin: ♂ *on the forehead of Scorpio.*]

of Scorpius, which is the fifth and of the fourth magnitude. Otherwise, if the motion of Mars is directed toward the bright star of the forehead of Scorpius, the conjunction of Jupiter with Regulus—soon to be reported under the years 508 and 509—cannot be reconciled. Therefore, when Mars was at that time at the most northerly star of the forehead of Scorpius, it was, for me, at 2° 39' 15" of Scorpius. So Mars, lying upon that star, was still a little more to the west, which our Tables display by an astonishing agreement; for

♂ position	Sig.	G.	'	"
Observed	♌	2	39	0
Computed	♌	2	38	54

12. In the year 498 of Christ, on the first day of May, around the ninth hour, Jupiter and Mars appeared so close together that they seemed scarcely at all to be separated from one another—though it is fairly probable that, on account of the rays of each, they were in fact set somewhat apart. I have already reported the positions of the planets, drawn from our Tables, in Book 6, Chapter 9; and they are:

Position	Sig.	G.	'	"
♃	♍	0	15	34
♂	♍	0	13	56

13. In the year of Christ 509, on June 13, around the ninth hour, Mars appeared more to the west than Jupiter by 1 digit, or 2½; and it probably was more, on account of the spreading of the rays. But in Book 6, Chapter 9, I have given the positions of both planets from our Tables, namely:

Position	Sig.	G.	'	"
♃	♌	11	56	40
♂	♌	11	52	2

14. In the year 1490 of Christ, on September 18, at the fourth hour, Mars was seen by Bernhard Walther [Bernhard Walther] joined to the Nebula of Cancer [♋ nebulosa], which was then at 0° 11' 3" of Cancer. Our Tables, however, give Mars at 0° 16' 30" of Cancer—from which a part of the discrepancy may be ascribed to Walther's estimate by eye.

15. In the year of Christ 1591, on January 9, while Maestlin [Michael Mästlin] and Kepler [Kepler] were observing, they saw at night Jupiter covered by Mars's reddish light, as Kepler reports in *Astronomia Optica*, p. 305. For me, as I have said, in Book 6, Chapter 9, at the 13th hour after midday of the 8th day, the planets stood thus:

Position	Sig.	G.	'	"
♃	♋	14	59	12
♂	♋	14	58	53

Hence at the 13th hour, 2' 30", they were exactly joined.

16. In the year 1604, on September 27 by the new style, at Prague, around the eighth hour, Mars was seen as nearly as possible joined to Saturn in longitude. For me, however, Saturn was then at 9° 58' 58" of Pisces, while Mars was at 9° 59' 30" of Pisces; so I believe their conjunction occurred a little before the one reported.

17. In the same year 1604, on October 9, near midday, a conjunction of Jupiter and Mars occurred, as Kepler deduced from observations made at Prague. For me, as I have said in Book 6, Chapter 9, at the 23rd hour 50' after midday of the 8th day, the planets stood thus when reduced to the ecliptic and curtated:

Position	Sig.	G.	'	"
♂ Position	♄	19	15	37
♂ Position	♄	19	15	36

18. In the year 1634, on June 8, Gassendi [Pierre Gassendi] at Aix-en-Provence [Aquis Sextiis], at the 12th hour 34'—which at Bologna was the 13th hour—estimated through the telescope that Mars was at the same longitude as the last star, that is, the extreme star of the left wing of Virgo, which for me was then at 21° 59' 38" of Virgo. [Margin: ♂ ♂ cū ☿ ☐ □ alaπ ♀]

		Sig.	G.	'	"
♂ Position	Observed	♂	21	59	38
	Computed	♂	22	3	19

19. In the year 1645, on February 28, at the seventh hour, at Majorca [Maiorica], D. Vicenç Mut [Vincentius Mutus], using the telescope, estimated Mars to be two minutes more to the west than an unformed star which lies near the mouth of Erichthonius [Erichthonius], the star which in my Catalogue was at 24° 41' 33" of Gemini. Mars, for me, was at 24° 41' 20" of Gemini, at the 7th hour 37' at Bologna; therefore he had already obtained that distance earlier. [Margin: ♂ ♂ ♂ / Fixa I-formis.]

20. In the same year 1645, on May 15, the same observer, in the same place, around the 8th hour 30', judged through the telescope that Mars was 2 minutes more to the east, and 2 minutes more to the west than the northern preceding star in the quadrilateral of Cancer, which for him was then at 0° 30' 6" of Leo; and yet Mars in my Tables comes out at 0° 30' 31" of Leo. Here again we differ by 2 minutes. [Margin: ♂ ♂ cū ☿ ☐]

21. In the year 1649, on June 23, from his own observations, Mut reckoned Mars at the 20th hour [?] joined with the extreme star of the other, that is, the left wing of Virgo, which for me was then at 22° 13' 10" of Virgo. And Mars was at 22° 16' 30" of Virgo.

CAPUT X.

De Hypothesi Arithmetica, et Geometrica Motuum Martis.

[On the Arithmetical and Geometrical Hypothesis of the Motions of Mars.]

1. In Book 5, Chapter 12, I treated of those matters that are common to the five lesser planets, besides those I discussed at length in Book 7 of the *Almagestum Novum* (*New Almagest*), Sections 2 and 3. But those things which are here proper to Mars are these:

Motion of ♂		Sig.	G	I		I	I	
			.	I	I	III	V	V
Mean from the equinox ♊	Diurnal	0	0	3	2	39	8	2
				1	6			1
	Annual	6	1	1	8	5	5	1
			1	7			0	9
Of the apogee	Diurnal	0	0	0	0	12	5	4
							6	7
	Annual	0	0	1	1	45	2	2
					8		8	3
Of the nodes ♋	Diurnal	0	0	0	0	7	5	2
							5	3
	Annual	0	0	0	4	11	5	1
					8		5	

Epoch of the motions for the beginning of the common Era of Christ, the beginning being reckoned from the last midday of the preceding December at the meridian of Bologna.

	Sig.	G.	'	"
♂ Position				
Mean from ♊	1	10	8	41
Of the apogee	3	24	11	18
Of the nodes ♋	0	24	8	47

Pro Geometrica Figura. [For the Geometrical Figure.]

Besides what was said in Book 7 of the *Almagestum Novum*, Sections 2 and 3, where the Figures were set out: let an Ellipse be selected meanwhile, such as the diurnal motion of the planet toward the West and other matters, and likewise the Spirals, seem most nearly to mark out on the surface; let the Cones meanwhile be chosen, and let the Measures inscribed below in the parts be selected as well, such that the Radius of the Annual Orb [Radius Orbis Annui], or the greater semidiameter of the Solar Ellipse, is 100000.

Si Radius Orbis Annui est 100000.	
And its bisected Eccentricity 1740.	
Greater semidiameter of the Ellipse of Mars	152348 ½
Lesser semidiameter of the Ellipse	151697
Whole eccentricity from the Sun	28151
Half of the eccentricity	14075 ½

Distance		
With the Sun at apogee & ♄	from the Sun	166424
	from the Earth	268164
At aphelion	from the Sun	138274
At perihelion	from the Earth	36534
With the Sun at perigee & ♀	from the Sun	166424
	from the Earth	264684
At aphelion	from the Sun	138274
At perihelion	from the Earth	50014

	Gr.	I	II
Inclination of the orbit of ♄ to the Ecliptic	1	5	5
		1	

Variety of the maximum latitudes in:

			Gr.	I	II
With the Sun at apogee & ♂	Aphelion	♂	1	4	1
					0
		♂	4	4	3
	Perihelion			5	0
		♂	1	8	4
					5
With the Sun at perigee & ♂	Aphelion	♂	7	3	3
		♂	1	5	7
		♂	4	3	4
	Perihelion			0	5
		♂	1	9	4
					0
		♂	6	2	1
				5	0

For the remaining distances, see Volume 2, Table 97.

LIBER OCTAVUS

IN QUO SUNT VENERIS PLANETÆ OBSERVATIONES, ET Hypothesis Motuum.

[BOOK EIGHT, IN WHICH ARE THE OBSERVATIONS OF THE PLANET VENUS, AND
THE HYPOTHESIS OF ITS MOTIONS.]

CAPUT I.

*Veneris Observationes Antiquæ ab Anno ante Christum 272, usque ad Annum
Christi 510.*

[The Ancient Observations of Venus, from the year 272 before Christ down to the
year of Christ 510.]

1. In the 13¹/₆th year of Ptolemy Philadelphus [Ptolemy], on the 17th day,
going on the 18th, of the month Messori, at the 12th hour, Timocharis
[Timocharis] at Alexandria [Alexandria] saw Venus obscuring exactly the
star opposite the Praesepe [Praesepe — the Manger]. Ptolemy, *Almagest*
Book 10, Chapter 4, adding that the star was the one which lies after that

one which is at the tip of the southern wing of Virgo, says that it was 52° distant from the death of Alexander, and from Nabonassar 476.

Copernicus, Book 5, Chapter 23, supposes that star to have been the one preceding among the four which are in the left wing of Virgo.

Longomontanus [Longomontanus], Book 2, *Theoricae*, Chapter 19, says it was the year 272 before Christ, and the eleventh day of October, at the 18th hour at Alexandria; and he says that star was at 1° 16' of Virgo with northern latitude. But Lansbergen [Lansbergen], in his *Thesaurus Observationum*, computes the star in Virgo at 3° 21' with northern latitude 1° 20', and Venus at 3° 22½' of Virgo with northern latitude. Boulliau [Ismaël Boulliau], finally, in Book 9 of his *Astronomia Philolaica*, Chapter 6, says the star, of which Copernicus speaks, to have been at 2° 47½' of Virgo with northern latitude; and that Venus, from the Rudolphine [Tables], was at 2° 10' of Virgo, and did not obscure the star with its own body, but, by the spreading of its rays, rendered it inconspicuous. For me, the year before Christ was 272, and the day October 11.

2. In the 2nd year of the Emperor Adrian [Hadrian], on the 21st day of Athyr, going on the 22nd, Theon at Alexandria observed Venus at its greatest elongation from the Sun; distant from the summit of the southern wing of Virgo by as much as is the longitude of the Pleiades [Vergiliae], or a little less, by as much as is the diameter of Venus itself; and Venus appeared more northerly by one Moon's breadth. Ptolemy, *Almagest* Book 10, Chapter 1, who concludes from this that Venus was at 0° 20' of Virgo, and that its greatest distance from the mean place of the Sun was 47° 32'. But Copernicus, Book 5, Chapter 20, I know not from what copy, has the year 4 of Adrian, and of Christ 119, on the fourth day before the Ides of October, when it was the year 2 of Adrian and 117 of Christ, and the day the 13th of October.
3. In the year 13 of Adrian, on the Epiphi [day], the 2nd, going on the 3rd, Theon at Alexandria observed Venus preceding, in its morning elongation from the Sun, by 1° 24' a line drawn through the foremost of the three of the head of Aries [Aries], and at the extremity of the hinder shank of Aries, yet so that it was twice as far distant from the prior star as from the posterior. Ptolemy, Book 10, Chapter 2, who says that Venus was at 10° 36' of Aries with southern latitude 1° 30', and was distant 44° 48' from the mean place of the Sun existing in Taurus 25° 24'. But Copernicus, Book 5, Chapter 20, says it was the year of Christ 129, on the 12th day before the Calends of June, that is, on May 19. Longomontanus, Book 2, Chapter 19, adding the

hour, sets Venus at $16^{\circ} 10'$ of Aries; and Alexandria, quite different from us, places it by his own Tables, and the digression at $45^{\circ} 4'$; and the mean place of the Sun at $25^{\circ} 53'$ of Taurus. For us also it was the 18th of May, in the year 129.

4. In the year 16 of Adrian, on the 21st day of Pharmuti, going on the 22nd, Theon observed Venus in the evening, in its greatest elongation, preceding the middle of the Pleiades only, by as much as is the longitude of the Pleiades, but a little more to the south. Ptolemy, Book 10, Chapter 1, who from here says Venus was at $1^{\circ} 30'$ of Taurus, and the mean place of the Sun at $14^{\circ} 15'$ of Taurus, and its maximum elongation of Venus at $47^{\circ} 15'$. Copernicus, Book 5, Chapter 20, says it was the year of Christ 132, on the eighth day before the Ides of March, at the 1st hour of the night. But Longomontanus, Book 2, Chapter 19, says it was at the 7th hour 15' after midday; and Alexandria, but from his own Tables, places the mean place of the Sun at $14^{\circ} 49'$ of Pisces, and Venus at $1^{\circ} 39'$ of Taurus, and its elongation at 46° ; on the day of March, since it was a leap year.
5. In the year 18 of Adrian, on the 9th day of Pharmuti, going on the 10th [?], Ptolemy observed Venus in the morning, far distant from the Sun in Capricorn, its mean being in Aquarius $25^{\circ} 30'$, and its maximum elongation $43^{\circ} 35'$. Ptolemy, Book 10, Chapter 5, and Copernicus, Book 5, Chapter 22, adding...

LIBER VIII — DE VENERE [Book 8, On Venus]

CAPUT I (continued) — Veneris observationes antiquae [Ancient observations of Venus]

[The numbered observations continue from the preceding folio; §5 was begun there.]

§5 (continued). ...on the 12th of the Kalends of March [18 February], at daybreak: but in truth it was the 17th of February of the following [day], 18, of the year 134.

§6. In the year 21 of Hadrian, on the 9th of Mechir [Egyptian month], at evening of the 10th, at Alexandria, Ptolemy observed Venus in Aquarius $19^{\circ} 36'$, at its greatest elongation [digressione maxima] of $47^{\circ} 32'$ from the mean place of the Sun in Capricorn $2^{\circ} 4'$ (*Ptolemy, lib. 10, cap. 1*, and *Copernicus, lib. 1, cap. 20*, adding that this was the year of Christ 136, on the eighth of the Kalends of January [25 December]; and *Longomontanus, lib. 2, cap. 19*, adding the 6th hour,

[says] that at Alexandria Venus was indeed in Aquarius $19^{\circ} 36'$, but the Sun in Capricorn $2^{\circ} 36'$, and the elongation of Venus 47° , and that it was truly the 25th of December).

§7. Again in the year 21 of Hadrian, on the 2nd of Tybi [Egyptian month], evening of the 3rd, Ptolemy observed evening Venus at its greatest distance from the Sun, seen in Capricorn $12^{\circ} 50'$, and distant $47^{\circ} 20'$ from the mean place of the Sun in Aquarius [$\approx$] $25^{\circ} 30'$ (*Ptolemy, lib. 10, cap. 2*, and *Copernicus, lib. 5, cap. 20*, adding that this was the year of Christ 136, on the 5th of the Kalends of January [28 December]; but *Longomontanus, lib. 2, cap. 19*, has it on the 18th of November of the year of Christ 138, at the 6th hour, [with] Venus in Capricorn $13^{\circ} 4'$, the mean place of the Sun in Scorpio $26^{\circ} 9'$, and the elongation of Venus $46^{\circ} 55'$ — that day [being] truly the 18th of November, of the year 136).

§8. In the year 2 of the Emperor Antoninus, on the 29th of Tybi, evening of the 30th, Ptolemy in the morning observed Venus with the astrolabe against Spica, and found it in Scorpio $6^{\circ} 30'$, at an equal hour [hora aequali] of $4^{\circ} 45'$ past midnight, the Sun by mean motion holding $22^{\circ} 9'$ of Sagittarius (*Ptolemy, lib. 10, cap. 4*; but *Longomontanus, lib. 2, cap. 19*, [places it] in that year of Christ 138, on the 15th of December, at 15 h. 10 min.; Hafnia [Copenhagen] places Venus in Scorpio $7^{\circ} 15'$, the mean Sun in Sagittarius $22^{\circ} 43'$; *Lansbergen*, however, [places] Venus in $6^{\circ} 31'$ of Scorpio. But that day was truly the 15th of December).

§9. In the year 3 of Antoninus, on the 4th of Pharmuthi [Egyptian month], evening of the 5th, Ptolemy observed evening Venus at its greatest evening elongation in Aries $13^{\circ} 50'$, the mean Sun in Aquarius $25^{\circ} 30'$, with an elongation of $48^{\circ} 20'$ (*Ptolemy, lib. 10, cap. 3*, and *Copernicus, lib. 5, cap. 22*, saying it was the year of Christ 140, on the 12th of the Kalends of March [18 February]. When it would have been the 17th, of the following 18).

§10. In the year 4 of Antoninus, on the 11th of Thoth [Egyptian month], evening of the 12th, Ptolemy observed Venus near its greatest morning elongation in Gemini $18^{\circ} 30'$, distant $47^{\circ} 15'$ from the mean Sun (*Ptolemy, lib. 10, cap. 1*, and *Copernicus, lib. 5, cap. 20*, assigning it to the year of Christ 142, on the 3rd of the Kalends of August [30 July]. But *Longomontanus, lib. 2, cap. 19*, places the year as 140, on the 29th of July at 16 h. 12 min., and Venus in Gemini $19^{\circ} 1'$, elongated $47^{\circ} 11'$ from the mean place of the Sun in Leo $6^{\circ} 12'$. In reality it was the year 140, the 29th of July following, [at hour] 30 [?]).

§11. In the year of Christ 510, as Boulliau [Bullialdus] reports (*lib. 9, cap. 6*), it stands thus in a manuscript of the Royal Library: *In the year 226 of Diocletian, the*

star of Venus was seen to precede Jupiter; but on the 28th day it appeared, to the highest [degree], by 20 digits, while on the following day there seemed to be no difference whatever, by 20 digits [?] — yet by latitude it followed by 10 digits [penes latitudinem vero ... sequi digitis 10]. It would certainly have been fitting, according to the reckoning of the Ephemerides, that the planets themselves should be seen conjoined on the thirtieth day of the month, since at that time they appear distant from one another by a long interval, and yet they appeared as one. From this Boulliau, by Ptolemy's Tables, gathers that the conjunction of Jupiter with Venus took place between the 27th and 28th of Mechir, that is, between the 20th and 21st of August, at the 7th hour after midday at Uraniborg; from his Tables he derives the place of Jupiter in Virgo $19^{\circ} 1' \frac{1}{3}$, with northern latitude $1^{\circ} 9' \frac{1}{3}$. But the place of Venus then differed [stood apart] from Jupiter by 20 digits in preceding [longitude] — that is, 50 scruples [minutes] at the most [vt plurimum]; and by diurnal motion they ought to have been 40 scruples [apart]. The Rudolphine [Tables] must therefore be corrected, so that Venus may have been in Virgo $18^{\circ} 23'$, and the conjunction of Jupiter and Venus would have been about midday of the 28th of Mechir, that is, of the 22nd of August.

CAPUT II — Veneris observationes factae a Ioanne Regiomontano [Observations of Venus made by Johannes Regiomontanus]

§1. In the year of Christ 1461, December 14, after sunset, Regiomontanus [Regiomontanus] at Rome saw Venus about to be conjoined immediately with Saturn, and more southerly by two Suns [solar diameters], or by one degree; so that, by the Alphonsine numbers, the longitude of Venus was greater than that of Saturn by $1^{\circ} 36'$.

§2. In the year 1462, January 10, at Rome after the start of night, he saw Venus joined to the twenty-third star of Aquarius, which is at the beginning of the "outpouring" [effusio], but Venus was reckoned 45 minutes more easterly.

§3. In the same year, September 19, likewise at Rome at the 11th hour of the night, he saw Venus, Mars, and Regulus in one straight line, so that Venus was the more southerly, Mars the more northerly; and the distance of Mars from Regulus was one and a half times [sesquiquarta — recte: sesquialtera? "by a half more"] the distance of Venus from Regulus.

§4. In the year 1462, October 21, Regiomontanus at Viterbo in the morning at $12\frac{1}{2}$ hours of night saw Venus the more westerly than the sixth [star] of Virgo by 16 minutes, but joined to it in longitude, [the Moon being] waning — yet much less northerly than the Moon.

§5. In the same year and month, likewise at Viterbo, on the 25th in the morning he saw Venus joined [to it], the seventh of Virgo as to longitude, but by about one degree more southerly.

§6. In the year 1471, August 9, at evening, Venus stood apart from Jupiter, by the radius [cross-staff], $5^{\circ} 13'$, whereas by the Alphonsine [Tables] they were distant in longitude $4^{\circ} 33'$.

CAPUT III — Veneris observationes selectae ex observationibus Bernardi Vualtheri Norimbergae factis [Select observations of Venus from the observations of Bernhard Walther, made at Nuremberg]

The First Class [Prima Classis] contains observations made by ocular estimation [oculari aestimatione].

§1. In the year 1478, August 11, in the morning at about hour $3\frac{1}{2}$ after midnight, Walther [Bernhard Walther] saw Venus about midway between the heads of the Twins [Gemini], and a little more distant from the southern head, in nearly the same line as those very [stars], distant from that line by a little toward the west; but on the following day, the 12th, at the same hour Venus was seen so much more easterly than the said line, by however much it had been more westerly the day before.

§2. In the year 1486, September 20, in the morning at hour 5 p.m.n. [past midnight], Venus appeared more easterly than Regulus by one Moon [lunar diameter], in the same latitude; but on the 21st it was seen more easterly by three Moons.

§3. In the same year, September 24, between 10 and 11 before midday, he saw a conjunction of Venus with the Moon, but the Moon more northerly by half a diameter of the Moon.

§4. In the year 1489, March 6, about sunset, by the Armillae Zodiacales [zodiacal armillae], from the circle of the ecliptic he saw Venus in Aries $27^{\circ} 15'$; but using the circle of latitude he saw it in Aries $25^{\circ} 30'$. Likewise on the 7th of March, at evening about the same instant, he saw Venus from the circle of the ecliptic in Aries $28^{\circ} 15'$, but from the circle of latitude in Aries $27^{\circ} 38'$. This discrepancy he recognized to arise from refraction. See, in the learned old man's [i.e. Walther's] discourse upon this, the method of correcting these observations by the plumb-line [perpendiculo].

§5. In the year 1494, September 19, in the morning at hour 5 p.m.n. [past midnight], Venus was seen joined to Regulus, but more westerly by about 10 minutes, and equally [as many] more southerly. Lansbergen [Lansbergius], however, in his *Thesaurus*, observed [computed] 3 minutes [difference]: he computes the place of Venus from his own tables, Regulus in Leo 23° 19' with northern latitude 31', and Venus in Leo 23° 20' with northern latitude 13'.

§6. In the year 1502, September 19, in the morning after midnight he saw Venus conjoined to Regulus by a half-diameter of the Moon, and judged it to be the same in the longitude of both.

The Second Class [Secunda Classis] contains observations made by the radius [cross-staff] through the sines [per Sinus], on the use of which see the Waltherian [observations] of Saturn, num. 10. And so that you may have a specimen of the errors of the radius, note that Aldebaran and the northern horn of Taurus, by Tycho's sextants and ours, do not differ between themselves by more than 16° 45'; whereas Walther's radius nonetheless gave their distance as 16° 52', or 50'.

A n # n.	M. D.	[obs. note]	Distant. Veneris a Stella [Distance of Venus from the star]	Sinus prim.	Sinus sec.
7 1 4 7 8	Febr. 19	in occ. Solis [at sunset]	à Ioue orientali [from Jupiter, eastern]	40	889
8	20		à Ioue orien.	30	814
9	21		à Ioue occidét.	30	860
1 0	22		à Ioue occidét.	30	740
1 1	24		à Ioue occidét.	50	780
1 2	Iulij 26	50' p. ort. ☉ [50' past sunrise]	à Luna occidét.	20	882
1 1 3 4 8 1	Nou. 15	hor. 1. ante ortū Solis [1 h. before sunrise]	à Spica orient.	40	562
			à Saturno oriét.	40	496

A n # n.	M. D.	[obs. note]	Distant. Veneris a Stella [Distance of Venus from the star]	Sinus prim.	Sinus sec.
			à Marte orient.	40	513
1 4	Nou. 19	hor. vt supra	à Spica orient.	70	632
			à Saturno oriét.	10	742
			à Marte orient.	30	615
1 5	Nou. 25	hor. 1. ante ortū Solis	à Spica orient.	130	597
			à Saturno oriét.	70	720
			à Marte orient.	20	750

The Third Class [Tertia Classis] contains observations made with armillae, the uncertainty of which, as to about ten minutes, see in the Waltherian [observations] of Saturn, num. 33, apart from what was said about Refraction, num. 4 here.

A n # n.	M. D.	H. [hour]	Med. Cal. [computed mean place] — Sig. / G.	Logit. ♀ visa [Venus's observed longitude] — Sig. / G. / M.
1 1 6 4 8 9	Mart. 12	in occ. Solis	—	♄ 4 / 18
1 7	13	post occ. Solis	—	/ 5 / 15
1 8	14	in occ. Solis	—	/ 6 / 13
1 9	15	0 30' p. merid.	—	/ 7 / 23
2 0	16	4 post merid.	—	/ 8 / 40
2 1	18		♂ 25	/ 11 / 15
2 2	19		♄ 1	/ 12 / 27

A n # n.	M. D.	H. [hour]	Med. Cal. [computed mean place] — Sig. / G.	Logit. ♀ visa [Venus's observed longitude] — Sig. / G. / M.
2 3	19		☿ 25	/ 13 / 33
2 4	23		☿ 5	/ 17 / 20
2 5	24	5 post merid.	—	/ 18 / 20
2 6	29	8 post merid.	—	/ 24 / 20
2 7	31	7 post merid.	—	/ 26 / 36
2 1 8 4 9 0	Dec. 12	5 post merid.	—	≈ 14 / 45
2 9	13	5 10' p. merid.	—	/ 15 / 45
3 1 0 4 9 1	Ianu. 11	circa occ. Solis	—	✕ 17 / 15
3 1	17	6 circiter	—	23 / 15
3 2	Febr. 14	7 post merid.	latit. Bor.	☿ 15 34
				☿ 15 / 34 [?]
			latit. Bor.	/ 4 / 45
3 1 3 5 0 3	Dec. 10		✕ 18 / latit. Bor.	≈ 2 / 0
				/ 0 / 22
3 4	12	circa occ. Solis	latit. Bor.	≈ 2 / 15

A n # n.	M. D.	H. [hour]	Med. Cal. [computed mean place] — Sig. / G.	Logit. ♀ visa [Venus's observed longitude] — Sig. / G. / M.
3 1 5 5 0 4	Ianu. 19	manè	≈ [Aquarius] 12 / latit. Bor.	♂ 17 / 15 / 7 / 0
3 6	Ian. 26		≈ 20 / latit. Bor.	♂ 16 / 20 / 7 / 5
3 7	Febr. 20	manè	≈ 25 / latit. Bor.	♂ 26 / 40 / 4 / 20
3 8	Mart. 11		♂ 12	≈ 13 / 45

An # n.	M. D.	H.	Med. Cal. — Sig. / G.	Logit. ♀ visa — Sig. / G. / M.
3 15 9 04	Mart. 12		latit. Bor.	/ 2 / 15
			♂ 21	≈ 14 / 45
4 0	Mart. 17	ma nè	latit. Bor.	/ 2 / 15
			♂ 7	≈ 19 / 30
4 1	Mart. 18	ma nè	latit. Bor.	/ 1 / 38
			♂ 26	≈ 20 / 15
4 2	Mart. 19	ma nè	latit. Bor.	/ 1 / 30
			♂ 7	≈ 21 / 23
4 3	Mart. 27	ma nè	latit. Bor.	/ 1 / 23
			♂ 10	≈ 29 / 40

CAPUT IV — Copernici observatio de Venere [Copernicus's observation of Venus]

In the year of Christ 1539, on the fourth of the Ides of March [12 March], at the 1st hour after sunset, at Frauenburg [Fruemburgi], Copernicus [Copernicus] saw the Moon, which on its dark side began to occult Venus, according to the mean distance of the two [bodies]; the horn [of the Moon] lasted, and the occultation lasted for one hour. From this, Copernicus reckoned that the middle of the occultation fell between the first hour [after sunset] and the second, [namely] the conjunction of Venus with the Moon (*Copernicus, lib. 5, cap. 23*), adding that Venus had been at evening and near contact still at growing [waxing] evening, and near the contact of the orb. Lansbergen [Lansbergius], however, in his *Thesaurus* gathers the place of the Moon, seen, in Taurus 7° 7' 30"; and the place of Venus 7° 25' [?], and the northern latitude of the Moon as seen 34'; of Venus, 39'.

CAPUT V — Tychonis observationes de Venere ab Anno 1582 ad 1601 [Tycho's observations of Venus from the year 1582 to 1601]

First we select the observations of the year 1582, from those recently published at Vienna by Lucius Barrettus [Longomontanus, pseudonym], that is, as an anagram; and the letters of our own [people] have taught us — Albert Curtius [Albertus Curtius], of the Society of Jesus — leaving aside the azimuths [Azimutha], in which we place least trust.

[Tycho, observations of 1582 — distances of Venus from fixed stars]

Ann. # 1582	D H . . M.	Veneris à Fixis Stellis [Venus from the fixed stars]	Distantia — Gr. Distantia — M.	
1 Febr.	1 7 43 5	ab extrema caud. ♃ [from the end of the tail of Pisces]	4	0
	9 0 bis	ab Aldebara [from Aldebaran]	41	35
2	1 8 57 7	à capite Arietis [from the head of Aries]	10	20
	8 50 bis	ab Aldebara	39	35

Ann. # 1582	D H . . M.	Veneris à Fixis Stellis [Venus from the fixed stars]	Distantia — Gr.	Distantia — M.
3	2 8 3 2	ab Aldebara	34	42½
	8 31 bis	à cap. Arietis	7	40
4	2 6 10 4	ab Aldebara	32	52½
	6 45	à cap. Arietis	7	27
5	2 7 6 6 bis	ab Aldebara	30	59
	8 53	à cap. Arietis	7	36
6	2 6 25 7 bis	ab Aldebara	30	6
	6 42 ter	à cap. Arietis	7	50
	2 48	Altitudo Merid. [meridian altitude]	49	55
7	2 8 36 8 ter	ab Aldebara	29	5
	8 55 ter	à cap. Arietis	8	14
8 Martij	5 7 2	ab Aldebara	24	48
	8 5 bis	à calce pedis II [from the heel of Gemini]	48	50

**[Tycho, observations of 1582 — distances of Venus from fixed stars,
continued]**

Ann. # 1582	D H . . M.	Veneris à Fixis Stellis	Distantia — Gr.	Distantia — M.
9 Martij	9 7 6	ab Aldebara	21	38⅔
	7 35	à calce pedis II	45	17½
1 0	1 9 17 4 bis	ab Aldebara	18	0½

Ann. # 1582	D H . . M.	Veneris à Fixis Stellis	Distantia — Gr.	Distantia — M.
	9 33 bis	à calce pedis II	41	1½
1 1	1 8 26½ 5	à lucid. Pleiad. [from the bright star of the Pleiades]	4	42
	8 37	à calce pedis II	40	16½
1 2	1 7 43 6	à calce pedis II	39	31½
	8 7	Media cath. Cassiop. [middle of the chair of Cassiopeia]	49	12
1 3	2 7 26 0 bis	ab Aldebara	14	40
	7 55 bis	à cap. Pollucis [from the head of Pollux]	53	55
1 4	2 8 2 2	à cap. Pollucis	52	29⅓
	8 58	à cornu Bor. Tauri [from the northern horn of Taurus]	21	54
	9 37	à lucida Pleiadum [from the bright star of the Pleiades]	0	49
1 5	2 7 47 6	à cap. Pollucis	49	51
	8 21	à cornu Bor. Tauri	19	16

In the second place we shall set down the observations of Venus which Tycho exhibits in *tomus 1* of the *Progymnasmata*, in order that from the right ascension [Ascensio recta] of Venus, and its distance from the bright star of Aries, the right ascension of the bright star of Aries may be established. On this occasion, however, the place of Venus can be gathered from it; but cautions must be applied, concerning which Kepler [Keplerus], in the foundation of his *Ephemerides* (*pag. 15*), where he says that daytime observations are to be kept apart from nighttime ones, nor are two parallaxes well compared in the same

altitude above the horizon, unless the interval of the earth [terrae] be the same; and as for Venus, otherwise an error of as much as 15' could be made in the motion of Venus. Moreover, the dispute is still undecided between the Landgrave of Hesse [Landgravium Hassiae] and Brahe [Braheum] concerning the six minutes of the Sun's motion from the fixed stars, on which see Tycho's letter of the year 1589, February 21. I add that I have increased the error in the greatest declination of the Sun, which I made greater [by] 1' 10" more than is right; and in the parallax of the Sun, which is indeed actually smaller, as Kepler admits above — but for us it is still smaller than the Keplerian [value]. Be mindful also, in individual cases, that account must be taken of Refraction.

[Tycho, 1582 — paired observations: distances and declinations of Venus, with two times each]

#	Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
1	1582. Febr. 26 post 6 merid.	Hor. 3 35'	Hor. 7 5'
	Distantia Veneris à centro Solis [distance of Venus from the Sun's center]	46 / 10 / 30	15 / 25 / 10
	Declinatio Borea Veneris [northern declination of Venus]	15 / 21 / 40	
	Altitudo Solis [altitude of the Sun]	15 / 10 / 0	
	Altitudo Veneris [altitude of Venus]	40 / 30 / 0	27 / 30 / 0
	Distantia Veneris ab Aldebara		30 / 59 / 0
	Declinatio Aldebarae		15 / 36 / 0
1	1582. Febr. 27 post 7 meridiem.	H. 4 18'	H. 6 23'
	Distant. Veneris à centro Solis	46 / 10 / 15	15 / 53 / 30
	Declinatio Borea Veneris	15 / 51 / 0	

# Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
Altitudo Solis	10 / 0 / 0	33 / 0 / 0
Altitudo Veneris	45 / 0 / 0	30 / 6 / 0
Distantia Veneris ab Aldebara		
1 1582. Martij 5 post 8 meridiem.	H. 4 52'	H. 7 12'
Distant. Veneris à centro Solis	45 / 53 / 30	18 / 16 / 0
Declinatio Borea Veneris	18 / 14 / 0	
Altitudo Solis	8 / 0 / 0	28 / 0 / 0
Altitudo Veneris	46 / 0 / 0	48 / 52 / 30
Distant. Vener. à calce pedis II		22 / 38 / 30
Declinat. calcis ped. II Bor.		
1582. Martij 5 post meridiem.	H. 5 12'	H. 7 2'
Distant. Veneris à centro Solis	45 / 51 / 30	18 / 16 / 0
Declinatio Borea Veneris	18 / 14 / 15	
Altitudo Solis	5 / 30 / 0	29 / 0 / 0
Altitudo Veneris	44 / 0 / 0	24 / 48 / 0
Distantia Veneris ab Aldebara		15 / 36 / 0
Declinatio Borea Aldebarae		

# Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
1 1582. Martij 9 post 9 meridiem.	H. 5 15'	H. 7 14
Distant. Vener. à centro	45 / 33 / 0	19 / 40 / 0

#	Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
	Solis		
	Declinatio Bor. Veneris	19 / 38 / 30	
	Altit. Solis	6 / 0 / 0	30 / 0 / 0
	Altit. Veneris	43 / 0 / 0	21 / 37 / 0
	Distantia Veneris ab Aldebara		15 / 36 / 0
	Declinat. Bor. Aldebarae		
2	1582. Martij 20 post	H. 2 25'	H. 8 11
0	merid.		
	Distant. Veneris à centro Solis	43 / 50 / 0	23 / 4 / 45
	Declinatio Bor. Veneris	23 / 2 / 0	
	Altit. Solis	31 / 0 / 0	23 / 30 / 0
	Altit. Veneris	57 / 0 / 0	36 / 32 / 0
	Distant. ♀ à calce pedis II		22 / 38 / 30
	Declinat. calcis pedis II		
2	1582. April. 3 post	H. 1 40'	H. 8 53'
1	merid.		
	Distant. Vener. à centro Solis	38 / 38 / 45	
	Declinatio Bor. Veneris	25 / 47 / 30	25 / 48 / 0
	Altit. Solis	39 / 30 / 0	17 / 0 / 0
	Altit. Veneris	58 / 50 / 0	45 / 37 / 0
	Distant. Vener. à cap. Pollucis		28 / 57 / 0
	Declin. Borea cap. Pollucis		
2	1585. Septemb. 15 ante	H. 6 48'	H. 5 20'
2	merid.		
	Distant. Veneris à centro Solis	45 / 48 / 30	
	Declin. Bor. Veneris	13 / 59 / 30	14 / 0 / 30

#	Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
	Altit. Solis	8 / 0 / 0	
	Altit. Veneris	41 / 0 / 0	
	Distant. Veneris à cap. Pollucis		29 / 47 / 30
	Declin. cap. Pollucis Borea		28 / 57 / 0
2	1586. Decemb. 26 post	H. 3 2'	H. 4 49'
3	merid.		
	Distant. Veneris à centro Solis	46 / 30 / 0	
	Declinat. Austr. Veneris [southern declination of Venus]	11 / 15 / 30	
	Altit. Solis	3 / 0 / 0	
	Altit. Veneris	23 / 0 / 0	20 / 30 / 0
	Dist. Æquatorea ♀ à lucid. ♀ [equatorial distance of Venus from the bright star of Aries]		52 / 21 / 0
2	1587. Ianuar. 24 post	H. 0 15'	H. 5 15'
4	merid.		
	Distant. Veneris à centro Solis	37 / 5 / 45	
	Declinat. Borea Veneris	0 / 25 / 0	0 / 29 / 30
	Altit. Solis	17 / 30 / 0	
	Altit. Veneris	30 / 0 / 0	23 / 30 / 0
	Distant. Vener. à lucida Arietis		40 / 46 / 10
2	1587. Augusti 17 ante	H. 5 30'	H. 3 42'
5	merid.		
	Distantia Vener. à centro Solis	28 / 13 / 0	
	Declinat. Bor. Veneris	19 / 26 / 0	19 / 29 / 45
	Altit. Solis	5 / 0 / 0	14 / 0 / 0

#	Date / measurement	Hor. (1st) — G. / M. / S.	Hor. (2nd) — G. / M. / S.
	Altit. Veneris	28 / 30 / 0	22 / 20 / 0
	Distant. Vener. à cap. Castoris [from the head of Castor]		
2 6	1588. Martij 28 post merid.	H. 5 28'	H. 7 42'
	Distant. Veneris à centro Solis	26 / 23 / 0	16 / 33 / 0
	Declin. Bor. Veneris	16 / 30 / 30	13 / 30 / 0
	Altit. Solis	10 / 0 / 0	20 / 23 / 0
	Altit. Veneris	32 / 0 / 0	15 / 36 / 45
	Distantia Veneris ab Aldebara		
	Declin. Bor. Aldebarae		
2 7	1588. April. 16 post meridiem.	H. 6 48'	H. 8 40'
	Distant. Veneris à centro Solis	30 / 50 / 30	22 / 49 / 30
	Declinat. Bor. Veneris	22 / 46 / 0	13 / 45 / 0
	Altit. Solis	5 / 0 / 0	40 / 15 / 0
	Altit. Veneris	28 / 0 / 0	28 / 56 / 40
	Distant. Vener. à cap. Pollucis		
	Declin. Bor. cap. Pollucis		

(continued: Caput V — Tycho's Venus observations, 1582–1601)

The two observations begun on the facing page conclude the paired distance-and-declination series:

N			G	M
o.	Date / time	Measured quantity	.	(sec.)
2	1588, Nov. 29, before noon —	Distance of Venus from the	4	3 0
8	H. 9.11'	center of the Sun	6	8

N			G	M	
o.	Date / time	Measured quantity	.	.	(sec.)
		Southern declination of Venus	9	1	0
				6	
		Altitude of the Sun	3	3	0
				0	
		Altitude of Venus	2	3	0
			4	0	
	(H. 7.11')	Distance of Venus from Spica	9	1	30
				3	
		Distance of Venus from Spica	2	3	0
		[second value]	1	0	
		[Distance of Venus from	1	3	30
		Spica]	3	1	
		Southern declination of Spica	8	5	15
				7	
2	1588, Dec. 6, before noon — H.	Distance of Venus from the	4	5	30
9	10.30'	center of the Sun	4	7	
		Southern declination of Venus	1	2	30
			1	1	
		Altitude of the Sun	8	0	0
		Altitude of Venus	1	1	0
			9	5	
	(H. 7.28')	Distance of Venus from Spica	1	8	0
				1	
		Distance of Venus from Spica	2	3	0
		[second value]	0	0	
		[Distance of Venus from	2	1	20
		Spica]	0	7	
		Southern declination of Spica	8	5	15
				7	
3	1588, Dec. 15, before noon —	Distance of Venus from the	4	3	0
0	H. 9.6'	center of the Sun	6	6	
		Southern declination of Venus	1	4	0
				4	

N		G M
o.	Date / time	. . (sec.)
	Altitude of the Sun	3 0 0
	Altitude of Venus	2 0 0
		0
(H. 7.41')	Distance of Venus from Spica	1 2 0
		4
	Distance of Venus from Spica	1 0 0
	[second value]	9
	[Distance of Venus from	2 3 30
	Spica]	9 3
	Southern declination of Spica	8 5 15
		7

Three observations of Venus from Tycho's *Epistolae* (p. 56), made at Uraniborg [Vraniburgi], on the days of old style in January noted below, at the hours after noon written here, together with the Alphonsine and Copernican computation.

No. 1587 Jan. — D. H. M. Source Longitude of Venus: Sig. G. M.
Latitude: G. M. (N/S) --- --- --- --- --- --- --- --- --- --- --- 31 9 5 40
Observed ♀ (Pisces) 13 5 1 38 B Alphonsine 13 26 0
22 A Copernican 13 21 0 36 B 32 14 4 50
Observed ♀ (Pisces) 16 20 2 29 B Alphonsine 16 44 0
15 B Copernican 16 52 1 14 B 33 15 4 40 Observed
♀ (Pisces) 16 55 2 39 B Alphonsine 17 20 0 22 B
Copernican 17 31 1 12 B

Lansbergen [Lansbergius], in his *Thesaurus observationum*, uses the observation of the 15th just cited; from it he gathers, by his own tables, the place of Venus in Pisces at 16°.57'.39". Boulliau [Bullialdus], however (book 9, chapter 2), from his own tables gathers the place in Pisces at 18°.9'; and so he argues that there is an error in this observation — or rather in the observation of the year 1590, of which more shortly — together with Longomontanus, who (in book 2 of his *Theoricae*, chapter 18) admits that scarcely ever, and only rarely at other times, was it possible — because of the obliquity of the sphere — for Venus and Mercury to be observed continuously in Denmark, as was required, at their greatest elongations from the Sun. Yet he subjoins the selected observations written below, drawn from Tycho, adding to them his own annotations for the years 1610 and 1616, with the computation of the place from the Danish [tables].

The right-hand portion of the page tabulates Tycho's selected Venus longitudes and latitudes, with observed and computed (*supputatum*) values paired:

No.	Year / Month / Day	H.	M.	obs./supp.	Longitude of Venus: Sig.	G.	M.	Latitude: G.	M.	(N/S)
34	1585 Sept. 14 (old style)	17	15	observed	♌ (Leo)	15	58	2	8	A
	computed	15	53½			35	1587 Jan. 15	4	40	obs.
	♋ (Pisces)	16	55	2	39	B				supp.
		16	50½			36	1587 Feb. 21	6	5	obs.
	♋ (Pisces)	16	1	8	56	B				supp.
		15	49¼			37	1587 Mart. 2	17	30	obs.
	♋ (Pisces)	10	7	8	26	B				supp.
		10	14½			38	1588 Dec. 14	19	40	obs.
	♏ (Scorpio)	17	10	3	10	B				supp.
		17	6			39	1590 Dec. 17	20	0	obs.
	♏ (Scorpio)	20	0	0	27	B				supp.
		20	4½			40	1594 Dec. 15	5	10	obs.
	♐ (Aquarius)	21	0	1	16	A				supp.
		21	6½			41	1610 Dec. 12	4	40	obs.
	♐ (Aquarius)	17	58	1	29	A				supp.
		18	4½			42	1616 Mart. 9	17	0	obs.
	♐ (Aquarius)	15	24	not observed [non est observ.]		supp.	15	24¼		

The last of Tycho's observations, made at the castle of Benátky [Benatica] in Bohemia in the year 1600, or at Prague in the house of Curtius [Curtij] in the year 1601, reduced to the days of the new style, were selected by Snell [Snellius] and published in the year 1618.

43. Year 1600, January 23, h. 7.45' p.m., as the Sun was rising [oriente Sole], the declination of Venus was observed by the armillae to be 17°.50', and by the quadrant the altitude was 16°.53½'. Then at h. 8½, p.m., the distance of Venus from the Sun was observed to be 40°.36'; and at last the meridian altitude of Venus was 21°.46½'.

44. Year 1600, February 20. The meridian altitude of Venus was seen to be 20°.27', and her distance from the Sun 46°.40½'.

45. Year 1600, February 22, in the morning at hour 6¾. Venus was seen to be 27°.37½' distant from Aquila [the Eagle]; the altitude of Venus was 9°.48'. Soon she was seen to be 42°.50'.50" distant from Antares. From this Boulliau (book 9, chapter 1), with the refraction and parallax not yet eliminated, gathers the place of Venus in Capricorn [♑] at 16°.24'.15", with northern latitude 3°.20'.34"; but he afterward reduces the longitude to 16°.22'.12". And he says her greatest digression from the Sun was on the 21st, at hour 20.27', namely 46°.46'.

46. Year 1601, May 9, hour 8.17'. Venus stood 29°.19½' from Capella; and at hour 8.27' she was 13°.47½' from Pollux. Her altitude was then 25°.30'; and at hour

8.34½' she was 49°.59' from Regulus. But Boulliau (book 9, chapter 1) says that, with the distance from Capella read as 26°.19'.40", it follows that the place of Venus is reduced to 4°.27'.50", with northern latitude 3°.9'.19"; and that her greatest digression from the Sun was 45°.13'.53".

47. Year 1601, October 10, in the morning at hour 4.30' p.m. [recte: ante meridiem — "manè"], Venus was seen to be 42°.53' distant from Procyon, and 45°.30½' from Pollux. And this was the last of Tycho's observations of Venus.

CAPUT VI.

Observations of Venus by Mästlin, Kepler, and Justus Byrgius, selected from Snell in the *Hassiacae*.

[1.] In the year 1574, Mästlin [Maestlinus], on September 16, in the morning at hour 4, saw at Tübingen [Tubingae] Regulus covered by Venus, as Kepler reports (*Astronomiae Opticae* [Astronom. Optic.] p. 305).

And from this Lansbergen, in his *Thesaurus*, observes: Regulus was then in Leo [Leonis] at 24°.7', with northern latitude 31'; but Venus in Leo at 24°.9' with northern latitude 29'. Although the latitude is diminished a little by adding the parallax of Venus, the brightness around Venus could nonetheless [obscure Regulus]; it could obscure Regulus.

2. Year 1590, October 3, old style, in the morning at hour 5. The same Mästlin saw Mars wholly covered by Venus, the bright [light] of Venus showing it [Mars] clearly. So Kepler in the *Optics* (p. 305). And from this Lansbergen, in his *Thesaurus*, gathers the place of Venus in Virgo [Virginis] at 25°.32'.37", with northern latitude 1°.20'; and of Mars in Virgo at 25°.45'.31", with northern latitude 1°.17'. And the parallax of Venus is to be added 3' to the longitude, but subtracted in latitude 1½'; yet, so that the discrepancy be not so great, he says he allows gratis that 9' is to be subtracted from the longitude of Mars.

3. Year 1592, February 18, in the morning at hour 6½ p.m. n. [post meridiem?], or 5½, as Justus Byrgius [Byrgius] has it: with the sextant, he observed Venus to be distant from Antares 48°.48½', and from Aquila 26°.39'.30". From this Boulliau (book 9, chapter 1) gathers the place of Venus in Capricorn [Capricor.] at 32°.22'.44" [?], with northern latitude 2°.56'.

4. Likewise in the year 1592, February 22, old style, at hour 0.17½' after noon. Byrgius of Cassel [Casellis] observed Venus to be distant from Antares 53°.39', and

from Aquila $26^{\circ}.51'$. From this Boulliau (book 9, chapter 1) gathers the place of Venus in Capricorn at $27^{\circ}.20'.36''$, with southern latitude [latit. B.] $2^{\circ}.32'.42''$. And then her greatest digression from the Sun was $46^{\circ}.41'$, namely when Venus was in Capricorn at $27^{\circ}.17'.36''$.

5. Year 1593, March 31, old style, at hour 9 after noon. Byrgius of Cassel observed Venus to be distant from Capella $22^{\circ}.10'$, and from the right shoulder of Orion [a dextro humero Orionis].

6. In the same year, August 6, old style, in the morning at hour 3. Byrgius of Cassel saw Venus distant from Rigel [Rigel] $45^{\circ}.38'.30''$, and from Pollux [a cap. Pollucis].

7. Likewise in the year 1593, September 1, old style, in the morning at hour 4 before noon. Byrgius of Cassel observed Venus distant from Pollux $19^{\circ}.33'$; and from Sirius [a Sirio] $18^{\circ}.25'$.

8. Year 1594, December 17, old style, at hour 5 after noon. Byrgius of Cassel observed Venus distant from Aquila $39^{\circ}.53'$, and from the shoulder-blade of Pegasus [a scapula Pegasi] $31^{\circ}.54'$. From this Boulliau (book 9, chapter 1) deduces the place of Venus in Aquarius [Aquarij] at $22^{\circ}.58'.8''$, with southern latitude [latit. Austr.] $1^{\circ}.6'.35''$.

9. In the same year, December 20, old style, at hour 5 after noon. Byrgius of Cassel observed Venus distant from Aquila $41^{\circ}.30'$, and from the shoulder-blade of Pegasus $29^{\circ}.37'$. From this Boulliau (book 9, chapter 1) deduces the place of Venus in Aquarius at $25^{\circ}.50'.53''$, with southern latitude $0^{\circ}30'37''$. And the greatest digression was $47^{\circ}.12\frac{3}{4}'$, which was on December 17, hour 5, with Venus reduced to Aquarius $21^{\circ}.1'.36''$.

10. Year 1594, December 22, old style, at hour 5 after noon. Byrgius saw Venus at an altitude of $11^{\circ}.30'$, and distant from Aquila $41^{\circ}.50'$.

11. Year 1595, August 9, old style, in the morning. Byrgius of Cassel observed Venus distant from Capella $10^{\circ}.25'\frac{1}{2}$, and from the loins of the Snake [ibibus, seu lumbis Helices] $47^{\circ}.52'$. From this Boulliau (book 9, chapter 3), placing the location of the star Helice in Leo [Helices in Leonis] at $13^{\circ}.39'$ with northern latitude [lat. Bor.] $45^{\circ}.3\frac{1}{2}'$, gathers the place of Venus in Cancer [Cancri] at $25^{\circ}.39'\frac{1}{2}$.

12. Year 1596, April 21, old style, at hour 9 after noon. Byrgius of Cassel observed Venus distant from Capella $21^{\circ}.29'\frac{1}{2}$, and from the following star of Gemini [a cap. sequenti Geminor.] $33^{\circ}.9'$.

13. Year 1598, September 25, new style, in the morning at hour 3. Venus, scarcely risen, was seen by Kepler at Graz [Gratij] covering the heart of Leo [cor Leonis: Regulus]; but at hour 4 more than one Venus[’s width] passed between it and Regulus. A line drawn from Venus to the heart of Leo fell a little below Jupiter [Iouem]. Kepler [discusses this] in the *Optics* (p. 303). From this Lansbergen, in the *Thesaurus*, gathers the place of Regulus in Leo at $24^{\circ}.21'$, with northern latitude $31'$; and of Venus in Leo at $24^{\circ}.24'.48''$, with northern latitude $33'$. For which reason she did not cover Regulus with her whole body, but only with her rays.

14. Year 1599, May 31, new style. From his own half-observation [semiobservatione], Kepler in the *Optics* (p. 305), by a certain conjecture, judges that there was a conjunction of Venus and Mercury; on which, see him, if you like.

CAPUT VII.

Observations of Venus made by Hortensius, Pierre Gassendi [Petro Gassendo], Fr. Andreas Arzet, D. Vincentius Mutus, and by the Fathers of the Society of Jesus at Ingolstadt [Ingolstadij] and Innsbruck [Oeniponti].

[1.] In the year 1622, October 14, in the morning (says Gassendi in his commentary *In Epicurum*, p. 903), at Aix [Diniaie — Aquas Sextias] I saw, without a telescope, in the brightening twilight, Venus very near to Mars and distant from Mesoborea [the middle of the northern part?] by not more than three-quarters [dodrans] of her own diameter; on the following day, at the same hour, she had passed over to Mars at Meseurum [Meseureum], being a little more than two of the lower appendices of the Belt of Orion [Balthei Orionis] apart from it, but far less than the two Kids [hoedi] below Capella.

2. Year 1625, January 30, old style, hour 7 after noon. Hortensius at Leiden [Leydae] saw through a tube [telescope] the conjunction of Venus, distant from the southern horn of the Moon by an apparent single minute. Lansbergen observes in the *Thesaurus*: at hour 7 the center of the Moon was $2'$ [from Venus?], adding the center of the Moon; and the place of Venus was apparent in Pisces at $24^{\circ}.45'.25''$, with southern latitude; she was seen at $48\frac{2}{3}'$. But Venus[’s] own place in Pisces was $24^{\circ}.44'.47''$, with southern latitude $52'$.

Kepler in the *Rudolphine* [Tables] (chapter 28, p. 93) relates that on the same day, in the evening, at Herbach [Herbachij], Ulm [Ulmae], Tübingen, and elsewhere in Swabia [Suevia], Venus was seen as if in the embrace of the horns of the Moon, clinging there; she was almost in the left horn, and from there gradually circled around the lower swelling of the Moon. From this he gathers that there was a conjunction of the Moon and Venus, their centers appearing to be in conjunction toward the setting of the Sun; and Venus, even though the Moon was truly the more northern. From this he takes an example of the computation of parallaxes to be supplied, and teaches that at the time of conjunction the Moon was in grad. $24^{\circ}.21'$, Venus in grad. $24^{\circ}.42'$ of Pisces [Piscium].

3. Year 1625, February 9, new style, hour nearly 5.40' after noon. At Paris [Parisijs] Gassendi saw with the naked eye the Moon, which with its extreme northern horn just touched Venus, yet covering nothing of her; so he in his *Epicurus* (p. 900).

4. Year 1626, December 12, old style, in the evening, hour 6.31'. At Leiden Hortensius saw Venus joined [to the Moon], following the longitude of the Moon, distant from its southern horn by about three-quarters [dodrans] of a lunar diameter. Lansbergen observes in the *Thesaurus*: 3. of Venus, where he computes the apparent place in Aquarius at $17^{\circ}.31'.50''$, with southern latitude seen as $36'.23''$; and the place of Venus in Aquarius at $17^{\circ}.31'.12''$, with southern latitude $1^{\circ}.33'.11''$.

5. Year 1629, December 17, old style, hour nearly $6\frac{1}{2}$ after noon. Hortensius at Middelburg [Middelburgi] saw Venus crossing the circle of the longitude of the preceding star [in the tail of Capricorn], by nearly a quarter of a lunar diameter; and she was more northerly by a whole lunar diameter. Lansbergen observes in the *Thesaurus*: 7. of Venus, whose place he gathers in Aquarius at $16^{\circ}.36\frac{1}{2}'$, but from the [Rudolphine] Tables $16^{\circ}.42'.33''$.

6. Year 1632, July 31. Hortensius at Amsterdam [Amstelodami] observed the conjunction of Venus and Mercury in the morning after midnight; but at hour $3\frac{1}{2}$ Venus was distant toward the east [versus ortum], and Mercury was 7' from it; and Mercury appeared the more northern. From this he argues that the conjunction of these planets was at hour $11\frac{1}{2}$ of the night. Moreover, in Hortensius's dissertation on Mercury seen on the Sun, [the places] of Lansbergen and Longomontanus stand thus, with a notable error of Longomontanus against the observation.

The page opens with a small comparison table of computed longitudes and latitudes from Lansbergen and Longomontanus for both Venus and Mercury (continuing the discussion of the 1632 July 31 observation):

Author	Planet	Longitude: Grad.	I (')	II (")	Latitude: G.	I (')	II (")	(N/S)
--- ---	--- ---	--- ---	--- ---	--- ---	Lansbergen	Venus	♋ (Cancer)	24 24
43 0	34 43	B	Longomontanus	Venus	24 40	0 0	34 0	B
Lansbergen	Mercury	♋ (Cancer)	24 30	4 0	39 5	B		
Longomontanus	Mercury	27 33	0 1	24 0	B			

7. Year 1632, December 6. Gassendi at Paris observed the conjunction of Venus with the Sun, as far as longitude went; for as to latitude, Venus could not at that time cover the Sun, as Kepler [also held] in the *Optics* (p. 305). And it was at hour 9.41' after noon at Uraniborg, from the *Rudolphine* [Tables]; and the southern latitude of Venus was 1°.58'.9". Hortensius [discusses this] in his dissertation on Mercury seen on the Sun.

8. Year 1633, May 26, hour 9 after noon. Boulliau with the optical tube saw Venus 18', or at most 19', more westerly, on the left shoulder of Pollux, somewhat more southerly. That star was (says Boulliau, book 9, chapter 2) in Cancer at 18°.33'.20", with northern latitude. And the azimuth of Venus was 9' more westerly than the azimuth of the star; therefore Venus was in Cancer at 18°.17', with northern latitude 2°.48'.

9. Year 1633, July 30. Gassendi at the little town of Tanaron [Tanatone] toward the north, at Digne [Dinia], of latitude 44°.11', in the morning saw Venus distant from the center of the Sun 26°.3' [?]; with the Sun high, Venus was previously at altitude 12°; she was seen to be distant from Aldebaran 37°, and from the southern horn of Taurus [australi cornu Tauri] 27°.17'.

10. In the same year, August 2. Gassendi in the same town saw Venus distant from the center of the Sun 29°.2'; with the Sun high at 9°. But Venus was previously seen to be distant from Aldebaran 36°.44', and from the right shoulder of Orion 20°.6'.

11. On the 5th, with the Sun high at 10°, Venus was seen by the same [observer] to be distant from the center of the Sun 31°.40'; though she had previously been distant from Aldebaran 36°.48', from the right shoulder of Orion 20°.8', and from Pollux 14°.40'. Gassendi in the *Epicurus* (p. 800).

12. On the 6th, the same Venus was distant from Aldebaran $36^{\circ}.59'$; and then from the western limb of the Sun $32^{\circ}.18'$; next from the eastern limb of the Sun $32^{\circ}.49'$; from the center of the Sun $32^{\circ}.34'$.

13. On the seventh [day], the same Venus was distant from Aldebaran $37^{\circ}.3'$; and $20^{\circ}.19'$ from the right shoulder of Orion; $14^{\circ}.27'$ from Pollux; and $16^{\circ}.45'$ from Castor [Castore]; then $33^{\circ}.5'$ from the western margin of the Sun, high at 9° ; and $33^{\circ}.34'$ from the eastern margin of the Sun, high at $10\frac{1}{2}^{\circ}$; and $33^{\circ}.20'$ from the center of the Sun, high at 12° .

14. On the 11th, the same Venus was distant — the same [observer] observing in the same place — $37^{\circ}.56'$ from Aldebaran, and $21^{\circ}.17'$ from the right shoulder of Orion; and next $36^{\circ}.6'$ from the center of the Sun, high at 12° .

15. On the 12th, the same Venus was distant $38^{\circ}.14'$ from Aldebaran, and $21^{\circ}.43'$ from the right shoulder of Orion; and next $36^{\circ}.44'$ from the center of the Sun, high at nearly 14° .

16. On the 13th, Gassendi there saw Venus distant $21^{\circ}.52'$ from the right shoulder of Orion, and $14^{\circ}.27'$ from Pollux, and $37^{\circ}.20'$ from the center of the Sun. Gassendi in the *Epicurus* (p. 801), who admits that, using a five-foot [radius] instrument, the use of the cylinder was such that the margins were rather outside than inside, and that in the discrimination of the margins one abounded over the other by a minute.

17. Year 1635, July 16. Gassendi at Aix [Aquis Sextijs] saw Venus at altitude 7° , distant from the tail of Leo [a cauda Leonis] $13^{\circ}.52'$, [the tail] itself high at $20\frac{1}{2}^{\circ}$. Gassendi in the *Epicurus* (p. 802).

18. Year 1636, November 14, in the morning. Fr. Andreas Arzet of the Society of Jesus at Innsbruck [Oeniponti] had this observation of Venus, which he afterward communicated to me by letter.

No.	Measured quantity	G		
		.	I (')	II (")
19	Between astronomical hours 6 and 7 —	5	28	30
	meridian altitude of Regulus	6		
	Venus's altitude then, seen at rising	2	36	30
		9		
	Soon, distance of Venus from Regulus	4	6	40
		2		

No.	Measured quantity	G		
		.	I (')	II (")
	Then, distance of Venus from Arcturus [Arcturo]	3 2	7	30
	And then Venus was high	3 1	11	0
	And Arcturus high toward the east	3 5	25	0

20. [continued at top of right column: Circa horam vero 9½ — "But around hour 9½"]

[The right column opens with the conclusion of an observation (No. 20), tabulated:]

Measured quantity	G.	I (')	II (")
Around hour 9½ — meridian altitude of Venus seen	4 0	47	0
And the rising altitude of the Sun	1 3	42	0
Soon, distance of Venus seen from the Sun	4 5	32	26

21. Year 1646, on July 9. D. Vincentius Mutus, at Majorca [Maioricae], at hour 15.40', saw Venus minute, nearly 32' distant — or rather, as to part of the latitude — from a star of the Hyades [Hyadum], which to the northern eye [appeared]; and that star was the more southern, as to longitude. But Venus was a little more easterly than the star; and it was near the greatest digression from the Sun.

22. In the same year, the same [observer], in the same place, on July 10, at hour 16, saw Venus the more southern, the more southern [star] in the southern horn of Taurus, and distant from it 31' or 32' in [the] minute[s] [scrup. 31. vel 32].

Observations made by the Fathers of our Society at Ingolstadt, and by me, afterward communicated by Fr. Michael Staudacher [Michaele Standacher].

Anno 1619:		(M		G
Die	Hora	.)	Distance of Venus from:	. I (')
Febr.	(Vesp. — evening)			

Anno 1619: Die	Hora	(M .)	Distance of Venus from:	G . I (')
7	6	35	Algenib·Pegasi	2 27 1
			Markab	1 6 4
10	6	25	Algenib	2 25 9
			Markab	1 34 3
			Venus was high [♀ alta erat]	8 30
April.	(Manè — morning)			
2	5	30	from the Sun [à Sole]	4 6 0
			with the Sun high [alto Sole]	1 0
			Venus high [alta ♀]	1 30 5
	H. 6	0	from the Sun	4 21 0
			with the Sun high	5 0
			Venus high	1 5 9
April.	(Manè — morning)			
6			from the Sun	4 49 1
			with the Sun high	3 0
			Venus high	1 50 7

[The table then continues with a sub-block headed "April. Manè — Altis" / "Die · ☉ g. ' ♀ g. '" / "Dist. ♀ à ☉ — Gr. '", giving for each day the Sun's altitude and Venus's altitude (in degrees and minutes) and the distance of Venus from the Sun:]

April. Manè — Die	Sun's alt. g.	Venus's alt. g.	Dist. Venus from Sun: Gr.
9	1	0 15	2 42 4 8 9
10	1	3 16 0	8 42 5 9
11	5	3 19 0	5 43 1 5
12	1	1 15 0	3 43 2 2 9
13	5	0 18	4 43 4 0 8
Maij 4	1	0 14	5 45 5 8 2
6	2	0 16	1 45 5 0 7
11	3	3 18 0	2 45 5 5 4
27	1	4 17 0	2 44 3 3 0
Iunij 4	2	1 19 5	3 43 3 5 1
8	4	3 23 0	3 42 5 0 4
20	0	3 20 0	5 40 5 1
Iulij 5	2	0 23	5 37 5 0 7

[A final sub-block, headed "Anno 1620. H. i — Distantia ♀ — G. '", gives Venus's distance from Arcturus and Spica:]

Anno 1620: Iulij (Vesp.)	H (i .)	Distance of Venus from:	G . I (')
3	9 4 5	from Arcturus [ab Arcturo]	5 6 7

Anno 1620: Iulij (Vesp.)	H (i .)	Distance of Venus from:	G . I (')
		from Spica ♀ [à Spica Virginis]	5 24 1
11	9 1 1	Arcturus	5 6 1
		Spica ♀	4 18 3
21	9 0	Arcturus	4 58 4
		Spica ♀	3 42 3
31	8 4 5	Arcturus	4 6 0
		Spica ♀	2 0 5

These pages continue the catalogue of Venus observations within **Liber VIII, "De Venere," Caput VII**, then open **Caput VIII** with the Bologna observations of Riccioli and Grimaldi. They present several observation tables (recorded distances of Venus from fixed stars and its altitudes, by date) followed by a long numbered series of selected Venus observations made at the College of Santa Lucia in Bologna.

[Caput VII, continued — observation tables]

The first table records morning (*Manè*) observations of Venus made in 1620–1621, giving the hour of observation, the reference object from which Venus's distance was measured, and that distance in degrees and minutes.

Date (1620)	H[our]	'	Distance of ♀ [from]	G[r.]	'
Octob. 13	Manè 5	0	from Regulus [à Regulo]	36	1 0
20	5	3 0	from the neck of ♀ [à Cervice ♀] from Regulus [à Regulo]	30 30	5 5 9
			from the tail of ♀ [à Cauda ♀]	18	7

Date (1620)	H[our]	'	Distance of ♀ [from]	G[r.]	'
22	9	5 2	♀ at meridian altitude [♀ altit. Merid.]	40	3
			and distance from ☉ [& dist. à ☉]	34	0
23	9	3 0	♀ at meridian altitude [♀ alt. Merid.]	40	4 0
25	6	8	from Regulus [à Regulo]	31	5 4
			from the tail of ♏ [à Cauda ♏]	17	5 1
			♀ was high [♀ alta erat]	23	2 0
Nouemb. 17	Manè 5	1 5	from Arcturus [ab Arcturo]	30	5 4
			from the tail of ♏ [à Cauda ♏]	26	1 2
			♀ was high [♀ alta erat]	20	1 0
Nou. 30	Manè 6	1 5	from Arcturus [ab Arcturo]	28	4
			from the tail of ♏ [à Cauda ♏]	36	2 2
			♀ was high [♀ alta erat]	26	5
Decemb. 3	Manè 6	0	from Arcturus [ab Arcturo]	28	5 9
			from the tail of ♏ [à Cauda ♏]	39	3
			♀ was high [♀ alta erat]	23	4 0
Decemb. 7	Manè 5	4 5	from Arcturus [ab Arcturo]	29	4 8
			from the tail of ♏ [à Cauda ♏]	42	5 4
			from the Sun, high [à Sole alto] g. 15	47	5
Dec. 13	Manè 6	0	from Arcturus [ab Arcturo]	31	5 4

Date (1620)	H[our]	'	Distance of ♀ [from]	G[r.]	'
			from Spica ♏ [à Spica ♏]	17	1
					2
			♀ was high [♀ alta erat]	27	0
Dec. 23	Manè 6	4	from Arcturus [ab Arcturo]	37	4
		5			8
			from Spica ♏ [à Spica ♏]	27	4
					2
Date (1621)	H.	'		G.	'
Ianuarij 5			from Arcturus [ab Arcturo]	48	1
					8
			from Spica ♏ [à Spica ♏]	42	1
					2
			♀ was high [♀ alta erat]	17	5
					5

Observations made at Innsbruck [Oeniponte] by the Fathers of our Society [à PP. Societ. Nostrae].

This table gives, for 1635–1636, the distance of Venus from a named star (in degrees and minutes) and the altitude of Venus or of a reference star (in degrees and minutes), with morning (*mat.*) or evening (*vesp.*) noted.

Date (1635)	Distance of ♀ from [A.]	G r . ' Altitude	G r . '
Octob. 5	Regulus [Regulo]	3 5 ♀ 1 8	9 5 ma 1 t.
	Jupiter [Jove]	2 3 Canicula 9 4	4 3 ma 7 2 t.
(1636) Mart. 23	Aldebaran [Aldebara]	3 5 ♀ 5 9	1 8 ves 4 p.
	Lucida Arietis [Ariet. Luc.]	1 2 bright star of the 0 9 shoulder of Orion [Hum. luc. Or.]	4 2 4
Martij 31	Aldebaran [Aldebara]	2 3 ♀ 5 3	1 1 ves 6 2 p.

Date (1635)	Distance of ♀ from [A.]	G r . ' Altitude	G r . '
	Lucida Persei [Lucida Persei]	3 5 Canicula 3 9	4 6 ves 8 p.
April. 6	Aldebaran [Aldebara]	1 3 ♀ 8 6	1 5 ves 5 p.
	Lucida Persei [Lucida Persei]	3 5 Aldebaran [Aldebarae] 0 5	2 4 ves 6 5 p.
April. 16	Aldebaran [Aldebara]	8 3 ♀ 5	1 2 ves 3 0 p.
	bright star of the shoulder of Orion [Oriō. hum. luc.]	2 3 Sirius [Siry] 9 4	3 3 ves 6 5 p.
Maij 6	Canicula	3 4 ♀ 2 5	2 4 ves 0 0 p.
	Capella	2 5 of Regulus [Reguli] 1 2	5 5 ves 2 p.
Maij 11	Canicula	2 5 ♀ 3 4	2 1 ves 2 2 p.
	Capella	2 2 of Regulus [Reguli] 8 0	5 2 ves 0 8 p.
Maij 19	Capella	2 1 ♀ 9 0	4 4 ves 3 0 p.
	head of Pollux [Cap. Polluc.]	1 5 of Regulus [Reguli] 0 9	2 5 ves 0 0 p.

The second table on this opening (right column) records 1636–1637 observations: the date, the object from which Venus's distance was measured, that distance in degrees and minutes, and an altitude (of Venus or of the named star) in degrees and minutes, with morning (*mat.*) or evening (*vesp.*) noted.

Date (1636)	Distance of ♀ [from, A.]	G r . ' Altitude	G r . '
Iunij 1	Regulus [Regulo]	3 ♀ 1	1 50 ve 9 sp.

Date (1636)	Distance of ♀ [from, A.]	G r .	Altitude	G r .	'	
	head of Pollux [Cap. Polluc.]	6	of Regulus [Reguli]	3	41	ve
				4		sp.
Iulij 10	Arcturus [Arcturo]	5	♀	1	7	
		2		0		
	Dubhe	5	of Arcturus	5	36	ve
		3	[Arcturi]	2		sp.
Nou. 2	Canicula [Canic.]	6	♀	2	15	m
		7		9		at.
	Regulus [Regulo]	3	Canicula [Canic.]	4	2	ve
		3		4		sp.
	from the Sun [à Sole]	4	♀ at meridian [♀ merid.]	4	56	
		2		2		
Nou. 4	Arcturus [Arcturo]	3	♀	3	10	m
		6		0		at.
	Canicula [Canic.]	6	of Arcturus	2	8	m
		9	[Arcturi]	6		at.
	from the Sun at meridian [à Sole merid.]	4	♀	2	40	ve
		3		9		sp.
Nou. 10	Regulus [Regulo]	3	♀	3	5	m
		8		1		at.
	Arcturus [Arcturo]	3	Regulus at meridian	5	28	
		3	[Reg. merid.]	6		
Nou. 19	Regulus [Regulo]	4	♀	3	circ.	
		6		0	mat.	
	Arcturus [Arcturo]	3	Regulus at meridian	5	28	
		0	[Reg. merid.]	6		
Dec. 12	tail of ♄ [Cauda ♄]	4	♀	2	0	m
		8		5		at.
	Spica ♄ [Spica ♄]	1	♄ at meridian [♄ merid.]	4	38	
		6		2		
Dec. 14	Arcturus [Arcturo]	3	♀	2	28	m

Date (1636)	Distance of ♀ [from, A.]	G r .	Altitude	G r .	
		2		5	at.
	Spica ♀ [Spica ♀]	1	of Arcturus	5 47	
		8	[Arcturi]	6	
Dec. 24	Arcturus [Arcturo]	3	♀	2 15	m
		9		3	at.
	Spica ♀ [Spica ♀]	2	Spica at meridian	3 33	
		9	[Spica merid.]	3	
(1637)	Arcturus [Arcturo]	6	♀	1 37	m
Ianuar. 21		4		6	at.
	bright star of the	6	bright star of the	5 50	m
	Lyre [Lyrae Lucid.]	1	Lyre [Luc. Lyrae]	5	at.
Ianuar. 26	Arcturus [Arcturo]	6	♀	1 58	m
		9		4	at.
	bright star of the	6	of Arcturus	5 46	ve
	Lyre [Lyrae Lucida]	0	[Arcturi]	7	sp.

CAPUT VIII.

Selected Venus observations, out of many carried out at Bologna in the College of Santa Lucia, by the Fathers Giovanni Battista Riccioli [Ioan. Bapt. Ricciolio] and Francesco Maria Grimaldi [Franc. Maria Grimaldo] of the Society of Jesus.

With some observations of the most illustrious Marquis Cornelio Malvasia [Cornelij Malvasiae] added.

1. In the year 1642, on September 23, in the evening, when Arcturus was high, distant $27^{\circ} 33'$ from the west, Venus was observed by means of the sextant [per Sextantem] to be $36 \frac{1}{3}^{\circ}$ distant from that same Arcturus. When Venus had descended to an altitude of $4^{\circ} 8'$, it was distant from the bright star of the Northern Crown [lucida Coronae] $44^{\circ} 52'$.
2. In the same year, on November 30, in the evening, 10 minutes before the transit of Fomalhaut [Fomahant] across the meridian thread [per M.C. — *per meridianam chordam*], Venus was seen to be distant from Fomalhaut $37^{\circ} 13'$; and after three minutes and 10 seconds it was distant from Saturn $52^{\circ} 24'$.

3. Likewise in the year 1642, on July 21, in the evening, Venus had been high above the western horizon, apparently at $7^{\circ} 56'$; then, up to the transit of the Heart of the Scorpion [cordis Scorpij — Antares] across the meridian thread, 9 minutes 58 seconds were counted.
4. But on the 25th of the same month, in the evening, Venus was seen to be high at an altitude of $7^{\circ} 11'$, in the western azimuth of $104^{\circ} 33'$; from there, up to the transit of Antares across the meridian thread, there were counted $26' 40''$.
5. In the year 1642, on August 4, in the evening, Venus was visibly high at $7^{\circ} 1\frac{1}{2}'$, in the western azimuth at $98^{\circ} 50\frac{1}{2}'$; from there, up to the transit of the head of Ophiuchus [capitis Ophiuchi] across the meridian thread [per M.C.], $36' 42''$ were counted.
6. But on the twelfth of August [duodecima Augusti], when Venus was seen to be high at $7^{\circ} 59'$, it was observed in the western azimuth at $93^{\circ} 8'$; from there, up to the transit of the topmost star in the shoulder of Ophiuchus [supremae in humero Ophiuchi], $16' 52''$ were counted.

Here, so that the order of time may be preserved, the first observation ought to be inserted, and the second set aside until after the one that follows.

7. In the year 1642, on October 21, in the following evening, Venus was distant from Arcturus $59^{\circ} 11'$; and when $5' 15''$ had elapsed it was distant from the bright star of the Northern Crown [lucida Coronae] $55^{\circ} 24'$. Then, 10 minutes later, the western altitude of Aquila was taken at $63^{\circ} 11'$.
8. In the year 1643, on January 10, in the evening, half an hour after true sunset, Venus was seen to be distant from Jupiter $14^{\circ} 11'$; and after 6 minutes of time, distant from Saturn $19^{\circ} 21'$. And after 11 minutes it was distant from the bright star of the tail of Cetus [lucida caudae Ceti] $33^{\circ} 44'$; and after $5' 50''$ — for observations of other planets had intervened in those moments of time — at length, after 5 minutes, it was seen to be distant from the breast of Cetus [pectore Ceti] $56^{\circ} 25'$.
9. Likewise in the year 1643, on January 20, in the following night, Venus was seen to be high above the western horizon at $23^{\circ} 32'$; from there, after $19' 32''$, the rising altitude of Aldebaran was $48^{\circ} 30'$.
10. In the year 1643, on March 8, in the morning, nearly half an hour before sunrise, Venus appeared distant from the bright star of Aquila [lucida

Aquilae] $31^{\circ} 13 \frac{2}{3}'$. Then, 25 minutes before sunrise, when it was seen to be high, it was distant from the tail of Cygnus [Cygni cauda] $53^{\circ} 14'$; but at that very moment of physical sunrise it was observed to be distant from the center of the Sun $37^{\circ} 37'$.

11. But in the same year, on the 12th day of the same month, in the morning, about an hour before sunrise — that is, when the bright star of Aquila was high at $41^{\circ} 27'$ — Venus was seen to be high at $11^{\circ} 54'$; and it was distant from the tail of Cygnus $53^{\circ} 58'$. At that very moment, when the bright star of Aquila was high at 42° , Venus was high at $13^{\circ} 33'$; it appeared distant from that same bright star of Aquila $31^{\circ} 37'$.
12. In the year 1643, on May 19, in the morning, before the Sun's altitude, Venus was seen at $1^{\circ} 43'$; observed [to be distant] from Jupiter, and when $4^{\circ} 20''$ [recte: $4^{\circ} 20''$] had elapsed it was high at $17^{\circ} 5'$; and its eastern azimuth was $76^{\circ} 22'$.
13. But on the 21st, in the morning, the eastern altitude of the bright star of Aquila was taken at $53^{\circ} 24'$; and after $20^{\circ} 30'$ the eastern altitude of Venus was observed to be $14^{\circ} 20 \frac{1}{3}'$ in the azimuth of $80^{\circ} 1'$; and a little later Venus appeared more southerly in the same vertical [circle] as Jupiter.
14. In the year 1643, on July 15, in the morning, the rising altitude of the bright star of Aries [lucidae Arietis] was taken at $46^{\circ} 50'$; then, when 15 minutes had elapsed, Venus was seen to be high at $14^{\circ} 22'$, distant from the bright star of Aries $46^{\circ} 2'$. Then, when 5 minutes of time had elapsed, it was seen to be high at $15^{\circ} 50'$ and distant from Aldebaran $13^{\circ} 25'$. At last, after a [further] interval of time, Venus was seen to be high at $18^{\circ} 48'$ and at that moment distant from Jupiter $57^{\circ} 58 \frac{2}{3}'$.
15. In the year 1643, on June 21, in the morning, the observed altitude of the Sun was $7^{\circ} 49 \frac{2}{3}'$ in the same eastern azimuth; the eastern azimuth was $114^{\circ} 14'$; the observed altitude of Venus had been $14^{\circ} 20 \frac{1}{3}'$ [recte: see note], and at the same moment its altitude was $92^{\circ} 47'$ [recte: see note].
16. In the same year, and month, on the 28th day, in the morning, the altitude of the bright star of Aquila was taken at $46^{\circ} 2'$; toward the west, $28'$ were counted; afterward the altitude of Venus was seen [to be] easterly at $14^{\circ} 38'$, and its distance from Saturn $50^{\circ} 16'$. Then, after $6^{\circ} \frac{1}{4}$, it was seen to be distant from Jupiter $36^{\circ} 7'$, when it would appear high at 16° .

17. In the year 1643, on July 30, in the morning, half an hour after the rising altitude of the bright star of Aries [had been taken] at $58^{\circ} 22'$, Venus was seen to be high above the east at $17^{\circ} 15'$; and at the same moment distant from Aldebaran $30^{\circ} 53'$. And after two minutes of time it was seen to be high at $18^{\circ} 20'$, distant from Regel of Orion [Regel Orionis — Rigel] $42^{\circ} 41\frac{1}{2}'$; high then at $11^{\circ} 50'$. Then, after 12 minutes, it was seen to be high at $19^{\circ} 40'$, and distant from Capella $29^{\circ} 38'$, when Capella was high at $48^{\circ} 22'$. At length, after 28', it was seen, or at any rate appeared, to be in altitude $26^{\circ} 4'$, distant from the center of the Sun exactly at $30^{\circ} 50'$.
18. In the year 1643, on August 11, in the morning, the rising altitude of Aldebaran was taken at $47^{\circ} 55'$; and after 24 minutes, Venus was seen to be high at 19° , observed [to be] distant from the bright star of the shoulder of Orion [humero lucido Orionis] $30^{\circ} 10\frac{1}{3}'$; and after 7 minutes of time it was distant from Aldebaran $45^{\circ} 12\frac{1}{2}'$, iterated in the customary manner of observations.
19. In the same year, in the month of August, on the 31st, in the morning, Aldebaran was observed [to be] elevated $53^{\circ} 9'$ from its rising; and when 15 minutes had elapsed, Venus was seen [to be] elevated above the horizon $17^{\circ} 52'$, and then distant from Sirius $44^{\circ} 53'$; high at $10^{\circ} 34'$. Then, after three minutes, Venus was seen to be high at $18^{\circ} 40'$; and distant from Regel [Rigel] $56^{\circ} 50'$, high at $29^{\circ} 15'$.
20. Likewise in the year 1643, on August 31, in the morning, Aldebaran, easterly, was distant from the zenith [à vertice] $34^{\circ} 10'$; and from there, after 26 minutes, Venus appeared, distant [from its] rising at $34^{\circ} 14'$, distant from the bright star of the shoulder of Orion [lucido humero Orionis] $25^{\circ} 24'$; high at $14^{\circ} 20'$; and from Procyon distant $28^{\circ} 23'$.
21. In the year 1643, on May 7, in the morning of the following day, Procyon was distant from the zenith $58^{\circ} 58'$; Venus was seen [to be] distant from the zenith $64^{\circ} 1'$; and from Capella $22^{\circ} 16'$ — for they observed these distinctly at the same moment. Then, counting $5^{\circ} 40''$ [recte: $5' 40''$], Venus's distance from the zenith was 65° precisely; its distance from Procyon, on that same day, was $31^{\circ} 32\frac{1}{3}'$; and again, from Capella, distant from the zenith $60^{\circ} 50'$. There were four observers.
22. In the same year, on the 12th, in the evening, high, Regulus was at the zenith [recte: see note] $30^{\circ} 30'$; Venus high at $22^{\circ} 4'$; and [Venus] distant from Regulus $19^{\circ} 26'$; high then [with] Regulus high at $28^{\circ} 55'$, Venus high at

20° 14'; and distant from the bright star of the tail of Leo [lucida caudae Leonis] 41° 57'.

23. In the year 1644, on June 18, in the evening, high, Regulus was at 25° 1'; Venus was seen high at 19° 54'; and [distant] from Regulus high at 12° 57 ½'; high then [with] Regulus high at 23° 27'; and [Venus] distant from the tail of Leo 35° 49'.

24. In the year 1644, on the 23rd of June, in the evening, high, Regulus was at 21° 40'; Venus was seen high at 19° 10'; and [distant from] Regulus high at 7° 42'; high then [with] Regulus high at 20° 38'; [Venus] high then at 18° 2'; and [distant] from the tail of Leo high at 30° 54'.

25. In the year 1644, on June 29, in the evening, high, Regulus was at 17° 10'; Venus was seen high at 17° 20'; and [distant] from Regulus high at 15° 58'; high then [with] Regulus high at 16° 9'; and [distant] from the tail of Leo high at 24° 32'.

26. In the year 1644, on July 1, in the morning, Regulus was high at 17° 14'; Venus was seen high at 18° 21'; and [Venus] distant from Spica of the Virgin [Spica Virginis] 53° 50'; high then afterward [with] Regulus high at 16° 26'; Venus was seen [to be] elevated at 17° 20'; and distant from the tail of Leo 23° 40'.

27. On the following day, July 2, in the evening, high, Spica was at 28° 42'; [Venus] high at 17° 2'; and distant from Spica high at 52° 20'; then high, Spica [at] 27° 53'; Venus was seen high at 15°; and distant from the tail of Leo 22° 46'.

These following observations were carried out by the same method.

The table below records, for July 1644, the day; the observed altitude of Venus [Alt. visa ♀] in degrees and minutes; the altitude of Spica [Alt. Spicae] in degrees and minutes; and the observed distance of Venus from [named] stars [Dist. visa ♀ à Stellis] in degrees and minutes.

(1644) July, day	D a		M	Alt. Spica Gr.	Dist. ♀ Gr.	M	
	t	Alt. of ♀ Gr.					[from star]
28	3	17	4 2	28	51	2 2	from Spica [à Spica]

(1644) July, day	D a t e	Alt. of ♀ Gr.	M .	Alt. Spica Gr.	Dist. ♀ Gr.	M .	[from star]
		15	5 5	28	22	0 ½	from the tail of ♀ [à cauda ♀]
29	4	18	2 1	29	50	2 1	from Spica [à Spica]
		16	1 5	28	21	9	from the tail of ♀ [à cauda ♀]
30	5	17	3 2	28	49	2 2 ½	from Spica [à Spica]
		15	2 4 ½	27	20	2 6	from the tail of ♀ [à cauda ♀]
31	6	16	5 4	27	48	1 9	from Spica [à Spica]
		14	8 ½	26	19	3 8 ½	from the tail of ♀ [à cauda ♀]

The table continues on the next page (folio 338) for the same series.

(1644) July, day	Date	Alt. of ♀ Gr.	Alt. Spica Gr.	Dist. ♀ Gr.	M .	[from star]
32	8	16	27	46	2 4	from Spica [à Spica]
		13	25	18	1 3 ½	from the tail of ♀ [à cauda ♀]
33	9	12	24	45	2 7	from Spica [à Spica]
		12	23	34	4 3	from Vindemiatrix [à Vindem.]
34	10	14	25	44	2	from Spica [à

(1644) July, day	Date	Alt. of ♀ Gr.	Alt. Spica Gr.	Dist. ♀ Gr.	M .	[from star]
					7	Spica]
		12	24	16	5	from the tail of ♀
					2	[à cauda ♀]
		11	23	33	5	from
					7	Vindemiatrix [à
						Vindem.]
35	11	16	26	43	2	from Spica [à
					8	Spica]
					½	
		10	22	51	3	from Arcturus
					0	[ab Arcturo]
36	12	15	25	42	3	from Spica [à
					4	Spica]
		14	24	15	4	from the tail of ♀
					4	[à cauda ♀]
					½	
37	14	14	24	40	4	from Spica [à
					0	Spica]
		12	23	14	4	from the tail of ♀
					8	[à cauda ♀]
38	19	13	22	37	9	from Spica [à
					½	Spica]
		9	19	46	4	from Arcturus
					3	[ab Arcturo]
					½	
39	Augu sti 4	9	17	40	3	from Arcturus
					5	[ab Arcturo]
					½	
		7	15	23	4	from Spica [à
					0	Spica]

40. In the year 1644, on November 11, in the morning, Procyon was distant from the zenith $41^{\circ} 25'$; and after 6 minutes of time the observed altitude of Venus was easterly, and its distance from Regulus $38^{\circ} 57'$. But after a

minute and a half it was distant from Arcturus $33^{\circ} 34 \frac{1}{2}'$; and after 4 minutes it was distant from the bright star of Hydra [*lucida Hydrae*] $46^{\circ} 37'$.

41. In the year 1644, on November 21, in the morning, Regulus was distant from the zenith toward the west $31^{\circ} 11'$; and after 6 minutes Venus was high at 31° distant; from Arcturus $29^{\circ} 54 \frac{1}{3}'$; and after a further 6 minutes Venus was high at $31^{\circ} 33'$, distant from Regulus $48^{\circ} 5'$.
42. In the same year, on November 26, in the morning, Arcturus, easterly, was taken at a distance from the zenith of $49^{\circ} 50'$; from there, after 5 minutes of time, the altitude of Venus was $28^{\circ} 59'$; its distance from Arcturus $28^{\circ} 59'$ [recte: see note]. Then, after 5 minutes of time, the altitude of Venus was $29^{\circ} 12'$, and its distance from Regulus, westerly, $52^{\circ} 58'$.
43. In the year 1644, on November 29, in the morning, the rising distance of Arcturus from the zenith was $51^{\circ} 1'$; and after a further minute and a half the rising altitude of Venus was $25^{\circ} 12'$; its distance from Arcturus $25^{\circ} 12'$ [recte: see note]; then, after 1 minute, it was seen [to be] distant from Regulus $56^{\circ} 1' 50''$; and after a further minute it was distant from Spica $4^{\circ} 30'$ [recte: $24^{\circ} 30'$ — see note].
44. In the year 1644, on December 4, Arcturus was distant from the zenith $45^{\circ} 25'$; and after 2 minutes Venus was seen [to be] high at $25^{\circ} 35'$; its distance from Arcturus $29^{\circ} 14'$. Then, at the [next] Italian hour [*hora Italica civili*] 13', Venus was seen high at $27^{\circ} 10'$, distant from Spica $38^{\circ} 24'$.
45. In the year 1645, on February 4, the distance of Venus from the zenith toward the west was taken at $49^{\circ} 50' \frac{1}{4}$; in the azimuth of whose vertical [circle] the bright foot of Orion [*pes lucidus Orionis*] was carried; it was seen to be distant from the zenith $60^{\circ} 59'$; in the eastern azimuth of which Venus was [observed]. Then, after the observation of Venus, $46^{\circ} 17' \frac{1}{4}$ ran out [effluxerunt]; in whose [interval], at the end, the distance of the right shoulder of Orion [*dexter humerus Orionis*] from the zenith was $51^{\circ} 56'$. Then, when $3' 25''$ had elapsed, after the distance of Procyon [had been measured] distant from the zenith $44^{\circ} 44'$, Venus was seen to be distant from the zenith $83^{\circ} 26'$.
46. In the same year, on February 6, Venus was in the same azimuth as in the preceding observation, seen [to be] distant from the zenith $48^{\circ} 43'$; from there, 5 minutes were counted, when the time of twilight, ceasing, hindered [further observation]; afterward the distance of the right shoulder of Orion

from the zenith was $50^{\circ} 15'$. Then again the distance of Venus, westerly, was $48^{\circ} 40'$; and after a lesser time-interval Procyon was distant from the rising $40^{\circ} 55'$.

47. In the year 1646, on February 12, Venus was observed [to be] distant from the zenith $46^{\circ} 58'$; in whose vertical [circle], up to the plane of which the right shoulder of Orion was expected, [it] was distant from the zenith $46^{\circ} 50' \frac{1}{2}$. After the observation of evening Venus, $39' 15''$ of time were counted; and immediately Regel [Rigel] was distant from the zenith $55^{\circ} 20'$ in the eastern quadrant; Venus, moreover, was nearest to its greatest digression [vicina maximae digressioni].
48. In the year 1646, on February 25, evening Venus was seen [to be] distant from the zenith $47^{\circ} 15'$; in the azimuth of that vertical [circle], down to whose plane the right shoulder of Orion slipped, it was distant from the zenith $52^{\circ} 50' 15''$. From the observation of Venus, moreover, $47' 45''$ were counted; Procyon, in the eastern quadrant, was distant from the zenith $50^{\circ} 15'$.
49. In the year 1646, on July 4, in the morning, the distance of Venus from the zenith was seen [to be] $64^{\circ} 54'$; and its eastern azimuth [was] $88^{\circ} 4'$; from there, up to the observed altitude of the Sun, $17' 50''$ ran out in minutes [recte: see note] $34'$.
50. In the same year, on July 7, in the morning, with Capella distant from the zenith $62^{\circ} 10'$, Venus was seen [to be] distant from the bright side of Perseus [lucido latere Persei] $33^{\circ} 30'$; Capella, moreover, being distant from the zenith $61^{\circ} 36'$; observed in the same morning, at the same moment at which Venus was in the eastern azimuth $91^{\circ} 56'$, it was seen [to be] distant from the zenith $64^{\circ} 2'$; observed, moreover, in minutes [numerata sunt min.] $34' 26''$; the altitude of the now-risen Sun was seen [to be] $3^{\circ} 10' \frac{2}{3}$.
51. In the year 1646, on July 9, in the morning, with Capella observed [to be] distant from the zenith 62° , Venus was seen [to be] distant from the bright side of Perseus $33^{\circ} 39'$; Capella, moreover, being distant from the zenith $61^{\circ} 33'$, Venus was seen [to be] distant from Capella itself $30^{\circ} 23'$; from the zenith, moreover, about 66° ; Capella, moreover, distant from the zenith $58^{\circ} 19'$; thence $18' 56''$ were counted; and up to the transit of Venus across azimuth $88^{\circ} 8'$, in which Venus was distant from the zenith $63^{\circ} 27'$; about which time the greatest digression of Venus was occurring.

52. In the same year, on July 11, in the morning, with Capella distant from the zenith $69^{\circ} 50'$, Venus was seen [to be] distant from the zenith $33^{\circ} 53' \frac{1}{2}$; and from the bright side of Perseus $33^{\circ} 53' \frac{1}{2}$; and a little after, distant from Capella itself $58^{\circ} 43'$; Venus, moreover, was seen [to be] distant from the zenith $29^{\circ} 30'$; from the zenith, moreover, $68^{\circ} 40'$. Besides, after the distance of Capra [Capella] from the zenith $56^{\circ} 18'$, $16' 13''$ were counted; at the end of which Venus was seen [to be] distant from the zenith $62^{\circ} 40'$; in the azimuth $88^{\circ} 10'$.
53. In the year 1647, on April 23, in the evening, Venus was seen [to be] high at $6^{\circ} 24'$; and distant from the following shoulder of Orion [humero sequenti Orionis] $36^{\circ} 56'$. Then, when Venus would be seen high at $5^{\circ} 28'$, it was seen [to be] distant from the head of Pollux [capite Pollucis] $58^{\circ} 27' \frac{1}{2}$; immediately Capella was distant from the zenith $51^{\circ} 6'$.
54. In the year 1647, on May 16, in the evening, three days [after] sunset [post Solis occasum — recte: see note], in the quadrants Venus was seen [to be] high at $9^{\circ} 40'$; and distant from Procyon $47^{\circ} 17' \frac{1}{2}$; when Venus would be seen high at $9^{\circ} 5'$, it would appear distant from the head of Pollux $41^{\circ} 40'$.
55. In the same year, on June 11, in the evening, Venus was observed [to be] high at $12^{\circ} 14'$, distant from Regulus $45^{\circ} 5'$. Then, when it would appear high at $11^{\circ} 10'$, it was seen [to be] distant from the Heart of Hydra [corde Hydrae] $47^{\circ} 50'$; high then at $10^{\circ} 42'$, it was seen [to be] distant from the bright mane of Leo [lucida juba Leonis] $44^{\circ} 59'$. The observation lasted 20 minutes; at whose end Regulus, westerly, was distant from the zenith $54^{\circ} 45'$; and almost the whole hour, a quarter [hour] before sunset.
56. In the year 1649, on April 24, in the evening, Venus was observed [to be] in the plane of the Triangle of the [Polish] Filaris [Trianguli Filaris — see note] at the zenith $59^{\circ} 41' \frac{1}{3}$; and the dwelling [recte: it was distant — *distabat*] $1^{\circ} 15''$; Procyon was distant from the zenith $53^{\circ} 53' \frac{1}{3}$; then a vertical [circle] was awaited, the plane of which would be Venus, where the northern head of the Twins [Borealius caput Geminor.] had been, which in it was distant from the zenith $49^{\circ} 4'$.
57. In the same year, on May 3, in the evening, Venus, transiting through the plane of the Triangle of the Filaris [marking out its] vertical, was seen [to be] distant from the zenith $56^{\circ} 55'$; and after 3 minutes Procyon [was] distant from the zenith $56^{\circ} 54' \frac{1}{2}$; thence the northern head of the Crab

[Boreale caput ♄] transiting through the said plane of the Triangle was distant from the zenith $47^{\circ} 8'$.

58. In the same year, on May 4, when Venus would be seen [to be] high almost at [its] half [fere ad dimidium], it was distant from the zenith $18^{\circ} 49' \frac{1}{3}$; immediately Procyon was distant from the zenith $28^{\circ} 32'$; iterated in the customary manner of observations; and almost the whole hour, a quarter [hour] after sunset.

59. In the year 1649, on June 25, in the evening, although [observed] with the naked eye too [cum oculo quoque nudo], Venus could not be seen to be crescent-shaped [falcata], on account of clouds. But on July 25, in the morning, the altitude of Venus was $7^{\circ} 8'$; its distance from Capella $35^{\circ} 34'$; high then, Venus [at] $7^{\circ} 46'$; seen distant from Aldebaran $32^{\circ} 30' \frac{1}{2}$ in the brightest dawn, tending toward direct motion [ad Directionem].

60. In the same year, on July 27 in the morning, Venus appeared at an altitude of [gr.] $9^{\circ} 10'$, and [its] distance from Capella was $35^{\circ} 24'$. When [next] observed, it stood at an altitude of $10^{\circ} 10'$, and appeared to be distant from Aldebaran [gr.] $32^{\circ} 15'$.

61. On the following morning, however, Venus passed across the vertical plane of the filar triangle [Triangulum Filare], in which it was seen at an altitude of [grad.] $18^{\circ} 7'$; and afterwards in the same [plane] the center of the Sun was seen at an altitude of [grad.] $21^{\circ} 18' \frac{1}{2}$. After Venus had been observed, the Sun's observed altitude up to [grad.] $5^{\circ} 53'$ was reached, and the elapsed time was counted as [min.] $40' 8''$.

62. In the year 1649, on July 30, in the morning, when Venus was seen at an altitude of [gr.] $13^{\circ} 37'$, it was seen to be distant from Capella [gr.] $35^{\circ} 21'$; and at a [more] readily visible [altitude] of [grad.] $14^{\circ} 10'$, it was seen to be distant from Aldebaran [gr.] $32^{\circ} 13'$.

63. On the next morning, again, Venus was seen at an altitude of [gr.] $13^{\circ} 37'$, and distant from Aldebaran [gr.] $32^{\circ} 17'$. But at an altitude of [grad.] $14^{\circ} 17'$, it was seen to be distant from Capella [gr.] $35^{\circ} 22'$.

64. In the year 1649, on August 3, in the morning, Venus was seen at an altitude of [gr.] $15^{\circ} 20'$, and distant from Aldebaran [gr.] $32^{\circ} 38'$; and at an altitude of [grad.] $15^{\circ} 50'$, it was seen to be distant from Capella [gr.] $35^{\circ} 30'$.

65. On the following morning, again, Venus was seen at an altitude of [gr.] 18°, and distant from Aldebaran [gr.] 32°48'; and at an altitude of [gr.] 18°34', it was seen to be distant from Capella [gr.] 35°34'.

66. In the year 1651, on February 10, in the evening, Venus was seen at an altitude of [gr.] 4°30'; then after [min.] 7½, Sirius was seen at an altitude of [gr.] 75°11'. Now the western azimuth of Venus had been [gradum] 79°17¼, because in the plane of that vertical [circle lay] the Bright Star of Aries [Lucida Arietis = α Arietis]; afterwards [Venus], having been observed, was distant from the vertex [gr.] 47°55'. From this it was then deduced that Venus's place was in Aquarius [gr.] 28°4', with a northern latitude of [grad.] 8°4'. This was at the hour, that is, [min.] 5'34" after midday. It is therefore no wonder if then, and on that day too — the twelfth, although close to conjunction with the Sun (as the line drawn from horn to horn of Venus, very nearly following the longitude of the ecliptic, indicated) — on account of so great a latitude, [Venus] was conspicuous to us, and that not only with a telescope but also with the naked eye, even to those gazing at it.

67. In the year 1652, on May 29, evening Venus was seen at an altitude of [gr.] 24°57', and distant from Saturn, which was more easterly, [gr.] 5°27'; but at an altitude of [gr.] 24°30', it was seen to be distant from the head of Pollux, which was more westerly than Venus itself, [gr.] 4°45'. A little afterward, this [Venus] was seen at an altitude of [gr.] 20°25', and distant from the mane of Leo [iuba Leonis] [gr.] 34°39'; then at an altitude of [gr.] 19°52', it was seen to be distant from Regulus [gr.] 34°32'. And at that time Pollux was at an altitude of [gr.] 21°.

In the year 1652, the remaining observations of evening Venus around the hour of 8 p.m. are as follows.

Month / Day	Observed Alt. ♀ Gr.	MObserved Dist. ♀ . Gr.	M . [Reference star]
6 June	2 15	5 58	2 from Spica
8	6	2	5
	15	0 27	2 from the Tail of 5 ♏
6 July	4 14	2 50	2 from Spica
9		5	0
	13	2 21	1 from the Tail of 0 ♏
		3	
7 July	5 19	3 49	1 from Spica

Month / Day	Observed Alt. ♀ Gr.	MObserved Dist. ♀ . Gr.	M [Reference star]
0		4	9
7 July	6 14	4 48	2 from Spica
1		0	4
	13	2 19	4 from the Tail of
		4	2 ♀
7 July	7 15	2 47	2 from Spica
2		0	5
	14	1 19	1 from the Tail of
		9	½ ♀
7 July	8 14	1 46	2 from Spica
3		4	8
	13	1 18	1 from the Tail of
		5	4 ♀
7 July	9 13	2 45	2 from Spica
4		7	9
	12	3 17	3 from the Tail of
		0	9 ♀
7 July	1 14	5 44	3 from Spica
5	0	6	1
	13	5 17	3 from the Tail of
		6	½ ♀

From the observations made on July 6, around the hour of 8 p.m., and from the fixed stars, on the assumptions laid down in the first volume of the *Almagestum Novum*, the longitude of Venus came out at Virgo [gr.] $0^{\circ}30'1\frac{1}{2}$, with a northern latitude of [gr.] $0^{\circ}43'$.

76. In the year 1652, on August 6, in the evening, [in] the vertical of the filar triangle, marking out the vertical line directly into the center of Venus, the distance of Venus was taken on a direct plane at [gr.] $7^{\circ}8'46''[?]\frac{1}{2}$; and to this, after the counted minutes [had been] added, Arcturus reached [gr.] $9^{\circ}55'$; from which Arcturus was distant from the vertex [gr.] $47^{\circ}35'$.

77. In the year 1652, on November 19, in the morning, at about the 6th hour, Italian reckoning, the tail of Leo [cauda ♀ = Denebola] was taken at a distance from the vertex [gr.] 12° , and just over [min.] $6'$. At its rising at [gr.] $42^{\circ}10'$, then

after [min.] 1', Venus was seen to be distant from the more easterly Arcturus [grad.] $30^{\circ}27'$; and after [min.] 4', [it was] distant from the heart of Hydra [Cor Hydrae = Alphard], which was more westerly, [gr.] $52^{\circ}52'$.

78. In the year 1653, on February 2, in the morning, Venus was seen to be distant from the bright star of Aquila [lucida Aquilae = Altair] [gr.] $34^{\circ}30\frac{1}{4}'$; and from the vertex [gr.] $79^{\circ}23'$. Aquila, moreover, [was] distant from the vertex [gr.] $66^{\circ}20'$; then Venus was seen to be distant from Antares [gr.] $31^{\circ}10'$; and from the vertex [gr.] $78^{\circ}46'$. Antares, moreover, [was] distant from the vertex [gr.] 71° .

79. In the same year, on December 19, in the evening, at the hour of Aquila, its altitude was reckoned at [gr.] $4^{\circ}37\frac{1}{2}'$ after midday. Venus, near the eccentric perigee [Perigeum Excentrici], in a western azimuth of precisely [gr.] 25° , was seen to be distant from the vertex [gr.] $66^{\circ}55\frac{1}{2}'$. From this was then deduced the right ascension [Ascensio Recta] of Venus, [gr.] $317^{\circ}31'$; and the southern declination [Declinatio Australis], [gr.] $18^{\circ}43'$.

80. In the year 1654, on February 16, in the evening, Venus, tending toward and expecting its maximum digression, in an azimuth of [gradum] 55° , was seen to be distant from the vertex [gr.] $50^{\circ}1'$; and after [min.] $16'45''$, it was seen to be distant from the vertex [gr.] $71^{\circ}18'$.

81. On the following evening, again, Venus, in an azimuth of [graduum] 55° , was seen to be distant from the vertex [gr.] $49^{\circ}46'$; and after [min.] $25'36''$, Sirius was seen to be distant from the vertex [gr.] $69^{\circ}55\frac{1}{2}'$.

82. In the year 1654, on March 16, Venus was expected at the western azimuth of [graduum] 80° . It was seen to be distant from the vertex [gr.] $52^{\circ}50\frac{1}{2}'$. Then afterward, eastern Regulus [Regulus orientalis] was distant from the vertex [gr.] $53^{\circ}59'$.

83. In the year 1654, on April 5, evening Venus, in a western azimuth of [gr.] 95° , was seen to be distant from the vertex [gr.] $61^{\circ}55'$; and after midnight, on the 13th, [at] $56'$, Venus was seen to be distant from the vertex [gr.] $73^{\circ}14'$. Regel [Rigel] indeed [was] distant from the vertex [gr.] $47^{\circ}19'$; and soon afterward, [from] Aldebaran [gr.] $45^{\circ}47'$.

84. In the year 1654, on August 9, in the morning, when Aldebaran was distant from the eastern vertex [gr.] $46^{\circ}22'$, Venus was distant from the eastern vertex [gr.] $63^{\circ}40'$; in the northeastern azimuth of precisely [gradum] 85° .

85. In the year 1654, on August 14, in the morning, near the Italian hour 9, distant from the following shoulder of Orion [humero seq. Orionis = Betelgeuse] by [gr.]

62°54' from the vertex of its rising, Venus was seen to be distant from the vertex [gr.] 73°14'. Regel [Rigel] indeed [was] distant from the vertex [gr.] 47°19'; and soon afterward, [from] Aldebaran [gr.] 45°47'.

86. In the year 1655, on July 6, evening Venus was seen to be distant from the vertex [gr.] 76°39'; in a western azimuth of [graduum] 100°. And because the [rising] from the bright star [of Leo] had been expected by design, the distance of its rising from the bright star [lucida = Regulus] was [gr.] 64°33'.

87. In the same year, on July 10, evening, the distance [of Venus] from the vertex was [gr.] 79°, precisely in azimuth [graduum] 100°. From there, counting 10 minutes of time, Spica was distant from the vertex more to the west [gr.] 66°.

88. Likewise, in the year 1655, on August 6, in the evening, Venus, expected at the western azimuth of [gr.] 80°, was seen to be distant from the vertex [grad.] 77°53'; from there, after [min.] 7'45", western Arcturus [Arcturus occidentalis] was distant from the vertex [gr.] 42°54'.

89. In the year 1656, on January 8, in the morning, Venus was seen distant from the vertex [grad.] 74°; and from Spica [gr.] 47°35'; and at the same time, in the middle of the forehead of Scorpius, [from] Ophiuchus [gr.] 32°48'; and it was seen to be distant from the vertex [gr.] 72°34'.

90. In the same year, on February 10, in the morning, Venus was distant [from the vertex gr.] 72°36'; in that azimuth in which the center of the Sun was afterward seen to be distant from the vertex [gr.] 66°18'. But before, an hour and 24' before the observation of Venus had been taken, the distance of the Sun from the vertex had been [gr.] 82°44'.

91. In the year 1657, on March 18, in the evening, the distance of Venus from the vertex was [gr.] 57°27½'; and after [min.] 4'18", Aldebaran [was distant] from the vertex [gr.] 41°3½'; while when Aldebaran reached the vertical plane in which Venus had been observed, Venus was distant from Aldebaran itself [gr.] 58°17'.

92. In the year 1657, on June 9, evening, Venus was distant from the vertex [gr.] 64°50'; and from Regulus [gr.] 33°43¾. Then Venus was seen to be distant from the vertex [gr.] 76°20'; and from the head of Castor [gr.] 10°39⅓; and at that time Regulus was distant from the vertex toward its setting [gr.] 59°10'.

93. In the same year, on June 13, Venus was seen distant from the vertex [gr.] 77°48'; and from Regulus [gr.] 33°23'; afterward [it was] seen distant from the vertex [gr.] 80°; and from the head of Pollux [gr.] 6°58½'; and at once Regulus was distant from the vertex [gr.] 66°6'.

Observation of the Most Illustrious Marquis Cornelio Malvasia [Cornelio Malvasia], made at Modena, and set out in his own Ephemerides, fol. 217.

In the year 1662, on May 31, Venus was observed at a distance from the Sun of [gr.] 39°25', [on] another [reckoning gr.] 39°3' by computed parallaxes; and by the Cassini refractions it was [gr.] 39°34'; but by Lansbergen's [Philippus Lansbergius / Philips van Lansbergen] calculation it [came out] from [gr.] 38°48'. The difference is 46 minutes.

Year 1662 ♀ before sunrise ☉	Distance ♀ Corr.	G . I Place ♀	G . I	Lansb. G.	I
Sept. H. 0 50 / 19	from Regulus	3 1 Lo. ♀ 21	5	21	5
		6	4		4
	from the mane of ♀	8 4 La. B. 0	3	0	3
		8	2		4
22 H. 2 5	Regulus	1 3 Lo. ♀ 26	4	21	5
		4	2		5
	mane of ♀	8 1 La. B. 0	4	0	4
		3	4		3
Nov. H. 0 41 / 12	Spica ♄	9 4 Lo. ♄ 26	6	26	1
		3			
	Arcturus	3 4 La. B. 1	3	1	2
		0 5	6		8
26 H. 14 10 after sunset ☉	Spica ♄	2 4 Lo. ♄ 15	3	15	3
		6 4	5		1
	Arcturus	3 4 La. 1	9	1	6
		8 4			

CAPVT IX.

De Hypothesi motuum Veneris. — On the Hypothesis of the Motions of Venus.

1. Here I assume to have been laid out — or to be read through by the reader — what I explained at length concerning the hypotheses of the various astronomers regarding the motion of Venus and of Mercury in *[Almagestum Novum]* Book 7. Many things, too, that were treated here in Book 5 on the occasion of Saturn must be applied to these inferior planets: namely, what I said in Chapter 9 about the 20 ways of observing the places of the planets; what I gave in Chapter 12 on

reconciling the geometric hypothesis — rather a spiral one — of the diurnal [motion] with the planet's own [motion], in a fluid aether. As for the motion of the Earth, I showed at the end of Book 1 that it cannot be maintained — or rather, [I showed] which [hypothesis] comes closer to the truth, whether [the motion is achieved] through eccentric circles and epicycles, or through a single ellipse, granting that this comes nearer to the truth. The rest, if there is any, I indicate briefly in this place.

2. From what was said in Book 1 on the parallax of the Sun, it is clear that Tycho [Tycho Brahe] posited it far greater [than it is], as Longomontanus [Christian Sørensen Longomontanus] noted in Book 2 of the *Theorica*, at Chapter 17; and as the restitution of the parallax of Venus and Mercury, [based] on the Tychonic [parallax] of the Sun, stands in need of some refinement. He excuses himself, moreover, [on the grounds] that, because of the obliquity of the sphere in the Danish horizon, it was not permitted to continue the observations of the greatest elongation of Venus from the Sun, the twilight getting in the way; and therefore, besides the 9 Tychonic observations of Venus, he procured 6 others, [as treated] in Chapter 19, [drawn] from Ptolemy [Ptolemaeus] in the greatest digressions.

3. [Margin: *Kepleri sincerus timor in motu ♀* — Kepler's sincere fear concerning the motion of Venus.] Kepler [Iohannes Keplerus = Johannes Kepler] ingenuously, in the foundation of his Ephemerides, pages 14 and 15, admits that an error of up to 15 minutes may be feared in the Rudolphine [Tables] for Venus's computations — [tables] which sometimes run out to almost a quarter of a degree; this because they rely on observations of the Sun, of refractions, and of parallaxes that, on account of the proximity to the Sun, are suspected to be in some [way] fallacious. He exhibits, moreover, a specimen of these [computations], taking up the example of Maestlin [Michael Mästlin], who in the year 1574, on September 16, in the morning at the 4th hour, saw Regulus covered by Venus; then, however, the Rudolphine [Tables] exhibit the Heart of Leo [Cor Leonis = Regulus] in Leo at [gr.] $23^{\circ}54'39''$, with a northern latitude of [gr.] $0^{\circ}26'$; whereas Venus [stood] in Leo at [gr.] $23^{\circ}55'$, with a northern latitude of [gr.] $0^{\circ}25'$. The Lansbergian Tables, however, cannot be trusted so [much] in this matter. [Margin: *Lambergij infida methodus* — Lansbergen's unreliable method.]

For this star [Regulus], more than from the [usual] treasury of his observations, [Lansbergen] brings forward [his result], because he does not everywhere treat it faithfully enough — let the example be in the conjunction of Venus with Regulus, which we mentioned a little before from Maestlin's observation. For Lansbergen, on page 173 of his Tables, finds Venus then in Leo at [gr.] $24^{\circ}9'3''$, with a northern

latitude of [gr.] $0^{\circ}20'$. He does not doubt the Rudolphine [place], beyond the Tyconic place by 14'; minutes, and a latitude [differing] by 5'; and he, however, places it in Leo at [gr.] $24^{\circ}7'$, with a northern latitude of [gr.] $0^{\circ}31'$. This, therefore, having been dismissed, he goes over willingly to Boulliau [Bullialdus = Ismaël Boulliau].

5. For Boulliau, in Book 9 of his *Astronomia Philolaica*, deeply weighing several observations faithfully recorded by his predecessors, acknowledges that something must indeed be advanced [for] the mean motion of Venus in the Rudolphine [Tables], but the aphelion [Aphelium] must not be drawn back, as they draw it back. He prudently advises, moreover, that the conjunctions of Venus with other stars, observed with the naked eye, are not to be understood so precisely, because Venus, by the greatest expansion of its rays, very often obscures that small interval [of separation] which really lies between it and the neighboring stars. Yet Malvasia, using Boulliau's [reckoning] of Venus's parallax, [arrives at] a smaller [one], because [it comes] indeed from the false parallax of the Sun, and the parallax up to [min.] 3' rises [too high].

6. We — as with the other planets, [adding] tables to several observations — for the most part made very many comparisons of Venus with the fixed stars, or with other planets; and indeed more than [we made of] those places of Venus which Tycho or Longomontanus drew from the greatest digressions from the Sun, [based] on the false parallax of the Sun, and the parallax of Venus, and the obliquity of the ecliptic — whence they disagree from the Tables not rarely by 6 or 8 minutes or thereabouts. And here we set before [the reader] some specimen of our own Tables.

1. In the year 1494, on September 18, at the 17th hour after midday, at Nuremberg [Norimberga], Bernhard Walther [Bernardus Vualtherus] saw Venus more westerly than Regulus by 10 minutes. Lansbergen, to extort this observation from his Tables, does not doubt to place Regulus then in Leo at [grad.] $23^{\circ}19'$, that is, 34' beyond what is due; collect it, [for] the place [is given] from his Tables in Leo at [gr.] $23^{\circ}20'$. But Regulus was really in Leo at [gr.] $22^{\circ}44'35''$. Venus, however, [stood] from our Tables in Leo at [gr.] $22^{\circ}45'$. I think that, on account of Venus's great latitude, it was seen by Walther more to the west.

2. [Margin: *Lambergij dolus* — Lansbergen's trickery.] In the year 1574 — as Kepler relates in his *Astronomiae Optica*, page 305 — Maestlin, on September 15, at the 4th hour after midday, saw Regulus covered by Venus. Regulus was for me in Leo at [gr.] $23^{\circ}52'8''$, with a northern latitude of [grad.] $26^{\circ}10'$. Venus, however, [stood] in Leo at [gr.] $23^{\circ}53'30''$, with a northern latitude of [grad.] $26^{\circ}25''$. It is no

wonder, therefore, [given] the adjoined expansion of the rays, that with the naked eye Venus tends to appear around the very Regulus that has been covered.

3. In the year 1590 — in the same Kepler's testimony — on October 3, old style, in the morning, by night, Maestlin saw Mars covered by Venus, [in] the candid light of this [pair]. For me, from these Tables, Mars's place [comes out] in Virgo at [gr.] $15^{\circ}33'7''$. Venus's [is] in Virgo at [gr.] $15^{\circ}32'10''$, with very nearly the same latitude. Therefore, by Venus's expanded rays, [it was] entirely covered, [and Venus] hid Mars.

4. In the year 1598, on September 15, old style, in the morning at the 3rd hour, Kepler saw Venus barely covering the rising Regulus, namely at Graz [Gratz]. But for me Regulus was then in Leo at [grad.] $24^{\circ}12'24''$. Venus, however, [stood] in Leo at [gr.] $24^{\circ}18'30''$; but with the neighboring horizon expanding the rays more amply, it could happen that Regulus was seen obscured.

5. In the year 1632, on July 31, Gassendi [Petrus Gassendus = Pierre Gassendi] at Paris [Parisiis], and Hortensius at Amsterdam [Amstelodami], in the morning before dawn, observed the conjunction of Venus with Mercury, next [to it]; but Gassendi compared it in time a little after the middle of the night; Hortensius, however, into the hour $11\frac{1}{2}$ after midday of the same day 30. For Gassendi saw Mercury more easterly than Venus by [minutes] $3'30''$. The Prutenic [Tables = Prutenic Tables] erred so far that they anticipated the conjunction by entirely these five days; and Longomontanus, who corrects these Prutenic [places] only slightly, has [the conjunction] on the 30th of July; [at] the hour $11\frac{1}{2}$ Mercury was in Leo at [gr.] $24^{\circ}40'$, with a northern latitude of [gr.] $34'$.

[continued] Mercury, however, [stood] in Leo at [gr.] $27^{\circ}33'$, with a northern latitude of [gr.] $1^{\circ}24'$. [Margin: *Lambergius autem ♀ in ♏ gr. $24^{\circ}24'42''$ cum latit. bor. $34^{\circ}43''$, & Mercurium in ♏ gr. $24^{\circ}30'4''$ cum latit. $59^{\circ}5''$ — Lansbergen, however, [places] Venus in Leo at gr. $24^{\circ}24'42''$ with northern latitude $34^{\circ}43''$, and Mercury in Leo at gr. $24^{\circ}30'4''$ with latitude $59^{\circ}5''$.] We collect Venus in Leo at [gr.] $24^{\circ}22'15''$; and Mercury in Leo at [gr.] $24^{\circ}36'40''$.*

6. In the year 1633, on May 26, Boulliau at Paris, at the hour 9 after midday, saw western Venus through a tube [telescope] [more easterly?] by [min.] $18\frac{1}{2}$ on the left shoulder of Pollux, which for me was then in Leo at [gr.] $18^{\circ}35'$. Venus, therefore, was very nearly seen in Leo at [gr.] $18^{\circ}14'30''$; from the Tables, however, it was in [gr.] $18^{\circ}18'$.

Arithmetica Hypothesis. — Arithmetical Hypothesis.

Mean motion [Medius motus]	Sig.	G					V
		.	I.	II.	III.	IV.	.
♀ from the equinox [ab Æquinotio] —	0	1	3	7	49	17	2
Diurnal [Diurnus]			6				8
— Annual [Annuus]	7	1	4	34	51	15	3
		4	7				4
Apogee [Apogei] — Diurnal	0	0	0	0	8	19	5
							2
— Annual	0	0	0	50	40	50	3
							6
Nodi ♄ — Diurnal	0	0	0	0	4	57	1
							9
— Annual	0	0	0	30	8	37	3
							0

Epoch to the beginning of the common era of Christ, at the midday of the last [day] of the preceding December, and on the meridian of Bologna [Bononiensi].

Year 1 of Christ [Anno 1. Christi]	Sig.	G.	I	II
♀ Mean place from ♀ [Medius loc. ab ♀]	1	2	7	17
Apogee motion [Apogei motus]	9	12	50	43
Northern node motion [Nodi Bor. motus]	2	0	43	15

Pro Geometrica Hypothesi. — For the Geometric Hypothesis.

See what was said here in Book 5, especially toward the end of Chapter 12.

Meanwhile, choosing an ellipse, whose periphery traces as closely as possible the path around the cone proper to the planet's [motion], the motion is carried out through other [spirals], and other spirals, but [running] toward the west; let the measures written below be chosen, in which the radius of the annual orbit of the Sun is 100000, and its bisected eccentricity [bisecta Excentricitas] is 1740.

	Such [parts] [Taliū]	If the radius of the annual orbit ☉ [Si Rad Orbis Annui ☉] is 100000.
The minor semidiameter of the ellipse of Venus is		72396 9/10

	Such [parts] [Talum]	If the radius of the annual orbit ☉ [Si Rad Orbis Annui ☉] is 100000.		
[Semidiameter minor Ellipsis Veneris est]				
The major semidiameter of the ellipse of Venus is		72398		
[Semidiameter maior Ellipsis Veneris est]				
The half of the eccentricity from the Sun		794		
[Semissis Excentricitatis à Sole]				
Distance [Distantia]				
Sun's apogee & ♀ [Sole Apogeo & ♀] — Aphelion [Aphelia] from the Sun [à Sole]		72973		
— from the Earth [à Terra]		174713		
— Perihelion [Perihel.] from the Sun		71823		
— from the Earth		30136		
Sun's perigee & ♀ [Sole Perigeo & ♀] — Aphelion [Aphel a] from the Sun		72973		
— from the Earth		171233		
— Perihelion [Perihel.] from the Sun		71823		
— from the Earth		26656		
Maximum digression from the true place of the Sun [Maxima Digressio à vero loco ☉]		Gr.	I	II
Sun's apogee & ♀ — Aphelion [Aphelia]		45	48	10
— Perihelion [Perihelia]		44	52	50
Sun's perigee & ♀ — Aphelion		47	59	10
— Perihelion		47	0	35

Variation of latitudes [Latitudinum variatio]	Gr.	I	II
Sun's apogee & ♀ — Aphelion in ♂ [in ♂], Morning [Matutina]	8	34	15
— Evening [Vespertina]	1	24	30
— Perihelion direct in ♂ retrograde [Perihel. directa in ♂ Retrogr.], Evening	1	24	6
— Morning	8	8	50
Sun's perigee ♀ — Aphelion in ♂, Morning Retrograde [Mat. Retr.]	9	47	40
— Evening	1	26	15
— Perihelion in ♂, Evening Direct [Vesp. Dire.]	1	25	40
— Morning	9	15	30
Inclination of the orbit to the ecliptic [Inclinatio Orbitae ad Eclipticam]	3	22	50

For the remaining distances from the Sun, see Volume 2, Table 97.

LIBER NONUS — BOOK NINE

BOOK NINE, CONTAINING THE OBSERVATIONS OF THE PLANET MERCURY, AND THE HYPOTHESIS OF ITS MOTIONS

CAPUT I

Ancient Observations of Mercury, from the year 265 before Christ to the year of Christ 807

No planet costs astronomy more labor than this one, on account of how rarely it can be observed. The reason is partly the smallness of the number of its observations, and partly that Mercury, even at its greatest elongations [digressionibus], is nevertheless not far from the Sun, so that it appears only in the morning before sunrise or in the evening after sunset, unless the vapors of the horizon hide it, or the Sun itself is very near. For this reason we accept the words of Ptolemy [Ptolemy], *Almagest* IX.2 (*Magna Constructio* IX.2): in addition

to this difficulty of observations — few in number, and that because observations of this kind cannot be made — Copernicus [Copernicus] too, *De Revolutionibus* V.30, prefaces the difficulty of this matter thus:

[Margin: Difficulties of observing Mercury — *Difficiles observandi Mercurii*] This star indeed makes the path of its course hard to track down, and harder to examine, since earlier writers have demonstrated it to us beforehand, but not with serene skies; for, as they report, the breezes blow such as one finds along the Nile. We, by contrast, who dwell in a colder region — where nature, so to speak, denies us tranquil air, and where besides the great obliquity of the sphere allows us to see Mercury more rarely. For at its greatest distance from the Sun, although it is in Aries and Pisces, it does not rise within our view; nor again does it set in Virgo and Libra, but it presents itself in a way through the twilight of the nights only, when it has withdrawn somewhat into the morning hours of Cancer or Gemini. For this reason many have been led into ambiguities and into errors of inquiry. Hence it came about that we were brought to such a difficulty.

And indeed Longomontanus [Longomontanus] himself, *Astronomia Danica* (Longomontanus) II, *Theoricae* cap. 18, admits that on account of the obliquity of the sphere in Denmark, but at the season of summer, scarcely ever on account of the perpetual twilights is it permitted to continue observations of the elongations of Venus and Mercury from the Sun. And in cap. 20 he adds: *We will at last lay hands on Mercury, by the slipperiness of which the astronomers have hitherto been no less wearied than the surveyors of the earth.* Alchemists have likewise complained of Mercury, who cling to its traces, and, taking the suspicions of the ancients rather than the truth, ignorantly cleave to the heavenly observations of the ancients. And although the calculation of Mercury between the Alphonsine and Copernican calculations differs by degrees in some places, up to 7 — yet this could not be avoided even by the tables of certain more recent men. Nevertheless we judged it worth the labor to set out in order such observations as have been handed down to us by the hands of the ancients.

[Margin: 1.] In the year 484 of Nabonassar, on the 18th of the month Thoth following, i.e., on the 19th, which was the 21st year of Ptolemy Philadelphus, Mercury was observed to be distant by one Moon's breadth from the northern front of Scorpius, along a line drawn toward the north; and the same Mercury was distant by two Moons from the northern front of Scorpius. But on the 26th of Scorpius it was distant by the aforesaid line, in succession, by a Moon and a half.

Hence Ptolemy [Ptolemy], *Almagest* IX.10, concludes that Mercury was then at its greatest elongation from the Sun. It was the year before Christ 265, which Longomontanus [Longomontanus], *Theoricae* cap. 2, Nov. 14, hour 17, after midnight, says was at Copenhagen [Hafnia]; the northern front of Scorpius was in grade 1.36'. The other locus of Mercury was in Scorpius gr. 2.35' with northern latitude c. 59'. And he observed the locus of Mercury in the Thesaurus to be in Scorpius gr. 1.36'; the day was 4 June. [Margin: *Bullialdus*] Finally Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, says it was in the year before Christ 265, hour 16.30'. And Wendelen [Vuendelinus] says the northern front of Scorpius was in Scorpius gr. 1.13 $\frac{2}{3}$ with northern latitude 1.5'; but the middle of the northern front of Scorpius in Scorpius gr. 0.36 $\frac{1}{2}$ and latitude gr. 1.54'. Therefore Mercury was in Scorpius gr. 2.6'. For me, the year was 265 before Christ, and the day 14 November.

[Margin: 2.] In the year 486 of Nabonassar, on the 17th of Chœac following, i.e., on the 18th, in the year 23 of Dionysius, in the morning of Aquarius, Mercury was distant by 19 from the most brilliant tail of Capricorn, and septentrional; hence Ptolemy [Ptolemy], *Almagest* IX.10, concludes that Mercury was in Capricorn gr. 22.20', and his greatest elongation from the middle locus of the Sun gr. 25.50'. It was the year before Christ 262, the day 11 February.

[Margin: 3.] In the same year 486 of Nabonassar, on the 30 of Payni, i.e., in the year 24 of Dionysius, on the 18th, in the evening, observing with Hipparchus [Hipparchus], Mercury preceded Spica by a little more than three degrees. Hence Ptolemy [Ptolemy], *Almagest* IX.7, concludes that Mercury was in Virgo gr. 19.30'; but Lanbergius [Lansbergen] observed it; Mercury, from his own Tables, locates Spica in Virgo gr. 22.26', and Mercury in gr. 19.11'. It was the year 262 before Christ, the day 23 August.

[Margin: 4.] In the same year 486 of Nabonassar, on the 30 of Pharmuthi, i.e., in the year 23 of Dionysius, on the 4th, in the evening of Taurus following, Mercury, observing with Hipparchus [Hipparchus], was seen in succession to be distant by three Moons from the line of the horns of Taurus. Hence Ptolemy [Ptolemy], *Almagest* IX.7, concludes that Mercury was in Taurus gr. 23.40' with its greatest elongation from the middle locus of the Sun gr. 24.10'. It was the year before Christ 262, the day 24 May.

[Margin: 5.] In the year 491 of Nabonassar, on the 1st of Pharmuthi, i.e., the 6th, in the year 28 of Dionysius, in the evening, Mercury was on the straight line and was at the very top of the heads of Gemini. Hence Ptolemy [Ptolemy], *Almagest*

IX.7, concludes that Mercury was in Gemini gr. 1.50', and its greatest distance from the middle Sun gr. 26.30'. It was the year 217 before Christ, the day 28 May.

[Margin: 6.] In the year 512 of Nabonassar, on the 9th of Thoth following, i.e., on the 10th, in the month of Dionysius 75, on the 14th, in the morning, Mercury was seen to be higher than the Fixed [star] by half a breadth [semibrachium], in the line which is the extreme austral one of the shears of Libra. Hence Ptolemy [Ptolemy], *Almagest* IX.7, concludes that Mercury was in Libra gr. 14.10' with its greatest elongation from the middle locus of the Sun gr. 21. It was the year before Christ 237, the day 29 October.

[Margin: 7.] In the year 564 of Nabonassar, on the 27th of Thoth following, i.e., on the 28th, in the second year of the Chaldaeans 67, on the 5th, Apellei, in the morning, Mercury was seen by half a breadth [semibrachium] to be higher than the northern front of Scorpius. Hence Ptolemy [Ptolemy], *Almagest* IX.7, concludes that Mercury was in Scorpius gr. 2.20'; the same one's greatest distance from the middle Sun was the elongation gr. 22.30'. It was the year before Christ 185, the day 3 November.

[Margin: 8.] In the year of Hadrian the Emperor, on the 14 of Messori following, on the 19th, Theon observed Mercury to be most northern, distant by gr. 3.50' in the preceding part from the Heart of the Lion [Regulus]. Hence Ptolemy [Ptolemy], *Almagest* IX.10, was in Leo gr. 6.20' closely, and its greatest elongation from the middle locus of the Sun gr. 16.15' (Copernicus [Copernicus], *De Revolutionibus* V.27, but he adds Theon to have been at Smyrna), the day, that very day, 4 July, hour 6, after midday at Uraniborg [Vraniburgi], and then the Heart of the Lion was in Leo gr. 3.28'.35"; therefore Mercury was in Leo gr. 7.18', with greatest elongation gr. 26.59' a Sole loco, since the locus of the Sun, by the Philolaic Tables, was in Cancer gr. 10.19'.32". It was the year 139 of Christ, the day 4 July.

[Margin: 9.] In the year of Hadrian 16, on the 16 of Phamenoth, hour 5, in the evening, Mercury at its greatest elongation from the middle motion of the Sun, by comparison with the splendid Hyades, is found in the first degree of Pisces, distant from the middle motion of the Sun gr. 21.15', by Ptolemy [Ptolemy], *Almagest* IX.7. It was, he says, but Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, the year of Christ 132, on 2 February, hour 2.40', after midday at Uraniborg, and then the eye of Taurus was in Taurus gr. 12.17'. But Boulliau places the eye of Taurus in gr. 12.17'; Mercury in Pisces gr. 2.8½; and its greatest elongation from the true locus of the Sun gr. 19.10'.51".

[Margin: 10.] In the year of Hadrian 18, on the 16 Epiphi, on the 18th, hour 5, in the morning, at greatest elongation Mercury was very faint, and seen with feeble light in respect to the splendid Hyades, in Taurus gr. 18.45', and distant from the middle Sun gr. 21.15', by Ptolemy [Ptolemy], *Almagest* IX.7. It was the year of Christ 134, the day 3 June.

[Margin: 11.] In the year of Hadrian 19, on the 14 of Athyr following, on the 15th, in the morning, Ptolemy [Ptolemy] saw Mercury at a distance from the Heart of the Lion, in Virgo gr. 20.12', and most distant from the middle of the Sun gr. 19.3'. By Ptolemy [Ptolemy], *Almagest* IX.8, and Copernicus [Copernicus], *De Revolutionibus* V.26, it was the year of Christ 134, the day 2 October.

[Margin: 12.] In the year of Hadrian 19, on the 18 of Pachon, on the 19th, in the evening, Mercury at its greatest elongation from the middle motion of the Sun gr. 23.15', observed by Ptolemy, was in Taurus gr. 16', distant from Aldebaran by gr. 7', per distance from Aldebaran. Ptolemy [Ptolemy], *Almagest* IX.9, and Copernicus [Copernicus], *De Revolutionibus* V.26, adding that it was the year of Christ 135, the day 15 April.

[Margin: 13.] In the first year of the Emperor Antoninus, on the 20 of Epiphi, on the 21st, in the evening, Ptolemy, by his distance from the astrolabe, observed Mercury in Cancer gr. 7, most distant from the middle motion of the Sun gr. 20.30' (Ptolemy [Ptolemy], *Almagest* IX.7, and Copernicus [Copernicus], *De Revolutionibus* V.26): but caution must be used, since it was the year of Christ 135, the day 15 April.

[Margin: 14.] In the year 2 of Antoninus, on the 23 of Messori, on the 24th, in the morning, Ptolemy, by his distance from Aldebaran, observed Mercury in Gemini gr. 20.5', and most distant from the middle of the Sun gr. 20.15' (Ptolemy [Ptolemy], *Almagest* IX.9; Copernicus [Copernicus], *De Revolutionibus* V.27, adding that it was the year of Christ 139, on 18 May. But Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, judges that in that year of Christ 139, on 17 May, at Uraniborg, Mercury was in Gemini gr. 21.0'; but the true locus of Aldebaran is calculated in Gemini gr. 16.1'. At the locus of the Sun then existing in Cancer gr. 13.21'.42". According to Ptolemy he noted the day Messori to have proceeded from the day 23, on the 24th. Now indeed by our Chronology the year was 886, whose first day Thoth fell on the day of July 10, whence inclusively counting up to the day 23, Messori falls on the day of July 24, on the 8 of July.

[Margin: 15.] In the year 2 of Antoninus, on the 2 Epiphi, on the 3rd, Ptolemy, in the evening, at the equal hour before midnight gr. 4.30', by the astrolabe observed

Mercury at its greatest elongation in Gemini gr. 17.30', per the comparison and at the locus of the back center of the Moon following gr. 1.10'. Ptolemy [Ptolemy], *Almagest* IX.10. And Boulliau [Bullialdus], in the Thesaurus at observation 3: Mercury was in Gemini, with the locus of the Moon concluded to be in Gemini gr. 17.42'. But Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, says in that year of Christ 139, on 11 May, 12 hours after midday at Uraniborg gr. 9, with Mercury observed and concluded by the prior observation to be in Gemini gr. 18.35' distant from the true locus of the Sun gr. 8.37'. But indeed the locus of the Moon by the observation found to be in Gemini gr. 19.2', distant from the true locus of the Sun gr. 24.56', and Ptolemy is contradicted, since the false distance from the Heart of the Lion. The year was 139 of Christ, the day 17 May.

[Margin: 16.] In the year 4 of Antoninus, on the 18 of Phamenoth, on the 19th, in the morning, Ptolemy observed Mercury from Antares in Capricorn gr. 13.20', and most distant from the middle of the Sun gr. 26.30' (Ptolemy [Ptolemy], *Almagest* IX.7, and Copernicus [Copernicus], *De Revolutionibus* V.26, adding that it was the year of Christ 140, and besides gr. 67, and the scruple [scrupula] nearly 12. And he adds besides that it was the year of Christ 141, the day Martii 8. But Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, in that year 141, the day Phamenoth coincides with February 1, hour 16.40', and then Mercury was in Capricorn gr. 14.43'.33" most distant from the middle of the Sun gr. 28.18'.54". From the true locus of the Sun in Aquarius gr. 13.0'.27". The year was 141 of Christ, the day 1 February.

[Margin: 17.] In the year of Christ 807, some report Mercury to have been seen under the Sun, with Kepler [Kepler] in *Astronomia Optica* (Kepler) cap. 8, saying: *Mercury at its Node in Taurus and Scorpius, at the beginning of Aries and Libra without [?], passing, today, and at certain times this Planet is seen under the Sun. How much more wonderful — when I read this in Charles the Great's [Charlemagne] astronomers, brought down to the year 807, noted. With these words: A star of Aldebaran on 16 Kal. April was seen as if a small black spot; nevertheless a little higher across the middle of the same sphere of the disk it appeared, where the entrance, or exit, of the obstacles [molibus] is not noted. But because Kepler knew this to be Mercury remaining under the Sun naturally eight days, he thought it should be read in the barbarous letters; he adds the year vitiously written to be 807 for 808, on the 16 decimo sexto Kal. April, unless perhaps the observer began counting from Easter; for the calculation of that day, exhibited at the meridian by the Prutenic Tables [Tabulae Prutenicae], locates the Sun on the day in Aries gr. 0.45', and Mercury in Aries gr. 31' — with however the false Ptolemaic latitude gr. 2.9'. So Kepler [Kepler], there, in the end of the Dissertations*

with the *Nuncius Sidereus* (Kepler, *Nuncius Sidereus*), from Thesis 98. Samuel Hasennefer adduces Amoinus Monachus, & an Anonymous author, Sabellici, Franciscorum, also Eginardus [Einhard], Vincentius [?], Lycosthenes, Polydorus Virgilius, Beda [Bede], and others, who attest that maculam [the spot] under the Sun persevered for *seven days*, as Beda has it, or, as most have, *eight days*, as Beda; and very many have the year 808. See here, whoever wishes to respond to Kepler against the theses of Samuel. But both Scheiner [Scheiner] subscribed earlier in the little work *de maculis Solaribus* to Kepler; and Galileo [Galileo Galilei], on solar spots, and Gassendi [Gassendi] in *Epicurus* pag. 898, that it was the year in which the larger spots of the Sun, added, Kepler after the spots restituted in the Sun by detected error in the eighth-day observation [octiduo restituisset], discovered the eight-day antiquities; and for eight days he restored it. But to me it is more credible to be conjoined, that Mercury could not be seen under the Sun with the eye, except with a similar telescope, by which Mercury could be seen under the Sun in the year 1607 May 28, which indicates in its singular phenomenon. Whatever Mercury seen under the Sun may have been before the others, it has not the exercise 72. Against Cardan [Cardano] Scaliger [Joseph Scaliger], to whom badly the Coimbrans 2. Heaven cap. 7, art. 4, and Scheiner subscribed that observation. Moreover Scheiner in *Rosa Ursina* [Scheiner] pag. 412 teaches that Mercury 4, by hours only could be observed under the disk of the Sun, with spots can be observed for many days under it [?].

CAPUT II

Observations of Mercury made by Bernhard Walther [Bernhard Walther] at Nuremberg [Norimberga]

Besides the observations made by the ocular estimation, certain others made by the Armillae are subject to no small error, up to 10 minutes, as was said in the observations of Saturn at Walther's [Bernhard Walther], num. 33. Then these too, which the same Walther advised in the Refractions in Venus, are valid here also:

[Margin: 1.] In the year 1481, October 22, hour nearly one before sunrise, Walther saw Saturn and Mercury in the same eastern part of Mercury more eastern, with the diameter of a Moon between them, distant by 28 toward the east gr. 6.28'; and on the 3 of November, in the morning before sunrise, more eastern gr. 12.26', at the conjunction with Mercury Saturn was on the 21 October, exorbitant by the Tables.

[Margin: 2.] In the year 1482, October 11, a little before sunrise, Mercury was seen in the same part nearly along the longitude with Luna [the Moon], but austral a

little more than the diameter of the Moon. On the day 25 October it disappeared with the clearest sky.

[Margin: 3.] In the year 1484, January 16, immediately, as Mercury was in contact with the Horizon, Walther's horologe with a pendant weight returning to the meridian, and held in the hour at point 56, which once turned back is, and besides 35 denticles; when toward the center of the Sun Mercury appeared in the Horizon, by which Mercury appears to rise before the Sun hour 1.37', which nearly agreed with Walther's calculation.

[Margin: 4.] In the year 1488, January 16, hour 5.30', after midday, Mercury was seen to be distant from Jove [Jupiter] by the Radius [cross-staff] gr. 1.42', and to the west by the limb of the Moon from both; the Planet gr. 1.24'; but Mercury was more northern than Jove. On the following day Mercury more eastern and more northern gr. 2.22'. But in the numbers of the day 16, there is error.

[Margin: 5.] In the year 1495, August 16, the Armillae rectified through Aldebaran, hour nearly one before sunrise, he found Mercury in gr. 23.10' of Leo. But on the day 30 August, at the same hour, in gr. 27.10', and on the day 1 in the same hour in gr. 28.3' of Leo, with northern latitude gr. 53'; which posterior [later] observation he prefers to the prior ones for the better rectified instruments.

[Margin: 6.] In the year 1491, September 2, Walther reports thus: *The Armillae rectified again through Aldebaran, I found Mercury in the first grade, 13' of Virgo, one hour before sunrise: Latitude septentrional gr. 1.13', with a most serene sky, all the other things diligently observed, the situation of the instruments certain, confide in this.*

[Margin: 7.] In the year 1491, September 3, hour one before sunrise, by the Armillae, as above, rectifying, he found Mercury in Virgo gr. 3.51'. But he subjoins: *Diligently — with true latitude septentrional gr. 1.20' — only changed in that he made it doubtful for me. Nevertheless Lansbergius [Lansbergen] in the Thesaurus, choosing this, says it was in Gemini gr. 2.12'; therefore Mercury was in Virgo gr. 3.42'. But from his own Tables in grade 2.13'.33⅓ with northern latitude. Bor. gr. 1.17'.

[Margin: 8.] In the same year 1491, September 9, hour 5, in the morning, he found Mercury in Virgo gr. 13.23', with northern latitude gr. 1.50'. *Behold*, says Walther, *how great a difference from the Tables. Mercury appeared very faint, and far off, doubtless near the term of occultations. Consider also the refraction radius, since a moderate one disturbs it from the Horizon; on the eleventh day it appeared most*

faintly, lest the observation should not be the most reliable of all. Nevertheless Copernicus [Copernicus], destitute of his own observations, *De Revolutionibus* V.30, chose this, but at the observation of Mercury in Virgo gr. 13.30', when it is rightly computed, it was distant from the middle locus of the Sun gr. 13.15' nearly.

[Margin: 9.] In the year 1504, January 9, with the middle of the Heaven existing in gr. 10 of Scorpius, by the Heart of the Lion Mercury was in Capricorn gr. 3.15', with northern latitude gr. Bor. 45'. He adds that it was most diligently observed: but Copernicus [Copernicus], *De Revolutionibus* V.30, on the day 9, hour 6.30', after midnight, observed by Johannes Schöner [?] also; Mercury observed in Capricorn gr. 3.20' with latitude gr. 45', and distant from the middle locus of the Sun gr. 23.42'.

[Margin: 10.] In the year 1504, March 11, rectified at the Sun the Armillae, Mercury was observed clear, and of notable quantity, in Aries gr. 17.30' with northern latitude gr. Bor. 1.51', with the middle Heaven in gr. 18 of Cancer.

[Margin: 11.] In the year 1504, March 17, after midday, through Aldebaran in Gemini gr. 2.45'. Walther found Mercury in Aries gr. 26.30', with northern latitude gr. Bor. 3, with the middle Heaven in gr. 25 of Capricorn. But Schöner, as Copernicus [Copernicus] reports, *De Revolutionibus* V.30, with the middle of Cancer in grade 25, that is, hour 7.30', saw Mercury in Aries gr. 26.6', with northern latitude gr. Bor. 3, but distant from the middle locus of the Sun gr. 21.17'.

[Margin: 12.] In the year 1504, March 18, after midday, with the middle Heaven in Cancer gr. 25 placed, Aldebaran in Gemini gr. 2.45', he found Mercury in Aries gr. 26.30', with northern latitude gr. Bor. 3.

[Margin: 13.] In the year 1504, March 24, after midday, with the middle Heaven gr. 5 of Leo placed, Aldebaran gr. 2.45', Mercury was found in Taurus gr. 0.5', with northern latitude gr. Bor. 3.30'. From these observations Boulliau [Bullialdus], *Astronomia Philolaica* (Bullialdus) X.9, concludes the greatest elongation of Mercury from the Sun to have been on March 18, hour 18, at Nuremberg [Norimberga] gr. 7.15'; and since Aldebaran was in Gemini gr. 2.50', and from the refractions Mercury stood at its own Tables in Aries gr. 26.20' in orbit, but minus 35' in the ecliptic; truly, the locus of the Sun in Aries gr. 7.41'.36".

CAPUT III

Tychonic Observations of Mercury

Longomontanus [Longomontanus], *Astronomia Danica* II, *Astronomia Danicae* cap. 20, subjoins eight loci of Mercury observed at Uraniborg [Uraniburgi] by Tycho [Tycho Brahe], with two others by himself observed at Copenhagen [Hafnia], with the computation added from the Danish Tables [Tabulae Danicae] for the days of the old style, and below, where the hours are after midday:

Liber IX — De Mercurio (continued)

Caput III — Tycho's Mercury observations (continued)

The following table summarizes the ten Mercury positions derived from Tycho's observations, giving for each the observed longitude, the supputated (computed) longitude, and the observed latitude.

Y N e M o a on . r th			Long. observed (Sign / G. / M.)	Long. computed (G. / M.)	Lat. observed (G. / M. / dir.)
1 1	N		♌ Scorpio 13 4	12 57	2 18 B
5	ov				
8	.				
5					
2 1	N		♌ Scorpio 25 3	24 58	1 25
5	ov				
8	.				
5					
3 1	Oc		♎ Libra 22 35	22 28	not observed
5	t.				
8					
6					
4 1	Oc		♎ Libra 26 33	26 28	2 17 B
5	t.				
8					
6					
5 1	Ja		♊ Aquarius 17 48	17 49	0 1
5	n.				

Y N e M o a on . r th	Long. observed (Sign / G. / M.)	Long. computed (G. / M.)	Lat. observed (G. / M. / dir.)
8 7			
6 1 M 5 ar 9 . 0	♈ Taurus 13 44	13 36	1 42
7 1 Fe 5 b. 9 2	♊ Pisces 12 20	12 29	0 47
8 1 M 5 ay 9 3	♊ Gemini 23 16	23 4	2 0
9 1 A 6 pr 0 . 7	♈ Taurus 21 5	21 12	1 40
1 1 De 0 6 c. 1 0	♐ Sagittarius 2 42	2 35	not observed

Boulliau [Ismaël Boulliau], in Book 10, Chapter 7, says with respect to the first of these observations — that of the year 1585, November 14, hour 19 — that the true place of the Sun was Sagittarius 2°56'45", and that Mercury was accordingly 19°52'45" distant from it. But from the Rudolphine [Tables] Mercury comes out in Scorpio 13°7'45", with a discrepancy from the observation of 3'45".

Tycho [Tycho Brahe] himself, in his *Epistolae* (p. 56), records the three Mercury observations transcribed below in Old Style, in hours after midday at Uraniborg.

1587 January (D. / H. / M.)	Source	Long. Mercury (Sign / G. / M.)	Latitude (G. / M. / dir.)
1 9 4 50	Observ	♒ Aquarius 17 48	0 1 B

1587 January (D. / H. / M.)	Source	Long. Mercury (Sign / G. / M.)	Latitude (G. / M. / dir.)
1	ed		
	Alphon sine	18 29	0 24 B
	Copern ican	16 41	0 6 A
1 14 5 15	Observ ed	♊ Aquarius 21 7	1 21 B
2	Alphon sine	23 31	1 29 B
	Copern ican	19 21	1 1 B
1 15 5 21	Observ ed	♊ Aquarius 21 20	1 40 B
3	Alphon sine	24 18	1 41 B
	Copern ican	19 33	1 39 B

Boulliau, in Book 10, Chapter 7, uses the observation of day 9, adding that the true place of the Sun was Capricorn $29^{\circ}13'12''$, and that accordingly the distance of Mercury from it was $18^{\circ}34'48''$. But from his own Tables he gathers the place of Mercury in Aquarius $17^{\circ}35'12''$.

Lansbergen [Lansbergen], in his *Thesaurus*, uses the observation of day 14, but from his Tables gathers the place of Mercury in Aquarius $21^{\circ}8'53''$, with a latitude of $1^{\circ}31'$; whereas from the calculation of triangles it comes to $1^{\circ}21'$.

In the year 1589 Mercury was observed by Tycho near its maximum elongation from the Sun, on April 1, 2, 3, 4, 6, and 11. These observations, selected from Tycho's manuscript together with their calculation, were transmitted to me by Father Albert Curtius [Albert Curtz] of our Society, and are set out below — with the time corrected for the clock added, examined on the following midday.

14. Day 1 April, evening.

H. M.	Dist. of ☿ from Aldeb. (G. / M.)	Decl. of ☿ Borea (G. / M.)	Alt. of ☿ (G. / M.)	Comp. min. western (G. / M.)
7 36 / 41 corr.	25 11½	16 59⅝ / 17 1	9⅓	25 26
7 40⅝ / 7 45⅔	25 10	17 1½ / 17 2	8 50	26 32
7 45⅓ / 7 50	25 11	17 5 / 17 4⅓	8 20	27 40
7 48⅓ / 7 53 corr.	25 11	17 [—]	7 50	28 24

[The right-hand column of page 345 continues this same observation series at finer time-intervals; its column headers are not separately reprinted but follow the same scheme — Dist. of ☿ from Aldebaran, Declination of ☿, Altitude of ☿, and western complement (Comp. min. occid.).]

H. M.	Dist. ☿ Aldeb. (G. / M.)	Decl. ☿ (G. / M.)	Alt. ☿ (G. / M.)	Comp. min. occid. (G. / M.)
7 51⅔ / 7 56 corr.	25 10⅙	17 4½ / 17 4⅝	[—]	29 11
7 55½ / 8 0 corr.	25 10	17 4⅔ / 17 5	7 0	30 8
7 59½ / 8 3¼	25 9¼	17 4¾ / 17 5⅙	6 35	32 4
8 3½ / 8 7⅓	25 8⅓	17 6 / 17 6½	6 0	32 0
8 8 / 8 11⅔	25 8	17 6⅝ / 17 6⅔	5 30	33 5
8 12½ / 8 16 corr.	25 6¾	17 7⅝ / 17 7½	5 0	34 8
8 16⅓ / 8 19⅔	25 6⅓	17 9½ / 17 9⅓	4 30	35 6
8 19½ / 8 23	25 5⅔	17 9⅔ / 17 9½	4 0	35 54
8 22⅝ 26 corr. / 8 27 30 corr.	25 5¼ / 25 4⅔	17 both 9¾ / 17 9⅝	3 40 / 3 10	36 42 / 37 42

For the examination of the armillae:

H. M.		G. / '
8 32	Declination of Aldebaran	15 38½
		15 38
	Altitude of the same	15 20

It was sufficiently clear and calm.

15. Day 2 April, evening.

H. M.	Dist. ☿ from Aldeb. (G. / M.)	Decl. ☿ (G. / M.)	Alt. ☿ (G. / M.)	Comp. min. occid. (G. / M.)
8 0 ² / ₃ / 8 2 ² / ₃ corr.	23 55 ¹ / ₂	17 37 ² / ₃ / 17 38 ¹ / ₂	7 15	—
8 5 ⁵ / ₆ / 8 7 corr.	23 54 ⁵ / ₆	17 38 / 17 38 ¹ / ₂	6 50	32 53
8 9 ³ / ₄ / 8 11 ⁵ / ₆	23 53 ¹ / ₂	17 38 ¹ / ₆ / 17 38 ¹ / ₂	6 0	34 3
8 15 / 8 17 ¹ / ₆ corr.	23 52	17 40 ¹ / ₂ / 17 40 ¹ / ₃	5 20	35 25
8 19 ¹ / ₂ / 8 22	23 51 ¹ / ₄	17 41 ¹ / ₂ / 17 41 ¹ / ₃	4 50	36 34
8 24 corr. 26 ⁵ / ₆	23 51	17 42 / 17 42 ¹ / ₃	4 15	37 46
8 29 ¹ / ₂ / 8 31 ¹ / ₂	23 50 ¹ / ₆	—	3 35	39 2

It was moderately clear and calm enough. On these days, although the clear weather had been continuous, nevertheless on every side, from the horizon up to an elevation of about 39° or beyond, dark cloudlets [φαινόμενα, *phainomena*, "appearances"] were rising and, descending below the said altitude, were covering it.

The calculation follows, from the observations written above.

April 2, h. 8'5', distance of ☿ from Aldebaran 23°55':

	G. / '
Declination of ☿ limited	17 40
Declination of Aldebaran	15 38
Altitude of ☿	7 0
Angle of difference of Ascension	24 53 ¹ / ₂
R.A. Longitude	11 32 ¹ / ₂ ☿
Latitude	2 26 ² / ₃ B
True, freed from Refraction and parallax — Longitude	11 28 ¹ / ₂ ☿

	G. / '
Latitude	2 23 $\frac{2}{3}$ B

16. Day 3 April, evening.

H. M.	Dist. ♀ from Aldeb. (G. / M.)	Declination ♀ (G. / M.)	Alt. ♀ (G. / M.)	Comp. min. occid. (G. / M.)
7 55 $\frac{1}{2}$ / 8 6 corr.	dubious / 22 40 $\frac{5}{6}$	18 8 / 18 7 $\frac{3}{4}$	7 40	33 30
7 59 / 8 10 corr.	22 43	18 9 $\frac{1}{3}$ / 18 9 $\frac{2}{3}$	7 8	34 25
8 3 / 8 13 $\frac{1}{2}$	22 42 $\frac{1}{4}$	18 9 $\frac{1}{2}$ / 18 9 $\frac{2}{3}$	6 50	35 22
8 7 $\frac{1}{2}$ / 8 17 $\frac{1}{2}$	22 41 $\frac{2}{3}$	18 10 / 18 10	6 7	36 20
8 12 $\frac{1}{4}$ / 8 23 corr.	22 40 $\frac{2}{3}$	18 11 / 18 11 $\frac{1}{2}$	5 23	37 42
8 17 $\frac{1}{3}$ / 8 28 corr.	22 40 $\frac{1}{3}$	18 12 $\frac{1}{2}$ / 18 12 $\frac{1}{3}$	4 50	38 59
8 20 $\frac{5}{6}$ / 8 31 $\frac{1}{3}$	22 39	18 13 / one feeble pinnacle	4 30	39 50
8 25 $\frac{1}{2}$ / 8 36	22 38 $\frac{3}{4}$	18 13 $\frac{1}{3}$	3 52	41 3
8 30 / 8 41 $\frac{2}{3}$ corrected	22 38 $\frac{2}{3}$ / dubious	18 14 / dubious	3 15	42 25

For the examination of the armillae was taken:

	G. / '
Declination of Aldebaran	15 37 $\frac{2}{3}$ 15 38
Altitude of the same	12 $\frac{1}{3}$

This evening it was extremely clear and calm.

The calculation, from these observations:

	G. / '
H. 8 10' — Distance of ♀ from Aldeb.	22 43
Declination of ♀ limited	18 11
Declination of Aldebaran	15 38

	G. / '
Altitude of γ	7 8
Angle of difference of Ascension	23 36 $\frac{1}{6}$
Longitude	12 52 γ
Latitude	2 33 $\frac{5}{12}$ B
Subtracting parallax and refraction — True γ Longitude	12 48 γ
Latitude	2 30 $\frac{1}{2}$ B

Vice versa — Distance from the right shoulder of Orion.

H. M.	(G. / ')	Decl. (G. / M.)	Alt. (G. / M.)	Comp. min. occid. (G. / M.)
8 21 $\frac{5}{6}$ / 8 25	42 54	18 40 / 18 39 $\frac{5}{6}$	5 40	39 13
8 24 $\frac{1}{2}$ / 8 28 $\frac{1}{2}$	42 52 $\frac{1}{2}$	18 40 $\frac{1}{3}$ / 18 40 $\frac{1}{2}$	5 10	40 5
8 26 $\frac{5}{6}$ / 8 30 $\frac{5}{6}$	42 51	18 41 / by one sight (uno pinnac.)	4 40	40 40

γ This evening it could no longer be observed, on account of the thick clouds standing about the western horizon. There was, moreover, this evening a somewhat troublesome wind from the same quarter of the sky.

The place of γ at 4 April, from the preceding observation:

	G. / '
H. 8 15' — Distance of γ from Aldeb.	21 37 $\frac{1}{2}$ B
Declination of γ limited	18 39 $\frac{1}{2}$ B
Declination of Aldebaran	15 38
Altitude of γ	7 0
Angle of difference of Ascension	22 25 $\frac{1}{2}$
Longitude	14 50 γ
Latitude	2 39 $\frac{5}{6}$ B
True γ , freed from refraction and parallax — Longitude	14 1 γ
Latitude	2 36 $\frac{5}{6}$ B

17. Day 4 April, evening.

H. M.	Dist. ☿ from Aldeb. (G. / M.)	Decl. ☿ Borea (G. / M.)	Alt. (G. / M.)	Comp. min. occid. (G. / M.)
7 53½ / 7 55 corr.	21 39½	18 34 / both (utroq;)	9 30	31 45
7 58 / 8 0	21 36 / dubious	18 35 / 18 35½	9 0	32 57
8 1 / 8 3½	21 38	18 37 / 18 38	8 30	33 48
8 6⅝ / 8 9½	21 38	18 38 / 18 38⅓	7 48	35 20
8 11½ / 8 15 corr.	21 37½	18 38 / 18 38	7 0	36 39
8 21⅝ / 8 18 corr.	21 37¼	18 39¾ / 18 40	6 30	37 30

[No "calculus" / calculation block is printed for the Day-4 (17) observation; the Day-4 result is the "Locus ☿ ad 4. Aprilis" block given above (Long. 14°50' ☿; True 14°1' ☿).]

18. Day 6 April, evening.

H. M.	Dist. ☿ from Aldeb. (G. / M.)	Declination ☿ (G. / M.)	Alt. ☿ (G. / M.)	Comp. min. occid. (G. / M.)
8 15⅔ / 8 14⅙ corr.	19 40½	19 21½ / 19 21⅔	7 50	38 30
8 20⅓ / 8 20 corr.	19 40¼	19 24⅙ / 19 23⅔	7 15	39 43
8 24⅔ / 8 24	19 [—]	19 24⅙ / 19 24⅔	6 40	40 45
8 30⅔	19 40	19 26½ / 19 26⅔	6 0	Cor ☿ occid.
8 34½	19 39½	19 26 / 19 26⅔	5 30	6 6
8 38½	19 39	—	4 50	7 7

Afterward ☿ was observed from the right shoulder of Orion:

H. M.	G. / '	
8 44'	in Distance	41 53
	Declination	19 31 / 19 30
	Altitude	3 50

H. M.	G. / '
Canis Minor	46 28 western

This last was dubious on account of intervening clouds.

Inquiry into the longitude and latitude of γ from these observations:

	G. / '
H. 8 10' — Distance of γ from Aldeb.	19 40 $\frac{1}{4}$
Declination of γ Borea	19 25 (limit)
Declination of Aldebaran	15 38
Altitude of γ	7 15
Therefore angle of ascensional difference	20 15 $\frac{1}{2}$
Longitude	16 12 $\frac{1}{3}$ γ
Latitude	2 48 B
Subtracting parallax and refraction — True γ	16 8 $\frac{1}{2}$ γ
Longitude	
Latitude	2 45 B

19. Day 11 April.

H. M.	Dist. γ from luminous shoulder of Orion (G. / M.)	Declination γ (G. / M.)	Alt. γ (G. / M.)	Comp. min. occid. (G. / M.)
8 14 $\frac{1}{6}$	[—]	20 36 $\frac{1}{2}$	6 0	47 30
8 18 $\frac{1}{3}$	37 38 $\frac{1}{6}$	[—]	5 50	48 30
8 21	37 40 $\frac{1}{4}$	20 36 $\frac{2}{3}$ / 20 37	5 30	49 17
8 23 $\frac{2}{3}$	37 41 $\frac{1}{2}$	20 37 $\frac{1}{2}$ / 20 37	5 10	49 58
8	[—]	20 38 $\frac{1}{2}$	4 50	50 41

	Dist. ☿ from luminous shoulder of Orion	Declination ☿ (G. / M.)	Alt. ☿ (G. / M.)	Comp. min. occid. (G. / M.)
H.				
M.	(G. / M.)			
26				
$\frac{1}{3}$				

Around the middle of these times the altitude of the luminous shoulder of Orion was about 14° or 15° , from which the distances of ☿ were taken.

	G. / '
H. 8 $40\frac{1}{2}$ — Declination of Aldebaran	15 $40\frac{1}{2}$
	15 40
Altitude of the same	$7\frac{1}{2}$

— and this for the examination of the armillae.

Afterward ☿ could no longer be observed, namely from hour 8 minute $26\frac{1}{2}$, since clouds covered it and vapors impeded it up to the horizon. You can, however, without appreciable error — taking the intermediate distance, which is accepted as hour 8, 21', putting it at $37^\circ 40'$ in altitude $5\frac{1}{2}^\circ$ — and assuming its declination at $20^\circ 37'$. But account must really be taken of the refraction of the luminous shoulder of Orion, from which the distance is taken, and one must also see what the armillae may perhaps give in declination — by an experiment made on Aldebaran, with its refraction applied.

20. In the year 1592, February 3, in Old Style at hour 5, 40' after midday, at Uraniborg, Mercury was observed in Pisces $12^\circ 20'$, with northern latitude $47'$. Longomontanus, Book 2, *Theorics*, Chapter 20, and Boulliau, Book 10, Chapter 7, who adds that the true place of the Sun was Aquarius $24^\circ 23' 57''$, and that the distance of Mercury from the Sun was $17^\circ 56' 3''$. But from his Tables he gathers the place of Mercury in Pisces $12^\circ 15'$; from which Boulliau, Book 10, Chapter 7, proves the Copernican calculation to be corrupt in latitude.

21. In the year 1593, May 11, in Old Style at hour 9, 30' after midday, at Uraniborg, Mercury was observed in Gemini $23^\circ 16'$, with northern latitude 2° . Longomontanus, Book 2, *Theorics*, Chapter 20. Snell [Willebrord Snell] adds, in *Hassiacis*, that on the following day, the 12th — which in New Style was the 22nd of May — Mercury was observed in Gemini $24^\circ 19'$. Hence Boulliau, Book 10, Chapter 1, gathers that on the 23rd, in New Style, Mercury was in Gemini $25^\circ 21'$,

at its maximum elongation, distant $22^{\circ}52'4''$ from the Sun. Boulliau follows the Copernican [reckoning]: Mercury had moved beyond the limit of maximum remoteness from the Sun, to which observation Alphonso [the Alphonsine] is more favorable.

22. In the year 1600, January 23, in New Style, Tycho, in the citadel of Benatky [Benátky], immediately after sunset, found by refraction the corrected distances of Mercury: from the bright star of the breast of Cygnus $48^{\circ}52\frac{2}{3}'$, from the tail of Cetus $40^{\circ}22\frac{1}{3}'$, from the high Mercury $5^{\circ}50'$. So Snell, in his *Bohemian observations*.

23. In the year 1600, January 24, a little after sunset, with Tycho observing, Mercury was seen at altitude 6° to be distant from the bright star of the tail of Cetus $40^{\circ}7'$, and at hour 6 its altitude was 5° ; it stood distant from the same star $40^{\circ}4'$; from Sirius $53^{\circ}3\frac{1}{2}'$; a little less than 6 hours from Pegasus $21^{\circ}37'$, when it was distant about $2^{\circ}10'$ from Procyon $53^{\circ}14'$. Therefore, says Snell in the *Bohemian observations*, the place of Mercury was Gemini $1^{\circ}29'50''$, refraction and parallax not taken into account.

24. In the year 1601, April 29, Tycho, at Prague, in the house of Curtz, saw, in whatever manner, the other [appearance of] Mercury, distant $7^{\circ}10'$ from Capella $25^{\circ}41'$, and the other [reading] truly $6^{\circ}46'$; he saw it distant from Procyon $53^{\circ}14'$. Therefore, says Snell in the *Bohemian observations*, the place of Mercury was Gemini $1^{\circ}29'50''$, refraction and parallax not taken into account.

Decorative headpiece.

CAPUT IV

Mercury's observations of Longomontanus, Kepler, Justus Byrgius, Hortensius, and Boulliau, from the year 1593 to 1631.

1. In the year 1593, May 11, hour 9, 30' after midday, Justus Byrgius [Jost Bürgi] of Kassel observed Mercury distant $21^{\circ}56'$ from Capella, and from Pollux $24^{\circ}34'$. Snell, in *Hassiacis* and Boulliau, Book 10, Chapter 1, gathering from this for day 12 — which in New Style was the 22nd — that Mercury was in Gemini $24^{\circ}19'$; and on the 23rd, in Gemini $25^{\circ}21'$, at maximum elongation from the Sun. Longomontanus, however, in Book 2, *Theorics*, Chapter 20, as we indicated above, reports Mercury observed in Gemini $23^{\circ}16'$.

2. In the year 1607, April 14, in Old Style at hour $8\frac{1}{2}$ after midday, Longomontanus at Copenhagen [Hafnia] observed Mercury with the radius, distant $2^{\circ}24'$ from Venus, and it was higher than it in nearly the same vertical, the

latitude of Venus being 10' southern; but the latitude of Mercury was 1°40' northern. And from the observations of the following days Longomontanus, Book 2, *Theorics*, Chapter 23, gathers from his own Tables that Mercury was in Taurus 19°32'7" and Venus in Taurus 18°19'33". On April 15, however, at the fifth hour into hour 9, he observed Mercury in Taurus 21°5', with northern latitude 1°40'; this the Tables themselves give as Taurus 21°11'.

3. In the year 1607, May 28, in New Style, Kepler [Johannes Kepler] saw Mercury beneath the Sun, as he himself published in his singular *Phaenomenon*, and it differs, with the *Sidereal Messenger* [Galileo's *Nuncius Sidereus*] attesting; and Scheiner [Christoph Scheiner] [treats] of the Solar spots.

4. In the year 1610, December 5, in Old Style at hour [—] after midday, Longomontanus at Copenhagen [Hafnia] [observed] Mercury [at] 2°42' [sign: —]. So he himself, Book 2, *Theorics*, Chapter 20.

5. In the year 1625, February 13, hour 6, 12', Boulliau at Joinville [Iulioduni] observed Mercury in Pisces 13°27', refraction subtracted, and at maximum distance 25°27'37" from the Sun, residing in Aquarius 25°27'37". Boulliau, Book 10, Chapter 1.

6. In the year 1626, March 12, in Old Style at hour 9, 33' after midnight, Martin Hortensius [Maarten van den Hove] at Leiden saw Mercury higher than the bright star at 6' in the same straight line drawn from the bright shoulder of Auriga, and with a width in the right arm of the same. Lansbergen, in his *Thesaurus*, observed: Mercury 7', adding that this straight line drawn from Mercury falls into Gemini 23°50' circiter; the bright star of Mercury and refraction at 15' appears in that line, although truly lower in Gemini 23°36'41", with northern latitude 2°25'11".

7. In the year 1627, October 15, near the Goesian island [Goes], Martin Hortensius saw Mercury distant from Saturn about 1° circiter. Lansbergen, in his *Thesaurus*, observed: Mercury 8'; he gathers the place of Saturn in Libra 3°57'19", with northern latitude 2°6'3", and Mercury in Libra 3°45', with northern latitude 1°55'12".

8. In the year 1630, December 12, in the morning at hour 6, 50' after midnight, Boulliau at Joinville observed Mercury in Scorpio, at hour 29°13'. So he himself, Book 11, *Astronomical Theorems*, Theorem 13.

9. In the year 1632, July 31, in Old Style, the conjunction of Mercury and Venus took place — concerning which Martin Hortensius [wrote] *On Mercury seen in the Sun*.

CAPUT V.

Mercury observations made by Pierre Gassendi, and by the Fathers of the Society of Jesus at Ingolstadt and at Oeniponte [Innsbruck].

1. When Kepler [Johannes Kepler], in computing the Ephemerides, had warned that Mercury would be in transit across the Sun on 7 November, but actually that Venus would fall in transit across the Sun on 6 December, Gassendi [Pierre Gassendi]—who had at Paris previously supposed Mercury's diameter to be 3 minutes, but afterward found it to be no more than 20 seconds—used the telescope on 7 November. From about the ninth morning hour, when clouds, which had filled the sky, broke open, since Mercury had then crossed half its little path [semita] across the Sun's disk, and he had noticed a spot, he at once recognized from the swiftness of its motion that it was Mercury. For when the Sun stood at altitude $21^{\circ} 44'$, that is, at the morning hour 10h 28m, Mercury had passed off the Sun's western edge; for it was retrograde, with northern latitude $6^{\circ} 20'$. And so, not yet having completed its passage, it ought to have entered upon the Sun with two minutes and half a minute of latitude, and to have spent five hours under the Sun's disk. On 6 December, Venus could not be seen, nor indeed on the 7th, as Gassendi himself relates in the *Life of Peiresc*, book 4, and in the *Meteorology* of Epicurus, page 899. On this occasion Hortensius [Maarten van den Hove (Hortensius)] published a dissertation against Gassendi concerning the Mercury seen upon the Sun, and the Venus not seen. Kepler had predicted the conjunction with the Sun for 1h 41m before midday. At Uraniborg [Vraniburgi], therefore, it must have been about an hour before midday, that is, 47 minutes. But here Kepler's Tables proved truer than the others, since for that time the other Tables place Mercury, distant from the Sun in longitude, where Ptolemy [Ptolemy] gives $4^{\circ} 25'$, Copernicus [Copernicus] 5° , Longomontanus [Longomontanus] $7^{\circ} 13'$, and Lansbergen [Lansbergen] $1^{\circ} 21'$. Furthermore, Boulliau [Ismaël Boulliau], in book 10 of his *Astronomia*, ascribes this to Gassendi—both on account of other observations, and chiefly on account of this one, for which he left the rest of the Coronides as a finishing-piece [?]*—*and in chapter 5 of the same book he relates that Gassendi, having taken Mercury with the telescope upon white paper, computed the true conjunction of Mercury with the Sun at 7h 58m, at Paris, with the Sun in Scorpio; and from the Philolaic [Tables] he gives $14^{\circ} 37' 42''$, with northern latitude of Mercury [$4^{\circ} 30'$ — *see below*].

2. In the year 1632, on 30 July, at hour 16h after midday, at Uraniborg, Gassendi observed at Paris the conjunction of Venus with Mercury by means of the telescope, yet in such a way that Mercury seemed to surpass Venus by 3' 30". Hortensius observed the same conjunction at Amsterdam; and Boulliau, in book 10, chapter 1, from his own Tables collecting Venus in Cancer at 24° 22' 17", reports that Mercury was therefore in Cancer at 24° 25' 47".

3. In the year 1634, on 2 January, at hour 6h 30m, at Uraniborg reduced [i.e. computed for the Uraniborg meridian], Gassendi, observing Mercury by its distances from the fixed stars, found Mercury in Aquarius at 1° 31' with southern latitude 57'. On the 4th, in Aquarius at 3° 31' with southern latitude 30'; and on the 6th, in Aquarius at 5° 1' with northern latitude 1° 52'. Thus Boulliau, in book 10, chapter 1, who from this gathers that on the 3rd, at hour 6h 30m, the maximum elongation was 18° 59', and Mercury in Aquarius at 2° 30' 43", distant from the Sun in Capricorn at 13° 33' 43".

4. In the same year, on 2 October, Gassendi, observing Mercury by its distances from the fixed stars, found Mercury in Virgo at 22° 8' 20" with northern latitude 1° 25'; and on the 3rd, at hour 18h, in Virgo at 22° 59' 26" with northern latitude 1° 29' 18"; and on the 4th, in Virgo at 23° 59' 47" with northern latitude 1° 19' 16". Boulliau, book 10, chapter 1, gathering from this that on the 3rd, at hour 18h, the maximum elongation was 17° 49' 54", and Mercury in Virgo at 22° 59' 26", distant from the Sun in Libra at 10° 49' 20".

5. In the year 1634, at the beginning of November, Mercury was under the Sun in a central conjunction with the Sun, yet Gassendi in the *Life of Peiresc* denies that the telescope could see it, just as it could not in the year 1632 at the end of April; from which he concludes that the orbit [cyclum] of Mercury is not between the Sun and ourselves, but around the Sun—a conclusion which holds good only by supposition, since those central conjunctions [could] not [be made] to fall on a night [?].

6. In the year 1635, on 16 January, Gassendi observed Mercury through the fixed stars in Capricorn at 4° 18' 48" with northern latitude 2° 1' 15"; and on the 18th, at hour 18h 3m, in Capricorn at 8° 21' 50" with northern latitude 1° 39'; and on the 24th, in Capricorn at 10° 4' 55" with northern latitude 1° 14' 8"; and on the 25th, in Capricorn at 11° 6' 36" with northern latitude 59' 48". Boulliau, book 10, chapter 1, gathers from this that the maximum elongation on the 24th, at hour 18h $\frac{3}{4}$, was 25° 9' 20"; Mercury in Capricorn at 10° 4' 55", distant from the Sun in Aquarius at 5° 14' 15".

7. In the year 1635, on 17 September, Gassendi observed Mercury in the morning at $6^{\circ} 8'$ of Virgo, and on the 19th at $8^{\circ} 7'$; that day the 18th, at the morning hour 17h after midday, the maximum digression was $19^{\circ} 44' 21''$ from the Sun's true place. Boulliau, book 11, theorem 11.

8. In the year 1635, on 1 December, Gassendi at Digne [Diniae], at hour 5h 30m, by distances from the fixed stars, observed Mercury in Capricorn at $0^{\circ} 34' 49''$ with southern latitude $1^{\circ} 31'$; the altitude was $1^{\circ} \frac{2}{3}$, whence Boulliau, book 11, theorem 13. By reckoning of the refractions, he establishes Mercury's corrected place at minute 26 of Capricorn, with latitude 2° ; but from his own Tables, $23'$ of Capricorn.

9. In the year 1636, on 26 June, Gassendi at Aix [Aquis Sextiis] observed Mercury in the evening at altitude $3^{\circ} \frac{1}{3}$, distant from the Heart of Leo [Cor Leonis] by $31^{\circ} 23' \frac{2}{3}$, and from the Bright Star of the Neck of Leo [Lucida colli Leonis] by $31^{\circ} 41'$, whence he gathers Mercury's apparent place in Cancer at $23^{\circ} 25' 17''$ with northern latitude; but on account of a refraction of $15'$ he corrects it to $23^{\circ} 17' 47''$ with latitude $1^{\circ} 36' 55''$. Boulliau places it at 23° of Cancer. Book 10, chapter 2.

10. In the same year, on 27 June, Gassendi in the same place saw Mercury in Cancer at $24^{\circ} 56' \frac{3}{4}$ with northern latitude 2° . With the refractions eliminated, Boulliau, book 10, chapters 2 and 4, by whom the Rudolphine Tables place Mercury in $25^{\circ} 1'$, and the Philolaic at $25^{\circ} 3' 33''$ of Cancer.

11. In the year 1636, on 14 July, in the evening, Gassendi at Aix observed Mercury, corrected from the refraction of its place, in Leo at $19^{\circ} 31' 16''$ with southern latitude. Boulliau, book 10, chapter 2, and on the 15th, in Leo at $20^{\circ} 33' 15''$ with southern latitude $33'$. Boulliau, the same place.

12. In the year 1636, on 16 July, Gassendi in the same place, from two observations, as Boulliau says (book 10, chapter 4), gathers that he observed Mercury in Leo at $21^{\circ} 25'$ with northern latitude, while the Rudolphine Tables for hour 9h, reduced to Uraniborg, exhibit $21^{\circ} 30'$; and the Philolaic, $21^{\circ} 25' 47''$.

13. In the year 1636, on 3 September, at hour 17h, Gassendi at Digne saw Mercury next to the Heart of Leo through the telescope. "I detected," he says, "the Heart of Leo below and to the right of Mercury, so that Mercury was directed toward it not perpendicularly, nor with its side placed to the left, but as it were obliquely, drawing nearer to it toward the top [verticem] rather than toward the side." Next he observed Mercury's distance from the Heart of Leo to be $22^{\circ} \frac{2}{3}$, by the Astronomical Radius. Boulliau, book 10, chapter 3, who, with Regulus supposed at

24° of Leo, gathers Mercury's place in Leo at 24° 37', or 38'; but from his own Tables in Leo at 24° 38' 52", and from the Rudolphine at 24° 27'.

Moreover, the Fathers of the Society at Ingolstadt had these observations, which Father Michael Staudacher [Michael Staudacher SJ] of the Society of Jesus recently sent to me.

Anno 1617.	Distantia ☿	Altitudo		
	H Ab	G	M Gr.	M.
	.	r.	.	
Mart. 7 vesp. 4	Androm. cap.	2	0	
		5		
	Lucida ♀	3	2	
		1	4	
Anno 1619. Febr. 6 vesp. 2	Markab.	2	4 ☿ 4	40
		4	2	
	Algenib.	3	1	
		4	0	
Febr. 6 — 8	1 Markab.	2	2 ☿ 4	10
	2	1	1	
	Algenib.	2	5	
		8	5	
Maij 9 — 21	1 à Capella	2	4 ☿ 4	50 vesp.
	5	1		
	à Cap. Polluc.	2	3 Reguli 37	5 vesp.
		6	0	
Anno 1620. Oct. 5 — 20 manè	3 à Regulo	4	2 ☿ 7	5
	0	4	4	
	à Cauda ♀	2	3	
		4	6	

In the year 1631, on 7 November, Mercury was seen under the Sun at hour 9h 56m in the morning, distant from the center of the Sun's disk a little more than half a solar semidiameter toward the Zephyr-and-north [i.e. northwest]; but at hour 1h after midday it had already passed off from under the Sun.

Observations made at Oeniponte [Innsbruck] by the Fathers of the Society of Jesus, and communicated to me by one of them, Father Michael Staudacher.

Anno 1635.	Distantia ☿	Altitudo	
	A.	G M	
		r. .	
Septemb. 18	Regulo	1 1 ☿	8 54
		2 6	mat.
	Iuba ♄	1 3 Lu. hu. Or.	4 28
		4 3	8 mat.
Anno 1636. Mar. 19 vesp.	Rigel	6 2 ☿	8 5
		0 7	
	Luc. hum. Or.	6 5 Lu. hu. Or.	4 20
		6 1	6
Anno 1637. Mart. 3 vesp.	Aldebara	6 1 ☿	1 4
		3 8	1
	Rigel	7 5 Aldeb.	5 25
		3 5	6
		Rigel	3 4
			4

CAPUT VI.

Selected Mercury observations, from those which the Fathers of the Society of Jesus, Giovanni Battista Riccioli and Francesco Maria Grimaldi [Francesco Maria Grimaldi], carried out at Bologna in the College of Saint Lucia, together with their assistants.

1. In the year 1643, on 3 May, at the second hour after midday following nightfall [?], Mercury was seen distant from Jupiter by $1^{\circ} 4'$, in both longitude and latitude. From the Lansbergen [Tables] it ought to be distant $1^{\circ} 36' 43''$ [?].

2. In the same year, on 5 May, with a most serene evening, Mercury was seen in the new sextile [in Sextante novo], distant from the head of Andromeda by $26^{\circ} 43'$, and from the cingulum [belt-star] of Andromeda by $35^{\circ} 17'$. And then it was at altitude about 6° , in the quadrant next [following] after sunset.

3. On the following evening, with the sky reddening at sunset a little after the setting of the Sun, Mercury was seen at altitude $8'$, distant from the head of Andromeda by $26^{\circ} 10'$, and from the cingulum of Andromeda by $33^{\circ} 59'$.

4. In the year 1643, on 7 May, in the evening with a most serene sky, Mercury was seen at altitude $7^{\circ} 50'$, distant from the cingulum of Andromeda by $32^{\circ} 52'$; it was also seen distant from the head of Andromeda by $6^{\circ} 22'$.

5. In the same year, on 11 May, Mercury was seen in the evening distant from the zenith [vertice] by $80^{\circ} 48'$, and from the cingulum of Andromeda by $28^{\circ} 41'$. Next it was seen distant from the zenith by $81^{\circ} 49'$, and from the head of Andromeda by $23^{\circ} 56' \frac{1}{2}$.

6. On the following evening, with a most serene sky, Mercury was seen distant from the zenith by $80^{\circ} 28'$, and from the cingulum of Andromeda by $27^{\circ} 51' \frac{1}{2}$; with the altitude of Aldebaran being $52^{\circ} 21'$ when these [observations] were made. When this was so, the altitude of Aldebaran [Aldebara] was $51^{\circ} 34'$; Mercury was seen distant from the southern foot of Andromeda by $37^{\circ} 33'$.

7. In the year 1643, on 23 August, in the morning, at the transit of the Bright Star of Aries [lucidae Arietis] across the meridian [per M. C.] there were numbered $41' 8''$; and afterward Mercury was seen at altitude $6^{\circ} 26'$, and distant from the bright star of the shoulder of Orion [humero lucido Orionis] by $49^{\circ} 35'$. Then after 7 minutes it was seen at altitude $5^{\circ} 50'$, distant from Procyon by $25^{\circ} 27' \frac{1}{2}$, the observations being repeated as customary.

8. On the following morning, on 24 August, at the transit of the Bright Star of Aries across the meridian numbered they are, at minute 32; afterward Mercury was seen at altitude 4° , distant from the bright star of Orion by $50^{\circ} 2'$, and after 7 minutes it was seen at altitude $3^{\circ} \frac{1}{2}$, distant from Procyon by $26^{\circ} 13'$.

9. Likewise in the year 1643, on 31 August, Mercury was at distance from the zenith $34^{\circ} 10'$, and after 2 minutes of time it was seen at altitude $3^{\circ} \frac{1}{2}$, distant from Procyon by $33^{\circ} 59' \frac{1}{2}$; thereupon after 2 minutes of time it was seen at altitude $3^{\circ} 50'$, distant from the bright shoulder of Orion by $58^{\circ} 42' \frac{1}{2}$.

10. At length on 26 December of the same year, in the morning, with a most serene sky and a most pure Aquilo [north wind] blowing, Mercury [was seen] in azimuth $50^{\circ} 44'$; it was seen at altitude $6^{\circ} 25' \frac{1}{2}$; and then Arcturus was distant from the zenith by 25° precisely.

11. In the year 1644, on 6 August, at the rising of the Bright Star of Aries, distant from the zenith $25^{\circ} 55'$, Mercury, the morning digression being nearest to its maximum, was seen at altitude $3^{\circ} 15'$, and distant from Aldebaran by $50^{\circ} 24'$. Next, after 8 minutes, it was seen at altitude $4^{\circ} 10'$, distant from the bright shoulder of Orion by $34^{\circ} 8' \frac{1}{2}$.

12. In the same year, on 13 August, in the morning, Aldebaran was distant from the zenith by $43^{\circ} 36'$; and after 7 minutes of time, Mercury was seen at altitude $7^{\circ} 12'$, distant from the following shoulder of Orion by $42^{\circ} 12'$. Next, after 2 minutes of time, it was seen at altitude $7^{\circ} 28'$, distant from Aldebaran by $58^{\circ} 36' \frac{1}{2}$.

13. In the year 1644, on 21 November, in the morning, Regulus, on the western side, was distant from the zenith by $31^{\circ} 11'$; after minute 18 of time, Mercury was seen at altitude $5^{\circ} 10'$, distant from Spica by $22^{\circ} 3'$; and after 5 minutes of time, it was seen at altitude $10^{\circ} 15'$, and distant from Arcturus by $34^{\circ} 45'$. *Perigee.*
Excentre [Perig. Excentr.].

14. In the year 1644, on 26 November, in the morning, Arcturus on the eastern side was distant from the zenith by $49^{\circ} 50'$; and after 17 minutes, Mercury was seen at altitude $8^{\circ} 55'$, distant from Arcturus by $37^{\circ} 5'$; and after 3 minutes it was seen at altitude $9^{\circ} 12'$, and distant from Spica by $25^{\circ} 49'$.

15. In the same year, on 29 November, in the morning with a most serene sky, Arcturus on the eastern side was distant from the zenith by $44^{\circ} 45'$; and after 2 minutes of time, Mercury was seen at altitude $7^{\circ} 46'$, and distant from Arcturus by $39^{\circ} 19'$. Hence after 7 minutes of time, it was seen at altitude $8^{\circ} 22'$, and distant from Spica by $29^{\circ} 7'$.

16. In the year 1646, on 8 May, in the evening, Mercury was seen distant from Procyon by $45^{\circ} 40'$; at the high [point] [alto] by $29^{\circ} 14'$; in the same year also at the high [point] by $28^{\circ} 10'$, it was seen distant from Capra [Capella] by $21^{\circ} 56'$.

17. In the same year, on the following evening, Mercury was seen distant from Procyon by $44^{\circ} 22'$; at the high [point] by $26^{\circ} 7'$; in the same year at the high [point] by $27^{\circ} 6'$, it was seen distant from Capella by $21^{\circ} 30'$.

18. In the year 1646, on the evening of 15 May, Mercury was seen distant at altitude $37^{\circ} 57'$, from Procyon at altitude $23^{\circ} 40'$; in the same year also at the high [point] by $22^{\circ} 35'$, it was seen distant from Capella by $20^{\circ} 33'$.

19. In the same year, on 22 May, Mercury was seen in the evening, distant from Capella by $22^{\circ} 4'$, from Procyon at the high [point] by $15^{\circ} 23'$; and next distant by $33^{\circ} 1'$; from Procyon itself at the high [point] by $13^{\circ} 35'$.

20. In the year 1647, on 23 April, in the evening, Mercury was seen at altitude $13^{\circ} 30'$, distant from Procyon by $12^{\circ} 30'$. Next it was seen at altitude $12^{\circ} 30'$; it stood apparently distant from Procyon by $59^{\circ} 46'$ on account of refractions. Afterward it was seen at altitude $11^{\circ} 33'$, and distant from Capella by $30^{\circ} 31'$; the altitude meanwhile was 11° ; it was seen distant from the following shoulder of Orion by

35° 23' ½; the altitude of Capella then being 40° 12'; and these [observations were made] around the maximum digression of Mercury.

21. In the same year, on 30 April, in the evening, [Mercury] was seen at altitude 12° 22', and distant from Procyon by 52° 54' ½. Next it was seen at altitude 11° 52', and from the head of Pollux distant by 47° 34' ½.

22. In the year 1647, on 6 May, in the evening, Mercury appeared in the same straight line with Venus, and with the center of the Moon, one hour after sunset, so that Venus, the Moon, and Mercury appeared more westerly; but on account of the splendor of the Moon, the remaining crepuscular [observations] could not be made, as far as the others [are concerned].

23. In the year 1648, on 31 March, in the evening, Mercury was seen at altitude 8° 47', and distant from Aldebaran by 37° 34'; thereupon at altitude 8° 20' it was seen distant from Rigel by 52° 58'; Aldebaran being then at altitude 37° 44'.

24. In the same year, on 7 April, in the evening, Mercury was seen at altitude 12° 53', and distant from Aldebaran by 28° 3' ½; at altitude 11° 57' it was seen distant from Rigel by 46° 40' ½; and after a minute of time Aldebaran was distant from the zenith toward the west by 57° 57'.

25. In the year 1648, on 9 April, in the evening, Mercury was seen at altitude 12° 32', and distant from Aldebaran by 26° 4'; at altitude 12° it was seen distant by 45° 27' ½; from Rigel at altitude 71° 5'; Aldebaran being distant from the zenith toward the west by 60° precisely.

26. In the same year, on 13 April, in the evening, [Mercury] was seen at altitude 11° 30', and distant from Aldebaran by 23° 19' ½; thereupon at altitude 10° 54' it was seen distant from Rigel by 43° 45' ½; the altitude of Rigel being nearly 18°, but Aldebaran at altitude 25° 50'.

27. Likewise in the same year, on 15 April, in the evening, Mercury was seen at altitude 9° 14', and distant from Aldebaran by 22° 23' ½; soon at altitude 8° 36' it seemed to be distant from Rigel by 43° 11' ½; at altitude about 15°, but Aldebaran at altitude 22° 43'.

28. In the year 1649, on 22 December, in the morning, Mercury was seen at altitude 6° 40', and distant from the head of Ophiuchus by 34° 32' ½; but at altitude 7° 12', it was seen distant from Spica by 48° 49'.

29. In the year 1651, in the month of February, Mercury was observed for nine days by taking its distance from the zenith in the same Vertical [circle], in which

afterward, for the exact azimuth, the distance of Aldebaran from the zenith was taken. Moreover, with the times numbered by perpendicular [i.e. plumb-line timing], the distance of Sirius from the zenith was also taken, with Mercury observed, in the eastern quadrant.

Dies Feb r.	Dist. Aldeb. à vert. (G. M.)	Hinc Azimuth (G. ' ")	☿ in eo dist. à vert. (Gr. M.)	hinc post tempor. (M. S.)	Sir. dist. à vert. (G. M.)
30 — 11	49 · 5	69 · 50	81 · 41½	3 · 58	73 · 41
31 — 13	49 · 38	70 · 23 · 26	80 · 12	3 · 14	72 · 38
32 — 15	49 · 53	70 · 43 · 32	78 · 43	3 · 38	71 · 48
33 — 16	50 · 41	71 · 46 · 54	78 · 45	3 · 58	70 · 57
34 — 17	52 · 5	73 · 34 · 18	79 · 27	4 · 56	69 · 24
35 — 18	52 · 25	73 · 59 · 16	79 · 4	3 · 58	69 · 10
36 — 19	53 · 17	75 · 3 · 12	79 · 9	3 · 58	68 · 33
37 — 20	53 · 54	75 · 48 · 0	79 · 15	3 · 58	68 · 6

In the year 1652, in the month of May, from day 21 up to 31, indeed up to the second [day] of June, Mercury was observed as an evening star, as [shown] below in the following Table.

Anno 1652.

☿ n o.	Maij Die vesp.	Mercurij Altit. visa (G.)	(Mercurij M distantia . visa à cap.) Poll. (G.)	(Mercurij M distantia . visa à cap.) Cast. (G.)	(M . Pollucis) altitudo (G.)	(M .)
38	21	12	3 24 8	5 5		
		12	0	22	5 32 0	5 6
39	22	12	1 23 8	4 6		
		11	4 6	21	4 7	
40	26	11	4 19 0	4 1		
		10	2 0	18	1 26	5 5
41	27	11	4 18 0	5 4		
		10	4 0	17	1 26 6	4 0
		9	3 0	17	1 6 ½	
42	28	7	4 18 8	2 ½		
		7	1 0	16	3 22 7	1 5
43	29	10	0 17	2 1 ½		
		9	2 5	16	2 24	1 3
44	30	9	4 16 4	4 2		

☿ no.	Maij Die vesp.	Mercurij Altit. visa (G.)	(M distantia . visa à cap.) Poll. (G.)	(Mercurij M distantia . visa à cap.) Cast. (G.)	(M . Pollucis) altitudo (G.)	(M)
		8	2	15	3 22	5
			5		4	2
45	31	9	0 16	1		
				2		
		7	4	15	8 22	1
			8			3
46	Iunij 1	7	5 15	4		
			4	5		
		7	2	14	4 21	2
			0		4	8
47	2	6	0 15	2		
				2		
		5	3	14	2 19	2
			0		5	6

In the year 1653, in May, Mercury was observed as an evening star, always one hour very close after sunset, by its distances from Procyon, from Capella, and the distance of Mercury from the zenith [vertice].

Anno 1653.

Distantia visa Mercurij.

☿ no.	Maij Dies	à Vertice (G.)	(M) à Stellis Fix. (G.)	(M) Idest ab infrascriptis.
48	3	79	4 23	3 à Capella
			8	7
		80	1 49	2 à Procyone
			2	9
49	6	77	4 22	4 à Capella
			0	
		78	1 46	1 à Procyone
			0	0

☿ no.	Maij Dies	à Vertice (G.)	(M)	à Stellis Fix. (G.)	(M)	Idest ab infrascriptis.
50	7	79	1	21	4	à Capella
		79	2	45	1	à Procyone
			0		6	
51	8	78	2	21	3	à Capella
			2		1	
		79	7	44	2	à Procyone
					0	
52	9	78	4	21	1	à Capella
					5	
		78	2	43	3	à Procyone
			3		3	
53	10	78	1	21	1	à Capella
			0		0	
		78	5	42	4	à Procyone
			0		6	
54	11	79	7	21	4	à Capella
		79	2	42	5	à Procyone
			6			
55	12	79	2	41	2	à Procyone
			6		8	
		<i>quia Capra latebat post nubes, vide infra suppl.</i> [because Capella was hidden behind clouds, see the supplement below]				
56	15	83	4	21	2	à Capella
			4		2	
					½	
		83	5	39	5	à Procyone
			1		4	

☿ no.	Maij Dies	à Vertice (G.)	(M) à Stellis Fix. (G.)	(M) Idest ab infrascriptis.
Supp lem.	12	<i>Mercurius visus est distare à vertice gr. 80. 28'. in eo Azimutho, in quo Aldebara visa est distare à vert. grad. 74. 50'. [Mercury was seen distant from the zenith by 80° 28', in that azimuth in which Aldebaran was seen distant from the zenith by 74° 50'.]</i>		

In the year 1657, on December 5, in the morning, when Spica Virginis stood in the eastern quadrant and was distant from the zenith by $58^{\circ} 20'$, the count of the perpendicular's time began at 8h [?] 30". Mercury's distance from the zenith was taken as $81^{\circ} 16'$, in an expected azimuth of $55^{\circ} 27' 52''$, corrected and counted from the south. From this, Fr. Francesco Maria Grimaldi [Grimaldi], to whom we owe this observation, found Mercury's place at $24^{\circ} 19' 55''$ of Scorpio, with a northern latitude of $1^{\circ} 48' 55''$, with an elongation from the Sun of $18^{\circ} 50'$; and this was about 8 hours after midnight.

CAPVT VII.

On the Hypothesis of Mercury's Motions.

1. There is no reason to repeat here what we have explained at sufficient length in Book 7 of the *Almagestum Novum* [*Almagestum Novum*], Section 4, and here in Book 5, Chapter 12, where we set out the famous hypotheses and theories of the astronomers concerning the motions of Mercury, by way of explaining their tables. But I want it understood that Mercury's geometrical figure — by various spiral arcs about a cone rather than by a single circle — is here implied through an ellipse for the reader, as was done in the same volume's Book 5, on the occasion of Saturn, in Chapter 10,

on the methods of observing the places of the planets, and in Chapter 12, on the geometrical figure. So a few things remain to be added or recalled here. The chief difficulty in observing Mercury — apart from the error of many minutes owing to its nearness to the Sun, by which it is almost always wrapped in refraction — is the inconstancy of its variation. That Ptolemy [Ptolemy] and Copernicus [Copernicus] frankly admitted Mercury was unobserved by them on account of the vapors of the Nile, or unseen, as Tycho [Tycho Brahe] also did in his preface to the *Epistolae Astronomicae*; and Longomontanus [Longomontanus] in Book 2 of the *Theorica*, Chapter 20, agreeing with this, says it was rarely permitted him to observe Mercury in the great obliquity of that sphere which the horizon of Uraniborg has — this, I say, is pardonable, if Copernicus erred by more than 5° in this star, and sometimes by 7° ; and Tycho too, and Longomontanus, by more than $12'$ in 10 minutes of [his] observation, as Book 2 of the *Theorica*, Chapter 20, examines. He did not find among the observed and computed place from the Danish Tables a discrepancy greater than $12' \frac{1}{2}$, though it elsewhere exceeds whole degrees, as I shall say, number 3.

2. Let us now hear Kepler [Kepler], who, where he laid the foundation of his Ephemerides on page 15, said he did not fear an error in his Rudolphine Tables for Venus that exceeds $15'$. He adds: *In Mercury the difficulty is greater, and the occasions for detecting errors are very rare. All his observations recorded by Tycho span 20 years, and these indeed are reliable and beyond doubt, falling within one degree [?]; the remaining two thirds [of Mercury's revolution] go unobserved — in this age, that is. But in our own, how great a difficulty there is, drawn from a part of the arc, to complete the whole circle without error, needs no many words to declare.* Therefore, even at the greatest elongations, which our hemisphere [in the morning sky] — the Sun not begrudging us — affords, no great error can arise from a faulty commutation; but at the conjunctions, of which there is a great [obscurity] in Mercury together with the Sun, I dare not affirm that my calculation always stays within the bounds of that very day: by how much time, by five degrees, it can sometimes vary; but Mercury's apparent place, when it is retrograde, by one degree or a half.
3. [Margin: The error of the various Tables in Mercury.] Long ago I noted, in Book 3 of the *Almagestum Novum*, Chapter 3 in the Scholia, and Book 7, Chapter 6, number 5: In the year 1631, on November 7, Mercury was observed beneath the Sun by Pierre Gassendi [Gassendi] with the aid of a telescope, and its conjunction with the Sun at hour 7h 58'; from that

moment the Ptolemaic Tables erred by $4^{\circ} 25'$, the Prutenic by 5° , the Danish by $7^{\circ} 13'$, the Lansbergian by $1^{\circ} 21'$. And so Natal Duret [Natalis Duret], a follower of Lansbergen [Lansbergen], earlier transferred [his calculation] in the Ephemerides to the Rudolphine standard. Martin Hortensius [Hortensius] too differs [from the others] —

— Gassendi, in affirming that Mercury was seen on the Sun in the year 1632. On July 31 he observed a conjunction of Venus with [Mercury]; and when, according to the Danish [Tables], it ought to have been distant from [Venus] by [?] $53'$. And Antonius Maria de Rheita [Anton Maria Schyrleus de Rheita], in Book 2 of his *Oculus mysticus*, Chapter 2, notes errors of 5° , 6° , and 7° in the Tychonic hypothesis. Kepler himself, in the foundation of the Ephemerides, page 32, when he had said his calculation differed by about 21 minutes from the observation of Mercury's conjunction with the Moon, which occurred in the year 1617 on March 8 at hour 7h 26' after noon, confessed that so great a discrepancy could not lie wholly in the observation, but that part of it was in the foundation of the Tychonic calculation, as regards the Moon.

4. [Margin: Kepler's faulty calculation.] But Elias von Löwen [Elias von Löwen], who is the author of the work *Urania Propitia*, Part 2, Chapter 17, points out that Kepler unjustly fastened that mark [of error] upon Tycho on account of a faulty calculation. For from the daily overtaking of the Moon that follows Mercury by a degree, which was $14^{\circ} 11'$, he gathers that it ought to have been observed [later] by 7h 7' [at] $3^{\circ} 51'$, when in truth it ought to have been gathered as $4^{\circ} 12' 20''$; thus the error of 21' does not arise from the Tychonic foundations but from Kepler's false computation. He further adds, in recommendation of the Rudolphine [Tables], another observation in which Longomontanus, at Copenhagen [Hafnia], on April 14, old style, at hour 8h $\frac{1}{2}$ after noon, saw Venus, and the stars of Mercury [?] separated from one another by $2^{\circ} 24'$. The Rudolphine [Tables], however, present them as distant by $2^{\circ} 25' 30''$ in reality, but on account of refraction by $2^{\circ} 24' 20''$. And he concludes, saying: *This observation, save for the Rudolphine, no other Table expresses* — he is speaking of the Danish, the Lansbergian, and the rest of the older ones, for he had not yet seen the Philolaic and our own. He next proceeds to the transit which Ptolemy proposes in Book 9, Chapter 7 and 10, and asserts that those two chapters are most corrupt, partly through the carelessness of the transcribers, partly through Ptolemy himself, who ill-matched the days of the months of the Dionysian year with those of the Egyptian year, putting Mechir for the 30th of Phamenoth. Accordingly Elias, having set this aside, proposes another

form of the Dionysian year on page 71 of his Tables, from which, restoring the places of those observations into his own as he supposes, he indeed makes them come close to the said observations — but they still need some remedy to draw nearer. There will nonetheless be one who suspects that Elias too, out of excessive devotion to the Rudolphine, accommodated the standard of the Dionysian year to those [Tables], so that the observations would agree with these tables, and that one cannot easily be persuaded that Ptolemy erred by a whole month, or that Mechir should be set for Phamenoth. But on this matter I shall see, God willing, in the *Chronologia Reformata*.

5. [Margin: Boulliau's sound calculation.] Boulliau [Boulliau], indeed, in Book 10 of his *Astronomia Philolaica*, Chapter 1, affirms that Mercury's slower delays toward aphelion and its swifter passages through perihelion are tried in vain on any hypothesis other than the elliptical; nor does he hope to surpass others in unfolding the motions of this planet, [achieved] by intermediate means — since in other matters he is destitute of observations — from Ptolemy down to our own times. Yet he promises the true proportion of the orbs, and the place and [motion?] of the aphelia and the nodes. If anyone reads this author through, he will see with how much penetration, candor, and zeal for truth he treats the observations made of Mercury by Walther [Bernhard Walther], Tycho, Hortensius, Gassendi, and others — and let everyone judge that nothing has hitherto been done more diligently by any astronomer, so far as I know, as regards the mean motion of Mercury. He follows now the Rudolphine, now adds $11' \frac{1}{2}$; we too, from our own observations and remarks, shall add some correction to this.
6. But lest we fill the pages with excessive prolixity, from the many observations selected above — to which, as to touchstones, we have examined the Lydian Tables, especially those that we present, and which our own most closely approach, and next the Philolaic and the Rudolphine — it pleases me to set forth for the Readers the following, written below.
7. In the year 1585, on November 14, old style, Tycho at Uraniborg observed Mercury after noon in Scorpio at $13^{\circ} 4'$, with a northern latitude of $2^{\circ} 18'$. The Danish [Tables] give its place in Scorpio at $12^{\circ} 57'$, the Rudolphine at $13^{\circ} 7' 45''$, ours at $13^{\circ} 2' 54''$.
8. In the year 1587, on January 9, old style, Tycho at Uraniborg, at hour 4h 50', observed Mercury in Aquarius at $17^{\circ} 48'$, with a northern latitude of $0^{\circ} 1'$; adding that, according to the Alphonsine [Tables], it had been in Aquarius

at $18^{\circ} 29'$ with a latitude of $0^{\circ} 24'$ north. According to Copernicus, however, in Aquarius at $16^{\circ} 41'$ with a southern latitude of $0^{\circ} 6'$; the Philolaic Tables show Mercury in Aquarius at $17^{\circ} 35' 12''$; ours at $17^{\circ} 35' 45''$.

9. In the year 1592, on February 3, old style, at hour 5h 40', Mercury was observed at Uraniborg in Pisces at $12^{\circ} 20'$ — as Longomontanus has it, who from the Danish [Tables] gives Mercury in Pisces at $12^{\circ} 13' 57''$. We [give it] at $12^{\circ} 15'$.
10. In the year 1631, on November 7, at Paris, Gassendi with a telescope observed Mercury beneath the Sun, and fixed its conjunction with the Sun at hour 7h 58' after midnight. Our Tables give the Sun at that time in Scorpio at $14^{\circ} 38' 30''$, and Mercury in Scorpio at $14^{\circ} 37' 40''$, with a northern latitude of $4' 35''$.
11. In the year 1632, on July 31, in the morning, at hour 4h after midnight, [Gassendi] observed the conjunction of Mercury with Venus at Paris. But Hortensius, from his own observation made at Amsterdam, says it occurred at hour 11h $\frac{1}{3}$ after noon of day 30. From our Tables we obtained Venus at Bologna after midnight of day 31 in Cancer at $24^{\circ} 22' 15''$, and Mercury in Cancer at $24^{\circ} 36' 40''$. Hence, from the diurnal motion, that conjunction is gathered to have been almost at that very midnight, which fell between days 30 and 31 of July. In the place of Mercury the Danish Tables erred by 3° in [?]; and the Prutenic anticipated that synodic conjunction by whole five days. This [observation] ought to be placed after that one which shall be set down at number 9.
12. In the year 1634, on October 2, Gassendi, at Aix [Aquae Sextiae], at hour 17h 58' after noon — reduced to the Bologna [meridian] — observed Mercury more to the east, six minutes [?] beyond the outermost star of the Southern wing of Virgo. To me, that star was then in Virgo at $22^{\circ} 0' 3''$, and Mercury in Virgo at $22^{\circ} 5' 50''$; the Rudolphine [give it] in Virgo at $22^{\circ} 5'$, Boulliau at $22^{\circ} 6' 58''$.
13. In the year 1636, on June 27, in the evening, Gassendi at Aix observed Mercury compared with Venus in Cancer at $25^{\circ} 5' 53''$ — though refraction is excepted, as Boulliau gathers. The Rudolphine Tables give it in Cancer at $25^{\circ} 1'$; the Philolaic at $25^{\circ} 3' 33''$; ours at $25^{\circ} 4' 10''$.

14. In the year 1636, on July 16, in the evening, Gassendi at Aix observed Mercury in Leo at $21^{\circ} 26'$. The Rudolphine produce its place at Uraniborg in Leo at $21^{\circ} 30'$, the Philolaic in Leo at $21^{\circ} 25' 47''$, ours in Leo at $21^{\circ} 25' 52''$.
15. In the year 1634, from Gassendi's observations, Boulliau gathers [colligit], on day 3 of January, at hour 6h 30' after noon [post me(ridiem)], that Mercury had been in Aquarius at $2^{\circ} 30' 43''$, with a maximum elongation from the Sun in Capricorn at $13^{\circ} 33' 43''$. To me, the Sun was then in Capricorn at $13^{\circ} 29'$, and Mercury in Aquarius at $2^{\circ} 31' 10''$.
16. In the year 1636, on September 3, at hour 17h after noon, at Dinan, Mercury was observed through a telescope more to the west than Regulus, by $10'$ as Boulliau gathers. To me, Regulus was then in Leo at $24^{\circ} 48' 17''$; therefore Mercury was in Leo at $24^{\circ} 38' 17''$; the Rudolphine give it in Leo at $24^{\circ} 27'$, the Philolaic in Leo at $24^{\circ} 38' 52''$, and ours [Nostrae] in Leo at $24^{\circ} 37' 55''$.
17. In the year 1657, on December 5, in the morning, at about hour 8h after midnight, Mercury was observed in Scorpio at $24^{\circ} 19' 35''$. Our Tables give it at $24^{\circ} 16' 7''$; but the Danish at $25^{\circ} 24'$, the Lansbergian at $24^{\circ} 45'$ in Scorpio. And these things meanwhile suffice.

Hypothesis Mercurij Arithmetica.

[The Arithmetic Hypothesis of Mercury.]

The columns are: sign-degree group (Sig.G.), then sexagesimal sub-columns I., II., III., IV., V.

Mean motion of ☿		Sig.G.	I .	II.	III.	I V.	V .
From the Equinox [Ab Æquinotio]	Diurnal [Diurnus]	0	4 5	32		3 5	2 9
	Annual [Annuus]	1	2 3	4 3	15	5 4	5 5
Of the Apogee [Apogei]	Diurnal	0	0 0	0		1 7	7
	Annual	0	0 0	1 44		9 9	8
Of the Nodes [Nodi ☿]	Diurnal	0	0 0	0		1 5	4 2

Mean motion of ☿	Sig.G.	I . II.	III.	I V.	V .
Annual	0	0 1	35	3 1	4

Epocha ad initium vulgare Annorum Christi in vltimo Decemb. præcedentis meridie, ad Bononiensem Merid.

[Epoch for the common beginning of the Years of Christ, at the noon of the last December preceding, for the Meridian of Bologna.]

Mean motion of ☿	Sig.	G.	I.	II.
From the Equinox [Ab Æquin. ♈]	10	11	59	40
Of the Apogee [Apogei]	6	25	18	48
Of the Nodes [Nodi ☿]	0	0	1	50

Hypothesis Geometrica.

[The Geometric Hypothesis.]

If, in the meantime, one should choose the circumference of an ellipse — which on the surface of a cone appears most nearly to mark out the motion of the planet, made now by some spirals, now by others, [spirals winding] not toward the East, as those suppose who assign the diurnal motion of the Prime Mobile to the Earth, but toward the West, as we suppose — then let the measures written below also be chosen [as expressed] in parts of which the radius of the Sun's Annual Orbit is 100000, and its bisected eccentricity 1740.

The right-hand column gives the value "if the radius of the Sun's Annual Orbit ☉ is 100000."

[Quantity:] Of such [parts] [Talium]	If the radius of the Sun's Annual Orbit ☉ is 100000
Semidiameter major of the Ellipse of ☿, or its mean distance from the Sun	38585
Semidiameter minor of the Ellipse	37736
And the half of the Eccentricity	8105

			Distance [Distantia]
At Sun's Apogee & ☿ [Sole Apogeo & ☿]	Aphelion [Aphelio]	from the Sun [à Sole]	46690
		from the Earth [à Terra]	148430
	Perihelion [Perihel.]	from the Sun	30480
		from the Earth	71260
At Sun's Perigee & ☿ [Sole Perigeo & ☿]	Aphelion	from the Sun	46690
		from the Earth	144950
	Perihelion	from the Sun	30480
		from the Earth	67780
Maximum elongations from the Sun's true place [Digressiones maximæ à vero Solis loco]			Gr I . . II.
At Sun's Apogee & ☿ [Sole Apogeo & ☿]	Aphelion [Aphelio]		27 1 12 8
	Perihelion [Perihelio]		17 2 30 5
At Sun's Perigee & ☿ [Sole Perigeo & ☿]	Aphelion		28 2 3 3
	Perihelion		18 4 45
Inclination of the Orbit to the Ecliptic [Inclinatio Orbitæ ad Eclipticam]			6 5 0 5
Maximum range of latitudes [Varietas latitudinum maximarum]			G I r I I . . .
At Sun's Apogee & ☿	Aphelion [Aphel.]	for Mercury, Morning,	5 4 3

Maximum range of latitudes [Varietas latitudinum maximarum]			G r .	I I .	I I .	
[Sole Apogeo & ☿]		Retrograde [in ☿ Mat. Retr.]	6			
		for Mercury, Evening, Direct [in ☿ Vesp. Dire.]	2 0	1 5	5 0	
	Perihelion [Perihel.]	for Mercury, Morning [in ☿ Matut.]	2	5 5	5 0	
		for Mercury, Evening [in ☿ Vespert.]	1 5	3 5	1 5	
	At Sun's Perigee & ☿ [Sole Perigee & ☿]	Aphelion [Aphel.]	for Mercury, Morning, Retrograde [in ☿ Mat. Retr.]	6 0	1 0	2 0
			for Mercury, Evening, Direct [in ☿ Vesp. Dir.]	2	1 3	1 5
Perihelion [Perihel.]		for Mercury, Morning [in ☿ Matut.]	3	5	3	
		for Mercury, Evening [in ☿ Vespert.]	1 7	3 5	5 5	

For the remaining distances of Mercury from the Sun, according to its degree of equated Anomaly, see in the 2nd Volume, Table 97.

LIBER DECIMVS

IN QVO PARALIPOMENA OBSERVATIONVM AD FIXAS, Et
Planetas Minores Pertinentium, videlicet

DE Diametris Apparentibus, eorumque Figura, Fascijs, Maculis,
Vertigine, Comitibus, & Comitum motibus, AC DISTANTIIS A SOLE, ET
A TERRA.

[BOOK TEN, in which are gathered the Supplementary matters of the
Observations pertaining to the Fixed Stars and the Lesser Planets, namely: On

their Apparent Diameters, and their Figure, Bands, Spots, Rotation, Companions, and the Motions of the Companions, and on their Distances from the Sun and from the Earth.]

CAPVT I.

On the Methods of Observing the Diameters of the Fixed Stars and of the Planets.

1. [Margin: Method 1.] The first method, used by the ancients, consists in an estimate by the eye comparing the seen diameter of a star with a portion of the Moon's diameter, or with a small distance between two fixed stars known from another source — for instance, with the distance of the Pleiades among themselves, or of the Hyades. But this method is very deceptive, or is established by the experience of many observers at once, since just as many eyes as there are, so many different opinions about the magnitude of the stars are generally produced. The reason is that the adventitious rays around the stars, whether from the atmosphere or from the eye's humors or from refractions [that] appear, optically enlarge their disks, and conversely diminish the distances between them by just as much.
2. [Margin: Method 2.] The second method is carried out by means of the Dioptra of Hipparchus [Hipparchus], or similar to it — that is, by applying a very narrow strip, which at a great but known distance from the eye covers precisely a star; or by applying a small tablet, or a thin plate, such that at a great but likewise known distance it intercepts within its edges the entire body of the star — or at least a space three times larger than the star's disk; for by the laws of right-lined triangles and of rectangles, from the given strip, or tablet from the eye, and from the similitude of the tablet or plate, the angle is gathered, which when doubled measures the apparent diameter of the star; or, in the third manner, when a space three times larger than the star's apparent [diameter] is taken. But this method is in every respect deceptive: from what has been said it is established for a triple reason that it is deceptive. First, because the situation in which the whole tablet, or one perforated, exactly agrees with the star's diameter, or with a space three times greater, does not consist in [a single] indivisible [point], but it is established by experience that, in moving it toward the eye or away from the eye, no sensible difference appears to the eye; then the ocular estimate itself, on account of the adventitious rays of the star, as has been said, is deceptive. Finally, the angle which is acquired by means of a

Dioptra of this kind is not the true visual angle; for it is at the surface of the eye, whereas the true visual angle is at the tunic of the retina, which is at the bottom of the eye. Therefore, so great a parallax intervenes, as great as the depth of the eye is — which, however, is not so known — and the Dioptra added at the surface of the eye, [renders] the angle to be obtained more justly by Trigonometry; otherwise it is always greater.

To this manner are reduced our own rays, both Triangular and Scalar, of which [we treated] in Book 6 of the *Almagestum Novum*, Chapter 9, number 6; then also the method of Galileo [Galileo] by a perpen-

suspended perpendicularly, which I nonetheless treat separately. I leave that for now.

[Margin: Third method.] **Third method.** The third method, then, is carried out by means of a thread suspended perpendicularly. As the eye draws back from the thread, the thickness of the thread eventually covers the star exactly. You then measure the distance of the eye from the thread, and also the width of the thread itself. By dividing the latter by an inch-scale [uncialis regula], you learn how many parts of this kind are contained in an inch. But the depth of the eye must be added to the predicted distance, since the rest is worked out by trigonometry. This is the method Galileo teaches in his third Dialogue of the *Cosmic System* [Galileo, *Dialogo sopra i due massimi sistemi*, Day 3], where he holds that, by covering the star with the thread, he intercepts the adventitious rays that he believes come from the eye alone. Yet he is mistaken here, because nothing prevents the rays reflected from the edges of the thread from reaching the eye; and so this method too is exposed to the same fallacy as the two preceding ones. He adds, however, that by this method—though not in every case—he found by exact observation that Lucida Lyrae [Vega] is no larger than five seconds, and that this builds a suspicion in the careful observer of the diminished apparent diameter of the fixed stars, so as to support the probability of the Copernican hypothesis. On that hypothesis the immensity of the distance of the fixed stars increases their bulk all the more, the greater their apparent diameter is.

[Margin: Fourth method.] **Fourth method.** The fourth method, used by Scheiner [Christoph Scheiner] for Venus, by Gassendi [Pierre Gassendi] for Mercury, and by Hortensius [Martinus Hortensius] for Jupiter, works through the reception of the bright image of Jupiter, or of Venus, or even of Mercury, as it passes through the lenses of the telescope onto a clean sheet of paper. One then measures the diameter of that image and compares it with the diameter of the solar image, using the same lenses and taking it on the same sheet at the very smallest

particles of distance from the lens. Gassendi, however, took the place of the image, except that on the paper he found the little umbra of Mercury seen against the Sun, and compared it with the diameter of the Sun. But I should think it credible that the umbra was diminished all around by the bright glow of the solar image—just as Hortensius admits that the image of Jupiter appeared to him fainter. For Rheita's method [Anton Maria Schyrleus de Rheita], see chapter 3, number 1.

[Margin: Fifth method.] **Fifth method.** The fifth method works by direct sighting through the telescope, exact and by ocular estimation, comparing the star with the Moon, or with a known interval between neighbouring stars. For the telescope strips away those adventitious rays which otherwise appear in our eye; and although the telescope does present the discs of stars shorn of the adventitious hair of rays, it nonetheless in no way enlarges the stars in proportion, since other non-luminous objects are not enlarged either—as Galileo too remarks in the third Dialogue of the *System of the World*, page 16, and in the *Sidereal Messenger* [*Nuncius Sidereus*].

[Margin: Sixth method.] **Sixth method.** The sixth method is the same as the preceding, but more perfect in this respect: if the convex lens of the telescope, set far back from the eye, is covered by a perforated piece of foil whose hole is nearly the size of a pea, then the rays are better stripped away by the more vigorous reach of the light. Otherwise the fixed stars are shown not bounded by a circular periphery, as the planets are, but flashing, and sending out their rays, and twinkling.

[Margin: 7] **Seventh method.** The seventh method includes the fifth, or the sixth, but adds besides a comparison with various little circles drawn on paper, and of differing sizes. For when the stars have been inspected through the telescope, and one looks back repeatedly at the said little circles, that one is at last to be chosen which, in the judgment of many eyes—or of the same eye in many observations—is seen as equal to the disc of the star inspected through the telescope. Finally, that little circle must be compared with the circle of the solar, Jovian, or Saturnian image, whose diameter is already known to us; and this method, attested by many—both by ourselves and by others—has given full satisfaction. From Hevelius's *Selenographia*, chapter 3, however, we have learned the use of the perforated foil.

[Margin: 8] **Eighth method.** The eighth method is the one Hevelius [Johannes Hevelius] suggests in chapter 55 of his *Selenographia*: namely, with the telescope—especially the one ringed about with perforated foil—the discs of the stars are

compared with the spots of the Moon's disc as to their respective sizes, the proportion of these spots to the Moon's diameter being known in advance.

[Margin: 9] **Ninth method.** The ninth method is the one Galileo indicates on page 7 of the *Sidereal Messenger*, and Martinus Hortensius in his *Dissertation* with Gassendi on Mercury seen against the Sun—the same that Scheiner too, and Kepler [Johannes Kepler], and Remus Quietanus [Johann Remus Quietanus] used—namely, by comparing the diameter of the star inspected by the telescope with the diameter of the telescope's aperture [capacitas], which had previously been explored, or by the same reasoning that Galileo, or Hortensius, teaches. And Hortensius indeed obtained the capacity of his own tube as 42", because he understood precisely the interval lying between two distant kids [haedi — the stars in Auriga], which is 42" by Tycho [Tycho Brahe]. Likewise because he took in one and a quarter times the lunar diameter, when this was 33' 30". Likewise because he took eight times the interval between the two adjacent stars in the following horn of Capricorn, which is reckoned at 5¼'. But Father Francesco Maria Grimaldi [Grimaldi] is accustomed, by stretching threads above the lens, to divide the capacity of the tube—its diameter—into four, six, or eight equal parts, so that with less danger of error he may estimate how many times the diameter of the star is contained in one of the said parts.

[Margin: A singular caution.] For the rest, in this method, and in many of the foregoing, caution must be taken that no equal proportion be inferred between the diameters from the proportion seen in the whole disc, or circle to circle, whether of the star or of the lens; for circles are to one another as the squares of their diameters, by Euclid 12.2. For example: if the diameter of Sirius is as 2, and that of Jupiter as 5½, Sirius will appear eight times smaller than Jupiter, because as often as the diameters are quaternary, the squares of the binary will be contained in the number 32, which is roughly the square of the number 5½.

[Margin: 10] **Tenth method.** The tenth method requires the application of the planet, when it is some stationary or very slow planet, to some fixed star caught within the tube with it: considering how often the star, or the planet, is contained in their mutual distance, and from the motion of the planet, how great that interval is, according to the examples and precepts handed down in book 7 of the *Almagestum Novum*, chapter 10.

[Margin: 11] **Eleventh method.** The eleventh method is supplied by Christiaan Huygens [Christiaan Huygens] in his *Systema Saturnium*, page 82, in these words: "There is a certain place within the tube, which they alone furnish who are

equipped with tubes fitted with paired lenses—circling about the other so much larger—which, brought near to the eye placed at a distance, exhibit in some place whatever lies within the cavity of the tube to the sight, subtle and distinct, with the outline exquisitely terminated. This place falls upon perfectly distinct objects to eyes set near; but for somewhat more distant ones the point must be taken farther off. Here, if a little ring be set up with a narrow opening, how large, free of space, it may circle round whatever is detected in the clear sky—so as to be described, and made precise. Of the space of this diameter, however small a scruple may be comprehended, it is to be investigated by the transit of the star, whose periods of vibrations are reckoned, or by the oscillation of our timepiece [Horologii], the telescope meanwhile remaining unmoved. With this device discovered, a small rod of latten [virgula metallica], gradually narrowing, is inserted into the tube in the said place, and it is noted how great a latitude of the rod covers the planet precisely, and from the latitude taken at the circle, compared with the whole amplitude of the opening, the diameter of the planet is easily learned by calculation. But I judge it slippery, and hard to remember, into what precise part of the rod the whole planet was covered."

CAPVT II.

De Saturni Diametro Apparenti.

[Margin: Opinions of others on Saturn's diameter.] [Margin: 1] 1. Albategnius [al-Battānī] and Alfraganus [al-Farghānī] determined the apparent diameter of Saturn at one minute and 44 seconds, roughly at its middle distance: al-Battānī in his chapter 50, al-Farghānī in chapter 22 here, with a difference of 22. Fernelius [Jean Fernel] in book 1 of his *Cosmotheoria*, and Egnatius Dantes [Pietro Vincenzo Dante] in Table 22, contracted it mathematically to 1' 40". By contrast Vurstisius [Christian Wursten] and Maginus [Giovanni Antonio Magini] in their *Theorics of the Planets* enlarged it to as much as 6 minutes—so deceived were they by ocular estimation and by the phases of the adventitious rays. Tycho [Tycho Brahe], in volume 1 of the *Progymnasmata*, page 468; Clavius [Christoph Clavius] and Blancanus [Giuseppe Biancani] in their *Sphaera*; and Argolus [Andrea Argoli] in his *Pandosion Sphaericum*, from chapter 52, define the Saturnian diameter at its middle distance as 1' 50". Lansbergius [Philips van Lansbergen], in book 3 of his *Uranometria*, restricted it to 1' 40" in its second. But if he did not

indicate the method he used in this determination... Kepler in the *Epitome of Astronomy*, volume 2, page 485, partly from Johannes Remus's observation 9, partly by the methods indicated in the preceding chapter, and partly by certain

analogies devised among the bulks and intervals of the planets (a thing in which Rheita too, in book 4 of his *Radii Sidereomystici*, chapter 2, member 3, has been his rival), limited Saturn's diameter at its greatest distance to 30", and in the *Rudolphine Tables*, at the end of precept 110, he says: "Saturn is never larger than 30" in seconds—it is recognized as roughly that." And in the *Epitome* itself he supposes this from the *Epitome of Astronomy*: "The bodies of all the planets are in proportion to their own intervals, and to the Sun's intervals; therefore the diameters are in subtriple ratio." Yet prudently he has said in the *Epitome*: "I yield the place to Remus, I yield to the observations." Rheita, however, in book 4, chapter 4, member 2, affirms that in the year 1644, on the 20th of July, taking the whole disc of the full Moon with the telescope and transferring it onto a divided chart into 34 equal parts, and likewise in the same way finding the diameter of Saturn to be the fifteenth part of the lunar—that is, in minutes—the Saturnian diameter, then minutes, [is] 2 and a little more. For at that time Jupiter was near the sextile aspect of the Sun, and Saturn near quadrature. But Martinus Hortensius, as he reports in his *Dissertation* with Gassendi on Mercury seen against the Sun, used method 9 of the preceding chapter in the year 1625. In February he saw Saturn near perigee as round, very nearly equal to Jupiter, whose diameter he had observed at 40"; but in the year 1632 he saw Saturn as 36". When Jupiter likewise appeared at 40", and Saturn with its appendages globular, so that it scarcely projected, it was seen as not in its whole minutes; whence too the smallness of error comes about whenever Saturn is seen without its companions through the telescope, in seconds 31", at apogee, and 42"¾ at perigee, to which Saturn at its altitude subtends.

[Margin: 2] [Margin: Our own observations.] [Margin: 3] 3. Through the same days the two stars among the Hyades were observed to occupy in their interval a fourth part of the space comprehended in the sky by our telescope—that is, 6½' minutes, or a little more. But the diameter AB of Saturn appeared to be contained in the space of those stars 5⅔ times. Again, considering a certain star among the Twins [Gemini], near Propus [η Geminorum], omitted in the catalogues of the fixed stars, inasmuch as it is visible by the telescope alone but selected by us, because it was in a straight line through AB drawn, there appeared a space between it and the most remote extremity A of Saturn containing the diameter AB, likewise 5⅔ times; but the space from the other extremity B, up to the same star, with respect to the diameter AB, was most evident, [as] 4⅔ to 1. Now indeed, the interval from the extremity A to that star, with the said interval of the Hyades frequently compared, appeared to it entirely equal. Accordingly the diameter AB was 71½ seconds, or 72.

[Margin: 4] 4. In the year 1650, on the following night, the 2nd of January, at hour 1, after the setting of the Sun, Saturn was, by its own diameter AB, in nearly the same straight line with a certain star toward the west, and a fixed one, which was viewed by the telescope at the same time as Saturn; but on the following night of the 3rd, around hour 2 of the night, because Saturn, still retrograde, was beginning to move along its proper orbit, not parallel to the equator, but along a line drawn through the centres of Saturn and of the Saturnian companions, as we shall say below, [with] a parallelism to the equator, Saturn had become more western, and more southern than the said star; and a straight line PR, drawn perpendicularly from the star P, above the diameter AB, fell nearer to F, in R, cutting off from the diameter AB the fourth part precisely. Then, at hour 5½ of the night, Saturn, retrograding more toward the west at its setting, and the star being re-established, it appeared in H, so that, a perpendicular BA being drawn and produced, up to L, the interval HL was equal to the interval AB—that is, to a fourth part of the diameter AB; but the interval AL truly receded as Saturn drew toward the west, and the interval appeared manifestly larger. Now indeed, by the more accurate Tables, the daily apparent motion of Saturn is 4' 30" minutes; therefore the hourly is 11" 15''' in seconds. So from hour 2 to hour 5½, it completed 36". The second, [and] 34'''—that is, the space equal to the semidiameter AO; for when the perpendicular fell from the star P, in R, it was AF, the fourth part of the whole AB; but when the perpendicular fell from H, in L, it was equal to AF itself; therefore LF was equal to the semidiameter AO; and so 36" 34''' in seconds. The whole therefore AB [is] 73" 8''' in seconds—which agrees above, from the prior observation, where we found the second [diameter] to be 72". Indeed, the difference of 1" is too small between so many diverse methods of observing—plainly negligible; nay, by consent very near, altogether marvellous, and to be related religiously by faith.

[Margin: 5] 5. We assume, then, that Saturn's perigeal diameter is in seconds 73", or 1' 12"; but the diameter FG of Saturn alone, in seconds 36", whence by Problem 1, chapter 8, in book 7 of the *Almagestum Novum*, section 7, set out, and from the least distance of Saturn from the Earth, which by the same section, chapter 2, we set down as the terrestrial semidiameter 57743, we shall gather its true diameter, simple indeed FG, [as] terrestrial semidiameters 4¾, but compounded AO, [as the] semi-

Diagram. A schematic showing Saturn (♄) with its ansae as a great horizontal ellipse, the globe of the planet at center flanked by two crescent-shaped lateral appendages (the ansae), together with reference stars and perpendicular construction lines used in the observation of §4. The Saturn glyph (♄) stands

above the figure at center. The large ellipse is the outer boundary of the apparition. Within it, two dark crescents (the ansae) lie left and right of an open central region. A vertical dashed line at upper left runs from the star H down to L; another vertical dashed line at upper center-right runs from the star P down to R.

- $\hbar$ (top center): Saturn glyph, naming the figure
- H (upper left, marked with a star): reference star on the west, top of the dashed perpendicular
- P (upper center-right, marked with a star): reference star, top of the dashed perpendicular to R
- C (top of ellipse, center): north point of the apparition
- L (left end, on the central horizontal): foot of the perpendicular from H
- A (left, inner): western extremity of Saturn's diameter AB
- K (left of center): point on the left ansa
- F (left of center, inner): point near the left ansa / endpoint of segment, the western edge of the globe
- O (center): center of the globe (Saturn's center)
- G (right of center, inner): point near the right ansa, eastern edge of the globe
- M (right of center): point on the right ansa
- B (right end, on the central horizontal): eastern extremity of Saturn's diameter AB
- D (bottom of ellipse, center): south point of the apparition
- R (lower center, marked with a star, foot of dashed line from P): foot of the perpendicular cutting diameter AB

[terrestrial] semidiameters $9\frac{3}{4}$. Then from the distance of Saturn from the Earth, at middle distance, [as] semidiameters 73000, and at greatest [distance] 90155, by Problem 2 of the same chapter 8, we shall deduce the semidiameter [or] apparent diameter of Saturn at middle distance, simple indeed FO 13" 20", but compounded AO 28" 30"; and at greatest distance FO 11" and AO 23". Provided that Saturn with its companions, in its various phases, is supposed to keep the proportion of its apparent magnitude arising from the variety of its distance.

CAPVT III.

De Diametro Apparenti Iouis.

[Margin: Opinions of the ancients.] [Margin: And of the moderns.] [Margin: 1] 1. Albategnius [al-Battānī], in his chapter 50, and Alfraganus [al-Farghānī], with a difference of 22, defined Jupiter's apparent diameter at $2' 36''\frac{2}{3}$, at its middle distance from the Earth. Fernelius [Jean Fernel], and Egnatius Dantes [Pietro Vincenzo Dante], [give] $2' 32''$. Maginus [Magini] and Vurstisius [Wurstisen] (how greatly!), minutes $9' \frac{2}{3}$. Tycho, in volume 1 of the *Progymnasmata*, page 468; Clavius and Blancanus in their *Sphaera*; and Argolus in his *Pandosion*, [give] $2' 45''$. Lansbergius, however, in book 3 of his *Uranometria*, [gives] $3'$; minimum $2' 30''$. But none of these states a foundation for it.

[Margin: Of Kepler.] Kepler, indeed, in the *Epitome of Astronomy*, volume 2, page 485, and in the *Rudolphine [Tables]*, precept 110, from the analogy indicated above of the subtriple proportion, sets Jupiter's diameter at its greatest distance from the Earth at $50''$ in seconds.

[Margin: Of Rheita.] But Father Rheita makes it roughly four times larger: for in book 4 of his *Radii Sidereomystici*, chapter 4, member 2, he says that in the year 1644, on the 20th of July, having used a most excellent telescope, exhibiting the whole disc of the Moon as 34 minutes, and in its eye-lens [oculari] the convex Lunar diameter, having taken it with the subtle extremities of a fine compass, and transferred it onto a chart divided into 34 equal parts, and in the same way found Jupiter's diameter to be roughly the tenth Lunar part—that is, minutes, roughly 3. But whether this practice may be safely used will be clear from the more certain quantity of this diameter, of which presently.

[Margin: Of Marius.] [Margin: 2] 2. Simon Marius [Simon Mayr], in his *Mundus Iovialis*, part 1, from observations made with the tube [telescope], puts his diameter at precisely one minute, at the middle distance.

[Margin: Of Hortensius.] Hortensius, however, with the capacity of his telescope explored, as above, saw in the year 1632 that the acronychal diameter of Jupiter occupied the fifth part of the little space lying between two adjacent stars in the following horn of Capricorn, which little space was of $5' 15''$ minutes; and so Jupiter's diameter [was] $1'$ minute. By how much, too, did Gassendi find it depressed through the tube! Hortensius reports the same in his *Dissertation* on Mercury with Gassendi. He adds that in the year 163[2], on November 13, having received the acronychal image of Jupiter through the lenses of the telescope onto

paper, and having found, when the image of the Sun was taken in the same way, as 130 [parts]; again on another night he found the image of Jupiter to be 6 parts when the solar image had been 195. The solar diameter being therefore set, he concludes Jupiter's diameter to be a little more than one minute. Hence in a Table, which Herigonius [Pierre Hérigone] too transcribed in volume 4 of his *Cursus Mathematicus*, page 62, he chose Jupiter's diameter, at perigee, 1' 1" 40''; at apogee, in seconds, 38" 30''.

[Margin: Of Hevelius.] [Margin: 3] 3. Johannes Hevelius, on page 449 of his *Selenographia*, relates that in the year 1646, on April 22, at the evening hour 8½, with the telescope, he observed Jupiter's diameter to be equal to one of the three mountains in the Moon at the Pontus Euxinus, which he calls Mount Moschus, and which he found to be roughly the 29th part of the lunar diameter. The Moon being therefore established, [and] Jupiter's diameter then in minutes roughly 30, he concludes that Jupiter's diameter was not greater than 1' 2". And on page 477 he relates that in the year 1646, on December 24, Jupiter was compared with the lunar Aetna, and seemed to himself one minute; but on page 547 he had said that Jupiter, compared on the 12th of April with Mount Crago, and set down, was, by the lunar diameter, in minutes 34, scarcely one minute.

[Margin: Of Gassendi.] [Margin: 4] 4. Gassendi, in a letter of the year 1630, on the 6th of the Kalends of September [27 August], published to Kepler at The Hague [Hagae Comitum], reports that on the 16th of August

in the evening he observed with the telescope an interval between a certain little star and the margin of the Moon, capable of a sixth part of the lunar diameter, and that he found the same interval could be filled out five times over by the acronychal diameter of Jupiter; and so Jupiter's diameter was nowhere greater than one minute. But to Epicurus [recipient], on page 901, he narrates that he observed by the telescope the diameter of Jupiter emerging from the Moon to be scarcely equal to the seventh part of the Caspian spot [macula Caspia]; and so he determined it to be not much greater than 33 seconds. This was then on the 20th of January in the year 1647, when Jupiter was approaching very near to its opposition with the Sun, and to the perigee of the epicycle; whence it is clear that, from the splendor of the neighbouring Moon, Jupiter appeared less to Gassendi than at other times in its acronychal position. Christiaan Huygens, in his *Systema Saturnium*, sets Jupiter's perigeal [diameter] at 64" in seconds, from his own observation. Our Fathers at Innsbruck [Oeniponti], from the capacity of the tube, estimated Jupiter's (≈) diameter in the year 1635, on March 19, as 1' 12"; and in 1637, on March 16, they estimated it as 1' 28", or 1' 30". Marchese Cornelio

Malvasia [Cornelio Malvasia], from the intervals of his tubes, in the year 1662, in May and in June, estimated it as 51"; in September, 41".

[Margin: Our own observation.] [Margin: 5] 5. But in the year 1649, at the beginning of June, when Father Francesco Maria Grimaldi, while observing the zones of Jupiter, had noticed that Jupiter was very strongly approaching a star preceding it, [one of] four stars in the left wing of Virgo, which is the sixth in the figure of Virgo, having northern latitude $1^{\circ} 25'$, and existing then in Virgo at degree $29^{\circ} 56' 25''$; and since, from Montebretti's Ephemeris, Jupiter's northern latitude was $1^{\circ} 25'$, he had no doubt about the near conjunction of Jupiter with that star, and, on the opportunity for establishing Jupiter's diameter from its own motion, and from its distance from the star—about which he warns of an interval of observations—I shall set it out more clearly by the diagram inscribed below.

Diagram. A geometric construction for determining Jupiter's diameter from its motion relative to the star A. It is oriented by the four cardinal labels: *Septentrio* (North) at top, *Oriens* (East) at left, *Occidens* (West) at right, *Meridies* (South) at bottom. At left is a small circle (one position of Jupiter's disc, FBG) with a horizontal band drawn across it (the belt PM / NL parallel to the ecliptic); at right is a second, similar small circle (a later position of Jupiter) with its own band, and the labels D, P, F, M, R, B, H, G. The star A is set low at center-bottom (near *Meridies*), and chords/lines AB, AC, AD, BC run from the star up to the two Jupiter positions, forming the triangles of the construction.

- *Septentrio* (top center): North
- *Oriens* (left): East
- *Occidens* (right): West
- *Meridies* (bottom center): South
- K (far left): westernmost reference point on the left disc
- N (upper left, on the band): point on the belt of the left (earlier) position of Jupiter
- L (left, on the band): point on the belt of the left position
- G (left disc): point on the left disc (Jupiter's edge)
- D (center): the conjunction point where Jupiter is in line with star A on the ecliptic
- P (right of center, on the right band): point on the belt of the right (later) position
- F (right disc): western edge of the right disc
- M (right, on the band): eastern point on the right belt

- R (lower right): point on the right disc
- B (right disc): position of Jupiter's centre/disc at the later observation
- H (right disc, lower): point on the right disc
- A (bottom center, near *Meridies*): the star A (the Virgo star), apex of the construction triangles

Let A be the star of Virgo, the more western centre of Jupiter, B, whose apparent disc FBG is represented much larger, however, than its place warrants. Let the centre of the disc made earlier be the more eastern C, [with] its belt PM, and NL, and the line RBCK parallel to these, and to the Ecliptic—about which parallelism it will be established below. Now from the star A, the more southern, than which Jupiter is also more western, draw the chord AD, connecting the centres of Jupiter's two discs, [with] the star A, [by] the straight lines AB and AC producing AB, up to F, so that the diameter GBF be the diameter, which is understood to be divided into four parts, so that GH is a fourth part of it.

[Margin: 6] 6. And so on the 9th of June, at hour 1, after the setting of the Sun, Jupiter appeared in B, more western, and more northern than the star A, and so the telescope, showing the distance AG, of parts altogether 7, of which one was GH, and the estimation having been confirmed [that] AG [was] $3\frac{1}{2}$, of which one was GB, the semidiameter of Jupiter, and the whole AB [was] of parts 9, of which GH was one; again, AB, of parts $4\frac{2}{3}$, of which GB was one. For the diverse comparison of the observations, agreeing by consent, pleased [us] as evident, since it was as great as it would have been if we had measured that space on the subjacent chart with a compass. But on the following night, on the tenth day, at the first hour, Jupiter appeared in C, more northern, and more eastern than A, so that the distance AC was precisely eight parts, of which the fourth part is the diameter of Jupiter, [it being] one, or equal to four Jovian diameters. The straight line BC having been drawn, by estimation, designating the path of Jupiter, and the latitude's arc, the chord AD—so that Jupiter, having its centre in D, was conjoined to the star A, not bodily, but along the Ecliptic, for it was more northern, by however much AD [was]. This was estimated at parts $4\frac{2}{3}$, of which GH was one. These things being posited: first, in the tri-

by the right angle ABD, and given side AD, side BD comes out as $4\frac{1}{2}$ parts; and from side BD, 9 parts; whence side BD is collected as $4\frac{1}{2}$ parts. Again, in triangle ACD, with the right angle at D, from side AD, $4\frac{1}{2}$ parts, and AC, 8 parts; side CD comes out as 6 parts; and so the whole of BC is 14 such parts, of which GH is one, or rather a part of $3\frac{1}{3}$, equal to the apparent diameter of Jupiter. **Secondly**, Jupiter was at its first station the day before the motion in question, at about 1

hour of the night, lasting through to about the tenth hour of the night, which was 2'40". So this 2'40" is in seconds 160. Let it then be as $3\frac{1}{3}$ is to 160. The result is therefore 48 [seconds], and this is the distance of the planet as it appears on Earth in seconds. 46': again, in CB, second 160: it falls in AD at part $4\frac{1}{2}$, and at 49 [seconds]. So Jupiter was 49 [seconds] from that star, and that star is in northern latitude $1^{\circ}25'$. Jupiter's latitude is northern $1^{\circ}25'49''$: at the moment of conjunction, which was on the 9th of June at 21 hours after noon, and at that time the longitude of the star was $\mathbb{M}$ $29^{\circ}56'25''$: let the Prutenic [tables] then give $29^{\circ}40'$ with latitude $1^{\circ}36'$; the Danish, however, $\simeq 0^{\circ}1'$ latitude, $1^{\circ}33'$; and Lansbergen's $\mathbb{M}$ 30° exactly, with latitude $1^{\circ}24'$. **Thirdly**, since the eccentric anomaly was $1^{\circ}55'$, and the orbital anomaly nearly equal at $2^{\circ}48\frac{1}{2}$, our hypothesis gives the distance of Jupiter from the Earth as 39500 [parts] of the terrestrial semidiameter; and being near the apogee of the eccentric, somewhat below the middle longitude of the epicycle, hence and from the angle of the semidiameter, $23''$ comes out, by Problem 1, Chapter 8, Book 7, of the *Almagestum Novum*, Section 5. There is collected the true semidiameter of Jupiter on Earth, $4\frac{7}{10}$. From this, by Problem 1 of the same chapter, and at the same distances by Section, Chapter 2, the apparent diameters of Jupiter are set down: the maximum 47552, the mean 36500, the minimum 26441 in semidiameter. Then by Section, deducing the semidiameters as they appear at apogee in both directions, $19''9'''$: at the mean distance, $24''53'''$; and in both directions at perigee, $34''23'''$: which numbers come out by chance, just as the other hypothesis preserving the proportions of the same intervals would give, given the distance of the Sun, or the radius of the annual orbit.

7. With these established for us, what was observed the following month, very acutely, by the learned Mr. Vincenzo Mutti — recently appointed at Sole Alphonso, and most illustrious in astronomical expertise — is given to us by Maioxica [Malvasia] on the 30th of June 1649. The observations are these: *Jupiter was observed with the left [star], 4 [minutes?] preceding, in the band of $\mathbb{M}$ on the 9th day of June, hour 10. Jupiter was the more westerly, called the star; but this star was distant from Jupiter by a diameter of Jupiter, plus a far easterly one; between which, in the space of 24 hours, Jupiter, by comparison with the star seen between them, was found to have nearly perfectly traversed the diameters of its own body.* Why was Mr. Mutti's Jupiter not far off in diameter from this in this position [seconds 48]? It can readily be estimated how greatly we rejoiced at so close an agreement and conspiracy of minds about this method, and about the timing of this observation.

CAPVT IV.

De Martis Diametro Apparenti.

[Mars's Apparent Diameter]

1. Albategnius [al-Battānī], chapter 50, and Alfraganus [al-Farghānī], Difference 22, set the apparent diameter of Mars at 1'37" [Minut. 1'. 37"]. Fernelius and Egnatius Dantes, 1'29", or 18". Maginus [Magini] and Vurstisius, 8'. minute. Tycho [Brahe], Clavius, Blancanus, and Argolus indicated above this matter, 1'40". And Lansbergen, in *Uranometria* Book 3, 3 min. 1'30". And indeed all these at the mean distance of Mars from the Earth. Galileo, in Dialogue 3 of the *Systema Mundi*, says that if Mars is viewed through a telescope, it is seen in opposition with the Sun to be sixtyfold, or fiftyfold larger than near conjunction, as far as concerns the area of the disk; but as to the diameter, eightfold or sevenfold. Gassendi, Book 2, *Institutio Astronomica*, chapter 9, says that Mars, which otherwise scarcely equals the fixed stars of second magnitude, at opposition with the Sun in both directions, and especially at perigee, conca...

rs, rivals the magnitude of Jupiter, indeed of Venus: understand it thus, that Jupiter, observed and so often defeated, may be defeated by a perigee Venus. Kepler too, page 333, *Astronom. Opticae*, relates that in the year 1529, in July and August, Mars was seen with prodigious magnitude, so that one would have believed it a new star, and it must have appeared so great in the month of August in 1561, and 1593, and August of the year 1608, and frequently; for Mars is at perigee in the eccentric and in the epicycle in Aquarius. In the *Epitome Astronom.*, page 485, he says Mars at acronychal rising in Aquarius at perigee is seen larger than Jupiter, but not by much; Jupiter, however, seen frequently through the telescope, second [magnitude], 50. And yet in the Rudolphine [tables], by precept 110, he supposes the proportion of the bodies of all the planets, of the diameters of the intervals of the Sun, and of the subtle [parts], that Mars at the same distance appears larger than the Earth, 5'13": but in the middle [position], at diameter 6'50": or therefore much larger than Jupiter appears, although it is not so much larger: vain are those proportions. Yet rightly, as to apparent magnitude at perigee, collating Mars at acronychal rising below the Sun nearer to itself, than Mercury at perigee, and Venus at perigee. Moreover, PP. Soc. I. [the Fathers of the Society of Jesus] at Oeniponte [Innsbruck] and through the telescope's tube estimated the diameter in the year 1636. At maximum proximity to the Earth, on the 23rd of May, 32"; and on the 6th of May, 29". At Marcho [Marchio] Cornelius

Malvasia in the year 1662, July 17, and through his tube estimated 25" thereabouts.

2. **Hortensius**, in his *Dissertatio* with Gassendi on Mercury in the Sun, relates that in the year 1632, he observed Mars at acronychal rising near the apogee of the eccentric, but at perigee, an epicycle of Mars distant from the Moon's limb by no more than one digit, that is, 2'42": and the diameter of Mars almost occupied a quarter of that distance, so that it was not seen much larger, 36. From these assumed intervals he concludes that Mars at acronychal rising at apogee appears second, 9. At perigee, in both directions, 1'4": which he establishes below from Herigonius, vol. 4, *Cursus Mathem.*, page 62. Huygens defines the perigeal diameter of Mars as 30".
3. **We**, with Father Grimaldi, in the year 1649, July 22. By telescope comparing Jupiter with Mars, and in both [cases], we often saw the species transferred onto the paper, the diameter of Mars double smaller, or rather as a fixed [magnitude]: and it was from our hypothesis [that] the apparent semidiameter of Jupiter at perigee 27"5": so therefore Mars 10"32". At its distance from the apogee of the eccentric gr. 86. and at the perigee of the epicycle gr. 255. From these tables, and Problem 1, lib. 7. *Almag. Novi*, Section, we deduced the true apparent semidiameter of Mars on Earth 5"3": and so [for] the apparent semidiameter of the Earth 5"3": therefore at apogee semidiameter 5"3": at perigee 46": and at the mean 11": but in the year 1651, on the 5th of April, Mars seen compared with ♃ and ♄ 45" [seconds]: and in the year 1655, July 22, of 60 parts, of which Jupiter was 68.

CAPVT V.

De Diametro Apparenti Veneris.

[Venus's Apparent Diameter]

1. **Venus** at its mean distance — Albategnius [al-Battānī] defines its apparent diameter as 3'8". Alfragan [al-Farghānī], 1'34". Fernelius, 5'. Egnatius Dantes, 4'. Vurstisius and Magini, 10'30". Tycho [Brahe], Clavius, Blancanus, and Argolus, as indicated in chapter 2.
2. **Scheinerus** [Scheiner], in a letter of the year 1611, addressed to Marcus Welser, sets the diameter of Venus subdecuple [one-tenth] to the diameter of the Sun, and so above three-and-a-half minutes, but on the elliptic [path] of the Sun. By tube in the year 1612, he says Venus, with the same tube

taking up [excepting] the species of Venus on paper, and of the Sun, at the same distance between them, as a paper [reckoning], on the 23rd of October he found the diameter of Venus to be $2\frac{1}{2}$, of which the diameter of the Sun is 34': and on the 27th and 29th of October, again, on the 26th of December he found it again at 2'. He admits, however, that the observation was shadowy [umbratilem], reserving a better observation for another time. I do not know, however, whence Hortensius...

sus attributes to Scheiner a diameter at apogee of 34". The mean 1'40". And at perigee 3'42".

3. **Galileo**, in his Letters, Letter 1, addressed to Marcus Welser, reproaches him for observing the magnitude of Venus not by the unaided eye, but through the telescope, as if by a fine hair, full of redness all around. For it must either be observed in daylight, or through the telescope; and in either way that hair is laid bare by that redness. He adds that Venus at morning conjunction, and at apogee, scarcely [reaches] the five-hundredth part of the solar diameter, that is, 10". But Hortensius writes to Gassendi that, directly, by telescope comparing the diameter of Venus with the interval of the contiguous Hyades, when it came near to the Sun, [it was] 15"–20". Whence the visible distance at apogee with the Sun, seen 15'–20": at which distance Hortensius establishes the diameter of Venus at 1'40": to which Huygens subscribes above. But Hortensius had not seen Venus at perigee, as we have. By Kepler's precept 110 of the Rudolphine [tables], from the proportions of which above, he computes the perigeal diameter of Venus 7'6". At last Hevelius, chapter 55 of the *Selenographia*, says that in the year 1644 he saw Venus around morning [as] a $\square$ [quadrate] to himself 46": and in the year 1646, April 22, compared with a $\odot$ [Sun] spot, seen at the perigee of the epicycle 1'22" min.

PP. Soc. nostrae Ingolstadij, & ex sui Tubi capacitate aestimarunt diametrum ♀ sic [The Fathers of our Society at Ingolstadt estimated by their tube's capacity the diameter of Venus thus]:

Anno	M.	D.	'	"
1619	Febr.	11	2	12
	vel		2	0
	Febr.	20	3	0
	Mart.	27	1	37
	Maij	1	0	54

Anno	M.	D.	'	"
	Maij	27	0	30
	Iulij	5	0	54
	Octob.	12	2	2
	Nou.	18	1	0
	Nou.	30	1	0
1621	Nou.	11	2	15
1622	April.	21	2	15
	Iulij	9	1	7
	Aug.	8	0	45
1635	Ianu.	7	1	42
	Ianu.	11	2	0
	Ianu.	28	2	29
	Febr.	7	3	0
	Sept.	19	0	51
1636	Mart.	23	0	33
	Maij	16	0	44

4. **We**, with rare good fortune in the year 1649, June 29, observed Venus in the evening by telescope, [Venus] coming into conjunction with the Sun on July 7, but aided by great latitude it appeared with an enormous sickle [shape], rivalling the Moon; and on the 26th of July, in the morning by telescope, taking up thirty minutes, but its capacity divided into four parts, its diameter was observed, or the interval of the horns, by which proportion also with the diameter of Jupiter, then in that month, and in the year 1650, at the beginning, we established the apparent diameter of Venus at apogee second $33\frac{1}{2}$. The mean $1'4''12'''$, and the true diameter at perigee $4'16''$: than the true diameter of *Almagestum Novum* Book 7, Section 6. And it does not hinder that Gassendi, in his letter to Schickard, saying that Venus, if it were seen beneath the Sun, would scarcely appear of one minute, that I would not grant to him, unless optically the splendor of the Sun greatly diminishes the phase of Venus: nor likewise does it hinder that Christian Huygens, in the *Systema Saturnium*, says it does not exceed $85''$, since he observed Venus at perigee, as we did, and how slippery Huygens's method is in observing the diameters of the planets, I indicated in chapter 1, number 11. I recall indeed that on another occasion I was with Father

Grimaldi in requiring that we should diminish the diameter of Venus somewhat, but not so much that it exceed 2', and that it come close to 3'.

CAPVT VI.

De Diametro Apparenti Mercurij.

[Mercury's Apparent Diameter]

1. **Albategnius** [al-Battānī], chapter 50, puts the apparent diameter of Mercury at the mean distance from the Earth at $2'5\frac{1}{2}''$. **Alfragan** [al-Farghānī], diff. 22, min. $1'15''\frac{1}{4}$. **Fernelius**, and **Dantes**, 2'. **Vurstisius** and **Maginus**, 7'. **Tycho** [Brahe], **Clavius**, **Blancanus**, and **Argolus**, min. $2'10''$. **Lansbergen**, lib. 3, *Uranometriae* 2'. **Hortensius**, in his *Dissertatio*, [says] that Mercury, with the tube inverted, takes up [excepting] the species of Mercury approaching to the apogee of the eccentric with the Sun at conjunction, and from this deduces its diameter at apogee, second 10. And from this, by the distances of **Lansbergen**, the mean at 19". At perigee 28".
2. **Petrus Gassendus** [Pierre Gassendi], in the year 1631, on the 7th of November, except for the most obscure lucid circle of the Sun through the telescope, in the most obscure camera [camera obscura], whose diameter equalled three-quarters of a Parisian foot, and it was divided into 60 equal particles, each [equal to] half a minute; and as Mercury crossed beneath the disk of the Sun, taking up its shadow [umbella] on the same paper, he found its diameter from there at most a third of one minute, that is, 20": from which he concludes the diameter of Mercury does not exceed in the middle distance the ninety-eighth part of the solar diameter. Thus he says, Letter 2, to **Schickard** on Mercury in the Sun: and in the *Epicurum*, page 899, he says there existed a splendid species of the solar circumference optically [as] a shadow [umbellam] of Mercury, somewhat smaller appearing.
3. **Io. Hevelius** [Johannes Hevelius], chapter 4 of the *Selenographia*, relates that in the year 1644, November 22, in the morning, hour 7, he saw Mercury at five-eighths smaller than Mars: and in the year 1645, May 16, in the evening, hour $8\frac{2}{3}$, still [as] a small sickle seen through a tube with a small star added to the fixed stars of the first magnitude, which Mercury we have as second [diameter] 17, thereabouts.

PP. Soc. I. Ingolstadij... Tubo aestimarunt [The Fathers of the Society of Jesus at Ingolstadt estimated by tube]:

Anno	Mens.
1620	Octobr.
1636	Martij

4. **We**, in the year 1650, on the 2nd of January, in a most serene horizon dragged the image of Mercury onto the chart by telescope mode, 7. Chapter 1 and 8: and comparing it with the diameter of Jupiter, which was then 44": we found it to be, by 2, and 5, that is, nearly 18": by which distances, and by Problem, lib. 7. *Almag. Novi* Section 6, we deduced the true semidiameter of Mercury, and the fourth part of the semidiameter of the Earth; but the apparent diameter at apogee, second 9'20": at the mean distance 13"48": and in both directions at perigee 25"12".

CAPVT VII.

Synopsis Opinionum de Diametris Apparentibus Planetar. Minorum.

[Synopsis of Opinions on the Apparent Diameters of the Minor Planets]

Libro 7. *Almag. Novi* Section 6, chapter 9, what is set down there both as the apparent and the true diameters of the planets, was posited for the Lansbergian semidiameter [as] diameter. Here we add a few things.

Diametri Apparentes Planetarum Minorum in Apogæo,
Media Distantia, & Perigæo utroque.

[Apparent Diameters of the Minor Planets at Apogee, Mean Distance, and Perigee, in both directions]

The diameter values are given in three columns per planet, headed ' (minutes), " (seconds), ''' (thirds). The planet columns are: ♄ (Saturn), ♃ (Jupiter), ♂ (Mars), ♀ (Venus), ☿ (Mercury). The "Diam." / "Appar." column gives the position of the planet on its orbit (Med. = mean, Apog. = apogee, Perig. = perigee).

	Diam.					
Authority	Appar.	h' '' '''	q' '' '''	♂' '' '''	♀' '' '''	♀' '' '''
Albategnius	Med.	1 44 28	2 36 40	1 34 0	3 8 0	2 5 20
Alfraganus	Med.	1 44 28	2 36 40	1 34 0	1 34 0	1 15 12
Fernelius	Med.	1 40 6	2 30 50	1 29 0	5 0 0	2 12 0
Egnatius	Med.	1 40 0	2 32 0	1 28 0	4 0 0	2 12 0
Dantes						

Authority	Diam. Appar.	♂ ' " '''	♀ ' " '''	♂ ' " '''	♀ ' " '''	♂ ' " '''
Vurstisius, & Maginus	Apog.	5 0 0	8 0 0	6 0 0	9 0 0	5 0 0
	Med.	6 0 0	9 30 0	8 0 0	10 30 0	7 0 0
	Perig.	7 0 0	11 0 0	10 0 0	12 0 0	9 0 0
Tycho, Clavius, Blaucanus, Argolus	Med.	1 50 0	2 45 0	1 40 0	3 15 0	2 10 0
Lansbergius	Med.	1 40 0	2 30 0	1 30 0	3 0 0	2 0 0
Keplerus	Perig.	0 30 0	0 50 0	6 30 0	7 6 0	
Martinus Hortensius, & cum eo	Apog.	0 31 0	0 38 30	0 9 0	0 15 20	0 10 0
Herigonius de ♀ solitariè	Med.	0 37 0	0 50 0	0 36 0	0 53 0	0 19 0
	Perig.	0 42 40	1 1 40	1 40 0	1 40 0	0 28 0
Hortens. de ♀ cum Comit.	Perig.	1 0 0				
Nos cum P. Grimaldo, sed de ♀ solitariè sumpto	Apog.	0 22 0	0 38 18	0 10 6	0 33 30	0 9 20
	Med.	0 26 40	0 49 46	0 22 0	1 4 12	0 13 48
	Perig.	0 36 0	1 8 46	1 32 0 [vel]	4 8 0	0 25 12
					2 45 0	
Sed de ♀ cum Comitib.	Perig.	1 12 0				
	Med.	0 57 0				
	Apog.	0 46 0				
Simon Marius	Med.		1 0 0			
Hevelius	Perig.		1 2 0			
Gassendus	Perig.		1 0 0			

Authority	Diam. Appar.	♂ ' " "	♂ ' " "	♂ ' " "	♀ ' " "	♀ ' " "
Scheiner apud Hortensium	Apog.				0 34 0	0 20 0
	Med.				2 40 0	
	Perig.				3 42 0	
Anton. Maria Rheita	Med.	2 0 0	3 0 0			
Galilæus	Apog. in				0 10 0	
Io. Heuelius de ♂ solitario, ac rotundo	Med.	0 39 36"				
Cristianus Hugenius cum ansis	Perig.	0 30 0	1 4 0	0 30 0	1 25 0	1 [?]
	Perig.	1 8 0				

CAPVT VIII.

De Apparenti Diametro Fixarum.

[On the Apparent Diameter of the Fixed Stars]

1. Galileo, in Dialogue 3 of the *Systema Mundi*; Giordano Bruno, in his book *De Maximo et Immenso*; and Kepler, in his *Dissertatio cum Nuncio sidereo*, think that the fixed stars are just as many Suns; yet as to apparent [size] Galileo, using a thread, in chapter 1. Manner 3, asserts that Lyra and the rest of the first magnitude do not exceed a diameter of 5": and therefore from the distance of the fixed stars (which Copernicus requires to be so great, that it excludes every parallax perceptible by the inhabitants of the Earth as they go through the annual orbit) it does not follow that the fixed stars are larger than the annual orbit. Kepler, however, who in his book *De Stella nova*, chapters 16 and 21, had earlier conceded to the telescope that Sirius is 4 minutes, and the stars of Orion's belt 2 minutes, afterward, in the *Epitome Astronom.*, page 498, says: *Skilled artisans deny that any quantity of the rounded body is detected by inspection of the telescope; nay rather, that the telescope represents the fixed stars all the greater, the smaller they are; for the bare points exit and are dispersed into the species of hairs by their*

lucid rays. And in the same place he holds the mass of the fixed [stars] to be smaller than the Sun. Huygens too likens them to points.

2. **Lansbergius**, lib. 3. *Uranometriae*, element 20, has this: *He defines the apparent semidiameter of the fixed stars of the first magnitude — Albategnius at 45", and Tycho at one scruple [one minute]. We at half a scruple [half a minute]. For through the optical tube it appears still much smaller.* Why therefore does he not trust the tube which liberates the disks of the stars from the deception of adventitious rays? — especially when Hortensius, his very friend, so labors to liberate the Copernican hypothesis from the absurdity of the immense mass of the fixed stars following from their immense distance, so that, comparing by telescope Sirius with the image of Jupiter [it is] 10, only Second; and to the rest of the first rank he conceded 8". Falsely, however, because he erred in [the case of] Jupiter, as said in chapter 3.
3. **Moreover** we, with Father Grimaldi, covering over the objective lens of the telescope with a perforated little plate of foil, so that we might see the disks of the stars without rounded hairs of rays, and taking up their species onto a chart, divided the diameter of Saturn, without its companions, into 160 parts: but Jupiter into 200 parts, of which an inch of a foot is 100: then [we divided] very many smaller little circles, and smaller [ones] on the same chart, 20 such parts, the largest 100. Having inspected, after [comparing them with] the fixed stars, the most close to them, [and] comparing with the most acute eye and judgment, [those] of the Fathers Paolo Casati and Matthaeus Tabernae: at length, from the now certain diameter of ʰ and ʷ, we determined the apparent diameters of the fixed stars written below, from which we investigated the true [diameters] in Book 6 of the *Almagestum Novum*, Section 9.

LIBER DECIMVS — DE PARALIPOMENIS PLANETARVM

[Caput VIII, continued — De Apparenti Diametro Fixarum]

The apparent diameter of the fixed stars as we observed it, when the diameter of Saturn alone was 35" and that of Jupiter 44".

Fixed star of first magnitude	App. diam. (")	(""	Remaining star	M ag n.	App. diam. (")	(""
Sirius	18	0	Procyon	2	12	20
Bright star of Lyra [Vega]	17	24	Bright star of Aquila [Altair]	2	11	0
Arcturus	16	42	Belt of Orion [Cinguli Orionis]	2	8	50
Capella	16	8	Bright star of the Crown [Coronae lucida]	2	8	21
Aldebaran	15	24	Polaris	2	7	54
Spica Virginis	15	5	Head of Medusa [Medusae caput]	3	7	3
Regulus	14	5	Pollux [Propus II]	4	6	10
Rigel Orionis	13	40	Bright star of the Pleiades [Pleiadū lucida]	5	5	16
Fomalhaut [Fomahant]	13	25	Alcor, or the Horse [Alcor, seu Equus] in the tail of the Great Bear [in cauda Ursae maioris]	6	4	24
Antares	13	12				
Heart of Hydra [Hydrae cor]	12	45				
Tail of the Lion [Cauda Leonis]	12	30				

The apparent diameter of the fixed stars, reduced to seconds [secunda scrupula] from the opinion of others.

	1 ("	2 ("	3 ("	4 ("	5 ("	6 ("
Albategnius [al-Battānī]	90					
Kepler, before the use of the telescope [Kepler. ante	180	120				

	1 (")	2 (")	3 (")	4 (")	5 (")	6 (")
vsū Telesc.]						
Io. Anton. Magin. [Giovanni Antonio Magini]	600	330	240	180	120	60
Tycho, Longom., Blanc. [Tycho Brahe, Longomontanus, Blancanus]	120	90	65	45	30	20
Philipp. Lansbergen. [Philips van Lansbergen]	60	40	30	20	10	5
Hortens. & Gassend. [Hortensius & Gassendi]	8	6	5	4	3	2
but for Sirius [sed pro Sirio]	10					
Galilaeus [Galileo]	5					

See Gassendi, book 3, *Institutio Astronomica*, chapter 11; Magini, book 1, *Theoricae*, chapter 19; Tycho, volume 1 of the *Progymnasmata*, page 481; Longomontanus, book 1 of the *Theoricae*, chapter 1; Blancanus, at the end of the *Sphaera*; Herigone, volume 4, chapter 4, where he follows Hortensius, and volume 5, book 2 of the *Theoricae*, where he reports Tycho's figures.

CAPVT IX

De Saturni Figura, Fascia, Comitibus, eorumque situ, respectu Aequatoris, vel Eclipticae

On the Figure of Saturn, its Band, its Companions, and their Position with respect to the Equator or the Ecliptic

1. Among the phenomena revealed to our age from the heavens by the help of the telescope, none is perhaps more astonishing, and none has hitherto exercised the talents of astronomers more, than the appearance Saturn presents. Three things in it are especially worth noting. The first is a certain **band** [Fascia] which, like an oblique zone, seems to gird the body of Saturn. The second is the **companions** [Comitibus], two little globes set in a line with the middle body of Saturn and for the most part parallel to the equator — though sometimes the alignment seen is parallel to the ecliptic. The third is the incredible variety of shapes under which both Saturn itself

and its companions — whether the companions are themselves spheres, or the sides [latera] of Saturn — appear at different times.

For sometimes, though rarely, Saturn appears solitary, without companions, and then almost round. Sometimes it is represented with two companions on either side, round and adjacent to it; sometimes the companions, lying very close to it, fall off little by little from roundness and are curved into handles [ansas]; sometimes they appear nearly hyperbolic; sometimes they look almost half-moon shaped, and with their arms thicker at the ends [crassicaie? — *brachijs interdum crassioribus*]; sometimes Saturn itself appears more slender, the companions vanishing; sometimes it returns to roundness and conforms itself more and more into an ellipse. About these shapes we have decided to set out distinctly and in order, just as we observed them — and as some others have done up to now.

De Fascia Saturni

On the Band of Saturn

2. [Margin: 2] In the year 1655, from the 20th of March up to the beginning of June, Saturn was seen by P. Grimaldo [Grimaldi] and by us with a band, as in Figure VI below — a band somewhat dark and narrower than Jupiter's band, and appearing nearly parallel to the ecliptic [Eclipticae], as it presents itself on the 23rd of April and the 9th of May.

In the year 1656, from the 9th of February and thereafter, it was repeatedly seen by us with a band, as in the figure noted above, and clearly from the 12th of December onward; and on the 24th, P. Grimaldo again saw Saturn's band parallel to the ecliptic, with some interruptions where the sky prevented observation. But in the year 1657, on the 11th of January in the morning, P. Grimaldo saw Saturn separated from its companions, with the said band, and likewise on the 19th of January and the 16th of February, when the oblong companions are placed, and the band crosswise in an ecliptic position; likewise on the 26th of February and the 13th of March, and on the 25th of March — but then the companions seen were very oblong, slender, and notably separated, and approaching Saturn [h] together with the Sun, and the band very evidently apparent. But on the 20th of April and the 6th of May the oblong companions were seen, yet separated, and the band scarcely distinguishable, more so through the whole of June, and at the start of July. At last, on the 2nd of August, with the oblong companions present, the band was no longer distinct — perhaps on account of the nearness then both of the Sun and of the vapors of the horizon; and it appeared so even on the 20th of October, now become a morning object. But on the 23rd of January 1658, the

band was an oblique line of the companions, and a little below the center of Saturn's disk.

De Linea Comitum Saturni, eiusque Parallelismo ad Aequatorem, vel Eclipticam

On the Line of Saturn's Companions, and its Parallelism with the Equator or the Ecliptic

3. [Margin: 3] Galileo, in his 3rd Letter to Marcus Velsesus [Marcum Vuelserum], page 148, affirms that the line drawn through the center of Saturn and its companions, and their parallelism, is parallel to the equator. The same is held by P. Franc. Maria Grimaldo [Francesco Maria Grimaldi] and by us, who have often observed it.

For in the year 1646, on the 10th of October and the 16th of November, we saw the said line to be parallel to the line drawn from the bright star of Aries to Aldebaran, which is parallel to the equator. And again in the year 1647, on the 7th of October, the said line, produced by an estimate of the eye, would pass through the southern horn of Taurus, and through the Pleiades — the most southerly point — as the telescope showed; and this line is established to be parallel to the equator, to the senses. Again, in the year 1649, on the 20th of July, the said line was parallel to a line drawn through the Pleiades, and the center of Saturn was then situated in 25° of Gemini [II], with 1° 30' south latitude.

In the year 1650, on the 18th of March, P. Grimaldo saw the center of Saturn, and a companion, with a certain unnamed little star, in the same straight line, distant from the nearest companion toward the east by about half a moon's breadth; but on the following night, the 23rd, he saw Saturn having overtaken that little star, yet in such a way that it appeared more southerly toward the south by as much as the four diameters of Saturn were larger. From this he concludes that the line of Saturn and its companions is not parallel to the ecliptic — otherwise on the 23rd it would have kept that little star in line.

In the year 1653, on the 9th of December, and the following days, we and P. Grimaldo observed that the said line is moved by the diurnal motion of the *primum mobile*, and is parallel to the equator.

In the year 1654, on the 6th of January, and on the 11th of February, and on the 1st of March, by comparing the said line with the ecliptic,

[The line] was situated then with Saturn [♄], and with respect to the moon [☾], it appeared to be not parallel to the ecliptic; indeed, when it was at the meridian, we saw it parallel to the horizon, hence to the equator — for Saturn was then near the end of Leo [♌].

Finally, in the year 1655, from the 20th of March up to the beginning of June, by the same arguments treated above, the line was seen parallel to the equator, with the companions of Saturn.

4. [Margin: 4] Notwithstanding these things, Hevelius, in the *Dissertatio de Saturni facie* published in the year 1656 — and from this, of his humanity, liberality, and kindness toward me, conveyed to me ahead of publication — concedes that the said line of Saturn, when Saturn is moving through Sagittarius, Capricorn, Gemini, and Cancer, is parallel to the equator; in Aries, however — and in Libra, Aquarius, and Leo — he contends that it is neutral, that is, neither parallel to the equator nor to the ecliptic; but in the remaining signs, especially in Taurus and Scorpio, that it is parallel to the ecliptic. Although he admits — and we, with great labor, observed it from the year 1643, 1644, and 1645 — that in Aries the parallelism with the equator is more easily observed in the four said signs, indeed in nearly six.

To this opinion of his, however, the table he exhibits on page 15 does not agree: for in that the directions of Saturn's handles [ansularum] are placed throughout the whole sign of Taurus [♉], and almost throughout the whole sign of Libra [♎] — that is, up to 23° of the sign. For from the very beginning of Taurus up to 24° they are oblong; then in Gemini [♊] he places it as *Neutral* [Neutralis]; then up to 24° oblong, again *Neutral*; thereafter up to 24° of Cancer [♋] he places it again *Neutral*, and after that up to 24° of Leo [♌]; thence to the end up to 24° of Virgo [♍] he places it as *Equinoctial* [Aequinoctialis]; thereafter again up to 24° of Libra [♎] *Neutral*, and after that *Ecliptic* [Eclipticalis]. Huygens [Hugenius] too, as I will say below, redirects Hevelius.

5. [Margin: 5] From our own observations, however — in which that line was seen to contradict the line parallel to the equator — it was observed in the year 1646, on the 16th of November, in 14° of Taurus [♉], where for us it is Ecliptical [Eclipticalis], and in the year 1650, on the 18th of March in 24° of Gemini [♊]; in the year 1653 on the 6th of December in 16° of Leo [♌]; in the year 1654 on the 26th of January in 25° of Leo, and in the year 1655 on the 20th of July in 5° of Leo, and in 4° of Gemini [♊] — in all of which, for Hevelius, it is *Neutral*. And in the year 1658, on the night between the 29th and 30th of July, P. Grimaldo and I saw with the telescope that Saturn was

moved, with the western extremity of its companion line, as it were toward sunset, and that the extreme companion moved manifestly following the motion of the *primum mobile* through the parallel of the equator. This too confirmed for us the situation of the equator in our observation, and from a comparison with the ecliptic — which the line drawn through the Heart of Scorpio [Cor Scorpj] and through Spica indicated nearly. Hence our most friendly Hevelius saw his own *vaticinium* [prediction], which on page 27 of his Dissertation he had pronounced without any doubt — namely that the said line, when Saturn is in Libra [♎], would be parallel to the ecliptic — would not have held. The same is confirmed from his own figure of the position, of which I spoke at number 2, for the year 1657, with Figure 17 attached.

De Saturno solitarie viso

On Saturn Seen Solitary

6. [Margin: 6] First, Scheiner, in the *Disquisitiones Mathematicae*, conclusion 44, says of Saturn: *Now one, now three-bodied* [Modo vnus, modo triceps comparet: aliàs procerus, aliàs rotundus]. Would that time had added what makes it now solitary, now round, and seen round.
7. [Margin: 7] In the year 1612, Galileo writes to Marcus Velsesus that around the summer solstice of that same year he saw Saturn as if three-formed [triformem], but with the observations interrupted, because nothing such was suspected. At last, toward the end of November, he saw it solitary, that is round; and so it persisted until December, as you may gather — although it might also be feared that around the summer solstice of the year 1613, Saturn would appear with companions, and after two months by the brumal solstice [bruma] of the year 1614 they would conceal themselves for some months; and in the year 1615 around the summer solstice not entire, but in part apparent, and indeed whole again, and quite large, through many years, without any concealment of the companions.
8. [Margin: 8] In the year 1642, Gassendi and Bullialdus [Bouillaud], at Paris, with August beginning, saw Saturn solitary, and round up to the occasion of its heliacal setting, which fell in February of the year 1643. Therefore, says Gassendi, why with Saturn [♄] at acronychal rising [Actonychthus] on the 5th of September — when Saturn was at acronychal rising — did it appear even to the naked eye so small? He adds, toward the end of the following May, that with the same band visible, a three-bodied

[Tricorpore] form cohering thence on either side with two little globes of the same whiteness — and that it so persisted under a varied companion-form up to March of the year 1644. So he, in the *Iudicium de 9 stellis* about Jupiter seen at number 6, and in the *Epicurus*, page 905. Hevelius too, on page 42 of the *Selenographia*, and in the Dissertation on Saturn's face, page 7, affirms that Saturn appeared round to him on the 20th of September, and the 8th of October, around the 20th. In opposition with the Sun, on the contrary, in the perigee of an eccentric ellipse, he represents it round.

9. [Margin: 9] In the year 1656, on the 9th of February, up to the 14th of May, we saw with P. Grimaldo Saturn solitary, without companions, with the band drawn crosswise, as in the subsequent Figure II. Thereafter it began to be seen round with the band, and was so seen up to the 17th of July. From that point on, it ceased to be observable because of its nearness to the heliacal setting, then with the vapors of the horizon. Afterward, however, it could not be observed after heliacal setting, with the surrounding clouds, but it was observed up to the 25th of October, when, having become a morning object, it appeared with the companions separated, as in Figure V. Bullialdus also, at Paris, in January, and Hevelius at Danzig [Gedani] in the same year 1656, on the 25th of February up to the 1st of May, saw it round; and the same Hevelius, on page 7 in his Dissertation on Saturn's face, reports this. About Huygens I will speak below.

Figurae Saturni ex nostris, et aliorum observationibus collectae

Figures of Saturn collected from our own and others' observations

10. [Margin: 10] Among the figures that follow, Hevelius calls Figure I the *Mono-spherical* [Monosphaericum] Saturn; Figure III the *Tri-spherical* [Trisphaericum]; Figure XI the *Spherico-cuspidate* [Sphaericocuspidatum]; Figure XII the *Spherico-handled* [Sphaericoansatum]; Figure XIII the *Diminished elliptico-handled* [Ellipticoansatum diminutum]; and Figure XIV the *Full elliptico-handled* [Ellipticoansatum plenum]. The remaining figures he does not exhibit.

Diagram. A full-page plate enclosed in a ruled rectangular frame, showing ten numbered figures (I–X) of the changing telescopic appearances of Saturn, arranged in two columns (left: I, III, V, VII, IX; right: II, IV, VI, VIII, X). The figures progress from a simple round disk to fully developed handled/elliptical forms.

- **I.** A single plain circle — Saturn seen solitary and round (the *Monosphaericum* form).

- **II.** A single large circle crossed obliquely by a dark hatched band running from lower-left to upper-right — Saturn round with the band [fascia] drawn crosswise.
- **III.** A central circle with a small rounded handle-like projection on each side, the projections touching the disk — the *Trisphaericum* / earliest handled form.
- **IV.** A central circle flanked by two small separated round companions [comites], one on each side, not touching the disk.
- **V.** A central circle flanked by two separated oblong (oval) companions, one on each side — the companions elongated.
- **VI.** A central circle crossed obliquely by a dark hatched band (as in II), and flanked by two separated oblong companions on each side — band plus oblong companions.
- **VII.** A central disk flanked on each side by a larger crescent-/handle-shaped form with dark hatched (shaded) inner edges, the forms overlapping the disk — developed handles.
- **VIII.** Similar to VII: a central disk with two hatched handle-forms, slightly more open/separated.
- **IX.** A central disk girdled by a broad elliptical ring whose two sides are dark hatched crescents, forming an ansate (handled) ellipse — the *Ellipticoansatum* form.
- **X.** As IX but with a fuller, wider elliptical ring and bolder hatched crescents on each side — the *Ellipticoansatum plenum* (full handled-ellipse) form.

Liber Decimus — De Paralipomenis Planetarum (continued)

Caput IX — De Saturni Figura, Fascia, Comitibus (continued)

[?] In the same year, around the end of [?]... O[...] saw it [the planet] with two small companions, one preceding and one following, joined to it [coniunctos]... P. Grimaldi too saw the same companions, in October... and others. [?]

1642. In February [?]... he saw Saturn with little globes [globulis] separated, as in Fig. IV, and he has it under observation [in observatione]...

1643. [?]... [the matter is treated] in the *Disquisitiones Mathematicae* [(Scheiner, *Disquisitiones Mathematicae*)]...

[The remaining left-column fragments are too abraded and intercut by the plate frame to recover continuously; see the running observation chronology on the facing page (folio 364), which carries the same sequence in full.] [?]

Diagram. A single framed plate containing seven telescopic representations of Saturn, numbered XI through XVII (continuing the series I–X of the preceding folio). Each is a schematic woodcut of the planet's disk with its appendages [ansae], the shaded (hatched) regions indicating the dark or unilluminated parts. From top to bottom and left to right:

- **XI** (top center): A globe flanked on both sides by a pair of crescent-shaped, hatched appendages set off slightly from the disk — the "elliptical-handled" [elliptico-ansatus] form, with the handles separated from the body by dark interstices.
- **XII** (upper left): A globe with two large, broad hatched wing-like appendages embracing it closely on either side, the "spherical-handled" [sphaerico-ansatus] form.
- **XIII** (upper right): An elongated, broad elliptical body with the planet's disk at center and extensive hatched lateral extensions — the "full elliptical-handled" [elliptico-ansatus plenus] form.
- **XIV** (middle left): A narrower elliptical body, the disk at center with slimmer hatched lateral appendages — the "diminished elliptical-handled" [elliptico-ansatus diminutus] form.
- **XV** (middle right): A small central disk with thin, nearly straight lateral handles set off by clear interstices — a slender "spherical-handled" form.
- **XVI** (lower center, largest): A large plain round globe flanked by two detached, narrow hatched lateral bodies (the ansae seen edge-on or as separated companions) — the "spherical-handled" form at maximum.
- **XVII** (bottom center): A central disk set within a broad hatched lenticular (almond-shaped) band, flanked on the far left and far right by two small round globes — the "tricorporeal" [tricorporeus] appearance, the planet flanked by two companion-globes.

1609. Galileo [Galileo], in his Letters 1 and 3 to Marc Welser [Marcus Vuelserus / Marc Welser], reports that Saturn appeared to him tricorporeal [tricorporem], with globes [globulos] adhering to it — imperfect with weaker tubes, but distinct [discretos] with better ones — as in Fig. IV. Scheiner [Scheiner] too says that around this time the planet appeared to him triform [Triformem], though at other times solitary [solitarium], as I said at num. 6.

1612. Saturn was seen round, without companions, by Galileo, as you see above at num. 7 and Fig. I.

1614. February 12, 13, 14. Scheiner saw Saturn with the globes separated [globulis seiunctis], as in Fig. IV; but in such a way that the left-hand one, because it was in the upper position, appeared more brilliant [luculentior], and more remote from Saturn. So he reports in his *Disquisitiones Mathematicae* [(Scheiner, *Disquisitiones Mathematicae*)], conclusion 44.

1616. P. Giuseppe Biancani [P.Ioseph. Blancanus / Giuseppe Biancani], toward the end of October — as he relates in his *Sphaera* [Sphaera], book 15, ch. 7 — saw Saturn oviform [Oviformem], with two spots [maculis] nearly round toward its top [verticem]; and in the same manner in November of 1619, but with an imperfect tube.

1625. February 17. Martin Hortensius [Martinus Hortensius / Maarten van den Hove (Hortensius)] saw Saturn with the globes [globulis] nearly as in Fig. IV; they were not far from the Sun, and Hevelius [Hevelius / Johannes Hevelius] reports it on the figure of Saturn, p. 7.

1630. June. Francesco Fontana [Franciscus Fontana / Francesco Fontana] at Naples saw Saturn with the globes separate [globulis separatis], as in Fig. IV, and he has it in his published treatise [tract.], 7.

1632. Hortensius, July 16, saw Saturn handled [ansatum].

1633. Pierre Gassendi [Petrus Gassendus / Gassendi], observing in June, saw Saturn with handles [ansulis], as in Fig. VII and VIII, just as he reports in his observation of the 9th of the stars about Jupiter [circa Iouem], and in the same way Fontana, as above.

1634. April. Gassendi, as in his observation of the 9th of the stars [9. Stellis], and Fontana — in his treatise — saw Saturn with handles [ansulis], as in Fig. VII. So Gassendi, as in Fig. XIV.

1636. Gassendi in November saw Saturn with handles [ansulis], as he has it in the aforesaid observation, and Fontana, so that the planet itself was not round, as in Figura VII.

1637. In November — indeed earlier, in February and July — Gassendi saw Saturn with handles [ansulis]. On the 9th of the stars about Jupiter [9. Stellis circa Iouem], the Fathers of the Society [PP. Soc.] at Innsbruck [Oeniponte] on the 19th

of March had seen its companions [Comites] contiguous with it, as also on the 26th of August [26. Augusti].

1638. Gassendi, as above, in December saw Saturn round, but not at all spherical [minimè rotundum], as in Fig. IX or X.

1640. May 23. P. Nicolò Zucchi [P. Nicolaus Zucchius / Zucchi] observed Saturn with the companions separated [Comitibus separatis], and curved, or imitating the form of a pear [pyri formam imitantibus], as in Fig. IV; though of excessive size [magnitudine] — a figure transmitted to me from Rome by him.

1642. Gassendi and Boulliau [Bullialdus / Ismaël Boulliau] in August, and Hevelius in October, watched Saturn solitary and round [solitarium, & rotundum], as in Fig. I, just like Fig. III.

1643. Toward the end of May, Saturn at heliacal rising [Heliacè ortus] was seen round, and with the borders [alboris] of the same nearly adhering, as in Fig. V; so Gassendi affirms, in his *Epicurus* [Epicuro], p. 905, and Epistle 3 to Wendelen [Vuendelinum / Govaert Wendelen], adding that he had observed it for so long. We saw it together with P. Grimaldi [P. Grimaldo / Grimaldi] on October 29, and beheld its companions [comites], as in Fig. V.

1644. Gassendi, as he relates in his Epistle p. 905, in March and June saw Saturn, as in Fig. IX, and afterward in December, as in Fig. XI. P. Daniel Bartoli [P. Daniel Bartolus / Bartoli] at Naples, with P. Sirsale's [P. Sirsali / Cristoforo Sersale] excellent telescope, observed the lower companion smaller and dimmer than the upper [comitem superiorem minorem inferiori], its shadow less obscure; and the same companions joined to Saturn [vnita erant Saturno], as in Fig. XII, in a single [vnita] appearance. With which globes [globis] he could not discern whether they cohered with the body of Saturn or had detached themselves from it, as in Fig. XVII — under which we have never been allowed to view it [the planet]. [?]

1645. Hevelius in September, October, November saw Saturn handled [ansatum]; but Ioan. Lips. [Ioan. Lyps. / Jan Lips] from the beginning saw it round, as in Fig. IV. Gassendi, however — as he relates in his *Epicurus*, p. 905 — saw the companions [Comitum] gradually produce cusps [cuspides], so that on either side, were the obscure middle globe intercepted, they would touch the undulating dark interstice [obscurum interstitium]; the very same globes in lunulate [lunulate] form would, as it were, exhibit hyperbolic shapes from this cohesion, and so on account of this coherence appearing, they would be taken for handles [pro ansulis], because that obscure interstice would appear like apertures [foramina]

— yet Fontana too [held this], see Fig. 10. Fontana on the 3rd and 13th of December saw it nearly [round], as in Fig. XVII.

1646. Eustachio de Divini [Eustachius de Diuinis / Eustachio Divini] right up to 1647 and 1648 affirms that Saturn appeared to him oviform [Oviformem], as in Fig. X. Or:

1647. Hevelius on September 7 saw Saturn elliptical-handled [Ellipticoanfatum], as in Fig. XII. Gassendi, however — where above — reports that it preserved [perseverasse] the same form, which it had had the preceding year; but it was seen more confused, and its interstices [interstitia] more blunted, its cusps [cuspidibus] become rounder, and projecting more toward the borders of its dark traces [versus vestigia ferè], as in Fig. XV. This appearance lasted right up to Saturn's heliacal setting [occasum Heliacum] in the year 1648. In the month of April; but Ioan. Lips. exhibits, for the year 1647, Fig. XIV.

1646. [carried over from the previous column] XIV. And Giovanni Battista Odierna [D. Io. Bapt. Hodierna / Giovanni Battista Odierna]. Odierna [Hodierna] of the present day [Hodierna] says it appeared to him similar in form to an olive [oleae similem], with a most constant face [vultu constantissimo], from April 10 of the year 1646, right up to 1653. But Gassendi, as above, reports under the year 1646 that that dark interstice [interstitia obscura illa] began to be obliterated toward the cusps, and that the bright borders [alborem] of its handles seemed as it were to merge with the brightness of the middle globe, being less perceptibly distinguished from it. And P. Grimaldi on October 10 saw the eastern companion smaller than the other [comitem orientalem minorem altero], and nearer to Saturn; but on the 16th of November the companions [were] equal to each other and equally distant from Saturn [aequè distantes].

1647. Hevelius on September 7 saw Saturn elliptical-handled [Ellipticoanfatum], as in Fig. XII. Gassendi, however — where above — reports that it preserved the same form which it had had the previous year; though it was seen more confused, the interstices more blunted, the cusps become rounder and projecting more toward the dark traces [versus vestigia ferè], as in Fig. XV. He says this appearance lasted right up to Saturn's heliacal setting in the year 1648, in the month of April; but Ioan. Lips. exhibits, for the year 1647, Fig. XIV.

1648. February 26 and April 16, we [vidimus] together with P. Grimaldi saw the companions equal to each other, and equally distant from Saturn — so that, on account of the brightness [longitudo lucida] of the single parts [singularum partium], there was such [tanta] [splendor] — by however much the

semidiameter of Saturn's disk [Semidiameter disci Saturni]; the obscurer part, however, a little shorter [paulo breuior]; the companions longer [longiores], yet narrower [breuiiores] and larger [magis]. But in the month of May, right up to the 24th of June. But on the 10th of July the companions appeared [faciebant] together with him an oval figure [ouatam Figuram], as in Fig. X.

1649. At the very end of March, and from the beginning of April right up to the beginning of May, and on the 20th of July, when Saturn rose [ortus est] heliacally [Heliacè], and likewise on the 27th: it was seen as in July, as in Fig. XIV — indeed in August on the 23rd and in September on the 29th. P. Grimaldi and ourselves [Nobis]. Hevelius, however, in December on the 23rd saw it elliptical-handled, as in Fig. XIII; or as in Fig. XIV, just as P. Grimaldi on the days of the 12th, 13th, and 21st of December, as in Fig. XIV.

1650. January 2 and March 18 and October 12. Saturn appeared to P. Grimaldi, as in Fig. XIV; nor does Hevelius dissent: he saw it in October elliptical-handled.

1651. April 23. Saturn was seen by P. Grimaldi of a middle figure between Fig. X and Fig. XIV. Hevelius, however, in November saw it nearly spherical-handled [Sphaericoanfatus], as in Fig. IX.

1652. May 29. P. Grimaldi saw Saturn, as in Fig. XIV. Hevelius, however, in October [saw it] elliptical-handled, as in Fig. XII.

1653. At the very beginning of February, P. de Rheita [de Rheita / Anton Maria Schyrleus of Rheita] saw the companions of Saturn drawn out like torches [faces] in pyramidal flames [in flammis pyramidales], that is, as in Fig. V; nor [did] Giovanni Battista Odierna [Io. Bapt. Hodierna]. Odierna [Hodierna] of the present day [held otherwise]: about the Kalends of April he saw it of such a form, as in Fig. P. Grimaldi, however, in December saw the companions of Saturn separated from it, and pear-shaped [pyriformes], as in Fig. V. Or in either way [vtriuslibet] it was of an elongated length [longitudo] just as 13 to 18, as 13 to its longitude. But Gassendi on April 6 saw it as in Figura XIV.

1654. Through almost all of January we saw, together with P. Grimaldi, the companions of Saturn slenderer and more sharply produced [graciliores & acutè productos], as in Fig. XV. But Giovanni Battista Odierna [P. Io. Bapt.]. Zuppi [Zuppus / Zupi] at Naples on the 16th of January saw it [illum], as in Fig. XVI. So that it would not differ from ours, except in magnitude on account of the prolixity of the telescope [Telescopij insignem prolixitatem].

1655. From the 10th of March to the end of June, but chiefly on the 23rd; on April 8 and 9; but it was seen handled before May [Saturnus prius], as in Fig. VI; then on the 6th [vI.] [or "in Fig. VI"]; though Hevelius on May 30 saw it triform [Trisphaericum], as in Fig. IV; but Gassendi in June and July.

1656. From the 9th of February to the 17th of July it was seen by us round, without companions; but on the 14th of May with a band [fascia], as in Fig. II. Boulliau [Bullaldus] too, in January, and Hevelius from the 25th. From February 2 to May it was seen monospherical [Monosphaericum].

That same year a certain Canon Leoninus [Canonicus Leoninus] wrote to D. Antonio Rocca [D. Antonium Roccam / Antonio Rocca] — as I take from his letters — that D. Christiaan Huygens [D. Christianum Hugenum / Christiaan Huygens], a noble Hollander, by multiplying the diameter of Saturn fifty-fold with his telescope, observed about Saturn two companions; that a third planet [tertium planetarium], which they call Saturn's Moon [Saturni Lunam], distant from it by about three of these smaller [diameters], completes its revolution [reuolutionem] in 16 days, as he asserts [addebatq]; and that he had had another tube multiplying [the diameter] a hundred times [centies]; from which D. Rocca suspected that this was a fixed star [Stellam fixam esse]; but more of this in a later observation.

1657. P. Grimaldi saw the companions of Saturn at times, as in Fig. V; he aligned [aliquando] them in Fig. VI, near the said num. 2, under this same year. And at the end of December the companions in part [were] Satur-

1658. January 1. It was seen by us [Nobis] [as] Saturn, as in Fig. XI; and at the end of January, nearly, as in Fig. XV; though with the band still below the center of Saturn [fascia infra centrum Saturni], and an oblique line of the companions [obliqua linea Comitum]. And on February 21, similar to Figura XV. As observed by P. Grimaldi. The longitude of the bright part [Longitudo partis candidae] of either companion was equal to the semidiameter of Saturn's disk; but the obscure part a little shorter [paulo breuior]; in March, however, almost the whole [penè toto], the companions longer but narrower, and chiefly in the month of May, right up to the 24th of June. But on the 10th of July it was seen, [with] Saturn falling away [deficere] from Fig. XV, and the arms of the companions [brachia Comitum] near Saturn growing slender [gracilesce].

1661. May 13. On the following night Saturn was observed handled [ansatus], and with the companions disposed just as it itself [is], as in Figura XIV — among the foregoing [examples].

Appendix observationum Cristiani Hugeni quas post superius scripta accepi

[Appendix of the observations of Christiaan Huygens which I received after the above was written]

1656. January 16. He saw Saturn monospherical [monosphaericum], as in Fig. I, and so right up to June — indeed up to December of that year, 1655. But in October, on the 13th of that year 1656, it had already manifestly recovered its handles [ansas recuperarat], sooner than he had predicted.

1657. December. On the 17th after the heliacal rising [post ortum Heliacum], the arms of Saturn [brachia Saturni] [were] caught in [its] handles [in ansis maturè capta], as in Figura X.

1658. November. On the 10th, Saturn, much after its heliacal rising [post ortum heliacè], appeared with the arms drawn apart into broader handles [in latiores ansas adducta], as in Fig. XVI.

1659. From the 12th of February, Saturn's handles appeared very broad [latissimè], as in Figura I; he expected the tube of 23 feet [tubo pedum 23.]; for with a tube of 6 feet [tubo pedum 6.] Saturn appeared triform [trisphaericus], as in Fig. IV; or as in Fig. V — at which times it appeared now round, now solitary, the zone [Zona] cutting across its disk [discum] in various ways [bifariam]; and at other times the middle part itself appeared higher [supra medium].

Indicatur Theoria aliorum circa praedicta Phaenomena

[The theory of others concerning the aforesaid phenomena is set out]

[Margin: 11]

What P. Anton Maria de Rheita [Antonius Maria de Rheita], in book 4 of his *Radius Sideromysticus* [(de Rheita, *Oculus Enoch et Eliae / Radius Sideromysticus* 4.4)], ch. 4, thought up [excogitauerit] regarding the cause of the aforesaid phenomenon, I have related and in part discussed in book 7 of the *Almagestum Novum* [Almag. Noui], sect. 6, ch. 14, Scholion 3. Among the other things [I add this]: I think it probable, and I judge that Saturn turns about [vertigine] some center of its own which it has rolled up [conuoluit], a fact I confirm from this — that the planet itself sometimes appears now round, now oviform [ouiformis], and sometimes with a band [fascia], sometimes round; and now its sides appear, now above, now below, with the band varying its position [vario motu] about it

[as] above, and below, as I shall be able to indicate below, but below I add another Theory.

[Margin: 12 — Hevelius's hypothesis concerning Saturn / Heuelij Hypothesis de Saturno]

Hevelius, however, by the swiftness and keenness of his remarkable genius — in a little work [opusculo] recently published on the face of Saturn [de facie Saturni] — has undertaken [conatus est] to render reasonable [rationi reddere] so admirable a variety of changes [vicissitudinum]. He reckons that Saturn exhibits so diverse phases on account of its diverse aspect [aspectu], because we look at it now more directly [rectiùs], now more obliquely [obliquiùs]. Since, by optical principles, a Cylinder and an Ellipse consist of [a body which], by the oblique situation of the eye, appears circular [circulares apparere]. Hence, asserting this, Saturn appears both at apogee [in Apogaeo] — when it appears elliptical-handled [Elliptico-anfatus] — than at the perigee of the eccentric [in Perigeo Excentrici], and at the mean distance from the Earth [media distantia à Terra], as in Fig. XIV; or from the Sun [à Sole], it appears monospherical [Monosphaericus], that is, solitary and round; but in yet other situations [sitibus] spherical-handled [Sphaerico-anfatus], by latitude [latitudine] and the diverse situation in the epicycle [in Epicyclo]. And because at this time [hoc tempore] the apogee of Saturn is in 27° Sagittarius [♐], and the perigee in 27° Gemini [♊], and the mean distance in 27° Virgo [♍] and Pisces [♓], for that reason he has distributed Saturn's phases throughout the entire eccentric by a most elegant figure [figurâ elegantissimâ], and likewise by a Table, the epitome of which it pleases me to insert here.

[Margin: 13]

Phases ♄ ex opinione Heuelij

[Phases of Saturn per Hevelius's opinion]

Position	Sign · Degree	Hevelius's name of the figure [Denomin. Figurar. Heueliana]	Fig.
Apogee [Apogaeus] — Waning [Decrescentes]	♐ 27	Full elliptical-handled [Elliptico-ansatus plenus]	XIII.
	♏ 12	[—]	XII.
	♏ 27	[—]	IX.
	♏ 12	Greater spherical-cusped	[—]

Position	Sign · Degree	Hevelius's name of the figure [Denomin. Figurar. Heueliana]	Fig.
Mean Distance [Med. Dist.] — Waxing [Crescentes]		[Sphaerico-cuspidatus Maior]	
	≈ 27	Lesser spherical-cusped [Sphaerico-cuspidatus Minor]	XI.
	⋈ 12	Trispherical [Trisphaericus]	III.
	⋈ 27	Monospherical [Monosphaericus]	I.
	☾ 12	Trispherical [Trisphaericus]	III.
	☾ 27	Lesser spherical-cusped [Sphaerico-cuspidatus Minor]	XI.
	☿ 12	Greater spherical-cusped [Sphaerico-cuspidatus Maior]	[—]
	☿ 27	Spherical-handled [Sphaerico-ansatus]	IX.
	♁ 12	Diminished elliptical-handled [Elliptico-ansatus diminutus]	XII.
	♁ 27	Full elliptical-handled [Elliptico-ansatus plenus]	XIII.
Perigee [Perigaeus] — Waning [Decrescentes]	♁ 12	Diminished elliptical-handled [Elliptico-ansatus diminutus]	XII.
	♁ 27	Spherical-handled [Sphaerico-ansatus]	IX.
	♂ 12	Greater spherical-cusped [Sphaerico-cuspidatus Maior]	[—]

Position	Sign · Degree	Hevelius's name of the figure [Denomin. Figurar. Heueliana]	Fig.
Mean Distance [Med. Dist.] — Waxing Phases [Phases Crescentes]	♌ 27	Lesser spherical-cusped [Sphaerico-cuspidatus Minor]	XI.
	♍ 12	Trispherical [Trisphaericus]	III.
	♍ 27	Monospherical [Monosphaericus]	I.
	♎ 12	Trispherical [Trisphaericus]	III.
	♎ 27	Lesser spherical-cusped [Sphaerico-cuspidatus Minor]	XI.
	♏ 12	Greater spherical-cusped [Sphaerico-cuspidatus Maior]	[—]
	♏ 27	Spherical-handled [Sphaerico-ansatus]	IX.
	♐ 12	Diminished elliptical-handled [Elliptico-ansatus diminutus]	XII.

[Margin: 14 — Indicated argument against Hevelius / Indicata argumenta contra Heuelium]

Where the Figures are wanting here, they are wanting also in Hevelius, p. 4. But neither can our Figures — the Fourth, Fifth, Sixth, Seventh, Eighth, Tenth, Fourteenth, Fifteenth, and Sixteenth, that is, the Decimaquarta and Decimasexta — represent the Hevelian hypotyposis [Heuelianam Hypotyposim] without doing violence [sine violentia]. Moreover, from our observation of the year 1656 — concerning which above, on May 14 — Saturn was in 16° Virgo [♍] [and] was solitary and round, although it was distant 11° from the place [à loco] of perfect roundness according to Hevelius; therefore on the 27th of October, in 1° Libra [♎], when it was not distant by whole degrees [non distabat integris gradibus] from the said place of perfect roundness, it ought still to have appeared round

and solitary; yet it was seen manifestly with the companions separated [cum comitibus separatis], as in Fig. V. Of Huygens's hypothesis, of which more below in several places, the Hevelian hypothesis is thereby chiefly to be disproved [improbrari], since by it Saturn ought to have been seen round throughout September of the year 1657; and yet on the 13th [of October — supplied], in the year 1656, it had already recovered its handles [iam ansas recuperarat]. In the year 1656, moreover, with Hevelius's positions, Saturn [was] placed in 18° Pisces [♊]; it ought to have appeared round, and on December 1 [it ought to have appeared] trispherical [trisphaericus]; yet in that year it appeared solitary to Galileo, and on December 1 solitary, and round.

[Margin: 15 — Roberval's hypothesis of Saturn / Roberualli Hypothesis de Saturno]

Roberval [Roberuallius / Gilles Personne de Roberval] thought the causes of the Saturn phenomenon could be explained, if it should be said that vapors [vapores] go out from its Torrid Zone [Zona Torrida], and these are elevated [eleuati], which reflect the Sun's rays back to us, when they go out from those distant places — but [they] are not elevated toward the poles [versus polos]. But these [explanations are] too liable [obnoxia] to uncertainty of physical causes, nor probably bound to certain places of the Zodiac; since nevertheless it is established [constet] that Saturn is set opposite [oppositus] in two places of the Zodiac — and in each of these it is seen round in its revolution [sui reuolutione videri rotundum], and twice in two other opposite places, where, at a quadrant's distance [quadrante] from the said distances, it appears most amply handled [amplissimè ansatum], as Huygens noted [aduertit] against him.

[Margin: 16]

Giovanni Battista Odierna [Io. Baptista Hodierna] — as Christiaan Huygens reports — at p. 43 of his *System of Saturn* [Saturnij Systematis], judged Saturn to be spheroidal in the manner of an egg [ouum] or a plum [prunum], and longer than the Hevelian [spheroid]; and that in it there are two spots devoid of light [binas esse maculas lucis expertes], as in Figura X or XIV. He held, moreover, that Saturn turns about its axis [Conuerti autem Saturnum circa sui axem] in the same period as Hevelius established, and that it is then seen round, when the longer axis of the spheroid [longior sphaeroidis axis] is directed toward us. "But," says Huygens, "since it appears altogether round as often as it is stripped of its arms [brachijs nudatus est], how are the gaps [lacunae] to be filled, which the two black spots [duabus maculis nigris] are to over-

shapes does Odierna admit? Finally, if anyone turns the aforesaid spots about the planet's axis, he will see that many phases appear far different from these — phases that do not appear on Saturn.

Christiaan Huygens's System of Saturn

17. First, Christiaan Huygens [Christiaan Huygens] reports that he used a telescope of 12 Rhineland feet down to 19 February of the year 1656; and that he then used a telescope of 23 feet. Its object-glass, the more distant lens [*remotum lamellum* / object lens], had an aperture of 4 fingers but a focal length [aperture] of 2; while the eyepiece consisted of two lenses joined together, with a single convex face of equal curvature, each lens being $1\frac{1}{2}$ fingers and a little less, with the rays converging. From this one can gauge the excellence of his object-lens, which can tolerate so short a convexity. [Margin: *The excellence of Huygens's telescope.*]

Now since he has demonstrated in his *Dioptrics* [*Dioptrica*] that the appearance seen through an optical tube has, relative to the appearance seen with the naked eye, the same ratio that the focal length of the object-glass has to the focal length of the eyepiece: and since the focal length of the aforesaid object-glass was 23 feet, or 276 fingers, while the focal length of the eyepiece was a little under 3 fingers — therefore he follows that the telescope magnifies the object some hundredfold, whereas Galileo's tube magnified only some thirtyfold. With such a telescope, then, he always saw the *ansae* [the handles] of Saturn joined together [as a ring]; whenever he saw Saturn with the handles joined, he twice saw it solitary and round; but when he saw it with the handles joined to the disk of Saturn, he twice saw it as solitary and round — that is, when the handle appeared joined to the body of Saturn through the telescope. He saw it round when he viewed it through a telescope of six feet (this was in the year 1658, on 10 November); from which he concludes that the tricorporeal [three-bodied] appearance arises from the imperfection of the tube, so that it appears tricorporeal.

Whenever, moreover, he saw Saturn round, he saw a belt [*Zona*] cutting its disk in two; at other times — namely in the year 1655 — a belt in the upper part, at other times in the lower; and he observed on Jupiter two belts [*Zonas*], no darker, as others have it, but brighter than the rest of Jupiter's body. By contrast, on Mars he observed a dark belt, and the part of the disk in the middle obscured and broad — the two parts amounting to about $\frac{1}{5}$ of the disk's diameter. As for the diameters of the fixed stars, with the lens first lightly smeared with soot he saw them as if they were bright points; and the middle star in the sword of Orion he

found not to be a single star but to consist of 12 stars, very distinctly persisting [as separate]. Finally, with such a tube he first observed for himself the little planet [*Planetulum*] wandering about Saturn, which he calls the Moon of Saturn [Titan].

18. From the year 1655, on 25 March in the Gregorian style, to the year 1659, on 26 March, in the space of 10 hours, he brings forward nearly 70 observations of this little Moon; from which it is established that this companion encircles Saturn in the same number of days [16], and returns to the same position in the same number of days, and is now nearer, now farther, and twice joined to it; and from it he obtains a distance now this way, now that, which does not exceed the first minute 3' 16", reckoned from the center of Saturn. From these things, then, having observed the positions of the Moon of Saturn, he constructs his Theory, with a circle described from the center of Saturn's globe, divided into 16 parts, whose diameter AP runs into our eyes; in which...

Diagram. A ring (annulus) seen in perspective, surrounding the globe of Saturn. The globe sits at the center, labeled A at its top. The encircling ring is labeled with letters at the four cardinal points of its ellipse.

- A (top of central globe): Saturn's globe
- B (left end of the ring): western end of the ring
- C (bottom of the ring): nearer/lower edge of the ring
- D (right end of the ring): eastern end of the ring

The ring BD passes in front of and behind the globe AC, depicting Saturn's ring system in oblique projection.

The ring here, BD, although it is separated from the globe of Saturn AC, nevertheless revolves in the Zodiac at the same pace as it [the globe], and with equal force; for it is constituted around the center of Saturn just as the Earth is, resting on no supports, yet always moving, since the whole thing is moved at once, and is equidistant from the center of Saturn, which is the center of gravity. Now when Saturn appears perfectly and most amply handled [fully open], as in Figure XIV indicated above, the diameter BD appears greater than the diameter of the apparent ellipse, of which the lesser is as 5 to 2. He proceeds then, from his own observations, on the authority of Galileo, Gassendi, Boulliau, and Riccioli, to take the line of Saturn's handles BD, that is the line of the handles, to be parallel to the Equator: in which, however, he says Riccioli is inconsistent with himself, because on one hand he shows the line of the handles to be parallel to the Ecliptic, and on the other to be parallel to the Equator. [Margin: *Riccioli vindicated against Huygens's censure.*]

[He says that] in the year 1650, on account of the observation made on 18 March by P. Grimaldi [Francesco Maria Grimaldi], he [Riccioli] denies that this line was parallel to the Ecliptic, since at that very moment Saturn was near the beginning of Cancer (for it was in fact at degree 24 of Gemini), nor could that line be parallel to the Equator, because it was parallel to the Ecliptic — and so he was therefore deceived, supposing P. Grimaldi to have erred in observing the approach to the Fixed Star, and to have thought it the same star, whereas it was a different one, as he says in *Almagestum Novum* p. 723. Now Huygens supposes, on I-know-not-what observation, which he does not cite — Saturn being at degree 20 of Gemini and ♄ — that the line of the handles passes out parallel to the Ecliptic. But here Riccioli does not suppose with him, but only that the line of the handles is at once parallel both to the Equator and to the Ecliptic, when Saturn is at the very beginning of Cancer or Capricorn, in that the parallel of the Equator does not then cut the Ecliptic, but touches it; whereas outside this position, by the very fact that the line of the handles is parallel...

Diagram. A circle representing the orbital circuit of Saturn's companion (the little Moon), divided into 16 equal parts numbered around its circumference. The center is marked **C**, with a small cross (the orthogonal axes) drawn through it. The vertical diameter runs from **A** at top (with the figures **1** and **16** flanking it) down to **P** at the bottom (flanked by **8** and **9**). The numbered positions run clockwise.

- A (top): apogee, flanked by 1 (left) and 16 (right)
- positions descending the right side: 15, 14, 13, 12, 11, 10
- P (bottom): perigee, flanked by 8 (left) and 9 (right)
- positions ascending the left side: 7, 6, 5, 4, 3, 2
- C (center): center of Saturn / center of the circuit

This companion is carried round according to the order of the Signs, from apogee **A**, through **C**, to perigee **P**. In the first observation, of the year 1655, on 25 March, it was found to have been at position 12, distant from perigee **P** by $3\frac{1}{2}$ parts; the whole circumference ACPD being 16; and on 26 March it was found to be at number 13; and on 27 March at number 14; and on 3 April...

\newpage

is parallel to the Equator, and parallels of the Equator cut the Ecliptic, that line must necessarily be inclined to the Ecliptic; which is evident from the same degree 24 of Gemini. He labors over this point most studiously, that Riccioli was not deceived; for although Huygens accedes elsewhere to Riccioli's opinion, he

affirms it neither here, since this observation overturns his own opinion concerning the parallelism of the Line of the handles, beginning at degree 20 of Gemini and ♊. Therefore, not yet content with what has been said, Riccioli shows that Grimaldi is contrary not to himself but to Riccioli — and that Grimaldi was deceived — but let me say these things in passing. Let us proceed to the remainder of Huygens's Theory.

20. The orbit of Saturn, of about 30 years, having been at length absolved [computed], he places in the same plane with the Ecliptic, with the inclination neglected, of $2\frac{1}{2}$ degrees. The axis of Saturn, about which it revolves, he posits always parallel to itself, and the plane of the surrounding ring [annulus] erected at right angles, so that around this center the parts in turn are turned [rotate], and the globe of Saturn, so that all its parts in turn are illuminated by the Sun; and the ring itself, and in the plane of the ring, a companion [Comes], or Moon of Saturn [Titan]. He posits the axis of Saturn to be roughly equidistant from the Earth's axis, at an angle of $23\frac{1}{2}$ degrees, and inclined to the plane of the Ecliptic. With the plane of the ring placed parallel to the plane of the Equator, the diameter of the apparent ellipse is greater, to which the ring is assimilated, and the diameter of the ellipse is reckoned parallel to the Equator. From this it comes about that, with Saturn existing at the beginning of Cancer ♋ and ♊, the ring ought to appear to us at its widest of all, since then our eye is raised above the plane of the ring by $23\frac{1}{2}^\circ$; and on the contrary it ought to appear most narrow at the beginning of Aries ♈ and Libra ♎ — at which positions Saturn, on our eyes incurring [falling on the plane of the ring], the ring appears [edge-on]. But by observation it is established that it is widest at degree $20\frac{1}{2}$ of Cancer ♋, and narrowest at degree $20\frac{1}{2}$ of Virgo ♍, and ♊ — from which one may conclude that the line of the handles is not exactly parallel to the plane of the Equator, but is inclined to the Equator by about 8° ; for Saturn was at degrees 25, 15' of Gemini ♊ and ♋ when it appeared widest, and this indeed in our age. The two places in Saturn's orbit are therefore opposite, in which the ellipse appears widest, and the two in which it appears narrowest; in other places, narrower or wider it appears, the more or less Saturn recedes from the said places, that is, as our eye is more or less raised above the plane of the ring.

21. Furthermore, if we were to view Saturn from the Sun, the same places of the Zodiac would be perpetually the [same], in which the plane of the ring would be led to our eyes; but as we view Saturn from the Earth, certain inequalities arise. The ring, then, by its latitude infected [affected], referring nothing of its surface to a straight line, appears as neither of the surfaces of the ring of Saturn, which on that account [appears] round and without arms [armless]. The phases — which

indeed are seen on Saturn's orbit twice in a half-year, and more — happen for another reason, namely that Saturn, existing at the beginning of Aries ♈ and Libra ♎, the plane of the ring, produced (by imagination), should pass between us and the Sun; in that case we cannot see that illuminated surface of the ring, which faces the Sun, but the other only, which suffers the alternations of shadow, because the exterior edge of the ring, although endowed with some thickness, is of such a nature that it reflects almost nothing of the Sun's rays, and so exhibits the globe of Saturn girded with a dark belt [*Zona obscura*]. Just as on the surface of the Moon certain parts appear darker, because they are unsuited to reflecting the Sun's light. And this happens the more to all the parts of the ring, the more obliquely they are illuminated by the Sun — as happens when the eccentric position of Saturn is not absent from degree 20½ of Aries ♈ and Libra ♎, beyond degree 6. With all these causes concurring, then, the round phase of Saturn lasts longer. Granted that the plane surface of the ring be even, and not rough with mountains. And so Huygens concludes: whoever sees Saturn from the Earth, whenever the eccentric position of it, or as seen from the Sun, is no more than 6 degrees distant from degree 20 of Gemini ♊ and Pisces ♉, the arms can never be seen with ordinary tubes; but with perfect tubes they can, at a distance of 6 degrees from the said limits (which limits he calls Saturn's Equinoxes), some beginning of the arms can be seen.

22. Therefore Saturn, according to Huygens's Hypothesis, either appears round about degree 20 of Virgo ♍ and Pisces ♉, or handled, but always with the handles connected to it, if the telescope is perfect...

and the feet [supports] are 12. And let it be reckoned the minimum. For if it is observed with smaller tubes, the handles are seen separated, because, as the same author teaches on p. 35, the extremities of the handles reflect a greater light to us than the parts near Saturn: whereas, when some shadow intervenes, then the extreme part of the handles appears round to some by a fallacy of vision, since all things observed from afar — as a flame and the like — appear round. But Huygens does not explain the said cause; for it cannot come from the body of Saturn, since then the shadow would have to be Calathoid [basket-shaped], and Saturn's globe would illuminate it with the greater globe of the Sun — though, on Huygens's own testimony, it [the shadow] is smaller; both because the shadow does not fall except onto that part which is behind the ring; and because that shadow which is between Saturn and the Sun, would have to be there. But still this enigma remains to be solved: why, with the perfection of the tubes equal at the same time, Saturn would appear, with the handles joined to it, with more imperfect tubes; whereas with separated handles it appears now round, now

pear-shaped [*pyriformis*], or of different figure; and why round when they [the handles] are slender, but when ample, then not round.

23. It remains, as it has appeared to Huygens himself in the times of this present age, and as those entering the future shall determine for us, that Saturn shall appear round, and without visible handles; to which, on the contrary, it shall be shown or about to be shown with the handles most amply drawn apart, and by which the thinnest [handles] are exhibited, when the telescopes are perfect, when the arm emits a brighter appearance after the heliacal setting [rising], or recovers [it] after the heliacal rising. Interval — for the intervals of these phases cannot be tied down even to the fifteenth year; or every tenth year, indeed they recur twice within one period of Saturn; both on account of the Anomaly of Saturn, and on account of the Retrogradations of it intervening between one phase and another. To this is added that the limits, which Huygens established at degree 20 of Gemini ♊ and ♎ for the most ample handles, and Virgo ♍ and Pisces ♉ for the round phase, are not certain, both on account of the inclination neglected by himself from the Ecliptic, and perhaps on account of some libration of Saturn, and the ring toward the Poles of the World. Meanwhile, however, by observation his opinion stands, that these are the times of the phases.

24. The First Phase of Saturn Solitary and Round, indeed perfect telescopes being had, ought to have been seen in the years 1613, 1626, 1642, 1655, about April; and it ought to appear in the year 1671, on 12 January, and 1685 on 2 September; and about the middle of the year 1701, Saturn existing at its eccentric position at degree 20 of Gemini ♊, or Virgo ♍, or Pisces ♉. Now about six months before the first predicted phase, when the telescopes are perfect, Saturn ought to appear with very slender arms, which it lost a little after, on account of its approach to the heliacal setting. By contrast, about six months after the first predicted phase, Saturn ought to, or shall, recover the arms, after the heliacal rising, with perfect telescopes; for indeed, on account of their thinness, it can still appear round, or be solitary. The predicted intervals can, however, be varied — produced on account of the Retrogradations of Saturn. *The Second of the extreme Phases* — namely when, with the telescopes perfect, Saturn appears most amply handled, with Saturn existing at its eccentric position at degree ♊, or ♎ 20½ — ought to occur in the year 1619 and 1634, and between 1648 and 1649; and it shall occur between 1663 and 1664, and between 1678 and 1679, and between 1693 and 1694, and between 1708 and 1709, and so on.

The Third Variety of the Phases, namely of the growing handles, occurs from the time of the recovered arms, down to the time of the second phase. *The Fourth*,

finally, occurs from the time of the second phase, down to the time at which Saturn loses, or is about to lose, the arms. Which intervals the Astronomers will then more certainly define, when, by more numerous observations through telescopes, more perfect handles of Saturn, as it were, they will have seized by hand.

Judgment concerning Huygens's Theory, and Indication of Our Own

25. Although we owe very much to Huygens, on account of his Theory of Saturn's figure, so ingeniously and learnedly invented by him; nevertheless there are certain things which still hold me in suspense. For first, as I indicated at number 21, Huygens does not adduce...

the cause whence that shadow proceeds, by which the parts of the handles near Saturn do not appear, with imperfect telescopes. But neither does he assert the reason why, with the same telescopes — for example, with our own — the whole of Saturn appears now tribodied [tri-spherical], now with the companions pear-shaped, now handled; for if those distant extremities appear round, the same things ought to appear to the same telescope. It is therefore to be added, as it seems, that those extremities appear round, when Saturn is not far distant from its Apogee, [appearing] pear-shaped when it is more distant; and at its approach to Perigee the handles are seen more and more coherent with Saturn — because then more, and more direct rays of the Sun, are reflected to us.

26. *Secondly*, from the Huygenian Hypothesis it follows that Saturn's globe always projects out beyond the plane of the ring, even when most amply handled; yet, as is established from Figure cap. 2, and from Figure 10, cap. 9, it is established that the whole appeared to us within the handles, nor can this be ascribed to an imperfection of the Tube — if [the tube] represented to us the parts of the handles nearest to Saturn, which nevertheless Huygens admits are more difficultly seen than the extremities; it would much more brightly have represented the whole globe of Saturn with the eminence projecting beyond the handles, if indeed it had thus projected.

27. *Thirdly*, there is no necessity of positing the plane of the ring parallel to the plane of the Equator, granted that the line of the handles, observed parallel to the Equator; nor likewise is it necessary that the ellipse appear, with which Saturn handled exhibits that ellipse, [or] that the ring be separated from it on every side equally. But it can be said that Saturn is girded with an elliptical ring [*Armilla Elliptica*] coherent at the extremes of the minor diameter of the ellipse; and this is the more probable, the more probable it is that the ring be joined to Saturn, and

that it traverse the Ecliptic together with it, than that the body be separated from the orbit of Saturn. Furthermore, it can be said that Saturn, about its major diameter, the elliptical ring, as if about an axis parallel to the Equator, [is] either turned [revolved] in a perfect revolution, or librated, in such a way that the ring — the part which optically bisects its own middle to us — when indeed it appears round, is sometimes in the highest part, sometimes in the lowest, so that it represents the whole of Saturn within itself, as in Figure X, cap. 9, and most amply handled. From observations both past and future, the times of these librations will be better established. But whether the plane of this ring is posited parallel to the Equator, or librating — both can be saved equally well, if I am not mistaken — all the phenomena of Saturn's figure, even if a ring coherent with Saturn be posited in place of the Huygenian ring, and be called...

A ring is girded, thin, plane, Elliptical, coherent in two places; or parallel to the Equator; or revolving in itself, or librating toward the Poles of the World.

28. It is also more probable that the plane surface of the aforesaid ring is not of equal width, but at the extreme parts wider, and at the parts coherent with Saturn's globe narrowest. For thus it is more easily understood by what cause, with imperfect tubes, the parts near Saturn more often do not appear, the extreme parts being seen rounder, nor are the angles of the ring discerned; but with tubes always imperfect, the parts of the ring coherent with Saturn are not seen — though sometimes the extreme and more remote parts appear in the form of a pear, or of a half-burnt [*semipruni*] oblong; with all tubes, however, when Saturn appears most amply handled, the handles appear broader [*latiores*] in the more remote parts.

29. But neither is it improbable that the chief cause why Saturn in this age appears most amply handled at about degree $20\frac{1}{3}$ of Gemini ♊ and Pisces ♉, is not because our eye is raised above the plane of the ring by $23\frac{1}{2}$ degrees, but because the declination of the Ecliptic from the Equator — for it [Saturn] ought to be at the very beginning of Cancer ♋ and ♎ [if it were due to that] — is not from the varied parallelism to the Equator, which is more probable, [but] is always...

continued, until the axis of the ring, by libration of the ring, or revolution, which can be so great that our line of vision falls at a right angle on the plane of the ring. But the limits of this libration, or the revolutions, can — contrary to the order of the signs — migrate from Cancer ♋ into Gemini ♊, and from Capricorn ♐ into Sagittarius ♏; or on the contrary, according to the order of the Signs,

change — say, from the beginning of the world at the beginning of Aries ♈ and Libra ♎ — also migrate at degree $20\frac{1}{3}$ of Gemini ♊ and Pisces ♉, the parallelism not always being saved of the plane, but the axis of the ring [being placed] toward the Equator. But whether either of these happens, or comes about, being destitute of the observations of past and future ages, we cannot determine.

Concerning the Figure of Saturn most recently observed by Don Giuseppe Campani

30. Don Giuseppe Campani [Giuseppe Campani], skilled in the most excellent telescopes and provided with them by his own peculiar industry through the wheel-machine he himself constructed, observed Saturn in the month of April of the year 1663 and 1664, girded with an apparent Elliptical circle, of which the Figure came to me by gift of the Author, with a little treatise expounding it, transmitted by P. Daniele Bartoli [Daniel Bartoli] — very similar to Figure XIV rather than X from the premises at number 10. But he adds the upper part, that is, toward the Arctic pole, the part of Saturn's body situated to be hidden by the ring [*Armilla*]; whereas on the contrary the lower part, toward the Antarctic pole, that is, the southern part to be covered by the part of the ring nearest to the body itself, or the globe of Saturn. He narrates besides that, inserting in the globe a white little circle, as if girded with an iron thread in the manner of a diameter through the globe, and the ring so depressed, and the equal part; and so placed in a suitable light, and observed through a small telescope, it represented to him all the diverse phases for diverse elevation, or depression of the ring, which now in this present age are discerned, and which in future years are discerned. The tube, moreover, with which he used was 28 Roman palms; observation of the year 1664, on 21 April, at the hour of the year 55; with which architects use.

31. I indeed, having inserted the globe in an elliptical ring [*Armilla*], in fact observed no less the said diverse Phases representing the diverse libration of the ring. With these things established hitherto, although Saturn never appears perfectly round, it cannot stand for an ellipse — so long as it shall not be demonstrated to be impossible that it be a ring in fact, and not appearing only elliptical — it represents all those phases that appear on Saturn.

CAPVT X.

Concerning the Figure of Jupiter, its Belts and theirs; its Parallelism to the Ecliptic, and its Satellites.

1. Whatever the vaporous Sphere may be, which P. Anton Maria de Rheita [Anton Maria Schyrleus of Rheita] asserts to be seen about Jupiter, with an ample perspicillum [eyeglass], in *Radius Sideromysticus* [*Oculus Enoch et Eliae / Radius Sideromysticus*] book 4, cap. 1, member 2 [Margin: *Jupiter's atmosphere.*]; and concerning the roughness [*asperitas*] of Jupiter, which the excellent telescope of D. Leander Bandtius, Abbot of Dispergen [Leander Bandtius], observed for himself in the year 1643, on 2 November — that is, 21 [days] after the opposition $\odot$ with the Sun — with two smaller spots, and two larger, or hollows [*cavernae*], one round, the other oval, equaling the seventh part of the Jovial diameter in length [Margin: *Jupiter's roughness and spots.*]; as I have from a Schematic from Flanders transmitted to me — since these things are rarely [seen], nor except through rare longest-sighted [most powerful] telescopes can they be discerned; these things, I say, being omitted, and similar ones — both as to the roughness, both as to the spots, which sometimes are observed in Jupiter — Hevelius bears witness on pp. 42, 44 of his *Selenographia*. Concerning the Belts [*Fasciae*] and the Satellites, as being ordinary Jovial $\sphericalangle$ phenomena, which by observing have been found out, we shall expound.

Diagram. A single rectangular ruled frame at the head of the page encloses nine small disks of Jupiter arranged in three rows of three, each disk numbered with a Roman numeral above it (I–IX, reading left to right, top to bottom). Each disk depicts a different observed configuration of Jupiter's belts [*fasciae*] — shown as shaded transverse bands across the disk. The figures illustrate the variety of belt appearances catalogued in the chronological observation list that follows.

- I (top left): two belts, both curving (concave toward the lower limb), set in the upper half of the disk, plus a fainter third band lower down.
- II (top centre): two strong, nearly straight transverse belts, one in the upper portion and one across the middle.
- III (top right): a single narrow belt a little above the centre of the disk.
- IV (middle left): two close-set belts in the upper portion, lightly curved, with a faint third band below.
- V (middle centre): a single broad belt across the middle, drawn between two boundary lines (a wide band bounded above and below).

- VI (middle right): two oblique (slanted) belts crossing the disk diagonally from upper left to lower right.
- VII (bottom left): a broad region of dense banding filling much of the disk — several belts close together, the middle one the widest and darkest.
- VIII (bottom centre): two belts, one above and one below the centre, with the lower portion of the disk appearing contracted/narrowed relative to the upper.
- IX (bottom right): two belts in the lower half of the disk, the upper one straight and the lower one curving toward the limb.

[Cross-reference: the figure numbers I–IX are cited individually throughout the dated observation list below.]

2. The belts [fasciae] that gird Jupiter's whole disk crosswise — or rather, the more prominent or deeper parts of it — were first noted, so far as I know, at Naples by Fathers Io. Baptista Zuppus [Niccolò Zucchi — *recte*; see note] and Daniel Bartolus of our Society, although Franciscus Fontana had observed the same there beforehand. Afterwards we ourselves, together with Father Franc. Maria Grimaldi [Francesco Maria Grimaldi], distinguished those same belts clearly and repeatedly with a more accurate telescope. They appear sometimes threefold, sometimes twofold, and occasionally single — bounded at each end, and now and then closed off, and at times single. Moreover, the belts are sometimes seen toward the middle of Jupiter's disk, sometimes lower down, sometimes higher up; nor are they always straight, but are sometimes bent with their convexity turned downward, and at other times turned upward. These facts are indeed a fairly clear sign of Jupiter's rotation [vertigo] about its own centre. For concerning the parallelism of these belts to the ecliptic and to the path of the satellites, I must speak separately below, after the history of the number of the belts. As for the fact that the belts sometimes do not appear at all — as is plain from the first figure of Io. Lipius of Munich [Johannes Lippius] — it is no wonder, since Gassendus [Pierre Gassendi] in his *Institutio Astronomica*, Book 3, denies that he himself ever saw them.

Fasciarum Iovis Observationes.

[Observations of Jupiter's Belts.]

In the year

1630 — On May 17, Father Nicolaus Zucchi [Niccolò Zucchi] at Rome saw two belts of Jupiter, as in Fig. II.

1633 — Franc. Fontana [Francesco Fontana] at Naples, as is recorded in the sixth treatise of his observations, observed three belts, as in Fig. I; likewise at the beginning of the year 1643.

1634 — Jupiter, which had long appeared with three belts, from the beginning of October up to the 13th — that is, up until conjunction [$\odot$, *recte*: opposition] with the Sun [?] — was seen by Father Grimaldi with two belts, one dark, the other brighter, than [the other; sentence continues below].

[The right-hand column continues the year 1634 and following:]

[1634, continued —] ... the other disks of Jupiter, as in Fig. III. But after conjunction with the Sun, up to October 20, they were seen the same, with the same three belts, one dark, the rest bright and somewhat curved, as in Fig. IV. From the beginning of November up to the 22nd of December, they frequently appeared now straight, especially at the meridian, as in Fig. V.

1644 — Father Io. Bapt. Zuppus at Naples observed two belts of Jupiter, as in Fig. II, but much larger, on account of the excellence of his telescope, which represented the Jovian diameter as nearly half a foot across.

1645 — On January 1 and 22, Fontana saw two belts of Jupiter, as in Fig. II; but on the 28th of January a third appeared to him near the margin, as in Fig. I.

1647 — On January 23, Father Grimaldi and I saw Jupiter girt with two zones at conjunction [$\odot$, *recte*: opposition] with the Sun, as in Fig. II.

1648 — Father Grimaldi, from February 24 to March 16, observed two belts on Jupiter, now straight, as in Fig. VI, which represents the observation of February 11, at 2½ hours after sunset, when Jupiter was at quadrature, moderately distant from the meridian. The upper belt appeared narrower and darker, the lower one broader and less dark; and the part of Jupiter's disk intercepted between them was much brighter than the rest of the disk. Jupiter's conjunction [$\odot$, *recte*: opposition] with the Sun had been on the 22nd of February.

1649 — On March 28, at 2 hours of the night, the belts appeared in nearly the same line with the 4 satellites of Jupiter; but on August 14 Father Grimaldi noted a single belt above the middle, in the line of the satellites, the rest not being clearly visible.

1650 — In the month of July, two belts were observed by Father Gri-[maldi]

[Margin, left of §2: Situs,]

[1650, continued —] ...maldi, in the upper part [of the disk], turned toward the south [Austrum], as in Fig. IX.

1651 — On May 29, Father Grimaldi saw Jupiter with two dark belts, enclosing a large bright space between them, as in Fig. II; but on July 11 he saw three dark belts, of which the middle one was broader and darker, and somewhat higher up near the limb than [the lower one]; the southernmost was lower down, as in Fig. VII.

1652 — On December 1, Father Io. Bapt. Hodierna [Giovanni Battista Odierna] wrote to me that Jupiter had appeared to him single-belted [Iovem Monozonium], in January and July.

1653 — On July 21, Father Grimaldi saw Jupiter three-belted [Trizonium].

1654 — Father Io. Bapt. Zuppus observed Jupiter as in Fig. VIII, in which the lower half-disk appeared contracted relative to the upper.

1656 — Father Grimaldi, on August 2, beheld Jupiter with two dark belts comprising a bright zone between them, as in Fig. VI, of which the lower belt was a little broader, and in the line of the satellites, as in October on the 1st. And on December 2, as in Fig. VII.

1657 — From October 17 up to November 6, Father Grimaldi observed three belts on Jupiter, as in Fig. III; but on the 12th up to the 19th of November, the two darker belts were failing in the manner of Fig. VII — for the two darker belts included three similar bright belts of the figure, and the third obscure one was nearest to the southern limb, as in Fig. IX; and the obscuration [reached] up to the third nearest the southern limb, as in Fig. VII. But at the end of December he saw three dark belts together with two bright ones enclosed nearly in the middle, as in Fig. VII; but in the margin a certain shading appeared toward the south, as a fourth belt [veluti quarta fascia]. [Note: this is among the earliest records of a discrete, persistent dark feature low on Jupiter's disk — a Great-Red-Spot-type observation.]

1664 — On July 1, Lord Iosephus Campanus [Giuseppe Campani], with an excellent telescope made by himself, observed three dark belts on Jupiter, fairly bright, as the most excellent Doctor Lord Io. Dominicus Cassinus [Giovanni Domenico Cassini] attests. But since I have not yet obtained the figure of these, I cannot exhibit a synopsis of them to the reader.

De Parallelismo Fasciarum, Viæ Satellitum, & Ecliptica.

[On the Parallelism of the Belts, the Path of the Satellites, and the Ecliptic.]

3. That the belts of Jupiter are parallel both to one another, and to the path of the satellites of Jupiter, and to the ecliptic — at least in respect of the satellites — was noted by Galileo in the *Nuncius Sidereus* [*Sidereus Nuncius*] and by Simon Marius [Simon Mayr] in Part 2 of his *Mundus Iovialis*, Phenomenon 6; and as to the belts, by Hevelius [Johannes Hevelius] in his *Selenographia*; likewise by us, together with Father Grimaldi, who often noticed it; and as we noted above, [drawn] through the lines from Jupiter's disk to the pair of stars [the satellites], according to the guidance of the belts and the path of the companions [satellites]. There is no need to fill so many pages with a multitude of these observations.

De Numero Satellitum Iovis.

[On the Number of Jupiter's Satellites.]

4. Although Jupiter's satellites are reckoned equal in apparent magnitude [v.] to fixed stars of the sixth magnitude — for such stars are, as it were, just so many — they nevertheless do not appear with the unaided eye, on account of the brilliance of Jupiter overshadowing them, just as the satellites of Jupiter cannot be seen without a telescope, on account of the brilliance and smallness of Jupiter, which is so near. Nor has anyone of them ever been seen at a distance of more than 12 minutes from Jupiter's disk — doubtless because of the weakness of mortal eyes, and (at the beginning, and even more in our age) on account of the lack of a telescope, until, the telescope having been granted to the world, Simon Marius in Germany — as he relates in his *Mundus Iovialis* of the year 1609, around the month of November on the occasion of conjunction [$\odot$, *recte*: opposition] of Jupiter with the Sun — began to notice three little stars around Jupiter, confirmed in the following years by varied distances [or: by observation of varied distance], on the 29th [December]; he saw three [stars] in a straight line on the 8th, and again toward the west. In the year 1610, on January 12, and from the beginning of January, he recognized [these to be] wandering planets, but Marius noticed nothing concerning Mars [the Martian observation — *recte*: ☿? see note]. Galileo, however, conscious of nothing of Marius's observation, first of all in Italy in the year 1610 on January 7, at the first hour of the night, observed around Jupiter first three little stars, and then four; nor ever more than four little wandering stars around

Jupiter, and [distinguished them] from the fixed stars by the sign that their distance from one another changed swiftly, as is [explained more fully].

[The matter is] more fully related in the *Nuncius Sidereus*. And although Scheinerus [Christoph Scheiner], in his first letter to Wellserus [Marcus Welser], suspects that there are more satellites than four — in his *Disquisitiones* he nonetheless acknowledges, both from his own observations and from those made at Rome, four only; and likewise the number, in his observations, Blancanus [Giuseppe Biancani] asserts in his *Sphaera*, page 14. Keplerus [Johannes Kepler], in his *Dissertatio cum Nuncio Sidereo*, and in the *Epitome Astronomiae*. Herigonius [Pierre Hérigone], in volume 5 of his *Cursus Mathematicus*. Carolus Malapertius [Charles Malapert] of the Society of Jesus, who calls them *Sidera Austriaca*, as Galileo [calls them] *Sidera Medicea*. D. Vincentius Reinerus [Vincenzo Renieri], who has observed them whole, for ten years. Likewise Peireskius [Nicolas-Claude Fabri de Peiresc], and Galtenus [Pierre Gassendi — *recte?*] in the life of Peireskius; and in the *Iudicium de 9 Stellis* [Judgement on the 9 Stars], these were observed by Massilia [the Marseille observers], naming them: the first, that is, the innermost, *Cosmus Minor* [the Lesser Cosimo]; the next innermost *Cosmus Maior* [the Greater Cosimo]; the next to outermost *Maria Medicea* [Maria de' Medici]; and the outermost *Catherina Medicea* [Catherine de' Medici]. Although Marius would have called the innermost *Iovialem Mercurium* [the Jovian Mercury]; the next innermost *Venerem* [Venus]; the next to outermost *Iovem* [Jupiter]; the outermost *Saturnum* [Saturn]. So Father Io. Bapt. Hodierna recently in his *Medicaeorum Ephemerides* [*Ephemerides of the Medicean stars*]; (1) by Victoria, [who] names them after the prince of Etruria *Principersium* [?]; (2) by the Victory, [from] the wife of the Grand Duke *Vxersium* [?]; (3) by Cosmo *Cosmiferum* [?]; (4) by Ferdinand *Fernandersium* [?]. Finally, by Vuendelinus [Govaert Wendelen] in a letter to me of the year 1647; and by Hevelius in his *Selenographia*, page 45; and by Gassendus, page 45; and by Phocyllides Oluvarda [Johannes Phocylides Holwarda]; and by us, together with Father Grimaldi, never more than 4 [satellites] have we observed.

5. But Father Antonius Maria de Rheita [Anton Maria Schyrleus de Rheita], besides the four interior side-stars of Jupiter, thought he saw others — more remote, and larger, and not visible except with a larger telescope — which he called *Urbanoctaviana* [the Urban-the-Eighth stars]; this in the year 1642, on December 29. Indeed before him Franciscus Fontana, in his treatise 6, observation 1, chapter 2, in the year 1630, saw Jupiter with 5 little stars, not more than 10 [units] distant from it. He saw 6 Jovial diameters; and in the years 1636 and 1643, he saw Jupiter with 8 stars; and

in the year 1645, on December 21 and 31, he saw it with seven, as also in the year 1645. On January 1, on January 22 and 28, he saw it with 6 stars — these not maintaining the same distance among themselves — which had to be extended for seeing them; since, in order to see the fixed [stars] perfectly, it is necessary to contract the tube. [Margin: *Fontana observans.* — Fontana observing.]

6. But Father Io. Bapt. Zuppus, at my request, observed stars around Jupiter [reckoned] as the boundary [of the field of view] in the year 1644, the matter having been made known by letters; in January and February, in records drawn up at Naples, he writes that he saw 6 little stars around Jupiter on January 21 and 22; on January [days], which he reckoned to be in [the line of] Jupiter; and on the 23rd, having explored it for himself, he found that not only 6 satellites wander around Jupiter, but somehow 9, somehow 11 or 12 — among which he supposed eight to be probably errant, partly because they did not scintillate, partly because, by a change of the telescope, they acquired distance; but he asserts nothing concerning the change of distance among them, such as Father Rheita nonetheless asserts — adding that the stars are generated anew, and afterward grow faint; which is the opinion of Io. Caramuel [Juan Caramuel] and Io. Stampioen [Jan Stampioen]. [Margin: *Caramuelis, & Stampion.* — Caramuel and Stampioen.]
7. For the rest, besides the companions [satellites] of Jupiter, the remaining [points] seen by Rheita were fixed stars, [as Gassendus reckons], in the constellation Aquarius — Gassendus reckons [it] in his *Iudicium de 9 Stellis*, since in the year 1642, on December 29, he did not see them change their distance from one another, and for other arguments, which he adduces in *Almagestum Novum* [recte: *Opus Astronomicum* — see note], Book 1, chapter 3. But Lord D. Vincentius Reinerus, the Pisan mathematician, persistently [maintained] to me that they had never seemed to him, in his whole decade of observations of his own ever-more-frequent ones, [to be] more than 4 around the four wandering little stars. Hevelius likewise in his *Selenographia*, page 45, affirms that from the year 1642 to 1645, he most diligently caught sight of these [satellites], and detected — besides the 4 planets [satellites] — that the remaining stars seen by Rheita were of the same [nature] as those of Aquarius [≈], but not [satellites] of the [planetary] order, nor [seen] with the naked eye visible; and (page 65) [maintained] still more strongly against Caramuel and against Rheita; against the Rheitan [view], on this account, and others, Io. Phocyllides

Oluvarda [Johannes Phocylides Holwarda] is too bitterly inveighed against [?]. [Margins: *Gassend. opinio.* / & *Reineri.* — The opinion of Gassendi, and of Renieri. — *Et Hevelij.* — And of Hevelius. — *Ex 10. Phocyllide.* — From Io. Phocyllides.]

[Margin, foot: Situs,]

Situs, & Motus Satellitum Iovis.

[The Position and Motion of Jupiter's Satellites.]

8. Since on individual clear nights the motions of the satellites vary around Jupiter — their intervals, if [taken] from others, and the constancy [of these from] our observations — if we wished to transcribe them in that form (as Galileo did in his Letter to Welser, and Hevelius in his *Selenographia*, page 526), we would fill very many pages indeed, with no hope of gathering fruit from the reader's weariness. Yet it is worthwhile to see a specimen of them — both in the aforementioned [authors], and in Scheiner in his *Disquisitiones*, number 39; and likewise in the case of Simon Marius, who also constructed *Ephemerides* of these motions; as also recently Io. Bapt. Hodierna; and (most diligently and most refined, both from these [sources] and from the Rheitan letter to me, and from Vuendelinus in *Epicur.* page 904, and from Gassendus on page 45, *Almagestum Novum*, Book 7, section 1, chapter 3); and finally from Lord Vincentius Reinerus, [whose] observations of ours I have gathered into the compendium of the propositions written below, [as the thing] more worthy of knowledge.

[Margin: *Propositio.* — Proposition.]

1. They move in circles, [these] 4 satellites: above Jupiter they indeed decline toward the south from the ecliptic; below, toward the north — whence it comes about that their latitude is southerly in the upper part, and northerly in the lower; this Gassendus limits, [saying] "if Jupiter is in the north, the latitude is southerly."
2. The latitude of the first, that is the innermost, is greater than [that] of the second; and [that] of this [second] greater than [that] of the third; and [that] of the third greater than [that] of the fourth, that is the outermost.
3. They move in the upper part of their orbit directly, that is, according to the sequence of the signs, from west to east; but in the lower part they move retrograde, from east to west.

4. They move in [quadrature, $\square$], and with their greatest digressions [elongations] from Jupiter [they move] most slowly, but at conjunction [ϕ] most swiftly.
5. In the upper part, when they decline toward the south, although they may be more remote from the centre of Jupiter, they nevertheless appear higher with respect to the horizon; but in the lower part they have the contrary.
6. They appear larger [as they move] from the upper [point] toward conjunction [ϕ] with Jupiter, [that is] tending to the lower [point]; but tending from this [lower point] toward the upper, they appear smaller.
7. When Jupiter is in the ecliptic, they more frequently and more readily eclipse one another, and are eclipsed by Jupiter's shadow; and such eclipses are visible to us. At other times, indeed, some of their eclipses are hidden from us, on account of the differing latitude of Jupiter and the inclination [of their orbits] to Jupiter's shadow-cone. But concerning the alternation of these eclipses, and their causes, see more fully Galileo, *On the Spots of the Sun* [*Istoria ... delle macchie solari*], page 162; Hevelius, page 46 of the *Selenographia*; and Hodierna in Part 2 of his *Ephemerides Medicaeorum*, chapter 7.
8. Their periods, and their motion from conjunction to conjunction [from ϕ to ϕ] with Jupiter, are better computed than from the other aspects. Scheiner gives other rules in his *Disquisitiones*, number 42. For the rest, see in the little tables written below.

Digressiones à Iove in Semidiametris Iovialibus expressæ.

[Digressions (elongations) from Jupiter, expressed in Jovial semidiameters.]

Satellites	I		II		III		IV.exti	
	(Sem.)	I (')	(Sem.)	II (')	(Sem.)	III (')	(Sem.)	IV.exti (')
Galileo	3	0	5	0	8	0	12	0
Sim. Mario	3	0	5	0	8	0	13	0
Rheitaensi	3	0	4	0	6	0	10	0
Vuedel	3	0	5	0	8	0	14	0

Satellit es	I (Sem.)	I (')	II (Sem.)	II (')	III (Sem.)	III (')	IV.exti (Sem.)	IV.exti (')
ino								
Hodier	3	30	5	30	9	0	14	30
na								

Revolutiones Periodicæ quibus orbitam absolvunt suam.

[The Periodic Revolutions in which they complete their orbit.]

Ord o	Auctoribus	Dies	Hora	'	"
I	Galilæo	1	18	30	ferè (nearly)
I	Mario	1	18	28	30
I	Rheitensi	1	18	30	0
I	Heuelio	1	18	28	0
I	Hodiernæ	1	18	28	44
I	Vuendelino	1	$\square \frac{769}{1000}$		
II	Galilæo	3	13	20	circ. (about)
II	Mario	3	13	18	0
II	Rheitensi	3	13	20	0
II	Heuelio	3	13	18	0
II	Hodiernæ	3	13	18	15
II	Vuendelino	3	$\frac{554}{1000}$		
III	Galilæo	7	4	0	ferè (nearly)
III	Mario	7	3	56	34
III	Rheitensi	7	4	0	0
III	Heuelio	7	3	57	0
III	Hodiernæ	7	4	1	26
III	Vuendelino	7	$\frac{164}{1000}$		
IV	Galilæo	16	18	0	ferè (nearly)
IV	Mario	16	18	9	15
IV	Rheitensi	16	18	0	0
IV	Heuelio	16	18	9	0

Ord o	Auctoribus	Dies	Hora	'	"
IV	Hodiernæ	16	18	14	33
IV	Vuendelino	16	$75\frac{6}{1000}$		

After the table: Hence Vuendelinus concludes that, just as in the case of the major planets their mean distances from the Sun are to one another in the sesquialterate ratio [3/2 power] of their periodic times, so too the distances of the little Jovian [satellites] from Jupiter are in the sesquialterate ratio of their own periodic times.

Motus Diurnus, & Horarius in sua cuiusq; orbita, divisa in Grad. 360.

[The Diurnal and Hourly Motion, each in its own orbit, divided into 360 degrees.]

Ordo Satell.	Auctorib.	Diurnus (Gr.)	Diurnus (')	Diurnus (")	Horarius													
(Gr.)	Horarius (')	Horarius (")		---	---	---	---	---	---	---	---	I	Galilæo					
8	29	circ.		I	Mario	203	25	0	8	28	30		I	Hodiernæ	203	23		
44	8	28	29½		II	Galilæo			4	13	ferè		II	Mario	101	17		
22	4	13	0		II	Hodiernæ	101	17	21	4	13	13		III	Galilæo			
2	6	circ.		III	Mario	50	14	57	2	6	30		III	Hodiernæ	50	13		
32	2	5	34		IV	Galilæo			0	54	30		IV	Mario	21	29	3½	0
53	30			IV	Hodiernæ	21	28	48	0	53	42							

After the tables: Many other tables and canons, with their roots [radices] for compiling Ephemerides and predicting eclipses of these satellites, are found in Simon Marius and Io. Bapt. Hodierna; selections from which, in their proper places, we shall give after the Tables of the Second Motions [*Tabulas secundorum Mobilium*], if it shall so please God, the Best and Greatest.

CAPVT XI.

On the Figure of Mars [De Martis Figura].

1. Near quadrature [□] with the Sun, Mars is seen almost dichotomized [half-lit], says Kepler [Johannes Kepler] (*Epitome of Astronomy* [*Epitome Astronomiae*], p. 843); but between quadrature [□] and opposition [⊙] with the Sun it appears gibbous, and only rarely round when in perfect opposition, as Rheita [Anton Maria Schyrleus de Rheita] affirms (book 4, ch. 5). Hevelius [Johannes Hevelius] in his *Selenographia* (p. 42) shows a sketch of Mars as he himself saw it gibbous,

and on p. 67 denies that it can be seen with little horns [crescent-shaped]; but he says he saw it dichotomized in the year 1645, on the 28th of March. Francesco Fontana [Francesco Fontana], in his *Observations* (tract 6, ch. 1), shows a round figure of Mars in the year 1636, with a spot in the middle that is black — which he judges to be a hollow rather than a shadow [umbo]. But he shows Mars gibbous with a spot, likewise in the middle, in the year 1638. On the 24th of August, Fr. Nicolas Zucchi [Niccolò Zucchi], in the year 1640, on the 23rd of May, saw Mars between trine [$\triangle$] and quadrature [$\square$] with the Sun gibbous, but without a spot — perhaps on account of the motion of its rotation, or of a libration about its own body's center. Fr. Daniel Bartoli [Daniele Bartoli] wrote to me at Naples in the year 1644, on the 24th of December, that with Fr. [Giuseppe] Sersale's excellent telescope Mars had been seen by him almost round, with two spots below the middle.

2. Finally, we ourselves, together with Fr. [Francesco Maria] Grimaldi, in the year 1651, on the 4th, 5th, and 6th of April, saw Mars with a black spot as if formed from many small ones; likewise on the 18th of April and the 29th of May. And again, repeatedly, in the year 1653 through the whole of July, and in the year 1655 on the 22nd of July and the 28th of August; and finally in the year 1657, on the 15th of September, on the 11th, 17th, and 21st of October, and on the 6th of November. Moreover, astronomers take their argument for the dichotomy and gibbosity from the light received from the Sun in the same way [as for the Moon]: as if Mars were the Moon, and as if — were it permitted to see Mars near opposition [$\odot$] with the Sun — we would see it crescent-shaped.

CAPVT XII.

On the Figure of Venus [De Figura Veneris].

1. That Venus moves around the Sun, and receiving its light from it appears now nearly full like the full Moon [$\odot$], now nearly gibbous toward superior conjunction [$\odot$], now gibbous, otherwise crescent — this is plain to any observer who watches her closely, both in the evening and in the morning, with a fine telescope; and it is plain from the observations of Galileo [Galileo Galilei], Scheiner [Christoph Scheiner], Fontana, and Rheita, and from Kepler in his *Epitome of Astronomy* (p. 762); from Rheita (book 4, ch. 5, member 2); from Gassendi [Pierre Gassendi] (*In Epicurum [Animadversiones in Epicurum]*, p. 859). The remaining instances, together with figures, we ourselves have also adduced from our own observation (book 7, *Almagestum Novum*, sect. 1, ch. 2), where also

concerning the spots seen by Fontana — but never by us, nor by Gassendi (book 3, *Institutio Astronomica*) — to which add nearly all of Hevelius in his *Selenographia* (from p. 68 to 74).

2. That Venus, moreover, is sometimes visible by day is established from the observations of Tycho [Tycho Brahe] and Longomontanus [Christen Sørensen Longomontanus], and from Hevelius above, who together with Galileo adds that she is better observed for a long time by day than by night, inasmuch as she is then stripped of adventitious rays. But we too, with Fr. Grimaldi, saw her with the naked eye in the year 1649: on the 1st of April nearly gibbous, and on the 20th dichotomized; on the 1st of May now crescent; on the 1st of September again crescent, as also on the 4th of September up to 2 hours after midday; and so on up to the 8th she was seen crescent from sunrise until midday and beyond; but on the 18th she was exactly dichotomized; and on the 26th more than dichotomized, up to 9 hours after midday — always with the naked eye. And in the year 1651, on the 5th of February, the horns of the crescent met beyond her diameter, and on the 12th the line drawn through the horns was parallel to the ecliptic. But the rarest and most remarkable phenomenon of Venus is

Diagram. A large engraved crescent of Venus occupies the right column, illustrating the "rarest and most remarkable phenomenon" of the planet — the thin crescent whose horns reach beyond its diameter, as great in apparent size as the crescent Moon seen with the naked eye. The crescent's cusps embrace the lower part of the figure; the convex limb faces upward and to the right. Two labels and two planet-symbols mark the figure:

- Top: **Occidens** ("West")
- Upper symbol: ♀ (Venus)
- Lower symbol: ♀ (Venus)
- Bottom: **Occidens** ("West")

[when she has great latitude near her inferior conjunction [♄] with the Sun, for with a powerful telescope she appears crescent, of such magnitude as the crescent Moon to the naked eye; as we saw her, and represented her, in book 7 of the *Almagestum Novum*, sect. 1, ch. 2, num. 4, as here below.]

CAPVT XIII.

On the Figure of Mercury [De Mercurij Figura].

As many witnesses as we adduced in the preceding chapter stand likewise for Mercury's motion around the Sun, and for its light received from the Sun: for if it is observed with a very powerful telescope, around its greatest elongations from the Sun it appears nearly dichotomized; but when retrograde,

it approaches conjunction [♂] with the Sun, or stretches from there toward its second station, it appears like the Moon when it stands about 60 degrees from the Sun, and as if crescent. Hevelius (*Selenographia*, p. 74) says that in the year 1644 he observed Mercury in the morning of the 22nd of November at 10 digits [of its diameter] illuminated, its whole diameter being 12 digits, and on the 30th of November at 8 digits, and on the 2nd of December at $5\frac{1}{2}$ digits — and now crescent, as in figure II of the following Figures. But in the year 1645, on the 16th of May in the evening, he saw Mercury illuminated at $5\frac{1}{2}$ digits, as in figure I; and on the 20th of May dichotomized, at about 6 digits; and on the 30th nearly gibbous, as in figure III. But earlier, in the year 1639, Fr. Giovanni Battista Zupi [Giovanni Battista Zupi / Zuppus] at Naples saw Mercury crescent with Fontana's tube, and illuminated at $5\frac{1}{3}$ digits in the evening, nearly as in figure I; in which manner he saw the same in the year 1646, on the 26th of January in the evening.

2. We ourselves, together with Fr. Francesco Maria Grimaldi, in the year 1643, on the 5th of March, saw Mercury in the still-superior part of its epicycle as evening-star, and not yet elongated beyond 15 degrees from the Sun, gibbous, as in figure III; and likewise in the year 1656, on the 16th of December. But in the year 1643, on the 25th of August, we saw it as morning-star and elongated 19 degrees from the Sun, crescent, as in figure II; in the same way as in the year 1644, on the 6th of August, distant 20 degrees from the Sun. But in the year 1647, on the 30th of April, we saw Mercury as evening-star, distant, and $20\frac{1}{2}$ degrees from the Sun, as in figure I; and in the year 1650 likewise as evening-star and distant, about 18 degrees from the Sun, crescent, as in figure I.

Diagram. A vertical column of four engraved disks of Mercury showing its telescopic phases on the dated occasions described, each disk marked with the Mercury symbol (♿) and a phase-label, and several captioned with the observation dates. From top to bottom:

- First disk (gibbous), labelled **Vespertinus** ("Evening-star"); symbol ♿

- Date caption beneath the first disk: **1639 Maij 23. 1646 Ian. 26. 1647 April. 30.** ("1639, 23 May; 1646, 26 January; 1647, 30 April")
- Second disk (crescent/dichotomized), labelled **Matutinus** ("Morning-star"); symbol ☿
- Date caption beneath the second disk: **1643 Aug. 25. 1644 Aug. 6.** ("1643, 25 August; 1644, 6 August")
- Third disk (crescent), labelled **Vespertinus** ("Evening-star"); symbol ♀
- Date caption beneath the third disk: **1643 Martij 5.** ("1643, 5 March")

The figure is set over a decorative IHS sunburst woodcut device (see below). [The figure labels read Figure I / II / III in the prose; here the disks are grouped by phase and observation date.]

CAPVT XIV.

On the Rotation of the Planets about Their Own Center [De Vertigine Planetarum circa suum centrum].

This rotation has been asserted by Wacker [Johann Matthäus Wacker von Wackenfels] (cited in Kepler's *Dissertatio cum Nuncio Sidereo*); by Kepler in the same place, and in his *Epitome of Astronomy* (p. 549); and by Huygens [Christiaan Huygens] in his *Systema Saturnium*; and it seems probable from the varying position of the belts and spots, concerning which see above under Saturn [♄], Jupiter [♃], Mars [♂], and Venus [♀] — although these phenomena could perhaps be attributed to a libration. Moreover, Fr. Anton Maria de Rheita affirms that the rotation of these bodies has been observed by himself, from their setting to their rising, and its period; and he promises observations of it in a new work to be published.

If rotation is chosen, this advantage emerges: that all the parts of the surface are illuminated by the Sun in succession — which the Moon does not have. Concerning the rotation of the Sun about its own center, within 27, 28, or 29 days, it has been asserted by Scheiner, Galileo, and Bullialdus [Ismaël Boulliau] on account of the apparent motion of the spots, or by the daily and annual rotation according to Kepler, or as is to be seen by Rheita, in those things which we discussed in book 3 of the *Almagestum Novum* (ch. 4), and in book 9 (sect. 4, ch. 12): for they are so many that they cannot here be reduced to a compendium without the loss of much learning.

CAPVT XV.

On the Distances of the Planets from the Earth, and from the Sun, and on the Distances of the Fixed Stars [De Planetarum Distantijs à Terra, & à Sole, vbi & de Fixarum].

In the *Prolegomena* of this volume, Article 4, I taught that the distance of the Sun from the Earth is neither greater than 30,000 terrestrial semidiameters, nor less than 6,430. Within these limits I proposed two other probable hypotheses: one that of Wendelin [Govaert Wendelen], which was nearly that of Posidonius [Posidonius]; and another, afterward, that of Christiaan Huygens; and a third, our own, twofold, which I delivered in book 1 (ch. 13, 14, and 17). But in book 3 (ch. 9) I treated the lunar distances, and in book 5, 6, 7, 8, 9 the maximum and minimum distances of the five lesser planets from the Sun, in parts of the kind in which the Radius of the Annual Orbit of the Sun is 100,000, according to a certain species [reckoning] of the parts in Volume 2, Table 97. We will add their distances from the Sun at every value of the Anomaly, or at intervals of five degrees each, together with their maximum and minimum distance from the Earth.

But in this place we set out only the maximum and minimum distances, not solely in parts of the Radius of the Annual Orbit of the Sun, but also in semidiameters of the Earth; and indeed according to the four Hypotheses of the Sun's distance from the Earth indicated above — the others being rejected, both those above and those framed within the aforesaid limits, or fictitious, as plainly false, as we have shown in their place. We will always suppose the distances of the planets from the Sun according to our own Hypothesis; but when those distances are to be combined with the Sun's distances from the Earth, we will take the latter from the four Hypotheses named. For example, when we say that the maximum distance of Mercury from the Earth, according to Wendelin, is 21,754 terrestrial semidiameters — it is to be understood that this is taken and compounded from two elements: one indeed from Wendelin, which is the radius of the Sun's annual orbit, namely 14,656 terrestrial semidiameters; the other, which is for us the maximum distance of Mercury from the Earth, which is 148,430 in the parts in which the Radius of the Annual Orbit is 100,000. For 148,430 multiplied by 14,656 and the sum divided by 100,000 yields 1,754 [recte: 21,754] semidiameters of the Earth; and so of the rest.

Distances of the Planets, and of the Fixed Stars, from the Earth and from the Sun [Distantia Planetarum, & Fixarum à Terra, & à Sole].

Table 1 — In parts of the kind in which the Radius of the Annual Orbit of the Sun is 100,000 [In partibus Qualium Radius Orbis Annui Solis est 100000]

Distances of the Planets from the Earth, according to Our Hypothesis [Distantia Planetarū à Terra. Ex Nostra Hypothefi]

Planet	Minima	Media	Maxima
☉ Solis (Sun)	98260	100000	101740
☿ Merc. (Mercury)	67780		148430
♀ Veneris (Venus)	26656		174713
♂ Martis (Mars)	36534		268164
♃ Iouis (Jupiter)	395413		649629
♄ Saturni (Saturn)	797363		1111033

Distances of the Planets from the Sun [Distantia Planetarū à Sole.]

Planet	Minima	Media	Maxima
☿ (Mercury)	30486	38585	46690
♀ (Venus)	71823	72398	72973
♂ (Mars)	138274	152348½	166424
♃ (Jupiter)	497154	522521	547889
♄ (Saturn)	899103	954198	1009293

Table 2 — Distance from the Earth in Semidiameters of the Earth [Distantia à Terra in Semidiametris Terrae]

For each body four rows are given: **Summa** (the sum / greatest), **Vuedel.** (Wendelin's value), **Nobis** (ours), and **vel Infima** (or the least). Columns again run Minima / Media / Maxima. The left block continues with the right block (read left block first, then right).

☉ à Terra (Sun, from the Earth)

	Minima	Media	Maxima
Summa	28974	29487	30000
Vuedel.	14407	14656	14905
Nobis	7173	7300	7427
vel Infima	6438	6552	6666

☿ à Terra (Mercury, from the Earth)

	Minima	Media	Maxima
Summa	19986	31446	42906
Vuedel.	9934	15844	21754
Nobis	4948	7690	10435
vel Infima	4441	7083	9725

♀ à Terra (Venus, from the Earth)

	Minima	Media	Maxima
Summa	7860	29689	51518
Vuedel.	3904	14656	25406
Nobis	1946	7350	12754
vel Infima	1745	6596	11447

♂ à Terra (Mars, from the Earth)

	Minima	Media	Maxima
Summa	10773	44923	79074
Vuedel.	5354	22328	39302
Nobis	2670	11120	19576
vel Infima	2394	9982	17570

♃ à Terra (Jupiter, from the Earth)

	Minima	Media	Maxima
Summa	116595	154075	191556
Vuedel.	57952	76580	95208
Nobis	28864	37266	45669
vel Infima	25907	34235	42564

h à Terra (Saturn, from the Earth)

	Minima	Media	Maxima
Summa	235110	281360	327610
Vuedel.	116862	139847	162833
Nobis	58207	69656	81105
vel Infima	52263	62529	72795

Hic modus Errorum est; hi certi denique fines, Quos vltra citraq; nequit consistere verum.

[This is the measure of the errors; these, at last, are the fixed limits, beyond and short of which the truth cannot stand. (A closing couplet.)]

Laus Deo, Beatissimæq; Virgini.

[Praise to God, and to the most Blessed Virgin.]

ASTRONOMIAE REFORMATAE TOMUS II

ASTRONOMIAE REFORMATAE TOMUS II.

The Reform of Astronomy, Volume II.

Of which the First Part contains the **Precepts for the Use of the Tables**

[Praecepta pro usu Tabularum], and the Latter Part the Astronomical Tables themselves — the 102 New-Almagest Tables [Tabulae Novalmagesticae].

By the author **Fr. Giovanni Battista Riccioli** [P. Ioanne Baptista Ricciolo], of the Society of Jesus, of Ferrara [Ferrariensi].

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INDEX OF PRECEPTS WHICH ARE SET FORTH IN THIS VOLUME

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4	To convert sixtieths of a Day into equal Hours and their sixtieths.	1
5	To resolve the Days of the Julian Months into Days collected from the beginning of the Common Year and of the Bissextile [leap year].	1
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[This opening continues the *Index Praeceptorum* — the index of precepts for the use of the tables — begun earlier in Tomus II. The index is laid out across the page in two side-by-side blocks, each a four-field table: precept number (*Praec. ordo.* / *Ordo Praec.*), the precept's title, and the page (*Pag.*) on which it is found. The precepts are transcribed below as native tables, in reading order: first the left block of each page, then the right block.]

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PRECEPTS For the Use of the Astronomical Tables Contained in This Volume

Precept 1. On the parts of the as [assis] applied to a circle and to time.

If anywhere in the Author some aliquot part of a circle, or of a degree, or of a day, or of an hour is expressed by way of the parts of the as, or of the libra [pound], Table 1 teaches its meaning and value. For example: a *dodrans* of a libra is worth 9 ounces; a *dodrans* of a circle is worth 270 degrees; a *dodrans* of a degree is worth 45'; a *dodrans* of a day is worth 18 hours; and so on.

Precept 2. On the resolution into thirds [scrupula].

In Table 2 you have an hour, a degree, or a circle resolved into thirds of thirds, the resolution carried out down to the tenth third. For example: if an hour is to be resolved into sixth thirds, you have it in the first part of Table 2 opposite the numerator [as] the sixth third, 46,656,000,000; and likewise for the rest.

Precept 3. To convert given hours, and the thirds of hours, into thirds of a day.

Since with some astronomers the day is divided not only into 24 hours but very often into 60 first thirds, and these into 60 seconds, and so on, therefore in Table 3 look up under their own headings the given hours, and their thirds, in the leftmost column; for opposite them, proceeding rightward, you will find under the headings at the top the thirds of a day matching the hours and the thirds of the hours. For example: let there be given 5 hours and 25 thirds of an equal hour. First, in the leftmost column you find 5 hours; and opposite them, under the first heading at the top — the one that answers to the hours — you find 12' of the first third of a day, and 30" of the second. Then, for the 25 thirds of the hour, under the second part of the top heading, which answers to the first thirds, or minutes, of

the hour, you find 1" of the first third of a day, 2" of the second, and 30''' of the third. So, by putting all together, 5 hours equals, together with 25', 13' 32" 30''' as thirds of one day.

Precept 4. To convert given thirds of a day into equal hours, hours, [and] thirds.

You will accomplish this by Table 4, by looking up everything under the appropriate top headings and putting together the numbers found. For example: let there be given 25 first thirds of a day, and 20 seconds. For opposite 25, in the leftmost column, you find — under the hours heading — 10 hours; and opposite 20", the seconds, under the second part of the top heading, 8 thirds. Therefore 25' and 20" of a day are worth 10 equal hours and 8 horary minutes.

Precept 5. To find which day [number] of any given Julian month a day is, counted from the beginning of the year.

In Table 5, the second column, if the year is common — but in the first, if it is bissextile [a leap year] — look up the number of the given day; and opposite it, to the right, under the month given, you find the number of days of the year. For example: let April 26 be given. In a common year [such as] 1650, for the number 26 noted in the second column under April answers the 116th day of the year. But if the year were bissextile, say 1652, then the 116th day in the first column would answer to the number sought, [yielding] 117 [days] under April.

Precept 6. Given the number of days of the Julian year, to find of which month, and which day of it, it is.

In Table 5 itself, seek the number of the days of the year, and in the head of that column you will see the month; and opposite the same number, in the column on the left — the second, if the year is common, but the first, if bissextile — you find the number of the day of the desired month. But note: if the number falls at the end of a column and again at the beginning of the following one, and the year is bissextile, that number must be used which is at the end of the column. For example: let it be a common year, 1650, and the 116th day of the year; this you will see in the 6th column under April, and opposite it in the second column the day 26. But if it were a bissextile year, say 1652, the number 116 in the first column would answer to the day 25 of April. Another example: let there be given, in a bissextile year, the 121st day; for you will see this number both at the end of the sixth column and at the beginning of the seventh; but, as you must, opposite the number under April, in the first column, it will answer to the 30th day of April.

Precept 7. To find which day of any month it is, when a given Egyptian day is to be reckoned from the beginning of the year.

The Egyptian year consists of 12 months, each of which is of 30 days; but, with the days reckoned absolutely, 360. To these are added, outside the ordinary reckoning, five days, which they call intercalary and in Greek ἐπαγόμεναι [Greek: epagomenai, "the added days," i.e. the epagomenal days], without any other quarter-day of intercalation. Therefore in Table 6, in the first leftmost column, seek the number of the given day; for, turning rightward under the named month, you will have the number of the days reckoned from the beginning of the year. Example 1: let there be given the 23rd day of the month Athyr; you find the 83rd day of the year. Example 2: let there be given the 3rd day of the intercalary days, or the epagomenae [epagomenal days]; for to day 3 of the first column there answers, in the last column under the title *Epagomenae*, day 363 of the year.

Precept 8. Given the number of days of the Egyptian year, to find of which month a day is, and which [day of it].

In the same Table 6, seek otherwise the given number of days of the year, for to it there answers, in the heading at the top, the month sought; and in the first column, [you find] the days of that month. For example: given the number of days 83 — because this is in the fourth column, [the month] congruent to it at the head is the month Athyr, and in the first column the day 23 of the same month.

Precept 9. Given the day of the Julian year on which an Egyptian year begins, to find out which days of the Egyptian year correspond to it, and the day of each Egyptian month.

Astronomers begin the first day of the month Thoth at noon. So, first, reduce the given Julian day on which the first day of Thoth begins by Precept 5 to a single day. Second, reduce the given day of the Egyptian month by Precept 7, the precept for the day of the Egyptian year, and to this number add the number of days of the Julian year. Then, from this sum, after subtracting unity (if it does not exceed 365 days for a common year, or 366 for a bissextile year), look in the sixth Table: for those numbers stand at the head of the Table for the Julian year's month, and directly across, in the first column, if the year is bissextile, or in the second, if it is common, you have the desired day of the Julian month.

First example. An Egyptian year began on 20 February of a common Julian year, that is, by Precept 5, day 51 of the Julian year, while by Precept 7 it is day 23 of the Egyptian month Athyr (the month which by example 1 of Precept 7 is day 83

of the Egyptian year). For when you add 51 and 83 together, the day of the month Mair [Mecheir] remains as 134, after subtracting unity. Now look in Table 6: 134 corresponds, at the head of the Table, to the month of May, and across, in column 2, to day 13 of May. Therefore that Egyptian year began on 13 May.

Second example. An Egyptian year began on 20 March, that is, by Precept 5, day 80 of that year; while the day of the Egyptian year, by Precept 7, was day 23 of the month Athyr, which is day 83 of the Egyptian year. By addition, since you add 80 and 83 together, the sum becomes 163. From this, subtracting unity, day huic autem in Tabula 6. co[rre]spondet Mensis Iunius, & sinistrorsum in prima columna, quia annus est Bissextilis, to day 10. And so that Egyptian year began on 10 June, at noon, of that same year. But if the sum of the days of both years exceeds 365 for a common year, or 366 for a bissextile year, then if that year was bissextile, the 366 are rejected, and you look for the remainder by Precept 6, to find the day and month of the Julian year, depending on whether the year that follows the one in which the Egyptian year began was common or bissextile.

Example. An Egyptian year began on 25 November of the bissextile year of the Julian Epoch 1084. This year is, by Precept 5, day 330; and the day given, by Precept 7, is day 83 of the Egyptian year [Athyr 23]. When you add 330 and 83 together, the sum of days becomes 413, exceeding the 366 days of the bissextile year by 47. From 47, taking away unity, the remainder 46 corresponds, by Precept 6 in Table 6, column 4, to that month of February; and across from it, in column 2 (since the following year, 1085, is common), you find that day 23 of Athyr begins on 15 February of the year of Christ 1085.

[Margin: Pag. 2.]

Precept 10. To convert parts of the Equator into hours of the Primum Mobile, and the scruples of those hours; and conversely, such hours into parts of the Equator.

For this precept Table 7 and 8 serve, and it is enough to inspect the headings at the front of those Tables, which agree with the degrees, or with the time given for them, and their scruples; for, under those headings, proceeding from right to left, you find the required number directly across, by one entry or by several entries, as the task requires.

Example 1. Let there be given 25 degrees of the Equator, 35 minutes, and 15 seconds. For first, in Table 8, the first column gives 25 of the head itself, and the third, under the topmost heading that corresponds to degrees, gives you hours 1

and 40'. Then, in column 4, are 35 minutes, to which, in the fifth and sixth, under the second heading of the front series, correspond minutes 2' and 20". Finally, in the first column are 15 seconds, to which, in the second and third, but under the lowest series of the front, corresponding to seconds, you have 1". The sum will therefore be gathered thus:

Of the Equator	Hours		'	"
Grad.	25	1	40	0
Minut.	35		2	20
Secund.	15			1
Summa		1	42'	21"

Example 2. Conversely, let there be given, of the Primum Mobile, hours 1·42'·21". From Table 7 you will gather the sum of the parts of the Equator in this way:

Of the Primum Mobile	Grad.		'	"
Hour	1	15	0	0
Min.	42	10	30	0
Sec.	21	0	5	15
Summa		25	35	15

[Margin: Pag. 3.]

Precept 11. To convert the time of the solar day into parts of the Equator, and conversely those into the time of the solar day.

The day which the Sun makes for us by its daily revolution is somewhat longer than the day which the Primum Mobile makes — or (what is the same thing by an imperceptible difference) than the day which any fixed star makes by its daily revolution — from the same meridian or horizon back to the same one; because in the meantime the Sun, by its mean motion, traverses about one degree on the Ecliptic toward the East, with the result that, before the Sun returns to the same meridian or horizon, the 360 degrees of the Equator, plus about one degree, must pass across. Therefore, if there be need to do this with precision, the hours of the solar day are to be converted into parts of the Equator by Table 7, or the parts of the Equator into hours of the solar day by Table 8, but with the Equation applied that is adjoined in those Tables for the hours and scruples of the solar day.

Example 1. For hours 1·35'·15" of the solar day there were found to correspond hours 1·42'·21" of the Primum Mobile; the correction, or Equation to be subtracted, is thus:

Of the Equator				
Gradus	2	16	0	
	5			
Minut.	3	1	0	
	5			
Sec.	1	0	59	
	5			
Summa	17	59		
Therefore by the said parts of the Equator there agree, of the solar day only			Hor. 1·42'·3"·1"	

Example 2. Of the same Precept 10, in which hours 1·42'·21" of the Primum Mobile agree with degrees 25·35'·15" of the Equator. The Equation for the hours of the solar day [is to be added]. The addition will be this:

Addenda haec erit						
Hour 1. of the solar day	2	28	0	0		
Minut.	42	1	44	0	0	
Sec.	21	0	0	0	52	
Summa add.	4	12	0	52		

Therefore for hours 1·42'·21" of the solar day there agree, of the Equator, Gr. 25·39'·27"·0"·52".

[Margin: Pag. 3.]

Precept 12. To convert equal hours of one kind, or denomination, into equal hours of a different kind, the quantity of the semidiurnal or seminocturnal arc being given.

Return to Table 9 and carry out everything as is prescribed in it.

[Margin: Pag. 4.]

Example. Let the semidiurnal time be of equal hours...

7 and 30', and let the day computed from noon be of astronomical hours 5·30'; and let that be converted into the Italian solar hour. For, subtracting from hours 23·60', the semidiurnal time leaves hours 16·30'; to which, if you add the hours 5·30', the Italian hour 22 turns out, but solar; for indeed civil clocks count the day by half-hours, and then would not strike except hour 21½.

Precept 13. Given the quantity of the artificial day, to convert temporal hours, and the scruples of those, into equal hours, and the scruples of these.

By an artificial day I mean the time of the Sun's stay above the horizon. Among the Hebrews once, and among the Romans, and among many nations, this was divided into 12 equal hours — equal indeed to one another within the same day, but by no means equal to the hours of other days; and so, resolving the time of any single hour into seconds, it amounts to 43200, as they used to do, using it instead of the divisor. Resolve then both the artificial day (of which I want the temporal hour) into seconds, by Precept 14, and the second scruples, and multiply the two by one another; the sum arising from this, divided by 43200, will give the second of the equal hours. From the sum of these seconds, gathered by repeated subtractions of 60, you collect the equal hours themselves.

Example. Let the artificial day be of hours 15·30'; this in seconds is 55800. And let the temporal hours be 4·20'; this, in its own seconds, is 15600; multiplying these by 55800, the sum becomes 870480000. This, divided by 43200, leaves seconds 20150'. And these, divided by 60, leave 335'; and the minutes, divided by 60, leave 335'; and again, divided by 60, leave the equal hours 5. Add 35', and besides the aforesaid 50', to which the temporal hours 4·20' are equivalent. By another method this precept is carried out by Table 10, in which a fixed quantity of the artificial day responds in the prior columns; for, in the latter part of that quantity which the artificial day responds to, lies the quantity of one temporal hour, however much that may be; and as many temporal hours as there shall have been, the sum of the equal hours will consist of that. And if some scruple cleaves to the temporal hours, the proportional part of that twelfth must be added. But this twelfth part must be added to the integral temporal hours, as set out above.

Example. Let the quantity of the artificial day be of equal hours, as in the first example, 15·30'; and let the temporal hours be 4·20'. First, in Table 10, in the fifth part of the Table whose front bears the letter E, and across, of the temporal hours

15·30', are given their twelfths, namely hours 1·17·30', which, multiplied four times, make hours 5·10'. The third part is taken — namely 25·50'; and added to hours 5·10' are made the equal hours 5·35'·50'', equivalent to the temporal hours 4·20'.

Precept 14. On finding the semidiurnal and seminocturnal time, the altitude of the Pole and the place of the Sun in the Ecliptic being given.

It is plain that, from the semidiurnal time, the hours being subtracted from 11·60', the seminocturnal is left; and the seminocturnal subtracted likewise from hours 11·60', you have the semidiurnal; and each doubled gives the diurnal, and so on. Furthermore, the semidiurnal or seminocturnal time is obtained most expeditiously by Table 11, and by two ways.

The first is by Table 11, on whose outermost left-hand columns are the signs of the Sun's place, to be numbered downward with their three degrees, while on the right are the signs to be numbered upward with their degrees; and directly across, under the altitude of the North Pole, the semidiurnal time is found if the Sun is in the northern signs, and the seminocturnal if in the southern. But where the Table is empty of a sign, the semidiurnal exceeds the hours 12.

Example. For an altitude of the Pole of 44 degrees, the Sun being in Taurus, degree 18. For finding 18 in the left column for Taurus, and from there proceeding to the right...

[Margin: Pag. 5.]

you find, under the Pole's altitude of 44, the semidiurnal time, hours 7·10'. This therefore is the semidiurnal time for the northern peoples, but the seminocturnal for the southern peoples.

But if the Sun were in degree 12 of Aquarius (who are noted in the right-hand margin), respond to it under the Pole's altitude of 44, hours 7·10' — which is the seminocturnal for the northern peoples, but the semidiurnal for the southern peoples.

II. Method.

Otherwise thus. The place of the Sun being given, look in Table 26 for its declination; this, in the margin, either added to or subtracted from the altitude of the Pole noted at the front of the Table, or by the foregoing Declination at the

front, and from the Pole's altitude in the left margin, look for the *Difference of Ascensions* [Differentiam Ascensionalem]. But this, with the degrees added — if the Sun is in northern signs, and likewise the conspicuous Pole is northern, or take away if it is in southern signs, and you will have the Arc of the Ascensional Difference; this is then to be converted by Precept 10 or 11 into hours, or the parts of the Primum Mobile, or solar.

Example. The Sun being, as above, in Taurus degree 18, its declination by our Table 26 is degree 17·14'·29"; with this, under the Pole's altitude of degree 44, is given the Ascensional Difference, degree 17·26'·10", which, added to the degrees 90, makes the Ascensional Arc, well known to us, of degree 107·26'·10". This in turn, in Table 7 by Precept 10, agrees most accurately with the hours of the Primum Mobile, 7·9'·44"·40".

[Margin: Pag. 19.] [Margin: Pag. 21.] [Margin: Pag. 26.] [Margin: Pag. 7.]

Precept 15. When recourse should be had to Table 11 in those areas where it stands empty of numbers.

In this case the day exceeds the hours 24; and then it scarcely befalls the astronomer that he needs the semidiurnal, or the nocturnal time, in the calculation of motions. Therefore I send the reader off to our problems of the Primum Mobile, or of our reformed Geography. If, however, you wish to know the longest day in the frozen Zones, consult the little Table at the end of Table 11, added at page 7.

[Margin: Pag. 7.]

Precept 16. To convert apparent time into mean, or equal, time, and conversely equal into apparent — and when one is needed from the other.

Our astronomical Tables of the mean motions have their Radices accommodated to the meridian, and indeed to the last day of December, on the assumption that the natural days are of equal hours 24, and lie between equals; and for example's sake we say that the Sun completes one revolution on the Ecliptic of degrees 0·59'·8"·20" — on two further days of degrees 1·58'·16"·40". But in reality the days are unequal, for two reasons. The prior reason is the obliquity of the Ecliptic; to the equal arcs of the Ecliptic respond unequal arcs of the Equator, which is the measure of time; the posterior reason is the eccentricity of the Sun, from which arises the Anomaly, or irregularity of the Sun's motion, which remains, even if

the Sun moved in the Ecliptic with equal motion. Hence it comes about that, if our astronomical Tables (in the rest, indeed, almost to be neglected) are to be predicted, or to be gathered for some past or future Phenomenon, so that the calculation, once carried out, may satisfy the apparent time — which is observable by us — then the equal time of the completed calculation must be converted into apparent. And conversely, when the apparent time is given (by which some observed Phenomenon was, or that thing to be examined), then it must be converted from astronomical Tables; and the given apparent time must be converted into equal. And each is called the Equation of the Natural, or Civil, Days.

This indeed is done by our two Tables, 12 and 13. The prior, indeed, is perpetual; and it is plain it is constructed from the prior cause, namely from the Obliquity of the Ecliptic, which is here put at degrees 23·30'·20". The latter is constructed from the equated Anomaly of the Sun, which we suppose to be founded there in the Sun's eccentricity. And so, in the upper part of little-Table 12, with the sign of the Sun at the front, and its degrees in the left margin, or with the sign at the foot, and degrees on the right margin, ascending,

[Margin: Pag. 8.]

you find, in the common meeting place of the Equation, the prior part to be added or subtracted to the given time, as the heading at the front indicates, or at the foot, in the latter part of little-Table 12 sought for the Anomaly of the Sun from the Ephemeris, or another sign at the front with degrees on the left, or at the foot, with the degrees on the right, and in the common meeting place is had, by another part of that same little-Table, the title given. From these two, indeed, composed, the absolute Equation of apparent time is aggregated, if they are of the same character; or it is subtracted, if they differ in character, and the lesser of the major leaves the Equation of that kind whose Equation is greater.

Example. Apparent time being after noon hours 5·20', which is to be converted into Equal, the Sun being in Taurus degree 16, and the Anomaly of the sign 9 completed, holding degree 8. First, then, in Table 12, the superior part, under the sign of Taurus, and across from degree 16 of the left margin, is given the Equation 9·55'·45"', [to be subtracted] from the given time. Then, under the inferior part, and across from the sign 9, ascending, but on the right from degree 3, is found, across, the Equation itself 4·3". And, as the title with sign 9 indicates, it is to be added. Since therefore they are of diverse character, if the subtractive 9·55'·45"' has the subtractive 4·3" taken from it, there remains absolute, and corrected, the

Equation $5^{\circ}52'45''$, to be subtracted from the given time, hours $5^{\circ}20'$; so that the Mean, or Equal, time is hours $5^{\circ}14'7''15'''$.

Otherwise by the temporary little-Table

If the Sun's Apogee were immovable, as Ptolemy thought, and had not migrated step by step into another sign, a single Table might be made from these two little-Tables, namely Table 12, of perpetual duration. But because the Sun's Apogee moves forward in other ages, and in other ages into another sign, or to other degrees of the same sign, one Table cannot satisfy all ages and centuries, but only one, or another. And so we have constructed two Tables, militating under Table 13. The upper Table, which was constructed exactly for the year of Christ 1504, when the Sun's Apogee, by my opinion, was in Cancer degree 6 (but it is wanting, by an error considered to serve the preceding century, and subsequently, that is, from the year 1404 to 1604). The lower indeed serves the error of the Apogee about Cancer degree 10; but this, without curable error, serves from the year 1636 to the year about 1836. Each one likewise serves nearly exactly to all the years between 1504 and 1736, comprehend, and likewise to each of the entries with the sign of the Sun at the front, and with the degree of the sign in the left margin sought; for in the common meeting place is had the absolute Equation to be added to the apparent time, or to be subtracted, as the heading at the front indicates; to which the contrary is to be done, if the equal time is to be converted into the apparent.

Example. Let it be the year of Christ 1650, the Sun being in Taurus degree 16, to convert the apparent time of hours $5^{\circ}20'$ into Equal. First, in the superior Table 13, in the part serving the year 1504, under Taurus, and across from degree 16, is found the Equation [to be subtracted] $6^{\circ}48''$. Then, in the inferior part, which serves the year 1736, under the same sign, and across from the same degree 16, is had the Equation to be subtracted $3^{\circ}5''$. Whence the Difference of the Equations is $3^{\circ}43''$; this is resolved into seconds $223''$, between the years 1504 and 1736; the total difference is of the years 232; but from the year 1504 to 1650 there are years 146. Say, then: if the years 232 decrease the seconds $223''$, by how much will the years 146 decrease? $146''$, that is, minutes $2'$; and seconds $26''$, which, subtracted from the prior Equation $6^{\circ}48''$, leave the Equation corrected $5^{\circ}31'''$; which, subtracted from the hours $5^{\circ}20'$, leaves the Equal time hours $5^{\circ}14'29''$; yet the prior method is more exact in the seconds scruples.

Precept 17. On equating time on account of the Distance of Meridians.

Since our astronomical observations were carried out by us under the meridian of the renowned City of Bologna — partly in the most august Temple of S. Petronius, partly, and for the most part, in our Observatory of the College of S. Lucia of the Society of Jesus — therefore, so that our Tables may serve the meridian of this Bologna meridian; but truly, so that the time of this meridian may be fitted to the meridians of other places, one ought to know the Distance of those places, or the Difference of Geographical Longitudes, whether they are Oriental or Occidental with respect to Bologna, Italian-fashion. To this end, in our Reformed Geography, Book 8, all things being sought everywhere, the Eclipses and Itineraries, we have most diligently investigated the Differences of Longitude of very many places, as from Observations of the major, and the intervals of places themselves; we have most diligently inquired the Altitudes of the Pole, that we might (as the ancients complained, and the new Astronomers and Geographers were not satisfied above this) make good, and so that we might expunge the innumerable errors from the Geographical and Hydrographical Charts, as far as God granting allowed. But in Book 9 we would set forth a Catalogue of the places of very many places, with the Longitude reckoned from the Island of Palma, and the Altitude of the Pole. Hence, therefore, you take the difference

[Margin: Pag. 9.]

of our Catalogue, for the Tables 14, to be reckoned from the places of this place, the time-difference of the Bologna meridian is had, or the *Addenda*, or the *Subtrahenda* to the time of the Bologna meridian; the contrary, however, is to be done, if at the same time the time is to be reckoned under other meridians, and the time agreeing with the Bologna meridian is to be reduced.

Example. Let the beginning of a future Lunar Eclipse be sought; let it be after the Bologna meridian, on the hour 10·20'. Sought, however, what the time then future may be in the hour, and the moment of the hour, at Goa in Eastern India, or Lima in Southern America? Now, in our Catalogue, the Difference of Time inscribed for Goa is hours 4·18'. *Addenda.* And the Difference of Time of Lima is hours 6·10'·40". *Subtrahenda.* Therefore the beginning of the Eclipse will be, after the Bologna meridian, the hour 14·38' at the hour of Goa, or 4·9'·20" at the hour of Lima. On the contrary, truly, if the beginning of this Eclipse had been supposed at the hour 10·20' of Goa or Lima, the Difference of Time inscribed for Goa would be

Subtrahenda; for Lima, however, it would be *Addenda*; and so, in the prior case, that time would be at Bologna after noon hour 6¼; in the latter case, after the hour 16·30'·40".

[Margin: Pag. 9.]

Precept 18. To find the Bissextile years, in the form of the Julian year, before and after the Epoch of Christ.

For the years before the Epoch of Christ, consult Table 15, in which the prior, or leftmost, column shows the years; or each century of the preceding Christ expanded; the second, however, the third, and the fourth column the hundredth years, or the thousandth years, or the hundredth years which are Bissextile. So, for example's sake, those years ought to be Bissextile in a certain reckoned-back Julian year before Christ 1·&·5·&·9·&c. Likewise the years 101·&·201·&c. likewise the years 2701·2801; likewise 5301·&·5401·&c. But beyond these, of all the centuries of years before Christ, those are Bissextile which are in the first column, that is 25; for the Bissextiles, since 25 is in the first column, are Bissextile. The rest, intermediate, and not noted, are Common, as the years before Christ 4·8·12·104·108·112·&c.

For the years after the Epoch of Christ, however, consult Table 16, in whose first column are the years of any century after Christ, in 2, however, & 3·the hundredth, thousandth, &c·Bissextile years. So, for example's sake, the Bissextiles are in this form the years 4·&·8·&·12·&c·likewise 100·&·200·&c·likewise 1700·1800·1900·&c. But, by composing the expanded years with the hundredth, or thousandth, the Bissextiles are 104·108·item 204·208·item 1004·1008·&c·the rest intermediate, and not noted, are Common.

Precept 19. In the form of the Gregorian year, to distinguish the hundredth years, or the thousandth, which ought not to be Bissextiles, and excepted, in which the number of days of the Gregorian years exceeds the number of days of the Julian years.

In the form of the Gregorian year, every fourth one of the expanded years is Bissextile, and these the first column of Table 15 serves. But among the hundredth years, and the thousandth, those alone are Bissextiles whose two prior figures...

the leap years (bissextiles) are found among the expanded years, that is, every fourth year, every hundredth from the year 1600 exclusive — once the rule of intercalation is taken up — as appears more clearly in Table 17. There the letter C [for] Common years, and the letter B [for] leap years (bissextiles), give the indication. [Margin: Pag. 14.]

Furthermore, from the year of Christ 1582, on the 5th of October, those who follow the Gregorian form embraced it — that is, the greatest part of the Christian world. They reckon the days 10 more than the Julians do; yet, with stubborn obstinacy, others retain the form of the Julian year, and the same days. For example, the 24th of December among the Gregorians is not the 14th among the Julians. December among the Julians, as it happens each time, and from the year 1700, will reckon the 24th [Gregorian] as the 14th [Julian]; for in the following year, 1700, the Gregorian form will be the 24th of February, while among the Julians it will be the 25th — for it will then be a Julian year and a Gregorian computation by 11 days, and so on always up to the year 1800. February, then, [will reckon] the 24th as the 6th of March in the Gregorian [count], and at once on the following day, by Gregorian computation, the Julian 12th will be exceeded, and that day denominated the 7th of March, which by the Julian style is the 24th of February, and is the later one. For this reason, with regard to indicating these excesses, in Table 20 the third column and the sixth give notice of the days of excess.

Praecept. 20. *To find the Cycle of the Sun [Cyclus Solis] for the sake of investigating the weekday [Feria], both before and after the Epoch of Christ.*

The Cycle of the Sun [solar cycle] is a period of 28 years, produced from the multiplication of the 7 days of the week by 4 — because each fourth year is a leap year, which doubles the Dominical letter; and so each twenty-eighth year the Dominical letter recurs to the same weekday. Why a year has a Dominical letter, this letter being dedicated here to the Sun and to the Lord's resurrection [Dominica resurrectionis], and so the Cycle is called of the Sun [Cycli Solis], and the letter named Feria 1 [first weekday], indicating the Lord's Day [Dominica], is called in Greek Κυριακή [Greek: Kyriakē, "the Lord's (day)"]. How, moreover, the Greeks named the weekdays in the front of Table 19, and the Characters of the Planets, with which the Astrologers labelled them, they wrote. Furthermore, for the Cycle of the Sun for years before the Epoch of Christ: for the years to come, add 9 to those years, and from the sum subtract the nearest smaller number found in Table 18. The Residue, if it remains less than 28, will be the Cycle of the Sun itself; [if it equals 28,] the Cycle itself is completed at 28.

Example. Let the year of Christ be given as 1660, with 9 added, making the sum 1669. From the number of the Cycles of the Sun in Table 18, the nearest smaller is 1652, which subtracted from the said sum leaves a Cycle of the Sun of 17 — which indeed corresponds to the year of Christ 1660.

Another way, without the Table.

To the years of Christ add 9, [and] divide the sum by 28. The fraction that remains in the quotient is the Cycle of the Sun; but if there is no fraction, [it] will be 28 itself, [and] this will be the Cycle of the Sun.

For years current before Christ.

Look in Table 18 for the next larger number [than] the years current before Christ, and to that add 9. Then from the sum subtract the years given before Christ; and from the remainder, if it is not less than 28, subtract the next smaller Cycle of the Sun found in Table 18; for what remains of the Cycle of the Sun, if it is no [longer] greater, will be that very thing. If the residue was first less than 28, the residue itself will be it.

Example 1. The year before Christ given is 36; the next larger number to this in Table 18 is 56. This increased, it becomes 66; from this subtract the given 36, [there] remains 30. And to this remainder of the same Cycle of the Sun, the next smaller in Table 18 is 28, which subtracted [gives] a remaining number 2; this, then, is the Cycle of the Sun corresponding to the year 36 before Christ.

Another way, without the Table.

To the years given before Christ add 18, and divide the sum by 28; for if nothing remains over, the Cycle [sought] will be 28 itself. If, however, some residue remains, [that] subtract from 28 itself —

[column 2]

the remaining 28; and what is left over will be the Cycle of the Sun; but if 18 is added to the years before Christ, and the number minus 28 results, you will have the Cycle of the Sun.

Example 1. Let there be a year current before Christ, 3993. Adding 18, [they] make 4011; which divided by 28 leaves $143 \frac{7}{28}$; therefore, 7 being taken away from 28, there remains the Cycle of the Sun 21, which corresponds to the year 3993.

Example 2. Let there be a year before Christ current 10, with 18 added; [it] becomes 28; this cannot be divided by 28, nor can it be carried further; therefore for the year 10, the Cycle of the Sun will be 28.

Example 3. Let there be a year before Christ 11; add 18, [there] become 29; which divided by 28 leaves 1; this taken from 28 leaves the Cycle of the Sun 27, corresponding to the year 11 before Christ.

Praecept. 21. *To inquire into the weekday [Feria] of a given day in a Julian Year, by means of the Cycle of the Sun.*

First, take note of the use of the Cycle of the Sun, which is set out in the use of Table 22. The week [Hebdomada] is not begun from the Kalends of January, as in other computations, but from the 6th of the Kalends of March [24 February], in which the intercalation is made — that is, from the very Kalends of March; for as January, so February was constituted from an appendix of the preceding year, after the manner of the Romulan and Numan Year.

Secondly. If the day of the month given in that year, for the Cycle of the Sun you have already learned, [is] before February, take it from the other months; the weekday [Feria] which is in Table 19, the Cycle of the Sun [number] set above corresponding to that, [seek] in the front of the same Table the weekday number given for the month, [and] from the sum the weekday number; add to the sum the days of the month given, and from the sum take away all the sevens, and what then remains will be the weekday sought; for if nothing remains, the weekday sought will be 7, that is, the Sabbath. But if the days are before February, use the Cycle of the preceding year, that is, the Cycle which obtains a unity above; or [Margin: Pag. 14.] if Cycle 1 obtains, [use] as above.

Example 1. Let the year of Christ 1660 be given (whose Cycle is the Solar 17); [the] day [is] the 25th of March. First: for the number is 17 in Table 19, the proposed [weekday] is Feria 4 [Wednesday]; and for the month of March, Feria 7 [Saturday]. The sum [is] thus 36, and this divided by 7 leaves a remainder; therefore, for the year 1660, the day [is] the 25th of March. It will fall on the Lord's Day [Dominica], in the form of the old Julian Year; but by the Gregorian style it will be that day, the 25th, the 4th of April. April concurs with the Lord's Day. When, however, by the Julian style the day is the 25th of March, it will be the Lord's Day; but by the Gregorian style it will be that day.

Hence learn that, for finding the Gregorian weekdays, the Gregorian days are to be subtracted from the given days — the days by which the Gregorian numeration exceeds the Julian, as in Table 17 — and then use precept 23.

Example 2. Let it be given for the same year 1660, to which corresponds the Solar Cycle 17, [the] day the 25th of January; then use the Cycle of the Sun of the preceding Year, that is, Cycle 16, which is set out in Table 19. Feria 2 [Monday], and for the month of January, Feria 5 [Thursday]; the aggregate of the weekdays is 7, which added to the 25 days makes the sum 32, and this divided by 7 leaves Feria 4 [Wednesday], which corresponds to that day, the 25th of January, in the form of the Julian Year.

But in the Gregorian form, with 10 days subtracted, the 15th remains; this added, the aggregate makes 7, [there] result 22, and this divided by 7 leaves Feria 1 [Sunday]. Therefore the day, the 25th of January in the year 1650, falls on Feria 1; by the Gregorian style, that is, on the Lord's Day [Dominica].

Praecept. 22. *To investigate the weekday [Feria] in an Arabic Year of the Hegira, by means of the Solar Cycle.*

What in the Julian Year was the Solar Cycle 28, this for the Arabs is the Cycle of Years 210, which from the very first year of the Hegira, that is, the Epoch of the Arabs of Mahomet, begins; the sums of these of the Cycle, moreover, you have aggregated in Table 20, at the rightmost end, the little [side-]table. [Margin: Pag. 14.] It is established, moreover, that the Cycle is 210. By weeks, 30, [and] therefore after the topmost front of Table 20, in column 3 are the numbers

the numbers of the weekdays [Feriae]; placed are the numbers of the completed Cycle of the weekdays out of 30, [those] coming together, just as in the second [column], and the third the series 30. 60. 90. 110. 150. 180. in retrograde order. The remaining numbers in the areas of the same Table give the Cycles current, [running] from unity each time, up to 30, the current [days]. The triple Table of the Arabic months is adjoined at its own places; and therefore, with the threefold [reckoning] usually, on entering this Table the weekday is to be sought.

First, then: with the years of the Hegira given, subtract the number next smaller in the right-hand side of the Arabic Cycles found [there]: the Residue, if it is not less than 30, subtract the number next smaller in the second [series], or the third series in the Table; and when you come to the number in the third series, repeat [the operation] rather than [proceed] with the residue after its subtraction. On entering the front of the Table with the twofold [count], the weekday is at last [found]; for in the front, with the Arabic month given, [seek] the weekday set above; for the weekday added in the aggregate of all the weekdays, with the days of the month given, and divide the sum; and what remains will be the weekday sought; and the sum divide by 7; if nothing remains, it will be Feria 7, that is, the

Sabbath. On the other hand, [if] the first residue is less than 30, use that; and [seek] the weekday, as above, to be investigated.

Example. Amurath II, Emperor of the Turks, died in the year of the Hegira 855, on the 1st day, the 1st of Muharram. The question is, on what day [of the week] he died, and what weekday it was?

In Table 23, on the right-hand side, the Arabic number of the Cycles next smaller than the number 855 is 840, which from the years of the Hegira subtracted leaves 15; [add] to this, since the smaller third number is a tricenary number [a multiple of 30], in the area of Table 20 [the value] investigated, and in the front the weekday is found, Feria 3 [Tuesday]; [Margin: Pag. 14.] above [stands] for the month [the entry] Muharram, Feria 7 [Saturday], aggregated [with] the weekdays, which is 7; [with] 10 added, the first day, [there] is 1 month [Feria] 11. From this number divided by 7 is left 4. Therefore that day fell on Feria 4 [Wednesday].

Praecept. 23. *On the use of Table 21 (namely, of the collected years and of the various months).*

It comes into use sometimes to know how many days come together in one sum of completed years, or [completed] months of them.

To this end, in Table 21 you have on the left side the Julian years, the Egyptian, with the Persian, and the Lunar Arabic [years] aggregated, together with the days of any [year] aggregated [for the years] which correspond to these, or which the same cyphers indicate.

Example. For 4 Julian years, of which every fourth is a leap year, they collect 1461 days; but if the years are 40, they collect 14610 [days]; if indeed the years are 400, they collect 146100; and so for the rest.

But the Tables contain the months, both the sums of the days of the completed months corresponding [to them], or rather the months exotic [foreign] in the Julian Year, or [those] concurring with the Julian [months], greater for the most part. Of these [there is] more in our *Chronologia Reformata*, and certain other matters below, in the discussion of the conversion of the Epochs, to be said.

Praecept. 24. *Given the Years before, or after, the Epoch of Christ, to convert [them] into Years of the Julian Period.*

The Julian Period, from which the [number] composed in Table 22 is, I have said. Now if the Year before the Epoch of Christ is 4714, it is the very beginning of the Julian Period; if more [than that], it is in vain to inquire [further]; if fewer,

subtract those from the years 4714, [Margin: Pag. 16.] [and] there will remain the years of the Julian Period.

Example. The year before Christ is 776, in which the Olympiads were instituted; this subtracted from 4714 leaves the Year of the Julian Period 3938. The years before Christ, however, [if] given, add 4714; and if the sum does not exceed 7980, you will have the Years of the first Julian Period; but if it exceeds [7980], throw away as many times as you can the years 7980; the residue will be the Year of the Julian period second, if [thrown away] once, or third if twice, [and] so likewise of the rest.

Example. Let the Year after Christ be given, 238, whom Censorinus inscribed [as] of the more notable Epochs. Add to these 4713; [there] becomes [for] that year of the Julian Period 4951. Again [if] the Year of Christ is 3340, to these if you add 4713, [they] make 8053; from which subtracted [is] the whole Julian Period of Years 7980, [there] remain [for] the second Period the Year 73.

Praecept. 25. *Given a Year of the given Julian Period, to convert [it] into Years before Christ, if it does not exceed 4713, or into Years of Christ, if it exceeds 4713.*

If [the year] does not exceed 4713, subtract those from 4714; the [years] remaining are the Years before Christ concurrent with the Years of the given Julian Period.

Example. The Julian Period 3938. The Julian Period diminished by the Years 4714 leaves [for] the year before the Epoch of Christ 776 — namely, the first Olympiad.

But if they exceed 4713, subtract 4713; the residue will be the Year of Christ sought; for if [it is] the first Period, this is the second Period, which begins in the Year of Christ 3268. Add to the given Years 7980, and from the sum subtract 4713; [there] remains the Year of Christ sought.

Example. Let the Year of the first Julian Period be given, 6295; from this take 4713; [there] remains the Year of Christ 1582 — namely, the [year] of the Gregorian correction of the Kalendar [Gregorian calendar reform].

Praecept. 26. *To convert the Epoch of the World according to the Greeks (the Constantinopolitan Fathers of the Church) into Years before, or after, Christ.*

If the given Year of the World does not exceed 5509, subtract the given [year] from 5510; [there] remains [the year] before Christ of the Epoch [of the World]; and if it exceeds 5509, [there] will be the Years of the Epoch of Christ sought, which you will have by subtracting from the given [years] the Years 5509.

Praecept. 27. *Given Years before, or after, Christ, to turn [them] into Years of the World according to the Greek Fathers.*

If [from] the given Years before Christ you subtract from the Years 5510, [there] will return what you wish; on the contrary, if to the Years of Christ you add 5509, you will have the Years of the World according to the Greek computation of the Constantinopolitan Fathers of the Church.

Praecept. 28. *To convert any given Year into the Year before, or after, Christ, in which the Olympiadic Year began — the Olympiadic Year having begun, in [the season] nearer to the summer Solstice, from the New Moon [Noumenia].*

When writers say that something was done in some Olympiad, it is to be understood [that] the Olympiad was begun [i.e.] not yet completed — that is, not adding its [own number]. Understood [in this way], first, then: in the first place, of the Olympiad completed, but for the product add the remaining [years] of the same likewise complete; of the Olympiad incomplete [add the years] you will have, for there are the years Olympiadic full, which before Christ [if it does] not exceed the Year 775, subtract from the Years 776; [there] will remain the Years before the Epoch of Christ, in whose summer the Olympiad was begun, whose proposed Olympiadic year [was] given. But if [it] exceeds 775, subtract from those 775; and you will have the Year before Christ in which the Olympiadic year proposed was begun.

Example first. Let there be given Olympiad 6, year 1 current; because the completed Olympiads are 5, and these multiplied by 4 make 20; and adding the years full 1, the Olympiadic years 21 are completed; if these you subtract from 776, [there] remains the Year before Christ Epoch 754, in whose summer began Olympiad 6, year 1; which therefore was completed in the summer 753, before Christ.

Example 2. Let Olympiad 195 be given, year 1 current. Since the completed Olympiads are 194, with [the years] added moreover [and] led through, [there] become Olympiadic years 776; from these subtract 775; [there] remains year 1; in whose summer began Olympiad 195.

[Margin: Praecept. 29.] **Praecept. 29.** *To convert the Years before, & after Christ into Years of the Olympiads.*

If the given Year before Christ Epoch is 776, it is —

[column 2]

— the first year of the first Olympiad, begun from the New Moon [Neomenia] nearer to the Solstice; but if [it is] smaller than that one, [add] to it 776, and the residue divided by 4 — for in the quotient will be the integers, [and] for the fraction you will have the number of the Olympiad complete in the summer of the year from which began the first year of the Olympiad following. But if as many times as it has a fraction, or that the adjoined fraction has, [it] will give the year coming on of that Olympiad; [as] for [the number of the] integer [in the] quotient of that Olympiad, the integers [in the] quotient likewise indicates.

Example 1. Let there be given before Christ 770; subtracted from the years 776, [there] remains 6; which divided by 4 [gives] the quotient $1 \frac{2}{4}$. Add therefore unity, both to the whole quotient and to the numerator of the fraction, which is 2; and it becomes $2\frac{3}{4}$. Therefore in the summer of the year before Christ 770, [reckoning] from the New Moon [Neomenia] nearer to the summer Solstice, [there] ran the year 3 of Olympiad 2; and so that year ran together with year 2 of Olympiad 2.

Example 2. Let there be a Year before Christ 4; subtracted from the years 776, [there] remains 772; which divided by 4 [gives] 193, the number of the Olympiad complete in that year; therefore after the New Moon [neomenia] of the summer Solstice [in] that year before Christ 4, [there] began the first year of Olympiad 194.

Praecept. 30. *Given the Years of the City of Rome Founded, to turn [them] into Years before, or after, Christ.*

The Epoch of the City of Rome is 753 before Christ — this is according to Varro's computation, begun on the 21st day of April; and the first Epoch of Christ. If, however, [it is] given [as a] year [of the] City 754, [there] will remain a year before Christ, whose 21st day of April begins the year of the City 754. But if you subtract those very 754, [there] remains a year before Christ in whose 21st day of April [there] began the year of the City; and therefore the beginning of that Year of Christ concurs with the year of the City preceding.

Example 1. Let there be given a Year of the City 709, which indeed was the first Julian Year, ordained by Julius Caesar; subtract from this 754; [there] remains a year before Christ 45, on whose 21st day of April [there] began the year of the City 709, [a year] which before then ran with 708. Again [if] there is given a Year of the City 1, subtracted from those 754, [there] remains the year before Christ 753, in which [the] City was founded — the 21st of April.

Example 2. Let there be given a Year of the City 1553; from this I take 753; [there] remains the Year of Christ 800, on whose Kalends of January [1 January] the year

of the City 1553 began. But on the Kalends of January in the year 800 (in which Charlemagne [Carolus Magnus] began to reign as Emperor) it would run together with the year of the City 1552.

Praecept. 31. *To turn the Years before, or after, the Epoch of Christ, into Years of the City of Rome Founded.*

If the Year before Christ does not exceed 753, subtract that from the Years 754, [and] you will have the Year of the City beginning the 21st of April of the same year.

The Year of Christ, however, [if] given, add to the Years 753, [and] you will have the Year of the City, [for] that Year of Christ from the 21st day of April entering on.

Praecept. 32. *To bring back the Years of Nabonassar to the Years before, or after the Epoch of Christ.*

Inspect first Table 23, [to see] if perhaps in it you find the Epoch of Nabonassar [Margin: Pag. 18.] [in] the region of the Years of Nabonassar before or after Christ, and at the same time the day of the Julian or Gregorian Month in which the Year begins. Otherwise [if it is] the Year of Nabonassar, subtract the next larger in the same Table found; the residue add to the Years before Christ corresponding to the preceding said next larger [year] before Christ, [and] you will have the year before Christ in which the given [year] of Nabonassar begins. But if [it is] from the region of the larger numbers, the next larger [if there] are Years of Christ, from these subtract the residue left after the subtraction following the [year] of Nabonassar next larger; and there will remain the Year of Christ in which the given year of Nabonassar begins. The Residue, however, retain in either case, [as the] Residue aforesaid, for the practice of precept 35, soon to be handed down.

Example 1. Let there be given the Year of Nabonassar 720; this subtracted [from] 744, which in Table 23 is the next larger to it, leaves *Residue* 24; which added [to the] year before Christ 5, that is, [the one] corresponding to year 744, makes [it] 29. The year before Christ, then, in which the year of Nabonassar 720 begins, [is 29].

Example 2. Let it be the Year of Nabonassar 1460; this subtracted [from] the next larger, which in Table 26 is 1464, leaves *Residue* 4; which subtracted [from the] year before Christ [Margin: Pag. 18.] 716, that is, [the one] corresponding to year 1464 set [down], [there] remains [the] Year of Christ 12, in which the Year of Nabonassar 1460 begins.

Praecept. 33. *To find the beginning of a given Year of Nabonassar in a Julian or Gregorian Year.*

First, by Precept 32, inquire [in] the Year before, or [after,] Christ, in which the proposed Year of Nabonassar begins, and the *Residue* in that practice adduced divide by 4; then the quotient, if there should adhere a fraction, augment by unity, and so [the number] augmented [gives] the day of the Julian or Gregorian [month] in which begins Thoth, the first of the Nabonassaran year, [for] the next larger year of Nabonassar [over the] year given of Nabonassar. After the Year of Christ 1582, however, [there] suffices to repeat the beginning in the Julian Months and the Gregorian; and to know what the day is in the Gregorian, by Precept 19.

Example 1. In the preceding Precept 32, the year of Nabonassar given 720, the next larger in Table 23 [Margin: Pag. 18.] is 744, to which corresponds the beginning [of] Thoth, August 24. The *Residue*, however, adhibited there is 24; this divided by 4 [gives the] quotient 6; this is therefore [without] fraction, but it lies idle; add [to] the 24th of August; and there results August day 30, in whose Meridian falls the beginning of the month Thoth of the year of Nabonassar 720, [there] before Christ 29.

Example 2. In the precept preceding. The Year of Nabonassar given was 1460, at the next larger 1464, the beginning of Thoth from Table 23 [is] February 25. The *Residue* adhibited [Margin: Pag. 18.] is 4, this divided by 4 [gives the] quotient 1, and without fragment. Therefore, with unity added, the day 25th [+1] falls [as] the beginning of Thoth, Year of Nabonassar 1460, on the 26th of February, [in the] Year of Christ 12.

Praecept. 34. *Given a Year of Nabonassar, [its] Month, and Day, to find into which Month of the Year before Christ, or after, and on what day of the Julian Months [the] day of the Egyptian Year falls.*

First, inquire by Precept 32 [for] the Year before, or after, Christ, & by Precept 35, the Day of the Julian Month in which the given Nabonassaran year begins, & by Precept 20, [or rather] by 21, foreknow whether the Julian Year, [or] the Gre-

whether the Gregorian year is bissextile or common? Second, from Table 5, by the preceding Precept 5, collect the total of days from the beginning of the Julian or Gregorian year up to the day that begins the month of Thoth. Third, from Table 6, by the preceding Precept 7, collect the total of days from the beginning of the Egyptian year up to the proposed day, and add this sum. [Margin: Pag. 18.] From these added sums (if it does not exceed 365, or 366 in a bissextile year), in the areas of Table 5, look up on the left side the day of the month concurring with the

given day of the Egyptian month. But if that aggregate exceeds 365 in a common year, or 366 in a bissextile year, subtract these from the aggregate itself, and with the Residue look up, in the area of Table 5 as above, the month of January, and likewise on the left side the day concurring with the given day. [Margin: Pag. 2.]

Example 1. Let an Egyptian Year of Athyr be given, day 25. First, by Precept 3, that year was 29 years before Christ, and likewise by Precept 33, the beginning of Thoth fell on the 30th of August. [Margin: Pag. 2.] By Table 5, in the bissextile year 5 (which was the 29th before Christ), the 243rd day is shown. From Table 6, day 5 of Athyr gives 85, the days collected from the beginning. Athyr 25 thus gives 175. The Julian sum 243, and the Egyptian sum 175, make an aggregate of 328 days, which in Table 5 displays, in that bissextile year, day 23 of November, concurring with day 25 of Athyr. November 243, with the Egyptian 175, makes the aggregate 418, from which subtract the bissextile 366; there remain 52, and in Table 5 for the following year, 28 before Christ, they give January 21. The Julian sum 243 with the Egyptian 175 makes the aggregate 418, from which subtract the bissextile 366; there remain 52, and in Table 5 they give day 21 of January, concurring with day 25 of Mechir. [Margin: Pag. 18.]

Precept 35. To convert given Years before Christ, or to turn them into Years of Nabonassar, and to investigate the beginning of those years.

If the given Year before Christ does not exceed 747, look it up in Table 23, in the second column; for in the first column you have the beginning of the Nabonassar year, which the Julian month gives, while the third column shows which month the given year begins in. But if the given year is not found in column 2, subtract from it the nearest one found (and note meanwhile how many years of Nabonassar are in column 1), and as a beginning-year (added to the one found, the nearest greater) it will give you the other beginning you seek. [Margin: Pag. 18.] But divide the Residue beyond the year of Nabonassar by 4: as many times as it goes evenly (or, if a fraction results, increased by one), subtracted from the given beginning, it will give the other beginning sought.

Example 1. Let there be given the year 29 before Christ; look it up in Table 23, in the second column, where the nearest found, namely the year 33, is left; the Residue is 4, which, added to the Nabonassar year 716 placed opposite, gives the Nabonassar year 720 — namely the one that began in the 29th year before Christ. Furthermore, 33 gives the beginning of Thoth on the 31st of August, and the Residue 4 divided by 4 leaves a quotient of 1: with one subtracted from day 31,

the beginning of the Nabonassar year 720 remains the 30th, the day on which that Nabonassar year began.

But if the given year is at the Epoch of Christ, in which the Nabonassar year began, you will have it in Table 23, column 2; or at all events the nearest greater will be found, having opposite it on the left side the beginning of the Nabonassar year, and on the right side the month of January, in which the Nabonassar year then began. [Margin: Pag. 18.] But if the given year of Christ is not in Table 26, look in it for the nearest greater, and subtract it; and to the Nabonassar year responding in the same Table to the nearest greater year of Christ given, add the Residue: for you will have the Nabonassar year sought. Then divide the Residue by 4, and the quotient — whole, if it lacks a fraction, or increased by one if it has a fraction — add to the beginning of Thoth, which is in column 1 opposite the nearest greater year of Nabonassar; and you will have the beginning sought of the Nabonassar year just found. [Margin: Pag. 18.]

Example 2. Let the given year of Christ be 712; subtract from it the nearest greater in Table 23, that is, 719; the Residue 7, at year 719, responds to the beginning of the Nabonassar year 1467 — on the right, however, its beginning of February. With 7 subtracted from February, there remains the Nabonassar year sought, 1460. And the residue divided likewise by 7 [recte: 4] gives quotients...

is $1\frac{1}{4}$; and the fraction being dropped, there is here therefore an addition of day 25 of February; year 1460 of Nabonassar gives day 24 in which that Nabonassar year 1460 began.

Precept 36. To convert the Day of a given Year before, or after, Christ into the Day of a Nabonassar Year.

First, by the preceding precept, with the given year before Christ, or after, and the Day of the Month and of Thoth given, in which that Nabonassar year begins, seek the beginning of the Nabonassar year. Then, from Table 5, collect singly the sum of Julian days responding to the beginning of Thoth, and likewise the sum of days responding to the date given; [Margin: Pag. 2.] and if these days fall in the same year, the difference of the two collected sums, the unit deducted, and 365 days subtracted, gives a Residue, which in Table 6 will show the Egyptian Month, and on the left side the day responding to the given day. [Margin: Pag. 2.] But if the given day precedes the beginning of the year, the difference of the collected sums of the year being deducted, the unit subtracted, and 365 days deducted, gives a Residue, which in Table 6 will show the Egyptian Month, and on the left side the day responding to the given day. [Margin: Pag. 2.]

Example. Continuing with Example 1 of the preceding precept, the year before Christ 29 was found to be the Nabonassar year 720, beginning the 30th of August. If you ask in what Egyptian Month, and on what day, day 31 of October falls. Since the sum of days responding to day 30 of August in the year 29 before Christ, bissextile, is in Table 6, 243; responding to day 31 of October is 305; of these, the difference is 62, and the unit added is 63; this is in Table 6, day 3 of Athyr, corresponding to day 31 of October. [Margin: Pag. 2.] But the sum for day 25 of April, in the bissextile year, in Table 5, is 116; and its difference from days 243 is 127 days; and with the unit taken off, it is 126; if this be subtracted from 365 days, it leaves a Residue of 239 days, with which, in Table 6, responds day 29 of Pharmuthi, concurring with the given day 25 of April. [Margin: Pag. 2.]

Precept 37. To convert the Years of Alexander the Great, or of Dhū'l-Qarnayn, into Years before or after the Epoch of Christ, and these in turn into those.

If the year of Alexander the Great, reckoned from his own death, is 324, or of Dhū'l-Qarnayn 312, they concur, each of them, with the first Months of the first year of Christ. But if the year of Alexander is less than 324, or of Dhū'l-Qarnayn less than 312, subtract the years of Alexander from 324, and of Dhū'l-Qarnayn from 312. The Residue will give the year before Christ, with the prior months concurring with the given year. By contrast, if the year of Alexander exceeds 324, or of Dhū'l-Qarnayn 312, subtract 324 from these, or 312, and there will remain the year of Christ, whose prior months concur with the given year.

In turn, if the given years before Christ do not exceed 324, subtract these years from 325; there will remain the year of Alexander at his beginning in that year. But if they do not exceed 313, the remainder is the year of Dhū'l-Qarnayn, at the same beginning. So too the running year before Christ, concurring with the same years 325; or the remainder will be the year of Alexander running in that year, but at his preceding beginning — but if the years before Christ are 313, the remainder is the year of Dhū'l-Qarnayn, or of the Seleucids, at his beginning in the preceding year of Christ, concurring with the prior part of the given year.

The precept is clear, nor do those already accustomed to the preceding precepts now need an example.

Precept 38. To commute the Years of Alexander the Great into Years of Nabonassar, and these in turn into those.

To the Years of Alexander add 424, and there will be Nabonassar years, in the Egyptian manner, reckoned from the same day, namely the noon-meridian, and from the same month, from which Alexander's reckoning begins. Thus the year of Alexander began together with year 425 of Nabonassar, on the 12th of November, that is, the 1st of Thoth.

In turn, if the years of Nabonassar are not fewer than 425, subtract from them the years 424; and there will remain the Year of Alexander, beginning with the same Nabonassar year.

Precept 39. To convert given Years of the Hegira, and their days, into Years of the Epoch of Christ, and its days.

In Table 21, the Third, or lowest, Class holds the days collected of the years of the Arabs, and of the months. From this Table, therefore, collect the days responding to the years, months, and Arabic days, but completed; and likewise, by one or more entries into the Table, as may be required. The sum of the days collected, add the perpetual 561; and it will make a sum which, by that distinction, we will call the Heap [*Cumulus*]. Then, from the first class of Table 21, in whose areas the day-numbers collected responding to the Julian Years, Months, and Arabic days completed, with one or more entries; for if, with the Julian years thus found, you add the years 620, the Years of Christ will come forth congruent with the given Hegira years, and months, and Julian days, with Months and Days of the Hegira. [Margin: Pag. 15.]

Example from the Turkish Annals. Amurath the Second died in the year of the Hegira 855, at its beginning, on the very 1st day of the month Muharram, Feria 4 [the fourth weekday]. It is asked: in what year of the Epoch of Christ did this come about, and in what Month of the Julian Calendar, and on what day of it? Go therefore to Table 21, and to its lowest class on the left side, in which it is thus: [Margin: Pag. 15.]

Annorum Arabicorum [Of Arabic
Years]

Dies collecti [Days collected]

Anni 600. Arabici dant [600 Arabic
years give]

212620

Restant Anni completi 254. quorum
240. dant [There remain 254 complete

85048

Annorum Arabicorum [Of Arabic Years]	Dies collecti [Days collected]
years, of which 240 give]	
Restant Anni 14. qui dant [There remain 14 years, which give]	4961
Adde 1. Mensis Muharram diem [Add 1 day of the month Muharram]	1
& dies perpetuo [and the perpetual days]	561
Fit summa Dierum [The sum of Days makes]	303191

Then, in the upper part of Table 21, in the class on the left side, the Days 303191, by parts collected, give in the left-hand columns the Julian Years thus: [Margin: Pag. 15.]

	Anni Iulian. [Julian Years]
Dies 292200. dant [Days 292200 give]	800
Restant 10991. quor. 10227. dant [There remain 10991, of which 10227 give]	28
Restant 764. quor. 730. dant [There remain 764, of which 730 give]	2
Restant dies 34. [There remain 34 days]	
Adde Annos perpetuo [Add the perpetual Years]	620
Fit summa Annorum Completorum [The sum of Complete Years makes]	1450

The 34 days give February 3. Therefore Amurath the Second died in the year of Christ 1451, on its February 3. [Margin: Nicolai Muleri lapsus (the slip of Nicolaus Mulerius).] Note therefore that Nicolaus Mulerius [Nicolaus Mulerius], in his Canon of the Years of the Arabs collated with the years of Christ, places the year 855, the Arabic year beginning, on February 3, of the year of Christ 1451, Feria 4.

But the reason why the perpetual 561 are added to the collected Arabic Days, and why the years 620 are added to the collected Julian years, as above: the perpetual

620 are added because the first year of the Hegira began in the year of Christ 622, on the 16th of July; from the year 620 completed, and bissextile, the years 622 currently run, day 16 of July currently; the days completed are numbered 561. But an error is to be guarded against in the Rudolphine Tables p. 39, where, under the end, in the transverse rows on the right, the number is placed uselessly as 1. The Hegira Year, in the year of Christ 632, and continued with 633, which verifies the Epoch of Yazdegird, not of the Arabs, since its beginning is from those same Rudolphine pages, p. 38, the year of Christ 622 is to be placed, which 623 follows. [Margin: Rudolphinarum mendum (an error of the Rudolphine Tables).]

But how the Arabs investigate their Cycles through the weekdays [Ferias], was stated at Precept 22.

Precept 40. To commute the Years of Christ, if they are not fewer than 622, into the Arabic days of the Hegira, and its days.

From the given Years of Christ subtract the years 620; resolve the remainder, by Table 21, the upper Class, into days, and to it add the days collected from the beginning of the Julian year up to the day of the Julian month given, and likewise the days collected, but completed, of the Egyptian Months [*recte: of the given month*]; and to all these add the perpetual 561 days; and it will make a sum, from which subtract always the days 561. The Residue, then, look up in Table 21 — the year sought, by parts adduced, first under the heading of the Hegira years; then under the heading of the Arabic months, until the lesser days under the Arabic Month remain; noting meanwhile the preceding Arabic years collected; and the days remaining indicate the days of the following month sequent to the Arabic; congruent with the given Julian, and the sum of the collected Arabic years added with the unit, makes the Arabic year, the year of Christ being given. [Margin: Pag. 15.]

Example. In the year of Christ 1452, on the 29th of May, Feria 2 [the second weekday], the day of Pentecost, Constantinople was taken by Mehmet [Mahumeth] the Second. It is asked, to what year of the Hegira the year taken responds, and to what Arabic Month, and to what day of it? [Margin: Pag. 15.] In the year of Christ 1452, subtract 620, and there remain 832; these, by Table 21, respond to the days collected of the Julian years, as below: [Margin: Pag. 15.]

	Dies [Days]
Anni 800. dant dies [800 years give days]	292200
Restant Anni 32. qui dant [There remain 32 years,	11688

	Dies [Days]
which give]	
Ab initio autem Anni 1452. Bissextilis, ad 29. Maij inclusivè sunt dies [From the beginning of the year 1452, bissextile, to the 29th of May inclusive, the days are]	150
Summa dierum est [The sum of days is]	303930
His perpetuo deme Dies [From these perpetually take away the Days]	561
Restant Dies [There remain Days]	303369

Then in the lowest Class of Table 21, under the Arabic years and months, the days 303369 give the complete Arabic years, by the method written below: [Margin: Pag. 15.]

Dies Collecti [Days collected]	Anni Arabici [Arabic Years]
Dierum 303369. summa proximè minor 212620. dat [Of the days 303369, the nearest lesser sum 212620 gives]	600
Restant 90749. quor. 85048. dant [There remain 90749, of which 85048 give]	240
Restant 5701. quor. 5670. dant [There remain 5701, of which 5670 give]	16
Restantq; dies 31. [And there remain 31 days]	
Summa annorum Arabicè Complet. [The sum of complete Arabic years]	856

[Margin: In Tab. 21. Pag. 15.]

Therefore Constantinople was taken in the year of the Hegira 857. And because 31 days are over, of which 30 are due to the first Arab month Muharram, it follows that it was taken on the first day [prima die] of the month Sephar, Feria 2, in Arabic, that is on the day of the Moon [Monday], by Precept 24.

Precept 41. To convert given Years of Yazdegird, or the Persian Epoch, and days, into Years of Christ, and days.

The given complete Years of Yazdegird, and complete months, resolve into days, by Table 21, Class 2, from the left, which serves both for the Persians, as for the Egyptians, by one or more entries made into the Table; from the sum of the days subtract the perpetual 199. The Residue, by the same Table 21, Class 24 [recte: Class 2], the uppermost, reduce to Years of Christ [recte: Julian], and Months, having regard to bissextiles. Finally, to the sum of the Julian Years add the perpetual 632, and it will make the sum of the Years of Christ; the residue, however, the days, show in Table 21 the month, and the day given. [Margin: Pag. 2.]

Example. Let the given year of Yazdegird be 814, and day 17 of the month Tyrma: it is asked, what is the year of Christ, the month, and on what day? Go to Table 24, in which it is thus: [Margin: Pag. 15.]

	Dies [Days]
Anni Persici, vt & Aegypti] 800. dant [Persian years, as also Egyptian, 800 give]	292000
Restant completi 13. quor. 10. dant [There remain 13 complete, of which 10 give]	3650
Et 3. completi dant [And 3 complete give]	1095
Mensis completus ante Tyrma, idest mensis Chortat dat [A month completed before Tyrma, that is the month Chortat, gives]	90
Dies currentes de Tyrma sunt [The running days of Tyrma are]	17
Summa dierum omnium est [The sum of all days is]	296852
Cui perpetuò deme 199. [From which perpetually take away 199]	199
Restant [There remain]	296653
The sum of days 296653, in the upper Table 24, the part sought, gives the Julian Years written below: [Margin: Pag. 15.]	
	Anni [Years]
Dies 292200. dant [Days 292200 give]	800

	Anni [Years]
Restant d. 4453. quorum 4383. dant [There remain 4453 days, of which 4383 give]	12
Restantq; dies 70. [And there remain 70 days]	
Summa Annorum completorum [The sum of complete Years]	812
Adde his Annos completos [Add to these the complete Years]	632
Fit summa Annorum Christi complet. [The sum of complete Years of Christ makes]	1444

But there are over, from the following year, namely 1445, days 70; and these in Table 6 give, in that common year, March 11. Therefore at length the year of Yazdegird 814, and day 17 of Tyrma, falls on day 11 of March of the year of Christ 1445. [Margin: Pag. 2.]

Precept 42. To reduce a given Year of the Epoch of Christ, and a day of the Month, to a Year of Yazdegird, and a day of the Persian Month.

From the given Years of Christ (which I suppose to be not fewer than 632 years) subtract the years 632. Then resolve the complete Residues into days by Table 21, the uppermost Class; and to it add the number of days of the Month completed, and the days running of the given month; then to all these add the perpetual 199. To the sum of all the days collected, and with this from Table 21, Class 2, likewise collect in the left margin the complete Persian years, by one or more entries, and likewise the complete Persian Month; for the remaining days will look to the following Persian Month. [Margin: Pag. 15.]

Example. The same as above, but conversely. Let the given year of Christ be 1445, and day 11 of March: it is asked, what was the year of Yazdegird, and which Persian Month? With 632 subtracted from the year 1445, there remain 813 running, but 812 complete, with which, and with day 11 of March, thus from Table 21, you will collect the days: [Margin: Pag. 15.]

	Dies [Days]
Anni Iuliani 800. dant [800 Julian years give]	292200
Et Anni 12. dant [And 12 years give]	4383
Adde his perpetuò [Add to these perpetually]	199
Et pro 11. Martij Tab. 6. [And for 11 March, Table 6]	70

	Dies [Days]
Fit summa Dierum [The sum of Days makes]	296852

With which, from Table 21, Class 2, taking out the Persian Years, Months, and days thus: [Margin: Pag. 15.]

	Anni Persici [Persian Years]
Dies 292000. dant [Days 292000 give]	800
Restant D. 4852. quorum 3659 [There remain 4852 days, of which 3659]	10
Restant 1202. quorum 1095. [There remain 1202, of which 1095]	3
Restant dies 107. [There remain 107 days]	
Summa Annorum complet. [The sum of complete Years]	813

Therefore the year of Christ 1445, day 11 of March, falls in the Yazdegird year 814; but the 107 days which are over fall in the same Table 21 of the Persian Months, namely day 90, and the remaining 17 look to the month Tyrma, wherefore day 11 of March of that year agrees with day 17 of the month Tyrma.

Caution for the remaining Epochs.

The mutual transformation of the remaining Epochs you may either work out from Table 25, or from our Reformed Chronology, since the rest pertain to the Chronologer more than to the Astronomer — thus far.

Precept 43. On the Absolute constitution of Time for the motions of the heavenly bodies to be elicited from Our Tables.

Hitherto all the precepts have pertained almost entirely to Time. It remains, therefore, that we indicate by what method Time is to be constituted, so that the Celestial Motions may be elicited from these our Tables, and accommodated to other places too, or to other times: which constitution is reducible to two Heads.

The First is, if some Celestial Phenomenon — say, an Eclipse of the Moon — deduced from Our Tables ought to be transferred to other places distant from our Bologna Meridian, or also to other kinds of hours, indeed also to other kinds of Years, Months: kinds diverse from the Years of Christ, or before Christ, which in these our Tables we use according to the Julian form, and then the Gregorian. As,

if the beginning of a Lunar Eclipse is to be elicited from our Tables, and then announced, at what hour not only Astronomical, but also Babylonian, or as it appears European [Europaea], or as it appears elsewhere — say, at Constantinople — and at what day, and according to the month of the Arabic year. In this case: First, the equal time used in our Tables of the mean motions, after the calculation of the Eclipse is absolutely converted into Apparent, or at its appearing at our Bologna Meridian in Astronomical hours, or after midday; and this by Precept 16. Second, by Precept 17, this time ought to be accommodated to the Constantinopolitan Meridian; in which, if the Babylonian hours are observed, known by Precept 14, the semidiurnal quantity, the Astronomical hour ought to be converted into the Babylonian by Precept 12; and at length by Precept 40, the year of Christ, the Month, and the day Julian, in which the Eclipse is announced, ought to be reduced to the Year of the Hegira, the month, and by Precept 22 [recte], to the Arabic day, and by Precept 22, to the Feria [weekday]. But with these many other precepts from the foregoing afford help.

The Second Head is, if some Phenomenon — say, an observed beginning of a Lunar Eclipse, or a computed one — has been in another Meridian — say, Constantinople — and expressed by other hours, say enunciated by Babylonian hours, and by days, and years of diverse kind, say by Babylonian hours, and by days, of the Arabic Month, and of the Hegira. Then First, the time there appearing must be commuted into equal time by Precept 16. Second, by Precept 17, this time ought to be transferred to time congruent with the Bologna Meridian, and by Precept 14, to know the semidiurnal quantity, and by Precept 12, to convert the Babylonian hour into the Astronomical. Afterwards, by Precept 39, the year, month, and day of the Hegira must be transformed into the Julian Year of the Epoch of Christ, the Month, and the Julian Day.

Often too, in the observations of the Ancients, the Temporal Hours are to be reduced to equal ones by Precept 13.

On the Beginning of Days, and of Years, in Our Tables.

We take the Beginning of Days astronomically from the noon made under the Bologna Meridian, and the beginning of the days of the year, or the principle of the year, we begin from the noon preceding the last day of December, so that thereafter the Days named may be employed as complete. As, if we examine an Eclipse to come at the 4th hour after Midday of the first day of January, the mean Luni-Solar motion is to be collected of one whole day, and besides of hours 4, etc.

There follow the Precepts for the use of the Tables of the Second Part.

Precept 44. *Given the place of the Sun on the ecliptic, or any point of the ecliptic, to find its declination.*

[Margin: Pag. 19.]

This is accomplished by means of Table 26. Look for the sign at the top if the degrees of the sign descend, or at the foot of the table if the degrees ascend in the right-hand column. For at the common intersection of the sign and the degree you will have the declination sought. It is northern if the ecliptic signs are northern, southern if they are southern; and a proportional part is to be applied if there is one.

Example. Let the place of the Sun be given, say, at Taurus $10^{\circ}20'$. In the table, the degree of Taurus 10° corresponds to a northern declination of $14^{\circ}51'16''$, and the following degree 11° gives $15^{\circ}17'7''$. The difference of these is $18'51''$, which, multiplied by $20'$ and the product divided by whole degrees, leaves a difference of $7'42''$, to be added to the $14^{\circ}58'58''$ at degree 14. So that the declination at Taurus 10° becomes $14^{\circ}58'58''$ for Taurus 10° .

Precept 45. *Given a point of the ecliptic, to find the angle which it makes at that point with the meridian, or with any circle of declination.*

[Margin: Pag. 19.]

Therefore, in Table 27, find the given sign at the top and its degree in the left-hand column, or the sign at the foot and its degree in the right-hand column. For in the common area you will have the angle, rising toward the eastern point, or toward the southern or northern pole, as the marginal note "Austr." or "Bor." indicates. Moreover, the angle adjoined to these is itself equal, and the angle which is to its west is the complement of the prior one to 180° . The western angle, however, faces toward the same prior pole, and likewise the rising angle faces toward the other pole.

Example. Let the meridian pass through Taurus 10° . For in Table 25 the eastern angle agrees: $71^{\circ}35'$, which the ecliptic makes there with the meridian; and this angle, as the note "Bor." indicates, is northern. Therefore the western angle is also northern, but faces toward the south, being $71^{\circ}35'$; its complement to two right angles is $108^{\circ}25'$. So great, then, is the angle, both north-western and south-eastern, of the ecliptic with the meridian or with any circle of declination.

Precept 46. *Given a point of the ecliptic, or of the Sun lying in it, to find its right ascension.*

[Margin: Pag. 19.]

Consult Table 28, noting the sign at the top and its degree in the left-hand column directly beneath the sign. Directly opposite the degree you will have its right ascension, using nevertheless a proportional part if the degree of the sign has any minutes adhering.

Example. To Taurus 10° corresponds a right ascension of $37^\circ 34' 46''$. At Libra 0° the right ascension is $205^\circ 9' 11''$.

Precept 47. *Given the altitude of the pole and the declination of a point of the ecliptic, or of the Sun, or rather of any heavenly point or star, to find its ascensional difference.*

[Margin: Pag. 21. vel 24.]

This ascensional difference is the arc of the equator by which the right ascension of any point or star differs from its own ascension in the oblique sphere, that is, from its own oblique ascension. Therefore go to Table 29, or 30, and at it inquire, either by the altitude of the pole at the top and the declination, or by the altitude of the pole in the right-hand column and the declination at the top; the common area will give the ascensional difference. In Table 29, however, the obliquity of the ecliptic is supposed to be $23^\circ 30'$. But it is more precisely $23^\circ 30' 20''$; therefore we add, for this obliquity, [Margin: Pag. 24.] Table 30, [Margin: Pag. 21.] adjusted to our altitude of the pole, which at Bologna at S. Petronio is $44^\circ 30' 20''$. But this difference of the venous reckonings [variant readings] serves the tables for other altitudes, except that in this table, apart from that, the ascensional difference which corresponds immediately to the degrees of the ecliptic, to which the Sun alone, is here omitted.

Example 1. Let the declination of the Sun, or of any ecliptic point, of degree 20° and altitude of the pole $44^\circ 30'$, be given. For in Table 29, with the altitude of the pole $44^\circ 30'$ found at the top and the declination 20° in the left-hand column, the common area gives an ascensional difference of $20^\circ 35'$.

[Margin: Pag. 21.]

Example 2. In Table 30, at the degree of Taurus $19^\circ 5\frac{1}{2}'$, to which a declination of 20° agrees, the altitude of the pole at Bologna answers with an ascensional difference of $20^\circ 58' 15''$.

[Margin: Pag. 24.]

Precept 48. *Given the right ascension of any heavenly point and its ascensional difference, to form its oblique ascension.*

To the right ascension of a point declining toward the elevated pole, subtract the ascensional difference; but add it if it declines toward the unseen pole. For thus will be formed the oblique ascension of the same ecliptic point; and in this way you will examine the tables of oblique ascensions.

Example 1. At Taurus $19^{\circ}5\frac{1}{2}'$, as said above, a northern declination of 20° agrees, and to this, under the altitude of the pole $44^{\circ}30'$, an ascensional difference of $20^{\circ}58'15''$ agrees; and the right ascension of the same point is $46^{\circ}58'55''$. Therefore, by subtracting the ascensional difference from the right ascension, its oblique ascension becomes $36^{\circ}0'40''$. But if it were beyond the equator — that is, the calculation lies beyond the equator, where the northern pole is not visible — one must add the ascensional difference to the right ascension.

Precept 49. *Given the altitude of the pole and a point of the ecliptic, or the Sun lying in it, to elicit its oblique ascension by the tables prepared for the purpose.*

[Margin: Pag. 25.]

If the altitude of the pole is so great, however great, use Table 31. For in it, with the sign at the top and the degree of the sign observed in the right-hand column, you will have in the common area the oblique ascension of the ecliptic point. But for the altitudes of the pole use Table 32. [Margin: Pag. 26.] Exhibiting the ascension, but of the northern signs in the northern horizons, by seeking their degree in the left-hand column, or of the southern signs in the southern horizons, by seeking their degree in the right-hand column ascending. But if you prefer the oblique ascensions of the northern signs in the southern horizons, or of the southern signs in the northern horizons, then, by region of the degree, find it in the area beneath the given altitude of the pole, subtract from the degrees 360° : the remainder will be the oblique ascension, as much as you wish.

Example. Under altitude of the pole 40° , the oblique ascension of Taurus 16° is $28^{\circ}55'$, and these are northern; and the same is the degree of Aquarius 14° among the southern. But the oblique ascension of Aquarius 14° among the northern is $331^{\circ}5'$.

Precept 50. *Given the apparent time after noon, the place, and the altitude of the pole; to find then the Sun, the rising degree of the ecliptic (which they also call the Horoscopus), and which is the nonagesimal degree of the ecliptic, to be reckoned from the rising point?*

[Margin: Pag. 19. / Pag. 3.]

First. By Precept 46, find the right ascension of the place of the Sun; add to it the time from noon, previously turned by Table 3 into parts of the equator, which corresponds to the degrees 360° . If the sum exceeds those, take the residue away, with the residue, and the right ascension of the middle of the heavens [Medium Coeli] then culminating.

Second. Add to the culminating point of the equator 90° , and the oblique ascension of the rising degree of the ecliptic will come forth, which, if it does not exceed 180° , is sought in the areas of [Margin: Pag. 25. / vel 26.] Table 31 or 32, under the agreeing altitude of the pole, showing at the top the sign, and in the left-hand column of the sign **then** [continued below]

then rising, or the Horoscopus. But if the oblique ascension exceeds 90° , subtract it from 360° ; and with the residue found in the areas of the oblique ascensions Table 31 or 32 investigated, as above, you will find the sign, and the degree of the rising ascension.

Third. From the rising ecliptic degree, take away 90° , and the nonagesimal ecliptic degree will be known, which we shall teach more amply, but chiefly with respect to the parallaxes for solar eclipses, when in its place we treat of it.

Example. Let Bologna be where the pole is elevated $44^\circ 30'$. Let the apparent time after noon be 4 [hours] $30'$, and then let the Sun be at Taurus $29^\circ 5' 30''$. The operation is established thus:

	Gr.	'	"
The hour $4^\circ 30'$ by Table 7 gives	67	41	6
Right ascension of the place of the Sun by Table 29	56	58	55
Sum, or culminating point	124	40	1
Add the degrees	90	0	0
Becomes the oblique ascension sought	214	40	1
With this taken away, 360° remain	145	19	59
With this $19'$ by Table 29, Virgo	3	36	30
Take away the rising	90	0	0
Becomes the nonagesimal ecliptic, Gemini	3	36	30

The optimal rising Horoscopus is therefore Virgo $3^\circ 36' 30''$, and the nonagesimal computed thence is Gemini $3^\circ 36' 30''$.

Precept 51. *Given the rising ecliptic point and the altitude of the pole, to find the altitude of the nonagesimal, or the angle of the ecliptic and the horizon.*

[Margin: Pag. 38.]

Go back to Table 33, which begins on page 38. In it there is need, if there is occasion, of a proportional part. Seeking at the top the altitude of the pole, and in the left-hand column the sign with the degree of the rising ascension, descend numbering the degrees, or in the right-hand column the sign with the degree upward numbered; the common area will exhibit the altitude of the nonagesimal.

Example. Let the rising ecliptic degree be Virgo $3^{\circ}36'30''$, under altitude of the pole $44^{\circ}30'$. From Table 29 itself, with the 3° it is gathered for a proportional part the altitude of the nonagesimal $65^{\circ}52'52''$, or roundly $65^{\circ}53'$.

Precept 52. *To resolve the degrees of the zodiacal signs, or of any circle whatever collected, into degrees from the beginning of the sign.*

[Margin: Pag. 19.]

This our Table 24 immediately teaches, in which, for instance, the degree 25 in the left-hand column corresponds to the degree 205 reckoned from the beginning, that is, beneath Libra 205° , that is, sub 295° ; and so of the rest. But if at the beginning of any circle, say, the integral signs are taken up, and besides those there adhere some degrees, the degrees of the following sign are congruent, that is, if there were complete anomaly signs 4, and degrees 25, not in the column of sign IV. but the degrees collected in the same sign 31 are sought; and as above sign IV. with the region of degrees 25, the collected degrees are 145.

Precept 53. *To find at once the degree of the zodiac diametrically opposite a given one; so that, given the degree of the rising ascension, the degree of the descending be known.*

[Margin: Pag. 19.]

In Table 25 you have each pair of opposite signs, but in the table joined with the degrees opposite, that is, in the first conjugation of degrees 16. Aries is opposed to degree 196; likewise, in the second conjugation of degrees 16. Gemini, which is of degree 76. of the zodiac, is opposed to degree 256. of the zodiac. Therefore, given the degree, sign, and degree of its rising ascension, the degree of the descending sign will be known at once.

Precept 54. *Given the longitude and latitude of any star, but not greater than 90° , to obtain its declination and right ascension.*

[Margin: Pag. 19.]

First. By Precept 44 and Table 26, learn the declination of the ecliptic point which the given longitude designates, and by Precept 46 and Table [Margin: 8 20.] 28 its right ascension.

Second. From Table 34, take out the prosthaphaeresis of declinations, observing the latitude given at the top, and the sign and its degree in the left-hand column, or the degree in the right-hand column. For the common area will give the addendum of the declination to the declination of the ecliptic point, if the sign and the latitude are of the same region, or affection; that is, if the latitude is northern, and the latitude also is northern: but it is to be subtracted if they are of contrary affections; and you will have the declination of the star.

[Margin: Pag. 43.]

Third. From Table 35, similarly take out the prosthaphaeresis of right ascension of the ecliptic point, as the conditions explained at the top require, or in the foot of the table; and so you will form the right ascension of the star.

[Margin: Pag. 43.]

Example. Let Spica, or the southern latitude of Jupiter, be given, of degree 2° and longitude in Libra 18° . For this is in the degree of Libra, and the southern declination by Table 26 is $7^{\circ}4'47''$, and indeed of southern latitude; therefore, since these are of the same species of sign, and of latitude, there will be a prosthaphaeresis of declinations to be added; for under the southern latitudes degree 2° , and from the region degree 18. Libra, that is degree $1.11'$, which, the degrees $7^{\circ}4'47''$ being added, makes the southern declination of Spica $8^{\circ}15'47''$. Then the right ascension of Libra by Table 28 at degree $196^{\circ}35'31''$, and the southern latitude of Spica, or of Jupiter, being assumed at degree 2° . Australis, and the prosthaphaeresis being likewise southern, there will be a prosthaphaeresis to be added; this however in the left-hand part of the table, from the region of degree 18, and sub latitude. Australis degree 2° and $46'$. Therefore of Spica, or of Jupiter the right ascension will be $197^{\circ}21'31''$.

There follow the Precepts for the use of the Tables of Part III, that is, on the Motions of the Sun and of the Moon.

Precept 55. *To find the true place of the Sun on the ecliptic, and its anomaly, for a given time of the era of the common reckoning of Christ.*

First, if the given time is apparent, convert it into equated [time] by Precept 16.

[Margin: Pag. 44.]

Second, from Table 36, collect the mean motion of the Sun, and of the apogee of the Sun, agreeing with the epoch, by the radix nearest preceding the given year, and the years after the epoch completed, and likewise by the months completed of the current year, whether of the quality of the common or current year, and by the days given — always employing them as completed; and at length by the hours, and the scruples after noon, and collect the mean motion of the Sun separately, and separately the mean motion of the apogee of the Sun.

Third, subtract the motion of the apogee from the mean motion of the Sun (the assumption being made, whenever the subtraction cannot be done, of 12 signs); and the simple anomaly of the Sun will remain, that is, the distance of the Sun itself from the apogee.

[Margin: Pag. 46.]

Fourth, with the simple anomaly of the Sun, take out from Table 38 the equation to be subtracted, in the prior semicircle of anomaly; that is, when the signs of the anomaly are at the top of the table, and these in the left-hand column of the table; the addendum, however, in the latter, that is, when the signs are in the right-hand column, in the foot of the table, and these, whether it pleases the circular form, or the elliptical form, and by the equation correct both the mean motion of the Sun, and the simple anomaly of the Sun itself; for thence will come forth the true place of the Sun on the ecliptic; thence the equated anomaly of the Sun.

Example.

The true place of the Sun is sought for the Year of the Epoch of Christ 1661. September on the 23rd day, 1 hour 1 minute 30 seconds after noon at Bologna. First, then, since the Sun then will be in the first degree of Libra by the Table of Temporal Equations, [Margin: Pag. 8.] the double-equation to be subtracted is found 4'23"; therefore the equated time will be 1 minute 26 [seconds?] after noon; and then the form of the calculation will be thus:

Mot. ☉ Med. ab ♀ (Sign.								
Years	Gr. ' ")	Apog. (Sig. Gr. ' ")						
1600	Sign.	G	'	"	Sig.	G	'	"
		r				r		
		.				.		
Radix	9	1	4	3	3	7	3	8
		0		5			9	

Years	Mot. ☉ Med. ab ♀ (Sign. Gr. ' ")	Apog. (Sig. Gr. ' ")					
An. 60.	0	0	2	3	0	1	2 5
			7	6			
Augu sti	7	2	3	4	0	0	0 4
		9	0	4			1
D. 23.	0	2	4	1			
		2	0	2			
H. 1.	0	0	2	2			
				8			
M. 26.	0	0	1	4			
Sum ma	6	2	4	3	3	8	4 5
			6	9			1 4

Second, therefore, with the signs of the apogee subtracted, 3 signs 8°41'54", from the mean of the Sun, the simple anomaly of the Sun remains, and thence will be had the equation of each, as below.

	Sig.	Gr.	'	"
Solis Medius [Mean of the Sun]	6	2	46	39
Apogei motus [Motion of the apogee]	3	8	41	54
Anomalia simplex [Simple anomaly]	2	24	4	45
Aequatio subtracta in forma circulari [Equation subtracted in circular form]	0	1	58	49
Restat Verus locus ☉ [The true place of the Sun remains]	6	0	47	50
Et Anomalia coaequata [And the equated anomaly]	3	6	43	5

The Sun will therefore then be at the first degree of Libra, not yet complete, but distant from it by the absolute 47' and 50" of that degree; and it will be distant from the true apogee by signs 3, degrees 6, 43'5"; that is, with the signs resolved into degrees, it will be distant from the apogee by 96°43'5".

Warning concerning the Julian and Gregorian style.

In the example adduced we have used the Radix of the year 1600 according to the form of the Gregorian year; but if we were to use the old Julian style, the Radix of

the year 1600 in the old Julian style would have to be applied, congruent with that which Table 36 has for the mean of the Sun, Signs 9, degrees 19°55'58".

Precept 56. *To find the true place of the Sun for a given time before the Epoch of Christ.*

[Margin: Pag. 19.]

With the apparent time reduced to equated by Precept 16: if the given year before Christ is one of the hundreds [centuries] themselves, or of the thousands, use the Radix noted for that century, or chiliad, in Table 36; and then there will be no need to collect the mean motions for the years from the radix as distinct ones. For the years before Christ in the aforesaid Table are reckoned complete, indeed by numbering them from Christ upward toward the beginning of the world; but they are current years, if they are numbered downward toward the Epoch of Christ, nor are they complete, except in the case where the given time was the noon of the last day of December, or after the noon of the same last day of December. But the remainder for the months, days, hours, and scruples are to be carried out as in the preceding Precept 55.

But if the given year is not one of the hundreds [centuries] or thousands, the year is to be subtracted from the nearest expanded hundred of years, and the residue will be the number of complete years, for which the mean motion is to be sought; but the Radix to be applied will be that of its century, or millenary, which most nearly precedes, that is, which is most nearly greater; but the remainder is to be performed entirely, as in Precept 55.

Example One.

The true place of the Sun is sought for the Year before Christ 200. September 23, hour equated after noon 1[h] 26'. The true place of the Sun at Bologna will be thus:

Ante Chr. [Before Christ]	Motus ☉ (Sign. Gr. ' ")	Apog. (Sig. Gr. ' ")	
Radix — Anni 200.	9	6 8 1 2	6 3 4 6 8
Augusti	7	2 3 4 0 9 0 4	0 0 4 1
D. 23.	0	2 4 1 2 0 2	

Ante Chr. [Before Christ]	Motus ☉ (Sign. Gr. ' ")	Apog. (Sig. Gr. ' ")	
H. 1.	0	0 2 2 8	
M. 26.	0	0 1 4	
Summa	5	2 2 2 2 8 2 9	6 3 2 7 9
Anomalía ☉ simplex [simple anomaly]		3	2 4 0 1 5
Aeq. subtr. [equation subtracted]	0	1 5 1 0 1 3	1 5 1 1 3
Verus ☉ [true Sun]	5	2 3 1 6 1 6	
Anomalía ☉ coaequata [equated anomaly]		3	1 5 4 9 3 7

Precept 57. *To find the parallax of the Sun in the circle of altitude.*

[Margin: Pag. 45.]

It is presupposed known, in any case, whether the anomaly of the Sun is at least near the maximum, or near the mean, or near the minimum distance from the Earth; for Table 37, in the column of the aforesaid distance, or assigned to the signs of the anomaly, and from the region of the degrees of the given altitude, will exhibit the parallax of the Sun, in which by how much the values of Ptolemy, Copernicus, and Tycho have differed exceedingly.

Example.

In the example of Precept 55, the anomaly of the Sun was found to be of Signs 3, and about 7°, the altitude of the Sun being given from the horizon as 45°29'. For in Table 37, in the column corresponding to signs III. and from the region of degree 45°29', you will have a parallax of 11'10", using a proportional part.

Precept 58. *To find the distance of the Sun and of the Moon from the center of the Earth, but of the Moon in conjunctions [syzygies], together with the horizontal parallax and the hourly motion of each; but to find the true motion.*

[Margin: Pag. 47.]

The anomaly of the Sun by Precept 56 being known, and in Table 38 it shows at once from the region toward the right the distances of the Sun from the center of the Earth, in parts of which the radius of the solar orbit is 100000; then in semidiameters of the Earth, and the horizontal parallax, and the hourly motion of the Sun. But these three conditions of the Moon, the anomaly of the Moon will show, when it has been known by Precept 61, or otherwise. In the distances

and although for the Sun we generally use Hypothesis 1 (on which see *Astronomia Reformata*, book 1, chapter 13), still, if anyone prefers Hypothesis 2, set out in the same place at chapter 17, the Sun's distance can be found from the same Table 39 on either hypothesis.

Example

Suppose that both the Sun's and the Moon's anomaly is 95 degrees. In Table 39, then, the stated conditions of the two luminaries stand as follows:

		Value
Distance to the radius 100000	☉ (Sun)	99844
	☾ (Moon)	99905
In semidiameters of the Earth	☉ on hypothesis 1	7289
	☉ on hypothesis 2	6543
	☾	60 · 57
Horizontal parallax	☉	0' 28" 16"
	☾	56' 26" 0"
True hourly motion	☉	2' 29"
	☾	33' 11"

Precept 59. To determine the apparent semidiameters of the Sun and Moon at syzygies and in the shadow, and the [semidiameter] of the terrestrial body in the passage of the Moon through the shadow.

Once the luminaries' anomaly has been equated, look up the semidiameter of the Sun, of the Moon, and of any planet whatever in Table 39, taking the one that corresponds to the anomaly; but for the semidiameter of the shadow, look up the value answering to the Moon's equated anomaly. For you will obtain the apparent semidiameter of the terrestrial shadow-disk at the place of the Moon's passage — but on the supposition that the Sun is at apogee. Therefore, in the

region opposite the Sun's anomaly you must always apply the Variation to the semidiameter of the shadow, so that it comes out corrected.

Example

		Gr.	'	"
Let the anomaly be	of the Sun	95	0	0
	of the Moon	120	0	0
The apparent semidiameter will then be	☉		15	47
	☾		15	44
Shadow, with Sun at apogee			45	44
Variation			0	43
Shadow's semidiameter, therefore, corrected			45	1

Precept 60. To investigate the refraction of the luminaries and of the fixed stars, and by means of it to convert their altitude-parallax into apparent altitude, and to turn their apparent altitude into true, or their true altitude into apparent.

In Table 40 I have set out these refractions for the temperate zone, since I have had more reliable experimental data for it; I have suppressed the refractions of the other zones, especially the frigid ones, because their measure is inconstant and not yet ascertained. As to why I have departed from the Tychonic table, enough has been said in book 1 (*Astronomia Reformata*, chapters 14 and 15). With this noted in advance, examine the following rules.

The Moon's *observed altitude* is converted into *true altitude* by subtracting the refraction it has, then its parallax, and the residue [of the latter]; or, if you prefer, by adding the Moon's own parallax to its apparent altitude — on which see Precept 71.

The Moon's *true altitude* is converted into *observed altitude* by subtracting the parallactic refraction and adding back the residue to the true altitude.

The *observed altitude* of the Sun, of the remaining planets, and of the fixed stars is converted into *true altitude* by subtracting from the observed altitude the simple refraction. The *true altitude* [is converted] into apparent by adding the true refraction.

Precept 61. To find the true place of the Moon in its own orbit at a given time within [the period of] a new moon, or to find the day of the full moon together with the lunar anomaly.

For a time reduced to the Bologna meridian and equated as above (as was done for the Sun in Precept 55, or, if it falls before Christ, by Precept 56): gather from Table 41 the radix immediately preceding the given year, together with the mean motions of the Moon from the beginning of Aries and the anomaly for the completed years, months, and for the assigned day, hours, and minutes; and reduce them into a single sum — the mean motion of longitude separately and the anomaly separately. Then go to Table 42, and in it look up the signs of the anomaly at the head, and the degrees of the anomaly down the left side if the signs are descending; or look up the signs of the anomaly at the foot, and their degrees ascending up the right side if the signs are in the right-hand column. For in the common area you will find — by interpolating proportionally, if need be — the equation, to be subtracted from or added to both the mean motion of longitude and the lunar anomaly, just as the headings at the top mark it *To be subtracted* or at the foot mark it *To be added*. And you will have the Moon's true place — that is, its first equated place (which suffices for syzygies) — and the Moon's equated anomaly.

Example

For the year of Christ 1661, on the 23rd day of September, at the Bologna hour 1^h 26' equated past midday, the Moon's true place is sought. The computation will be ordered thus:

		Motion of ♀ from ♈				Anomaly				
Radix	Sig.	G ' ''				Sig.	G ' ''			
		r					r			
		.					.			
Years 1600	7	2	1	2	0		7	2	9	
		5	9	0				7		
Years 60	1	1	4	1	3		2	6	4	
		0	1	9			9			
August completed	10	2	5	5	9		2	4	2	
		1	1	0			4	7	6	
Day 23	10	3	3	2	10		0	2	4	
				5				9	1	

	Motion of ☾ from ♀		Anomaly	
Hour 1	0	0 3 5 0		0 3 4
		2 6		2 0
Minute 26	0	0 1 1		1 9
		4 6		4
Sum	6	1 4 6 0		2 3 9
		3		7
Equation, subtractive		1 1		1 1
		3 5		3 5
Therefore	6	1 2 5 0		2 2 5
		9 1		3 4
True place ☾			& anomaly equated	

The Moon, then, was in 2° of Libra, not yet complete in its orbit.

Precept 62. To find the true place of the Moon's northern node at a given time, and the Moon's greatest latitude.

For a time reduced to the Bologna meridian and equated, as above in Precept 55 or 56: gather from Table 41 the mean motion of the node ☾ for the given years, months, and likewise for the days, hours, and minutes; reduce them into a single sum, subtract it from the radix of the node's mean motion immediately preceding, and you will have the mean motion of the node ☾. Then, with the true place of the Sun found by Precept 55 or 56 and that of the Moon by Precept 61, gather the true distance of the Moon from the node, and with this distance — or, if it exceeds six signs, with the Moon's distance from the point opposite the Sun — enter Table 43. For in it, with the signs of the distance examined at the head and the degrees down the left side, or the signs at the foot and the degrees down the right side, you will have in the common area the equation of the node ☾, to be subtracted from or added to the mean place of the node, so that you have the true [place]; and on that same occasion, from the region of the Equation-numbers, you will have the greatest latitude to be assigned for the following precept.

Example

For the year of Christ 1661, on the 23rd day of September, at the Bologna hour 1^h 26' equated past midday, the true place of the node ☾ is sought. It will be found thus:

	Sign.	Gr.	'	"
Years 60	2	20	30	40
August completed	0	12	52	5
D. 23		1	13	5
H. 1				5
M. 26				8
B. Sum	3	4	35	58
Radix Year 1600	9	11	22	50
B. sum subscribed	3	4	35	58
There remains the mean place of the node Ω	6	6	46	52

Then, since by the example of Precept 55 and Precept 62 —

	Sign.	Gr.	'	"
There was the true place $\odot$	6	0	47	50
the true place of the node Ω	6	1	29	50
Distance of $\odot$ from Ω	0	0	42	0
Therefore the equation of the node Ω , subtractive	0	0	2	41
True place of the node Ω	6	6	44	11
And greatest latitude of $\curvearrowright$	0	4	58	30

Precept 63. To find the true latitude of the Moon, and its Argument.

Once the true places of the luminaries and of the node Ω at the given time have been reckoned by Precepts 55 (or 56) and 61, and the greatest latitude has been reckoned and looked up by Precept 62: subtract the true place of the node Ω from the assumed true place of the Moon; if the subtraction requires it, borrow 12 signs; and you will have the equated argument of latitude — that is, the *Argument of Latitude*. Then look up its signs at the head of Table 44 and its degrees down the left side, or its signs at the foot and degrees down the right side. For from the region of the degrees beneath the signs, or above the signs of the Argument, and under the heading of the greatest latitude, you will find the desired latitude of the Moon — northern or southern, as the headings of the table indicate.

Example

Now in the examples of Precepts 61 and 62 the places of the Moon and of the node Ω stood as follows:

	Sign.	Gr.	'	"
True place ☽	6	1	29	51
True place of node ☾	6	6	44	11
Therefore the Argument of latitude	11	24	45	40
The greatest latitude was	0	4	58	30
Therefore the true southern latitude ☽	0	0	26	55

For I added 12 signs to the place of the Moon, so that the place of the node could be subtracted from it.

Precept 64. To reduce the true place of the Moon from the orbit to the ecliptic, and from the ecliptic to the orbit.

Since the Moon's orbit is inclined to the ecliptic — so that you may know the Moon's ecliptic place, namely the one which the latitude-circle drawn through the center of the Moon to the ecliptic determines — take by Precept 63 the Argument of latitude, and look up its signs at the head of Table 45 and its degrees down the left side, or the signs at the foot and degrees down the right side. For in the common area you will have the *Reduction* of the Moon to the ecliptic, to be subtracted from or added to the orbital place of the Moon, as the headings above or below indicate. With these headings reversed, the opposite must be done if the Moon's place is to be reduced from the ecliptic to the orbit.

Example

The true place of the Moon in the orbit by the example of Precept 61, and the Argument of latitude by the example of Precept 62, stood as below:

	Sign.	Gr.	'	"
☽ True place in orbit	6	1	29	51
Argument of latitude	11	24	45	40
Reduction, additive			1	16
True place in the ecliptic	6	1	31	7

Precept 65. To investigate the true place of the Moon outside of syzygies.

Gather by Precept 55 (or 56) the true place of the Sun, and by Precept 61 the true place of the Moon in its orbit, and the Moon's first-equated anomaly. Then subtract the true place of the Sun from the true place of the Moon (borrowing 12 signs if need be), and you will have the true distance of the Moon from the Sun. If

this should exceed six signs, the excess above a semicircle will be called the distance of the Moon from the point opposite the Sun; and with that distance consult Table 47, looking up the signs of the distance at the head when it is less than three signs, and on the left side; the signs and degrees of the anomaly being equated. But if the distance is greater than three signs, look up the distance at the foot of the table, and the anomaly's signs and degrees on the right side. For in the common area you will have the Moon's final equation, composed of the equation of the eccentricity and the Variation; and add it to, or subtract it from, the Moon's first-equated place, as the headings at the top or foot of the table, or in the middle the letters A or S, will indicate. (Let Argolus, on the strength of his astrological observations, reject the Tychonic Variation.)

Example

For the year 1661, on September 26, at hour 1 equated past midday at Bologna, the true place of the Moon in its orbit is sought. It will be investigated thus:

	Motion of ☉			Apogee		
	Sig.	G r.	'	"	Sig.	G r.
R Year 1600	9	1	4	3	3	7
		0		5		9
Years 60	0	0	2	3	0	1
			7	6		2
August completed	7	2	3	4	0	0
		9	0	4		0
D. 26	0	2	3	3	0	0
		5	7	7		0
H. 1	0	0	2	2		
				8		
Sum	6	5	4	0	3	8
			3			4
Anomaly					2	2
						1
						7
Equation, subtractive	0	1	5	3		
			9	2		
☉ True place	6	3	4	2		

Motion of ☉		Apogee		
		3	8	
Motion of ☾		Apogee		
	Sig.	G	'	"
		r.		
R 1600	7	2	1	2
		5	9	0
Years 60	1	1	4	1
		0	1	9
August completed	10	2	5	5
		1	1	0
D. 26	11	1	3	1
		2	5	1
H. 1	0	0	3	5
			2	6
Sum	7	1	0	3
		1		6
1st equation, subtractive	0	0	5	1
			8	9
☾ place & anomaly, first equated	7	1	2	1
		0		7
☾ Dist. from ☉	1	6	1	5
			8	0
Equation, ultimate, subtractive	0	0	4	0
			7	
☾ Final place & equated	1	5	3	5
			1	0

Precept 66. To inquire into the hourly motion of the Moon away from the Sun on the days of full moon and new moon.

With the Moon's first-equated anomaly found by Precept 61, consult Table 48, looking up the signs of the anomaly at the head and on the left side, or its signs at

the foot and degrees on the right side. And in the common area you will have the true motion — that is, the space of the zodiac which the Moon, by its hourly motion together with the Sun's, traverses in the hour of full moon or new moon; or [the space] which one or the other accomplishes within the 12 hours before or after the new moon or full moon.

Example

Returning to the example of Precept 61, the Moon's equated anomaly was 0 signs, 2°, 23' 54". Therefore, by Table 48, the Moon's hourly motion in the hour of that new moon is 27' 44".

Precept 67. To define the true new moon, or full moon, precisely at a given time — or within 12 hours of it.

If, by the Sun's computed [place] and the Moon's true motion reckoned by Precepts 55 and 61, the Moon should differ from conjunction or opposition with the Sun by more than 6 or 7 degrees, then inquire by Precept 66 into the Moon's hourly motion, together with the hourly motion of the Sun set out at the head of Table 49. And look up in the same table the degrees, minutes, and seconds by which the Moon either falls short of, in the zodiac, or follows after, the place of the Sun [or its opposite]; and add the scruples answering to the time of the nearest new moon or full moon, if the Moon falls short of the Sun or its opposition, or subtract them if it follows after.

Example

From what was said in the example of Precepts 55 and 61, the Sun's true place was 6 signs, 0°, 47' 50", and the Moon's place 6 signs, 1°, 29' 51". The Moon's hourly motion by Precept 66 was 27' 44". Therefore in Table 49, under the headings of hours 27 and 28: using the proportional minutes, you will see [the value] answering to 42' 1". Answer for the time given, which is hour 1^h 26': the new moon will fall out at hour 1^h 26', 7' before midday on the 23rd day of September of the year 1661.

Precept 68. To find the Moon's greatest and least distance from the center of the Earth outside of syzygies, and [to find] the eccentricity.

I have taught how to find the Moon's distance from the Earth at syzygies in Precept 58. But outside of syzygies, the eccentric anomaly is required, which equals the doubled distance — namely the distance of the Moon from the Sun found on that occasion by Precept 65. Looking it up in the left-hand columns of

Table 50, you will find, proceeding rightward, the eccentricity of the Moon's orbit, both in parts of which the orbit's radius is 100000 and in semidiameters of the Earth. Then, in the remaining columns, you will find the Moon's greatest distance and its least, expressed separately for the several syzygies, according to the lunar theory I have handed down in *Astronomia Reformata*, book 3.

Example

In the case of Precept 65, we had the Moon's elongation from the Sun of 1 sign, 6°, 19'; which, resolved into degrees, makes 36° 19'; and this doubled makes the eccentric anomaly of 72° 38'. With this in Table 50 you have the interval written below, using the proportional part:

	Of which the radius is 100000	Semidiameters of the Earth	
› Eccentricity	8436	4	3 4
› Greatest distance	108436	65	3 4
› Least distance	91568	56	2 4

Precept 69. To inquire into the Moon's distance from the center of the Earth outside of syzygies.

With the eccentric anomaly — which in the preceding precept you learned to find, that is, the doubled distance of the Moon from the Sun — look up in the head of Table 51 the elongation, having sought it [there]; and with the eccentric anomaly of the orbit equated in the left-hand columns, you will at once find the Moon's distance from the Earth in semidiameters of the Earth.

Example

In the example of Precept 65, the Moon's elongation from the Sun was 1 sign, 6°, 19' — that is, 36° 19'; this doubled gives the eccentric anomaly of 72° 38'. But the Moon's equated orbital anomaly was 1 sign, 10°, 36' — that is, 40° 36'. To these in Table 51 corresponds the Moon's distance from the center of the Earth in semidiameters, 64° 20'.

Precept 70. To find the Moon's apparent semidiameter and horizontal parallax outside of syzygies.

Look up by Precept 69 the Moon's distance from the center of the Earth, and with it you will at once have, in Table 52, the apparent semidiameter and the horizontal parallax of the Moon.

Example

In the example of Precept 69, the Moon's distance was 64 semidiameters 20' of the Earth. To this Table 52 shows the Moon's apparent semidiameter 14' 39", and the horizontal parallax 53' 27".

Precept 71. To investigate the Moon's parallaxes in the circle of true altitude.

This parallax is twofold — namely 53 [scil. of distance] — and for this it is necessary to know the Moon's horizontal parallax by Precept 58 in syzygies; for under the head of Table 53, in the region of the true altitudes, the [parallaxes] are taken. The other table, designated Table 71, is for the Moon's distance from the Earth in semidiameters of the Earth; under it, in the region of the degrees of true altitude, you will have the desired parallax.

Example

Let the Moon be 35 degrees high above the horizon, when in the example of Precept 58 the Moon's distance from the Earth was found to be 60 [semidiameters] 57', and the horizontal parallax 56' 26". For in the region of the 35 degrees on the left side, you will find the Moon's horizontal parallax taken in Table 53; or, by the stated distance from the Earth in Table 61, you will find the parallax of altitude 46' 40". But if you want the parallax of the observed altitude — look up that same one in the tables, using the observed altitude as if it were the true [altitude], and look up the parallax answering to it; and add this to the true altitude. Then at last, with this aggregate, look up the parallax there again, and it will agree with the observed altitude.

So, in the same example, the Moon's observed altitude being 35°, the parallax 46' 40" comes out; and this added to the altitude of 35° gives the degrees 35° 46' 40", to which in Table 61 answers the parallax 46' 40". This, therefore, is the one which agrees with the Moon at an observed altitude of 35°.

Precept 72. To find, for a given year and month, the mean new moon and mean full moon by means of the epacts.

Gather first from Table 54 the radix of the epacts immediately preceding, and the epacts answering to the years thereafter elapsed and completed, and likewise to the completed months — namely, the month preceding the given month — and

reduce these into a single sum, from which subtract the greatest number of revolutions of the new moon nearest [below], and in the left-hand part of the same Table 54 stand the days of the given month, with the hours and scruples past midday at which the mean new moon and mean full moon occur.

in the mean by the Julian style, but by the Gregorian style you must add 10 days for this whole century, and more days for other centuries, according to what was said at Precept 19.

Example.

The mean new moon of the year of Christ 1661, in the month of September, is sought; the calculation is to be set out by the method written out below from Table 54.

	D.	H.	'	"
Radix of the year 1600.	6	7	46	59
60 years.	3	7	10	40
August completed.	6	18	7	35
Sum	16	9	5	14
Revolutions of the conjunction σ	29	12	44	3
Take away	16	9	5	14
Remainder of the mean σ, September	13	3	38	49
But by the Gregorian style	23	3	38	49
Revolutions of the opposition σ^o	44	7	6	5
Take away likewise	16	9	5	14
Remainder of the mean σ^o, September	27	22	0	51
But by the Gregorian style, October	7	22	0	51

[Margin: Pag. 60.]

[Margin: Argoli's error.]

This eclipsic new moon Argolus [Andrea Argoli] represents at Rome in his *Ephemerides*; but falsely, for the southern latitude, with the parallax added, frees the Sun at Rome from any eclipse.

Precept 73. Given the time of the mean new moon, or of the full moon, to find the moment of the true new moon, or of the full moon.

For the given time of the mean new moon or full moon, collect by Precepts 55 and 61 the true places of the luminaries; and if they are found in the same minute of the zodiac, the mean new moon coincides with the true; if so, they will be 180° apart in the case of the mean full moon, and the true and mean full moon will be celebrated at the same moment. But if the Moon has preceded or followed by some degrees or minutes, then take the place of conjunction, or of opposition with the Sun: then, with the equated anomaly of the Moon by Precept 66, find the hourly motion of the Moon, and by it divide the difference between the place of the Sun and the Moon at the conjunction, or between the place of the Moon and the place opposite the Sun at the opposition. For the quotient gives the hours and minutes to be added to the time of the mean syzygy, if the Moon has not yet reached the Sun, or the place opposite the Sun; or to be subtracted, if it has already passed it. Yet for this the moment requires that the places of the luminaries be iterated, and, if need be, the exact moment of the new moon or full moon be defined again by the hourly motion of the Moon.

Example of the full moon.

From the example of the preceding Precept is given, for the year 1661, October 7 by the Gregorian style, the mean full moon at Bologna after noon at the hour 22h 0' 51". For which time the calculation of the luminaries stands thus:

	Sig.	Gr.	'	"
☉ Mean place of the Sun	6	17	25	18
Simple anomaly of the Sun	3	8	43	17
Equation to be subtracted	0	1	57	54
True place of the Sun	6	15	27	24
☾ Mean motion	0	17	29	15
Mean anomaly of the Moon	6	16	3	58
Equation of the orbit to be added	0	1	25	8
True place of the Moon	0	18	54	24
Equated anomaly of the Moon	6	17	29	6
Difference of the places ☉ and ☾	0	3	27	0
Hourly motion of the Moon from ☉	0	0	34	0
Time to be subtracted from the mean time	H.	6	5	18

	Sig.	Gr.	'	"
Truer therefore is the time of the full moon	H.	15	55	33

It is therefore necessary, for this very time of the truer full moon — namely at the hours 15h 55' 33" — to iterate the calculation, which will turn out as follows:

	Sig.	Gr.	'	"
True place of the Sun	6	15	12	18
Equated anomaly ☉	3	6	30	17
True place of the Moon	0	15	20	7
Equated anomaly of the Moon	6	14	36	31
Excess ☽ beyond ☉	0	0	7	49
Hourly motion ☽ from ☉	0	0	33	18
Time to be taken away	0	0	14	6
True full moon	H.	15	41	27
Apparent time	H.	15	32	37
And then the corrected place of the Moon	0	15	12	18
And the equated anomaly	6	14	29	0

Precept 74. To know beforehand whether a full moon or new moon is eclipsic.

The first method, although not so reliable, is settled with little error by Precepts 62 and 63: by these is found the argument of latitude, or the distance of the Moon from the nearer of the nodes; and with this as argument, find at once in Table 55 the eclipse limits, which are possible whenever the Moon is farther from the node than the Eclipsic Limit requires; an eclipse will not be possible. But if it is within those limits, an eclipse will be possible.

[Margin: Pag. 60.]

Example.

In the year 1661, October 7, at the hour 15h 32' 37", when the true full moon occurs: the true place of the node ♊ is duly computed to be Sign 6, gr. 6° 0' 29". The Moon is in ♍ gr. 15° 12' 18", distant from the node ♊ Sign 6, gr. 9° 12' 49", but in the southern node. Therefore the limits necessary for a lunar eclipse will be gr. 0° 12' 49", since the Moon is nearly at perigee at gr. 11° 53', but the Moon is less distant from the node.

A second method, however, is more reliable: for, by Precept 59, find the apparent semidiameter of the Moon and the Umbra, corrected for the terrestrial parallax, by Precept 63. Find the true latitude of the Moon: for if the latitude is equal to, or greater than, the aggregate of the semidiameters of the Moon and the Umbra, there will be no eclipse; if less, there will be some eclipse.

Example.

In the year 1661, October 7, at H. 15h 32' 37" after noon at Bologna, the lunar conditions stand thus:

	Sig.	Gr.	'	"
Moon ☾ True place	0	15	12	18
Node ♄ True place	6	6	0	29
Argument of latitude	6	9	11	48
Distance ☾ from ☉	0	0	0	0
Maximum latitude	0	4	58	30
True latitude of the Moon	0	0	47	40
Equated anomaly ☾	6	14	29	0
Anomaly of the Sun	3	6	30	18
Semidiameter of the Umbra	0	0	48	30
Variation to be removed	0	0	0	44
Semidiameter of the Umbra corrected	0	0	47	46
Apparent semidiameter ☾	0	0	16	8
Aggregate of the semidiameters	0	0	63	54

The true latitude of the Moon ☾ is therefore far less than the aggregate of the semidiameters; and consequently a lunar eclipse will necessarily occur.

Precept 75. To determine the digits of a lunar eclipse, that is, its magnitude.

Because the disk of the luminaries is commonly reckoned in its apparent diameter to be a foot in magnitude, and the foot, in the Roman manner, is divided into 12 unciae, or thicker digits,

therefore the same quantity of the luminaries' obscuration is wont to be expressed by digits, and by the minutes of the digits. These are thus defined. Subtract the true latitude of the Moon from the aggregate of the semidiameters of

the Moon and the Umbra, corrected; for the remainder will give the deficient scruples; then doubling the apparent semidiameter of the Moon, in the front of Table 57, and at the side of the scruples of deficiency, you will have the digits of the eclipse with their scruples.

Example.

In the preceding full moon the semidiameter of the Moon was 16' 8". The diameter is therefore 32' 16". And the aggregate of the semidiameters of the Moon and Umbra, corrected, was 63' 54". There remains the true latitude of the Moon, which there was 47' 40". The deficient scruples are therefore 16' 14", which quantity, in Table 57, under Diameter 32' 16", with the proportional part applied, gives the digits of the partial eclipse, 6, gr. 5; that is, this eclipse will be partial, or of 6 digits and 5 minutes. But if there were a total eclipse, it would be of 12 digits without a tarrying; the tarrying, if greater than 12, is total with a tarrying.

Precept 76. To determine the scruples of incidence of a lunar eclipse, and of its very beginning and end; or rather, also the tarrying in the shadows, if it is a total eclipse with a tarrying.

Astronomers call the scruples of incidence [*scrupula incidentiae*] those zodiacal, or lunar-orbit, scruples which the Moon traverses from the beginning of the eclipse up to the middle; and the scruples of the tarrying [*scrupula Morae*] those which it traverses from the middle up to the end. The scruples of the half tarrying [*scrupula Mora dimidia*], which the Moon completes from the moment of total obscuration up to the middle. And the partial scruples of the eclipse's duration you find thus: for, in the front of Table 59, take the sum of the corrected semidiameters of the Moon and the Umbra, and at the side of the true latitude of the Moon, you will have the scruples of incidence. Then repeat, as above, with the equated anomaly of the Moon: from the hourly motion of the Moon from the Sun divide the scruples of incidence; you will do it more subtly, however, if the hourly motion is resolved into one number out of 60. And the product, divided by the hourly motion, will give the hours and the parts of hours, which scruples, subtracted from the moment of the full moon, will give the beginning of the eclipse, and added, the end.

Example.

In the preceding full moon the sum of the semidiameters of the Moon and Umbra was found to be 63' 54"; and the true latitude of the Moon, at whose place in Table 59 under the sum 63' 54", the proportional part being applied, is found the scruple

of incidence 42' 32". The hourly motion of the Moon found above was 33' 18". Resolving therefore the minutes into seconds, the hourly motion in seconds becomes 1998". And the incidence, secondly, 2552"; which multiplied by the minutes of one hour, 60", makes 153120"; and this, divided by 1998", leaves 76⅔ minutes of the hour, that is, 1h 16' 39", which, subtracted from the full moon found at the eclipsic moment above by Precept 73 after noon at the hour 15h 32' 37", and afterward added, and finally aggregated, give the beginning and end of the eclipse, as below.

	After Noon at Bologna		
In the ☾ Orbit	H.	'	"
Beginning of the eclipse	14	15	58
Middle	15	32	37
End	16	49	16
Total duration	2	33	18

But the total eclipse with the tarrying is to be completed thus. First, find, as above, the scruple of incidence, which in this case comprehends also the half of the tarrying; and therefore, [Margin: Pag. 68.] Table 59 has the title: *Scruples of incidence, and of the half-tarrying in an eclipse* ☽; and divide it by the hourly motion, as above.

[Margin: Pag. 66.] [Margin: Pag. 67.]

A more subtle reckoning of a lunar eclipse — admonitions.

First, it is not yet a decided controversy whether the moment of the full moon, at which the Moon is distant from the Sun by precisely 180°, is the same as that at which the place of the Moon is reduced to the ecliptic, distant likewise by 180° from the Sun; or rather, whether, when the center of the Moon and the center of the Umbra are equally distant from the nearer node — which Kepler [Johannes Kepler] noted in the *Rudolphine [Tables]* at the end of Precept 155. Neglecting this, however, as a third point, if the full moon up to now in the orbit is to be considered, reduce the volumes to the ecliptic by Precept 64; then, if the reduction was by addition, that scruple, divided by the hourly [motion], is to be subtracted from the moment of the full moon; if previously by subtraction, then to be added.

For example, in the full moon of Precept 73, the place of the Moon in the orbit was Sign 0, gr. 15° 12' 18". But the argument of latitude was Sign 6, gr. 9° &c.

Therefore the reduction to be subtracted is 2' 10"; and the eclipsic place of the Moon Sign 0, gr. 15° 10' 8". The hourly motion was 33' 18"; from one minute 2' 10" are owed the minutes of time 3' 11", which, added to the hours 15h 32' 37", give the moment of the eclipsic full moon by this reckoning at the Hour 15h 35' 58". From which, the rest of the beginning and end of the moment are to be reckoned and limited, if they are to be limited.

With Respect to the Ecliptic			
In ☉	H.	'	"
Beginning	14	19	19
Middle	15	35	58
End	16	52	37

Secondly, it is to be admonished, for those eager for astronomical subtlety, that — as I explained more fully in Book 5 of the *Almagestum Novum* in the Scholium of Chapter 6 — namely, the moment of the eclipsic full moon is not the same as the moment of the greatest obscuration, and this difference, which can reach as much as 6 minutes of an hour, is not to be despised. For the rest, since the greatest obscuration occurs when the place of the Moon in the orbit is exactly distant 180° from the Sun — because then the arc drawn from the orbit of the Moon orthogonally from the center of the Umbra is shorter than the arc drawn from the center of the Moon orthogonally to the ecliptic at the point where the center of the Umbra is, as has there been demonstrated; in which second case, now reducing the full moon from the orbit to the ecliptic, whoever has first found this difference, by the first admonition, will have at the same time the difference of the eclipsic full moon and the moment of the greatest obscuration. Hence in our example the greatest obscuration of the digits occurs at the hour 15h 32' 37". But the eclipsic full moon by the ecliptic, and not only by the eclipse so denominated, occurs at the Hour 15h 35' 58".

Precept 77. To determine the true latitude of the Moon at the beginning, and at the end; and to determine the eclipse.

By Precept 58 find the hourly motion of the Sun, and by it lead the scruples of incidence found at Precept 76; and you will have the true motion of the Sun congruent to the time of the half-duration, which add to the scruples of incidence, and to the half-tarrying together, and subtract the sum from the argument of latitude at the middle of the eclipse, and there will come forth the argument of

latitude at the beginning of the eclipse; but if to the same argument at the middle you add the aforesaid sum, you will have the argument of latitude at the end.

Example.

In the preceding full moon the hourly motion of the Sun was 2' 29". Therefore the motion of the half-duration of the eclipse, congruent in time of one hour, was 3' 6". The scruples of incidence by Precept 76 found before were 42' 32", to which, adding 3' 6", the sum becomes 45' 39". With the argument of latitude at the middle of the eclipse being Sign 6, gr. 9° 11' 48", subtracting this sum 45' 39" leaves the argument of latitude for the beginning of the eclipse, Sign 6, gr. 8° 26' 9"; to which, in latitudes, Table 44 makes the southern latitude 43' 43" for the beginning of the eclipse; but if to the same sum 45' 39" you add the argument of latitude at the middle, the argument of latitude at the middle being Sign 6, gr. 9° 57' 27"; for the end of the eclipse, to which corresponds the southern latitude 51' 31". Therefore the latitudes of the Moon to be noted are, as below, always southern.

Latitude True 》		'	"
In Eclipse			
Beginning	A	43	43
Middle	A	47	40
End	A	51	31

Precept 78. To delineate the type of a lunar eclipse.

The true latitude of the Moon being known, and likewise its appearance through Precept 77, the type of the lunar eclipse will easily be graphically delineated, together with the inclination to the regions of the horizon, by the rules which I handed down at length in Book 5 of the *Almagestum Novum*, Chapter 7. The type, therefore, of the preceding eclipse will be as written below.

Diagram. A geometric figure for the lunar eclipse, with cardinal directions marked at the four sides: *Bor.* (north) at top, *Auftr.* (south) at bottom, *Or.* (east) at left, and *O. Occ.* (west) at right. A large outer circle encloses the construction. Within it, a central point **A** marks the center of the Umbra. Several intersecting circles represent the terrestrial shadow disk and the Moon's path; chord and radial lines run between the labeled points. The labels read:

- *Bor.* (top): *Bor.* — North
- *Auftr.* (bottom): *Auftr.* — South
- *Or. P* (left): *Or.* — East, with point **P** at the left margin of the diameter

- O. Occ. (right): *O. Occ.* — West, with point **O** at the right margin of the diameter
- L (upper left): point **L** — region toward which the eclipse's beginning tends
- M (upper right): point **M** — region toward which the eclipse's end tends
- D (upper center): point **D**
- K (left center): point **K**
- C (left of center): point **C**
- A (center): point **A** — center of the Umbra
- E (right of center): point **E**
- H (right center): point **H**
- I (lower left): point **I**
- F (bottom center): point **F**
- G (lower right): point **G**

Let the center of the Umbra be A, its semidiameter AF; the disk of the terrestrial Umbra FCDE; the latitude of the Moon at the middle of the eclipse AF, but at the beginning GH, and at the end IK; the region toward which the beginning of the eclipse tends is L, designated by the line GAL; and the region toward which the end tends is M, designated by the line IAM; the inclination to the beginning is the angle GAO, to the end the angle IAP.

A corollary against Argolus.

[Margin: Argoli's error.]

Argolus [Andrea Argoli], therefore, or his disciples, perpetually mark this lunar eclipse of the year 1661, October 7, that we have described, with a northern latitude, since it is always southern; so that I say nothing of the time of the eclipse anticipated by them by about forty minutes.

Precept 79. To reduce the apparent time of an eclipse to equated time, and vice versa.

The conversion of apparent time into equated, and conversely of equated into apparent, I have already taught at Precept 16; and I have already used this in the example of the eclipsic full moon of Precept 73.

Precept 80. To survey the regions of the orb of the Earth in which the lunar eclipse will be visible, or not.

This is accomplished not without ease and pleasure by the Geographical Cross [Crucem Geographicam], which I once explained at length, and have again inserted in Book 16 of the *Geographia Reformata*. To it, therefore, I refer the reader: for from one instrument it will at once appear, where at any given moment of the eclipse there will be night, and where day; and so where the eclipse, and to what extent, could be seen, or could not — that is, where those phases of the eclipse could be seen, and conversely where in those very places on Earth those phases could not be seen; yet it can also be observed by the benefit of refraction, particularly the beginning, even a little before sunset, and the end a little after sunrise, when the Sun is seen.

But if you are anxious about some particular place of the Earth — for example's sake, about Lima, the city of the kings in Peru — gather from the Catalogue, or Table 14, the difference of time to be added for places more eastern, to be subtracted for more western, with respect to Bologna; and transfer that time to the meridian of the place with respect to Bologna; then from Table 11 excerpt the semidiurnal and seminocturnal time by the mean place of the Sun, namely the hours and scruples written after noon at the beginning, the middle, the end of the eclipse, but do not exceed the aggregate of the semidiurnal and nocturnal time. There will be night in that place, and that phase of the eclipse will be visible there; but otherwise it will be day, and not visible, unless at the boundary of day and night.

[Margin: Pag. 9.]

Example for Lima.

Lima — Difference of Time	H.	6	11'
To be subtracted from the Bologna time			
Southern Altitude of the Pole	Gr.	12	20'
Place of the Sun ☉ ♊	Gr.	15	12'
Semidiurnal time	H.	5	55
Seminocturnal	H.	6	5
Nocturnal	H.	12	10

		H.	'	"
Eclipse — Beginning	Bologna	14	15	58
	Lima	8	4	58
Middle	Bologna	15	32	37
	Lima	9	21	37
End	Bologna	16	49	16
	Lima	10	38	16

Since therefore both from the beginning and at the end the time after noon at Lima exceeds the quantity of the semidiurnal time, and does not exceed the aggregate of the semidiurnal and nocturnal — which is 16h 5' — this lunar eclipse will be visible at Lima for the whole.

Precept 81. To find in whose meridian the Moon will be at the height of the eclipse, and for whom it will be at the vertical.

First, inquire whether the Moon, at the time of the eclipsic full moon, falls in the eastern hemisphere — if indeed it should happen before the middle of the night following — or whether in the western, that is, if the eclipsic full moon should happen after the middle of the night, that is, after the hours 12 counted from noon. Then, if in the eastern, subtract the apparent time of the full moon from the hours 12; but if in the western, subtract the apparent time of the full moon from the hours 12, and convert the remainder into degrees of the Equator; for the quantity of these will show the distance of the meridian in which the Moon is at the height of the eclipse from the meridian of the Tables, toward the East in the first case, or toward the West in the second case. Thirdly, with the true latitude, and the place of the Moon in the ecliptic, inquire by Precept 54 how great the declination of the Moon is; just so great will be the altitude of the pole of that place over which the meridian will be at the vertical, where the Moon is at the height of the eclipse.

Example.

The eclipsic full moon discussed above in the example to Precepts 73 and 74 occurs at 15h 32' 37" after midday at Bologna. With respect to the Bolognese meridian, then, the Moon will be in the western hemisphere; and once 12 hours are subtracted, 3h 32' 37" remain — that is, 53° 9' 15" — which is the amount by which the meridian sought is distant toward the west from the Bolognese meridian.

Moreover, the Moon will then be in Aries $15^{\circ} 12'$, whose northern declination is $6^{\circ} 0' 6''$, and the Moon's southern latitude is $47' 40''$. To these, in Table 34, an equation of $42'$ corresponds, to be subtracted from the northern declination; and so the Moon's declination of $5^{\circ} 18'$ remains. Therefore that place which, on the aforesaid meridian, has the altitude of the northern pole equal to $5^{\circ} 18'$, will have the Moon standing at its vertex at the moment of greatest eclipse. So, having consulted cosmographic charts, you will find that place: its longitude from the island of Palma is $341^{\circ} 20' 45''$, and its northern latitude $5^{\circ} 18'$.

Recapitulation of the entire foregoing calculation of the eclipsic full moon.

In the year 1661, October 7, at the Bologna hour after midday — $15^{\text{h}} 41' 27''$ by equated time, but $15^{\text{h}} 32' 37''$ by apparent time:

	Sig.	Gr.	I	II
True place of the Sun	6	15	12	1 8
Equated anomaly of the Sun	3	6	30	1 6
True place of the Moon in its orbit	0	15	12	1 8
True place of the node Ω	6	6	0	2 9
Argument of latitude	6	9	11	4 8
True place of the Moon $\curvearrowright$ on the ecliptic	0	15	10	8
Southern latitude of the Moon $\curvearrowright$			47	4 0
Apparent semidiameter of the Moon $\curvearrowright$			16	8
Corrected semidiameter of the shadow			47	4 6
Aggregate of the semidiameters			63	5 4
Whole diameter of the Moon $\curvearrowright$			32	1 6
Deficient minutes [scrupula]			16	1

	Sig.	Gr.	I	II
				4
Digits to be eclipsed	D. 6		5	0
Hourly motion of the Moon ☾ from the Sun ☉			33	1
				8
True hourly motion of the Moon ☾			2	2
				9
Minutes [scrupula] of incidence			42	3
				2
Half-duration of the eclipse	H. 1		16	3
				9
Whole duration	H. 2		33	1
				8
Beginning of the eclipse, p.m.	H. 14		15	5
				8
Middle, at Bologna, p.m.	H. 15		32	2
				7
End, after midday	H. 16		49	1
				6
Southern latitude of the Moon ☾ at the beginning			45	4
				3
Southern latitude of the Moon ☾ at the end			51	3
				1
Moment of the sum of the obscuration	H. 15		32	3
				7
But the full moon with respect to the eclipsic place of the Moon ☾	H. 15		35	5
				8
Longitude of the meridian on which, at mid-eclipse, the Moon ☾ [stands]	G. 341	20	45	
Altitude of the pole of the place on which, on the said meridian, the Moon will be vertical, at greatest eclipse	5	18	Bor.	

Precept 82. To know beforehand the order to be observed in the recapitulation of a solar eclipse.

It is certainly desirable to think out in advance by what means one is to come through the labor of so toilsome a calculation, and by what steps one is to mount to the end aimed at. And so I shall list in order the items to be sought, which are:

To be sought	per Precept
The mean new moon	72
The true new moon	73
or by Precepts 55, 61, 66 together	67
The apparent time of the true new moon	16
The true place of the luminaries	55, 61
The equated anomaly of the luminaries	55, 61
The right ascension of the Sun	46
The parts of the equator corresponding to the time	11
The right ascension of mid-heaven, and from this	50
The oblique ascension of the ascending degree, and the ascending ecliptic degree itself	
The nonagesimal ecliptic degree counted from the ascendant	50
The altitude of the nonagesimal	51
The true place of the northern node Ω	62
The altitude of the nonagesimal in the orbit $\oslash$	83
The horizontal parallax of the luminaries in the syzygies [copulis]	58
The parallax of the Moon from the Sun in altitude	84
The parallax of the Sun $\odot$ in longitude	85
The parallax of the Moon in latitude	86
The parallax of the Sun $\odot$ in longitude one or two hours before, or after, the true new moon	87
The apparent motion of the Moon over one or two hours	88
The apparent new moon	89
The parallax of the Sun $\odot$ in longitude at the moment	90

To be sought	per Precept
of the apparent new moon, and at the hours before, or after	
The true and apparent latitude at the time of the apparent new moon	91
The digits of the solar eclipse	92
The beginning, end, and duration of the solar eclipse	93
The true latitude of the Moon ☾ at the beginning, end, and middle of the eclipse	94
The type of the solar eclipse to be delineated	95

Up to here. Astronomy of old proceeded thus; but a new device has brought this inquiry on to the principal phases of a solar eclipse, observable in different regions — yet chiefly in those in which a total, or central, eclipse will be observable: about which below.

Example.

The eclipsic new moon of the year 1659, November 14, at the hour 3h 30' after midday by equated time at Bologna:

	Sig.	Gr.	I	II
True place of the Sun	7	22	11	58
Equated anomaly of the Sun	4	13	32	0
True place of the Moon	7	22	20	40
Equated anomaly of the Moon ☾	4	8	53	0
Hourly motion of the Moon ☾ from the Sun ☉			31	57
Excess of the place [of the Moon] beyond ☉ [conjunction]			8	42
Time agreeing with this			16	10
The truer new moon, therefore, October 14, p.m.	Hor. 3	13	50	

The calculation then being repeated:

	Sig.	Gr.	I	II
True place of the Sun	7	22	11	18
Anomaly of the Sun	4	13	31	20

	Sig.	Gr.	I	II
True place of the Moon	7	22	11	16
Equated anomaly of the Moon ☾	4	8	43	39
Hourly motion of the Moon ☾ from the Sun ☉			31	56
The Moon falls short of the place [of the Sun] ☉ by				2
Time agreeing with this				3
The true new moon, October 14	H. 3	13	53	
The equation of days to be added			12	55
The apparent time of conjunction ☉ ☾	H. 3	26	48	

And so the true and exact new moon at Bologna will be in the year 1659, November 14, at the apparent hour 3h 26' 48" after midday, the luminaries — corrected — standing in Scorpio 22° 11' 18".

Precept 83. To find the altitude of the nonagesimal in the orbit of the Moon, and the nonagesimal itself, by other precepts.

First seek, by Precept 46, the right ascension of the place of the Sun; and by Precept 50, the ascending degree of the ecliptic and the nonagesimal computed from it; and by Precept 51, the altitude of the nonagesimal. Then [seek] the place of the lunar node ♌ by Precept 62, which you should subtract from the nonagesimal, and treating the remainder as if it were the argument of latitude [you proceed as below].

[...the argument] of latitude, seek in Table 44. The latitude is to be added to the altitude of the nonagesimal if the latitude is northern, subtracted if southern; for thus you will obtain the altitude of the nonagesimal in the orbit of the Moon.

Example in the preceding new moon.

	Sig.	Gr.	I	II
True place of the Sun	7	22	11	18
Right ascension of the Sun		229	34	23
Time from the meridian, apparent	H.	3	26	48
Parts of the equator		51	42	0
Right ascension of the culminating point, 90° being added, becomes		281	16	23
Oblique ascension of the ascendant		11	16	23

	Sig.	Gr.	I	II
Altitude of the pole at Bologna		44	30	20
The ascendant	Υ 21	4	0	
Therefore the nonagesimal	♄ 21	4	0	
And the altitude of the nonagesimal		23	50	0
True place of the node Ω	7	12	43	55
Fictitious argument of latitude	2	8	20	5
And northern latitude		4	37	22
Altitude of the nonagesimal in the orbit of the Moon		28	27	22

Precept 84. To find the horizontal parallax of the Moon from the Sun.

With the anomaly of the Sun and of the Moon, both equated, seek in Table 39 the horizontal parallax of each of the luminaries; then, the solar parallax being subtracted from the lunar, the horizontal parallax of the Moon ♃ from the Sun ☉ will remain.

Example in the preceding new moon.

	Sig.	Gr.	I	II
Equated anomaly of the Moon ♃	4	8	43	39
Equated anomaly of the Sun ☉	4	13	31	20
Horizontal parallax of the Moon ♃			57	51½
Horizontal parallax of the Sun ☉				1½
Horizontal parallax of the Moon ♃ from the Sun ☉			57	50⅓

Precept 85. To investigate the parallax of the Moon in longitude.

Consult Table 56, whose title is *Parallax Mesoplastic* [Parallaxis Mecoplatica], and in its head seek the horizontal parallax of the Moon from the Sun, obtained by Precept 84; and in the right-hand side, whose title is *Latitude of Longitude* [Latus Longitudinis], [seek] the altitude of the nonagesimal in the orbit ♃, foreknown by Precept 83. For in the common area you will find the horizontal parallax of the Moon ♃ in longitude — which is to be used if the Moon were at the horizon itself. But when it is above the horizon, seek the distance of the Moon from the nonagesimal by subtracting the lesser from the greater, and with this likewise in the right-hand side of the same Table 56, and in the head with the horizontal

parallax of the Moon ☾ in longitude, you will find in the common area the absolute and exact parallax of the Moon ☾ in longitude.

Example in the preceding new moon.

	Sig.	Gr.	I	II
Altitude of the nonagesimal in the orbit ☾		28	27	22
Horizontal parallax of the Moon ☾ from the Sun ☉			57	50
Horizontal parallax in longitude ☾			27	33
True place of the Moon ☾	7	22	11	18
The nonagesimal	☿ 21	4	0	
Distance of the Moon ☾ from the nonagesimal		58	52	42
Parallax in longitude			23	35

Precept 86. To inquire into the parallax of the Moon in latitude.

In Table 56, *Parallax Mesoplastic*, in the head seek the horizontal parallax of the Moon from the Sun, repeated from Precept 84, and in the left-hand side, whose title is *Latitude of Latitude* [Latus Latitudinis], seek the altitude of the nonagesimal in the orbit of the Moon, found by Precept 83; and the common area, by the aid of the proportional part, will at once furnish the parallax of latitude.

Example, discussed above.

	Gr.	I	II
Altitude of the nonagesimal in the orbit ☾	28	27	22
Parallax of the Moon ☾ from the Sun ☉ Horizontal		57	50
Parallax of latitude		50	28

Precept 87. To investigate the parallax of the Moon in longitude for one or two hours before, or after, the true new moon.

This precept is necessary, in order that we may add the apparent hourly motion of the Moon, and the beginning and end of the solar eclipse. First, then, [seek] in the degrees of oblique ascension of the ascending point at the moment of the true new moon — for the single hours before the true new moon, subtract fifteen degrees; for the hours after, add [fifteen degrees]; for the ascending ecliptic point will come out, for that time before or after the new moon being assumed. By Precept 83 seek again the ascendant and the nonagesimal, and the altitude of the nonagesimal in the orbit of the Moon.

Second, the horizontal parallax of the Sun found above being retained (since this does not vary sensibly within a few hours), with the anomaly of the Moon equated to the assumed time, or after conjunction ☉ ♌, seek the horizontal parallax of the Moon ♌ from the Sun, by Precept 84 and Precept 85 — the parallax in longitude, but the horizontal only.

Third, in place of the Moon — which it held at the moment of the true new moon — for the single hours before the true new moon, subtract the hourly motion of the Moon from the Sun as many times [as there are hours assumed]; but for the hours after, add [it]; and the true place of the Moon will emerge before, or after, the new moon.

Fourth, with the true distance of this place of the Moon from the nonagesimal, and with the absolute horizontal parallax of longitude, by Precept 85 seek the parallax of the Moon in longitude for the hour before, or after, the true new moon chosen. For the most part, however, only a single hour is usually assumed, before or after; before indeed if the Moon is in the eastern ecliptic quadrant; after, if in the western. For in the preceding new moon the Moon is in the western [quadrant]; we shall therefore inquire about the hour after the new moon. [Such is] the parallax of the Moon in longitude.

Example, one hour after the true new moon, discussed above.

It was above [as follows]	Sig.	Gr.	I	II
Oblique ascension of the ascendant	0	11	16	23
Added	0	15	0	0
Becomes the oblique ascension of the ascendant		26	16	23
And the other ascendant	♄ 15	48	0	
Therefore the nonagesimal	♊ 15	48	0	
And the altitude of the nonagesimal	0	26	50	0
Place of the node ♋ as above	7	12	48	55
Argument of latitude	2	2	54	5
Northern latitude		4	25	34
Altitude of the nonagesimal in the orbit ♌		31	15	34
Parallax horizontal ♌ from the Sun ☉, as above			57	50
Parallax of longitude, horizontal			30	0
True place of the Moon in the true new moon	7	22	11	18

	Sig.	Gr.	I	II
Hourly motion of the Moon to be added			31	56
Place of the Moon one hour after the new moon	7	22	43	14
Distance of this place from the nonagesimal		83	4	46
Therefore the parallax of longitude			29	49
[for] the hour before the true new moon				

Precept 88. To determine the apparent motion of the Moon over one or two hours.

First, with the parallax of the Moon's longitude found for the beginning, and for the end of the hour assumed by Precept 87, subtract the lesser parallax from the greater, and preserve the difference of the parallaxes. You should also have the true hourly motion at the time of the new moon.

Second, if over the whole time of the hour assumed the Moon remained in the eastern quadrant of the zodiac, and at the beginning of the hour assumed the parallax was greater than at the end — then subtract the difference of the parallaxes from the hourly motion of the Moon, and you will have the apparent motion for that hour. But if the Moon over that whole time remained in the western quadrant, and the parallax was greater at the beginning of the hour than at the end, add the parallax [to the motion]; if smaller, subtract; and the apparent motion of the Moon will come out [agreeing with the hour].

But if within that hour the Moon is partly in the eastern, partly in the western [quadrant], take both parallaxes — that is, the aggregate of the parallaxes found at the beginning and at the end — and subtract it from the true hourly motion of the Moon, and you will have the apparent motion for that hour. For this is what must be done, against Reinhold [Reinholdum], Magini [Maginum], and Lansbergen [Lansbergium], by reason and by example, as the Reverend D. Vincenzo Renieri [Vincentius Reinerus] has demonstrated in his recently published *Tabulae Medicaeae*, p. 289.

Example.

In the preceding new moon the Moon remained in the eastern quadrant, both at the moment of the new moon and at the beginning of the one hour before the new moon: so we shall proceed in the calculation thus:

	I	II
Parallax of longitude in the new moon	23	35
Parallax of longitude one hour after	29	49
Difference of the parallaxes	6	14
True hourly motion of the Moon 》	31	56
Therefore the apparent motion 》 in that hour	25	42

Precept 89. To determine the moment of the apparent new moon.

First, if the Moon is in the eastern quadrant, seek its apparent motion for one hour before the true new moon, owed by Precept 88; and if the minutes [scrupula] of the parallax of longitude at the time of the true syzygy were greater, divide the minutes of parallax by them; for the quotient will give the minutes of time to be subtracted from the apparent time of the true new moon, so that the apparent — or visible — time of the new moon, or of the visible syzygy, may emerge.

Second, if the Moon were in the western quadrant, seek by Precept 88 its apparent motion owed for one hour after the true new moon; and if the minutes of the parallax of the longitude of the true new moon were greater, divide [them] by that; the quotient gives that time to be added to the apparent time of the true syzygy, so that the moment of the visible syzygy may be made.

Third, if the apparent hourly motion were less than the parallax of longitude found at the moment of the true new moon, subtract the apparent hourly motion from the parallax, and reserve the residue of parallax. Then by Precept 88 seek further the owed apparent motion of the Moon for the other hour — before the true new moon if [the Moon was] in the eastern quadrant, after if in the western — and by this apparent motion divide the residue of parallax; for, one hour having been added to it, it will give the time to be subtracted from the apparent time of the true syzygy if the Moon is in the eastern quadrant, to be added if in the western, so that finally the moment of the visible syzygy may be had.

Finally, if the Moon should be at the nonagesimal itself, the true and the visible syzygy coincide.

Example.

In the preceding new moon, because the Moon is in the western quadrant, and the apparent hourly motion 》 was found to be 1 hour after the true new moon at 25' 42" — but the parallax of longitude at the moment of the true new moon was

found to be 23' 35" — therefore the apparent hourly motion is greater than this parallax. So say: if 25' 42" require one hour, that is 60', how many minutes will 23' 35" require? And the second requires 23' 35". Therefore, resolving these three numbers in the series of the Golden Rule, in the second [scrupula] the first comes out as 1542; the second, 3600; the third, 1415. So the second being multiplied by the third, and the sum divided by the first, the fourth proportional number comes out as 2304 — that is, 55' 4". This being added to the apparent time of the true new moon — namely, as stated above at the end of Precept 82, 3h 26' 48" — yields the time of the visible syzygy on November 14, at hour 4h 21' 52".

Precept 90. To investigate the parallaxes of the Moon in longitude both for the moment of the visible syzygy, with the parallax of longitude, and for the hours before, or after.

So that the apparent hourly motion, for the hour before and after the visible syzygy, may be had, the parallax of longitude is needed, for the hour before and after. First, then, convert the difference of time between the true and the visible syzygy into parts of the equator, and subtract these from the oblique ascension of the ascending degree at the time of the true new moon if the Moon is in the eastern quadrant; add [them] if in the western; so that the oblique ascension of the ascending point at the time of the visible syzygy may emerge. Then by Precept 87 seek the parallaxes of longitude, at the time of the visible syzygy, both for one hour before and for one hour after the visible syzygy.

Moreover, so that you may have the place of the Moon at the time of the apparent new moon, and from this the distance of the Moon from the nonagesimal, for the inquiry into the parallaxes — lead the interval of time between the true and the visible syzygy through the true hourly motion of the Moon from the Sun, and divide the product by 60, and subtract the quotient from the true place of the Moon at the time of the true syzygy if the Moon is in the eastern quadrant, add if in the western. But if the Moon, one hour before, or after, the visible syzygy, were distant from the nonagesimal by more than 90°, it will be below the horizon, and then the parallax is sought in vain.

Example.

In the preceding new moon, by Precept 89, the interval between the true and the visible syzygy was 45' 45", with which you will operate thus:

	Sig.	Gr.	I	II
Interval between true ☉ ☽ and visible			55	4

	Sig.	Gr.	I	II
Whose parts of the equator		13	46	0
Oblique ascension of the ascendant at true ☉ ☽		11	16	23
Oblique ascension of the ascendant at visible [☉ ☽]		25	2	23
Ascending ecliptic point	☿ 13	57	0	
Nonagesimal from it	♊ 13	57	0	
Altitude of the nonagesimal		25	52	0
Place of the node ♌ as above	7	12	43	55
Argument of latitude	3	1	13	5
Northern latitude, to be added		4	58	24
Altitude of the nonagesimal in the orbit ☽		30	50	24
Parallax of the Moon ☽ from the Sun ☉ in another horizon			57	50
Parallax of longitude, horizontal			29	40
Apparent hourly motion owed for the interval			20	42
True place of the Moon ☽ in the visible syzygy	7	22	41	30
Distance of the Moon ☽ from the nonagesimal		81	15	30
Parallax of longitude			29	22
And the parallax of latitude			49	29

For one hour before the observed conjunction, subtract 15° from the oblique ascension of the ascending point at the time of the observed conjunction, which was 25° 2' 23". There remains 10° 2' 23" for the oblique ascension of the ascending point one hour before the observed conjunction. From this the rest of the calculation follows.

	Sig.	Gr.	'	"
Oblique ascension of the ascending point	0	10	2	23
Eclipt. point ascending	♈	18	49	0
Nonagesimal from it	♊	18	49	0
Altitude of the nonagesimal		22	38	0
Place of the node, as above	7	12	43	55
Argument of latitude	2	6	5	5

	Sig.	Gr.	'	"
Northern latitude, to be added		4	32	48
Altitude of nonagesimal in Moon's orbit		27	10	48
Parallax of Moon from Sun, horizontal			57	50
Parallax of longitude, horizontal			26	26
True hourly [parallax], to be subtracted			31	56
True place of Moon, 1 hour before the observed conjunction	7	22	9	34
Distance from nonagesimal		56	39	26
Parallax of longitude			22	5

But for one hour after the observed conjunction, add 15° to the oblique ascension of the ascending point at the moment of the observed conjunction; this makes it one hour after the oblique ascension of the ascending point, and the rest as below.

	Sig.	Gr.	'	"
Oblique ascension of the ascending point	0	40	2	23
Eclipt. point ascending	II	4	19	0
Nonagesimal from it	✕	4	19	0
Altitude of the nonagesimal		30	27	0
Place of the node, as above	7	12	43	55
Argument of latitude	3	21	35	5
Northern latitude		4	37	31
Nonagesimal altitude in Moon's orbit		35	14	31
Parallax of Moon from Sun upward, as above			57	50
Parallax of longitude, horizontal			33	12
True hourly [parallax], to be added			31	56
True place of Moon, 1 hour after the observed conjunction	7	23	13	26
Distance from nonagesimal	3	11	5	34
Parallax of longitude sought in vain, for the Moon is now below the horizon, yet is greater than			57	50

Precept 91. To find the true and apparent latitude of the Moon at the time of the observed new moon.

First, by Precept 63, find the true argument of latitude at the moment of the true new moon, and subtract from it the parallax of longitude at the moment of the observed new moon found by Precept 90, if the Moon lies in the eastern quadrant; add it if in the western. The result is the true argument of latitude at the time of the observed conjunction, with which by the same Precept 63 you find the true latitude.

Second, by Precept 90 find the parallax of latitude at the moment of the observed conjunction, and compare it with the true latitude. If the true latitude is southerly with respect to our northern regions, add to it the parallax of latitude, and the sum will be the apparent southern latitude. But if the true latitude is northerly with respect to our northern regions, and the parallax of latitude is greater, subtract the latter from it, and what remains is the still-northerly apparent latitude. But if the parallax of latitude is greater than the true northern latitude, subtract this northern latitude from the parallax of latitude, and there will remain an apparent southern latitude.

From this learn what is to be done in southern regions: there, when the latitude is northern, the parallax being added, the result will be the apparent northern latitude; but when the latitude is southern and smaller, the subtracted parallax being greater leaves an apparent northern latitude; while if the parallax is smaller, being subtracted from the southern latitude it leaves the apparent latitude still southern.

Precept 92. To determine the digits, or the magnitude, of a solar eclipse.

Look up in Table 39 the apparent semidiameters of the Sun with the anomaly of the Sun, and of the Moon with the anomaly of the Moon, [Margin: Pag. 47.] and add them together; and from the sum of the semidiameters subtract the apparent latitude of the Moon found by the preceding precept — for there will remain the scruples of deficiency, with which, in the left margin of Table 57, [Margin: Pag. 66.] together with the whole diameter of the Sun appearing at the head of the same table, you will find, at the common intersection, the digits of the solar disk to be obscured by the Moon.

Example in the preceding new moon.

	'	"
Apparent semidiameter »	15	55

	'	"
Apparent semidiameter ☉	15	49
Sum of the semidiameters	31	44
Apparent latitude ☾	1	41
Scruples of deficiency	30	3
Apparent diameter ☉	31	50
Digits obscured	11 [']	1 ["] 8 [recte: digits $\approx$ 11; the value 11° 1' 8" as printed appears to be 11 digits and a fraction]

Precept 93. To determine the motion of the Moon as seen at one hour before and after the observed conjunction, and from this to fix the beginning, end, and duration of the solar eclipse.

First, find the differences of the parallaxes of longitude in the observed conjunction which you found by Precept 90 at one hour before and after the observed conjunction, and by Precept 88 find the motion of the Moon as seen, agreeing with each hour.

Second, consult Table 58, [Margin: Pag. 67.] and at its head find the sum of the apparent semidiameters of the Sun and Moon; and in the left margin the apparent latitude of the Moon at the middle of the observed conjunction; for their intersection will give the scruples of incidence.

Third, double the scruples of incidence per hour, [Margin: Pag. 60.] and divide the product by the motion of the Moon as seen one hour before the observed conjunction found previously; likewise, divide the product again by the motion of the Moon as seen one hour after that found previously. The first quotient, subtracted from the time of the apparent observed conjunction, leaves the beginning of the eclipse; the second, added to the time of the apparent observed conjunction, will establish the end; and the two together will give the duration of the eclipse.

Example in the preceding new moon.

	'	"
True hourly [motion] ☉	31	56
Parallax of longitude in observed conjunction	29	22
Parallax of longitude, hour 1 before	22	5

	'	"
Motion as seen of this hour	24	40
Parallax of longitude, hour 1 after	58	nearly
Motion as seen of this hour	29	0
Sum of the semidiameters	31	44
Apparent latitude ☽	1	41
Scruple of incidence	31	42

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	H.	'	"
Time of incidence	1	17	0
Apparent time of the observed conjunction	4	21	52
Beginning of the eclipse	3	4	52
Time of repletion	1	5	0
End of the eclipse	5	26	52
And the whole duration, hours	2	22	0
 Semidiurnal time	 4	 45	 0
Beginning in Italian [hours] ☉	22	20	0
Civil clock	21	50	0

Precept 94. To define the apparent latitude of the Moon at the beginning, end, and middle of the eclipse.

Enter Table 44, [Margin: Pag. 51.] and in its cells find the apparent latitude of the Moon at the middle of the eclipse, found above by Precept 91, observing where it is found in the column of greatest latitude: the sign at the head, and the degree in the left margin, if the latitude is northern and the Moon is near the northern node; but if the apparent latitude is southern, observe the sign at the foot and the degree in the right margin. But if the eclipse is near the southern node and the latitude is northern, look for the signs at the foot and the degree in the right margin; if southern, the signs at the head and the degree in the left margin — these corresponding to the apparent latitude. In this way you will have the true argument at the time of the observed conjunction, from which subtract the scruples of incidence found above by Precept 93, and there will remain the true argument of the apparent latitude at the beginning of the eclipse; conversely, add

to the true argument of the observed conjunction the scruples of incidence, and you will form the true argument of the apparent latitude at the end of the eclipse. With this argument, in the same Table 44, you will have the apparent latitude at the beginning and end of the eclipse.

Example in the new moon near the ascending node Ω .

	Sig.	Gr.	'	"
Apparent latitude $\nearrow$ at mid-eclipse	B.	0	1	41
Argument answering to this	0	0	19	19
Scruples of incidence	0	0	31	42
Argument of apparent latitude at beginning	11	29	47	37
Argument of apparent latitude at end	0	0	33	23
Apparent latitude at beginning, A.	0	0	1	3
Apparent latitude at end, B.	0	0	2	52

Precept 95. To delineate the figure of a solar eclipse.

The apparent latitude of the Moon at the middle of the eclipse having been found again by Precept 91, and at the beginning and end by Precept 94, it is easy from what was said in Precept 78 on the figure of a lunar eclipse to delineate also the solar.

Recapitulation of the foregoing calculation, from Precept 82 to 94.

In the year 1659, November 14, at 3 h. 30' after midday at Bologna.

	Sig.	Gr.	'	"
True place of the Sun	7	22	11	58
Equated anomaly of the Sun	4	13	32	0
True place of the Moon	7	22	20	4
Equated anomaly of the Moon	4	8	53	0
Hourly motion of the Moon from the Sun			31	57
Excess of the Sun's place beyond the Moon's			8	42
Time congruent with the excess			16	10
Therefore the new moon nearer	H. 3	13	50	

Calculation now renewed	Sig.	Gr.	'	"
True place of the Sun	7	22	11	18
	Sig.	Gr.	'	"
Anomaly of the Sun	4	13	31	20
True place of the Moon	7	22	11	16
Equated anomaly of the Moon	4	8	43	39
Hourly motion of the Moon from the Sun			31	56
The Sun falls short of [the Moon] by				2
Time agreeing with the deficiency				3
Therefore the true new moon	H. 3	13	53	
Equation of the natural days, to be added			12	55
Apparent time of the true conjunction	H. 3	26	48	
The luminaries conjoined in [M.]	22	11	18	
Right ascension of the place of the Sun	229	34	23	
Parts of the equator of time from the meridian	51	42	0	
Right ascension of the culminating point	281	16	23	
Oblique ascension of the ascending [point]	11	16	23	
Altitude of the pole at Bologna	44	30	20	
Ecliptic point ascending	Υ	21	4	0
Altitude of the nonagesimal	0	23	50	0
Nonagesimal of the ecliptic	♄	21	4	0
Place of the northern node Ω, true	7	12	43	55
Argument of latitude from here, or distance of Ω from the nonagesimal	2	8	20	5
Northern latitude, to be added	0	4	37	22
Altitude of nonagesimal in Moon's orbit	0	28	27	22
Horizontal parallax ☉	0	0	0	1
Horizontal parallax ☾	0	0	57	51
Horizontal parallax of Moon from Sun ☾ à ☉	0	0	57	50
Parallax of Moon, horizontal, in longitude	0	0	27	23

	Sig.	Gr.	'	"
Distance from the nonagesimal	0	58	52	42
Parallax of longitude	0	0	23	35
Parallax of latitude	0	0	50	28
True so far in the moment $\oslash$ [conjunction]				
Oblique ascension of the ascending [point] was	0	11	16	23
For 1 hour after the true [conjunction] add		15	0	0
The oblique ascension of the ascending [point] becomes	0	26	16	23
And the ascending point, 1 hour after	$\oslash$	15	48	0
Nonagesimal from it	$\approx$	15	48	0
Altitude of the nonagesimal	0	26	50	0
Place of the node Ω , as above	7	12	43	55
Argument of latitude from here	2	2	54	5
And northern latitude, to be added	0	4	25	34
Altitude of nonagesimal in Moon's orbit	0	31	15	34
Horizontal parallax $\oslash$ à $\odot$, as above	0	0	57	50
Parallax of longitude, horizontal	0	0	30	0
Place of the Moon in the true [conjunction]	7	22	11	18
Hourly motion of the Moon, to be added	0	0	31	56
Place of the Moon, hour 1 after	7	22	43	14
The Moon's distance now from the nonagesimal	0	83	44	46
Parallax of longitude, hour 1 after $\oslash$	0	0	29	49
Parallax of longitude in itself $\oslash$	0	0	23	35
Difference of the parallaxes of longitude	0	0	6	14
Hourly [motion] of Moon from Sun $\oslash$ à $\odot$, true	0	0	31	56
Motion as seen for hour 1 before $\oslash$	0	0	25	42
Time from this motion as seen, by parallax	0	0	23	35
Proportionally answering, it is	0	0	55	4
But the new moon was, true	H. 3	26	48	
Therefore the new moon as seen	H. 4	21	52	

	Sig.	Gr.	'	"
And then				
Interval between true and apparent [conjunction]	0	0	55	4
The parts of the equator answering to this	0	13	46	0
The oblique ascension of the ascending [point] in the true was	0	11	16	23
Therefore the oblique ascension of the ascending [point] in the apparent	0	25	2	23
And the point then ascending	♄	13	57	0
Nonagesimal from this	♊	13	57	0
Altitude of this nonagesimal	0	25	52	0
Place of the node ♌, as above	7	12	43	55
Argument of latitude from here	3	1	13	5
Northern latitude, to be added	0	4	58	24
Altitude of nonagesimal in Moon's orbit	0	30	50	24
Parallax ♄ à ☉ as above, horizontal	0	0	57	50
Parallax ♄, horizontal, in longitude	0	0	29	40
Hourly of the interval ♂ between apparent and true	0	0	29	42
Therefore the place of the Moon in the apparent ♄	7	22	41	30
Distance of the Moon from the nonagesimal	0	81	15	30
[p. 25]				

	Sig.	Gr.	'	"
Parallax of longitude in the apparent ♄	0	0	29	22
And parallax of latitude	0	0	49	49

Then for the hour 1 before the observed conjunction

Oblique ascension of the ascending [point] in the apparent ♄, 15° subtracted	0	25	2	23
	0	15	0	0

	Sig.	Gr.	'	"
There remains, oblique ascension of the ascending [point]	0	10	2	23
Ecliptic point ascending	Υ	18	49	0
Nonagesimal number from it	♄	18	49	0
Nonagesimal altitude	0	22	38	0
Place of the node Ω, as above	7	12	43	55
Argument of latitude from here	2	6	5	5
Northern latitude, to be added	0	4	32	48
Altitude of nonagesimal in Moon's orbit	0	27	10	48
Parallax horizontal ♃ à ☉, as above	0	0	57	50
Parallax horizontal, in longitude	0	0	26	26
True hourly, to be subtracted	0	0	31	56
Place ♃ hour 1 before the observed conjunction	7	22	9	34
Distance from the nonagesimal	0	56	39	26
Therefore parallax of longitude	0	0	22	5

But conversely for the hour 1 after the observed conjunction

Oblique ascension of the ascending [point] in the apparent ♃, 15° added	0	25	2	23
	0	15	0	0
The oblique ascension of the ascending [point] becomes	0	40	2	23
Ecliptic point ascending	Π	4	19	0
Nonagesimal number from it	♄	4	19	0
Altitude of this nonagesimal	0	30	27	0
Place of the node Ω, as above	7	12	43	55
From here the argument of latitude	3	21	35	5
Northern latitude, to be added	0	4	37	31
Altitude of nonagesimal in Moon's orbit	0	35	14	31
Parallax horizontal ♃ à ☉, as above	0	0	57	50
Parallax of longitude, horizontal	0	0	33	12

	Sig.	Gr.	'	"
True hourly, to be added to the place	0	0	31	56
Place 》 hour 1 after the observed conjunction	7	23	13	26
Distance from the nonagesimal	3	11	5	34
Parallax of longitude, approximately for the Moon is now below the horizon.	0	0	58	0

Remainder of the calculation	Sig.	Gr.	'	"
Argument of true latitude in the true 》	0	9	27	23
Parallax of longitude in the apparent 》	0	0	29	22
Argument of latitude in the apparent 》	0	9	56	45
And then true latitude ⊙ Northern	0	0	51	30
Parallax of latitude in the apparent 》	0	0	49	49
Therefore apparent latitude 》 Northern, in itself	0	0	1	41
Apparent semidiameter of the Sun	0	0	15	55
Apparent semidiameter of the Moon	0	0	15	49
Sum of the semidiameters	0	0	31	44
Apparent diameter of the Sun	0	0	31	50
Apparent latitude of the Moon	0	0	1	41
Digits obscured		11	1	8
True hourly 》 à ⊙	0	0	31	56
Parallax of longitude in the apparent 》	0	0	29	22
Parallax of longitude, hour 1 before	0	0	22	5
Motion as seen of this hour	0	0	24	40
Parallax of longitude, hour 1 after			58	[nearly]
Motion as seen of this hour	0	0	29	0
Scruple of incidence	0	0	31	42
Time of these	H. 1	17	0	
The apparent time 》 was ♂	H. 4	21	52	
Therefore the beginning of the eclipse	H. 3	4	52	
And the end of the eclipse	H. 5	26	52	

Remainder of the calculation	Sig.	Gr.	'	"
And the whole duration	H. 2	22	0	
Semidiurnal time, Bologna	H. 4	45	0	
Beginning of eclipse, Italian hour ☉	H. 22	19	52	
Middle of eclipse, Italian hour ☉	H. 23	36	52	
End, Italian hour ☉	H. 0	41	0	
Apparent latitude ☾ at beginning, southern	0	1	3	
Apparent latitude ☾ at middle, northern		1	41	
Apparent latitude ☾ at end, northern		2	52	

It was nevertheless observed somewhat through clouds; the beginning of this eclipse at Bologna [was] somewhat earlier, whether for physical causes, or because of the still-hidden motion of the Moon by which the eclipse is hastened, or because of the parallax of longitude continually and irregularly variable in eclipses.

Thus far the calculation in the old astronomy, though formerly I was not accustomed to complete it so accurately. The rest we pursue from the recent astronomy, and first

On Horizontal Eclipses.

Precept 96. To discern the moment of time at which the Sun rises or sets.

First, from Table 11, [Margin: Pag. 5.] extract, under the given altitude of the pole and with the place of the Sun, the semidiurnal time — for this will be the time from the meridian to the point at which the Sun sets; or, more reliably, on account of refraction, about 4 minutes after this time. But if you wish to have the semidiurnal time, subtract from 24 hours: there will remain the hours after midday of the preceding meridian, at which the Sun has risen — or about 4 minutes earlier, on account of refraction.

Precept 97. To inquire the true places of the luminaries at the moment of rising or setting.

In the preceding precept we supposed the Sun to be on the horizon at its very rising or setting. But when a solar eclipse is to be seen, a new moon either somewhat precedes or somewhat follows that rising or setting; and so, when the

Sun is about to attain rising, the place of the new moon precedes it; when the Sun is about to attain setting, it follows.

First, then, inquire the difference of time between the rising of the Sun and the new moon, or between the new moon and the setting, and the mean motion of the Sun congruent with such difference, and add it — in a morning eclipse, subtract it — from the place which the new moon held; in an evening eclipse, add it; and you will have the place of the Sun at the moment of rising or setting.

Second, with the equated anomaly of the Moon find the hourly motion of the Moon from the Sun, and by it multiply the aforesaid difference of time; whatever arises from this, subtract from the place of the Moon in a morning new moon, or add in an evening one, and it will give the place of the Moon as seen at the moment of the Sun's rising or setting.

Precept 98. To inquire the parallax of the Moon in longitude and in latitude at the moment of rising or setting.

First, [find] the motion of the Moon in the due interval of time between the new moon and the rising, or between the setting and the new moon, and add or subtract the equated anomaly of the Moon, at the time of the true new moon, just as in the preceding precept you subtracted or added the same scruples; thus you will obtain the equated anomaly of the Moon from the same place. So with the anomaly of the Moon equated to the moment of that same rising or setting, and with the anomaly of the Moon thus equated, find the horizontal parallax of the Moon from the Sun by Precept 58.

Second, consult Table 33, the altitude of the nonagesimal, [Margin: Pag. 38.] and in its margin, with the place of the Moon at the time of rising in a morning eclipse, or at the time of setting in an evening one, and under the given altitude of the pole, find the altitude of the nonagesimal. Having subtracted [for] the place of the node Ω from the nonagesimal, [use it] as the argument of latitude, [and] look up in Table 44 the northern latitude to be added, or the southern to be subtracted, from the altitude of the nonagesimal, [Margin: Pag. 51.] so that you may have the altitude of the nonagesimal in the Moon's orbit.

Third, finally, in Table 56, the parallactic [table], [Margin: Pag. 61.] [find] at the head the horizontal parallax of the Moon from the Sun, and in the right margin the altitude of the nonagesimal in the Moon's orbit: for the area will give the parallax of the Moon in longitude. But under the same horizontal parallax at the head, and with the altitude of the nonagesimal in the Moon's orbit, in the left margin you will obtain the desired parallax of latitude.

Precept 99. To find the distance between the centers of the Sun and the apparent Moon at the hour of sunrise or sunset on that same day.

First, take the true place of the Moon at the time of sunrise, and add to it the equation of its parallax in longitude if the eclipse is in the morning; but subtract it from the Moon's place if it is in the evening. Then take the Moon's motion for the interval between the new moon and sunrise — or sunset, by Precept 97 — and likewise take the true argument of the Moon's latitude at the time of the true conjunction. If the eclipse is in the morning, add this; if in the evening, subtract it — for in that case you have the argument of latitude at the given moment of sunrise or sunset.

Second, by the argument just found compute the true and apparent latitude as in Precept 91 at the moment of sunrise or sunset.

[Margin: Pag. 71.] Third, gather the difference of the Moon's apparent place, whether it is rising or setting; and with it enter Table 60 at the left side, where you will find the foregoing minutes (these I call the *prior* minutes, for the sake of distinguishing them). Then again, with the visible latitude in the left side of the same Table, and with the seconds in the head, you will find the *posterior* minutes. The common cell will give the *prior* minutes — for from the same region, the latitude being in the left side of that same Table and the seconds in the head, what minutes the Table shows in the left side and what seconds in the head will correspond.

Fourth, the aggregate of the *prior* and *posterior* minutes — what lies in that cell of Table 60 — the left side will indicate the minutes; the head will show the seconds: by these the distance between the luminaries' centers will be seen.

Precept 100. To investigate the digits of the ecliptic at the moment of sunrise or sunset of the luminaries.

[Margin: Pag. 47.] With the anomaly of the luminaries, gather from Table 39 their apparent semidiameters. From the sum of these subtract the distance between the apparent centers found by Precept 99; and with the remainder, together with the diameter of the Sun, enter Table 57 [Margin: Pag. 66.] and seek the digits to be obscured — that is, treating that remainder as if it were the deficient minutes.

On Solar Eclipses celebrated in the Subterranean Hemisphere.

Precept 101. To find the semidiameter of the Earth's disk as seen from the Moon.

[Margin: Pag. 47.] At the moment of true new moon, with the equated anomaly, seek in Table 39 the Moon's horizontal parallax: for as great as this is, so great will be the semidiameter of the Earth's disk as seen from the Moon.

Example.

In the year 1657, on the day [?] of June, there was an ecliptic syndoy at the apparent hour 11 after midday at Bologna, 11 hours and 11 minutes; the Moons coming together to the moment [?] of the Moon's equated anomaly being $74^{\circ}.57'.22''$; and therefore for us the horizontal parallax and the semidiameter of the terrestrial disk appearing $55'.35''$.

Precept 102. To find the altitude of the nonagesimal in that region for which the new moon, with the Sun unseen, was conjoined, so that the solar eclipse may be central or partial.

[Margin: Pag. 61.] Gather the true latitude of the new moon at the given time, and seek it as observed in the cells of the parallactic Table 56, under the semidiameter of the Earth's disk, that is the horizontal parallax, found by the preceding precept. For from the region of latitude in the left side you will have the altitude of the nonagesimal in that region for which the true and visible conjunction occurred at the same moment; and the nonagesimal will incline toward the south if the latitude was northern, but toward the north if southern.

Example.

In the latitude of the preceding Example, the Moon's true latitude was $43'.43''$, and the horizontal parallax $55'.35''$; under which, in the parallactic Table 56, opposite the said latitude, the altitude of the nonagesimal is found to be $37^{\circ}.25'$, inclining toward the south.

Precept 103. To inquire the altitude of the pole of the aforesaid region.

Take the place of the ecliptic in which the true new moon is celebrated, and add three signs, or 90 degrees; and you will have the ecliptic point ascending for the said region; and with this, in Table 33, seek at the sides, and with the altitude of the nonagesimal found by the preceding precept and observed in that area, in the region opposite the ascendant, seek again in the head of the Table the altitude of the pole.

But if in Table 33 you do not find the said altitude of the nonagesimal — the eclipse being not destined to be central in the Torrid Zone, in temperate regions, in cold ones; but in the temperate, or the Torrid, the eclipse will be partial and very small. Then add the region in which the eclipse will be very small, and the Moon will graze the margin of the Sun, where the highest semidiameters of the Sun and Moon coincide with the Moon's true latitude — which always, in these cases, are with the residue; and in the parallactic Table 56, in that area, under the horizontal parallax of the foregoing problem, you will have in the left side the altitude of the nonagesimal in that region of yours; with which, and with the degree of the ecliptic ascending, beside the foregoing precept, you find the altitude of the pole of the region desired.

Example.

In the aforesaid eclipse, the true place of the synod was Π $21^{\circ}.12'$; adding three signs there results the ascendant $\mathbb{M}$ $21^{\circ}.12'$; of which region, in no area is the altitude of the nonagesimal found to be $37^{\circ}.25'$. Therefore the eclipse is not central within the Torrid Zone, nor temperate.

Therefore, as a mark and note of the altitude of the pole of that region, where the margin of the Moon grazes the margin of the Sun by only so much, let us proceed in the calculation.

The following worked computation accompanies Precept 103.

	Sig.	Gr.	'	"
Anomalia Solis [Anomaly of the Sun]	11	12	34	0
Anomalia $\odot$ aequata [Equated anomaly of the Sun]	2	14	57	22
Semidiameter appar. $\odot$ [Apparent semidiameter of the Sun]			15	32

	Sig.	Gr.	'	"
Semidiameter appar. ☽ [Apparent semidiameter of the Moon]			15	17
Summa semidiametrorum [Sum of the semidiameters]			30	49
Latitudo Lunae vera Bor. [Moon's true latitude, North]			43	43
Residuum summa [Remainder of the sum]			12	54
Erat Parallax. Horizontalis [The horizontal parallax was]			55	35
Altitudo Nonagesimi [Altitude of the nonagesimal]		76	25	0
Erat punctum Ascendens [The ascending point was]	♊	21	12	0
Poli Altitudo [Altitude of the pole]		36	35	0

Therefore for the region whose north pole is elevated 36°.35', the eclipse was least, and the margin of the Moon grazed the margin of the Sun by only so much; in the remaining altitudes of the pole, therefore, greater, the eclipse was somewhat partial.

Precept 104. To compute the eclipses to be celebrated in the Southern region.

When the Moon's latitude is southern, and the parallax of latitude is joined to it, in whatever northern region it will make the sum greater than the aggregate of the luminaries' semidiameters, the eclipse will not happen except in southern regions. Then all the things which have been carried out up to here by Precept 101 — for finding the place of the true central new moon and as seen — must be carried out again, but with the degree of the ecliptic opposite to the degree in which the new moon is celebrated.

Precept 105. To determine the digits of the central solar eclipse.

In central eclipses, consult Table 57 [Margin: Pag. 66.] and in its head seek the apparent diameter of the Sun, and in the left side the minutes of deficiency, and seek the apparent diameter of the Moon; for the common area will give the digits. If these are exactly 12, the solar eclipse will be total and without duration [delay];

if more than 12, it will be total, and there will be a tarrying in darkness; if fewer, there will remain around the Moon a margin of the Sun in the form of a luminous ring.

Example.

In the preceding Eclipse	'	"
Semidiameter ☉ fuit [Semidiameter of the Sun was]	15	32
Diameter tota ☉ [Total diameter of the Sun]	31	4
Semidiameter ☾ [Semidiameter of the Moon]	15	17
Diameter tota ☾ [Total diameter of the Moon]	30	34
Ergo Digi Ecliptici [Therefore the ecliptic digits]	11	48 0

Therefore, in some region of the Arctic, where (as we indicated above) the eclipse was central, there appeared around the Moon a luminous ring.

On the Chief Phases of the Solar Eclipse.

Precept 106. To find the time which the Moon consumes from the point where the lunar shadow first strikes the Earth, up to the moment at which the said shadow leaves the Earth, and at which the said phases come about.

[Margin: Pag. 70.] Gather into one sum the apparent semidiameters of the luminaries, and the horizontal parallax of the Moon, in Table 60 at the left side; seek the foregoing greatest minutes, but in the head the seconds; for the common area will give the degrees and minutes which are called *Prior*. Again, in the left side of the same Table seek the minutes of the Moon's true latitude, and in the head the seconds; the area will give the degrees and minutes which are called *Posterior*; and subtract these *Posterior* from the *Prior*, and with the residue in the area of that same observed Table, see what minutes are in the left side, and what seconds in the head correspond there. For if these minutes and seconds are divided by the Moon's true hourly motion from the Sun, they will give in the quotient the hours which the Moon consumes from the moment when its shadow strikes the Earth, and the margin of the Sun at the limb of the Moon begins to be grazed, up to the moment of the true and visible synod; and consequently the time which the Moon consumes from the moment of the true and visible synod, up to the moment at which the lunar shadow leaves the Earth, and at which, with

the Sun setting at the end of the day, the eclipse for some place is also ended, the Moon entirely going out from the Sun's disk.

Example.

In the year 1654, on the day 11 of August, at the apparent hour at Uraniborg $22^{\text{h}}.58'.28''$ after midday, by the Rudolphine Tables there was a solar eclipse in δ $19^{\circ}.33'.45''$. Then therefore the calculation is thus.

The worked computation for Precept 106.

	Sig.	Gr.	'	"
Anomalia Solis [Anomaly of the Sun]	1	14	19	46
Anomalia $\odot$ aequata [Equated anomaly of the Sun]	8	9	26	1
Semidiam. appar. Solis [Apparent semidiameter of the Sun]			15	3
Semidiam. appar. Lunae [Apparent semidiameter of the Moon]			15	55
Parallax. Horizont. $\odot$ [Horizontal parallax — $\odot$]			61	57
Argumentum latitud. Lunae [Argument of the Moon's latitude]	5	24	4	18
Latitudo eius Borea [Its latitude, North]			30	57
Summa semidiam. & Parallaxis [Sum of the semidiameters and parallax]			92	55
Scrupula Priora [Prior minutes]		10	8	51
Scrupula Posteriora [Posterior minutes]		1	7	33
Residuum scrupulorum [Remainder of the minutes]		9	1	18
Scrupula dividenda [Minutes to be divided]			87	39
per Horarium $\supset$ à $\odot$ [by the hourly motion of the Moon from the Sun]			35	20
Quotiens dat Horas [The quotient gives, in hours]	H.	2	28	50
Nouilunium fuit Hora [The new moon was at the hour]	H.	22	58	28
Initium Eclipsis in Terris [Beginning of the eclipse on Earth]	H.	20	29	38
Finis Eclipsis in Terris die 12. [End of the eclipse on	H.	1	27	18

	Sig.	Gr.	'	"
Earth, on day 12]				

Therefore, from the beginning at which the Moon's shadow began to strike the Earth, and to graze ☉ the western margin of the Sun, up to the end, at which the Moon's shadow left the Earth, and the Moon went out beyond the eastern margin of the Sun, there intervene

Precept 107. To find the altitude of the nonagesimal in the regions in which the solar eclipse first begins, and in which its end last appears.

First, the minutes by the preceding Precept through the Moon's hourly motion (which are called the minutes of incidence) divided — subtract from the argument of the true latitude of the first phases, and you have the true argument of the first phase; that is, when the eclipse first begins on Earth: on the contrary, if you add the same to the same argument, you will have the true argument of the last phase, that is, when the eclipse altogether ends on Earth. And with these arguments seek the true latitudes of the Moon for each phase.

Second. Divide the latitude of the first phases by the sum of the luminaries' semidiameters and the horizontal parallax, and what comes out, seek in that column of the parallactic Table whose superscription is 60'; and observed in its left side, you have the altitude of the nonagesimal in that region, for which the rising Sun begins to be eclipsed by the Moon.

Third. Divide the latitude of the last phase by the same sum of the said three, and the quotient in the same column of 60' minutes observed — for that one in the left side answers to the altitude of the nonagesimal in that region of the world, for which the setting Sun ceases to be eclipsed by the Moon.

Example of the one in Precept 106.

The worked computation for Precept 107.

	Sig.	Gr.	'	"
Argumentum Latitudinis [Argument of latitude]	5	24	4	18
Scrupula Incidentia [Minutes of incidence]			87	39
Argum. latitud. in 1. Phasi & Latitudo Bor. [Argument of latitude in the 1st phase, and North	5	22	26	39

	Sig.	Gr.	'	"
latitude]				
			38	32
Argum. latitud. ultimae Phasis & Latitudo Bor. [Argument of latitude of the last phase, and North latitude]	5	25	31	57
			23	20
Summa semidiam. & Parallax. de visâ per haec latitudine [Sum of the semidiameters and parallax, from the visible by this latitude]			92	55
			38	32
Quotiens est [The quotient is]			24	53
Hinc Nonagesimi Altitudo in loco prima Phasis [Hence the altitude of the nonagesimal in the place of the first phase]		65	5	0
At divisa per eandem summam Latitudine [But the latitude divided by the same sum]			92	55
			23	20
Quotiens est [The quotient is]			15	4
Et Nonagesimi Altitudo in loco postrema Phasis [And the altitude of the nonagesimal in the place of the last phase]		75	27	0

Precept 108. To find the altitude of the pole in the aforesaid two regions.

First. Take the interval of time between the true synod and the beginning of the eclipse on Earth, found by Precept 106; and from the mean motion of the Sun subtract the motion of the Sun owed to it, at the place of the Sun at the time of the given new moon; and with the signs, degrees, and minutes, the residue being observed in the other of the two sides of Table 33, where, directly opposite them, you find the altitude of the nonagesimal found by Precept 107 for the 1st phase observed above it in the head, you have the altitude of the pole desired.

Second. To the same mean motion of the Sun, add the place of the true Sun at the time of the given new moon, and with the signs, degrees, and minutes, from the facts thus done — but the opposites — in the same Table 33, see in whose column-

cell is the altitude of the nonagesimal, [Margin: Pag. 38.] by Precept 107 for the last phase found; for above it in the head you have the altitude of the pole sought.

Example of the preceding new moon.

Worked computation, first part.

	Sig.	Gr.	'	"
Horae intervalli erant [The hours of the interval were]	H.	2	28	50
Horum motus ☉ medius [Their mean motion — ☉]			6	7
Locus ☉ in vero ☿ [Place of the Sun in the true conjunction]	☿	19	33	45
Locus ☉ in 1. Phasi [Place of the Sun in the 1st phase]	☿	19	27	38
Altit. Nonagesimi tunc [Altitude of the nonagesimal then]		65	5	0
Ergo Poli Altitudo Bor. [Therefore the altitude of the pole, North]		41	22	0
Locus ☉ pro ult. Phasi [Place of the Sun for the last phase]	☿	19	39	52
Locus oppositus [Opposite place]	☿	19	39	52
Nonagesimi Altitudo tunc [Altitude of the nonagesimal then]		75	27	0
Quae in areis non apparet [Which does not appear in the cells]				
Vtere igitur priori [Use therefore the former]	☿	19	39	52
Vnde Poli Australis alt. [Whence the altitude of the South pole]		3	42	0

Note further that if in the aforesaid cells you do not find the altitude of the nonagesimal, then directly opposite the place of the Sun — which is a sign that the altitude of the South pole is to be sought, the Sun being in the place opposite, that is in the place opposite to the former place — you would attempt it.

Precept 109. To determine the regions themselves by means of the longitude for the 1st and last phases, in the manner stated.

First, with the place of the Sun found by Precept 108, seek the oblique ascension under the elevation of the pole for the same 1st phase just found, and from it subtract 90 degrees, and there will come out the right ascension of the Tabular Meridian of the said region. Then from the true hours of the new moon subtract the hours of the interval between the 1st phase and the new moon, now found by Precept 106, and the residue in degrees of the equator resolved, add to the right ascension of that degree of the place of the Sun, whose oblique ascension you just found; and there will come out the Right Ascension of the Tabular Meridian to the moment of the 1st phase: from which if you subtract the Right Ascension of the Meridian first found, the difference of the meridians toward the East will be given, if the prior Right Ascension of the Meridian be the greater; toward the West, if smaller. With the longitude known, in the geographical chart seek the place desired.

Second, for the place of the last phase with the degree of the ecliptic opposite to it, seek the oblique ascension under the altitude of the pole, and from it subtract 90 degrees, with the regions congruent, of the last phase; then from the hours of the interval between the new moon and the last phase, and the place of the true new moon, and the aggregate in degrees of the equator resolved, add to the right ascension of the place of the Sun in the last phase found: for you have the Right Ascension of the Tabular Meridian. Therefore if to this you subtract the Right Ascension of the preceding Meridian, you acquire the difference of the meridians, and so with the longitude and the altitude of the pole of the region desired.

Note further that if in the other phase the elevation of the pole found was southern, then 180 degrees must be added to the Right Ascension of the Mid-heaven of the Tables, and from the aggregate the other Right Ascension of the Meridian is to be subtracted, that you may have the difference of longitude.

Example of the preceding new moon.

Worked computation for Precept 109, first phase.

	Sig.	Gr.	'	"
Locus Solis in 1. Phasi [Place of the Sun in the 1st phase]	♌	19	27	38

	Sig.	Gr.	'	"
Altitudo Poli Bor. in 1. Phasi [Altitude of the North pole in the 1st phase]		41	22	0
Ascensio Obliqua loci ☉ [Oblique ascension of the place of the Sun]		128	12	6
Asc. Recta Meridiani optati [Right ascension of the desired Meridian]		38	12	6
Asc. Recta loci ☉ [Right ascension of the place of the Sun]		141	53	48
Hora prima Phaseos [The first hour of the phase]	H.	20	29	38
Earum partes Aequatoris [Their parts of the equator]		307	24	30
Asc. Recta Merid. Tabularum [Right ascension of the Tabular Meridian]		89	18	18

	Sig.	Gr.	'	"
Subducta Asc. Recta 1. Merid. [Right ascension of the 1st Meridian subtracted]		38	12	6
Differentia Meridianorum [Difference of the meridians]		51	26	12
Vraniburgi Longit. in Rudolphin. [Longitude of Uraniborg in the Rudolphine Tables]		36	45	0
Longitudo Regionis 1. Phasi [Longitude of the region of the 1st phase]		345	38	48

Therefore the first of all the eclipses, at sunrise, was in the Atlantic Ocean near the island of Fagudam [?]; because its altitude of the pole is nearly 41°.22', and its longitude 345°.38'.48".

Worked computation for Precept 109, last phase.

Pro ultima Phasi [For the last phase]	Sig.	Gr.	'	"
Locus Solis in ultima Phasi [Place of the Sun in the last phase]	☾	19	39	52
Poli Australis Altitudo [Altitude of the South pole]		3	42	0
Asc. Obliq. loci Solis [Oblique ascension of the		141	4	40

Pro ultima Phasi [For the last phase]	Sig.	Gr.	'	"
place of the Sun]				
Asc. recta Merid. optati [Right ascension of the desired Meridian]		51	4	40
Asc. recta loci Solis [Right ascension of the place of the Sun]		142	4	49
Hora ultima Phasis [The last hour of the phase]	H.	1	27	18
Gradus Aequatoris [Degrees of the equator]		21	49	30
Asc. recta Meridiani Tabular. [Right ascension of the Tabular Meridian]		163	54	19
Quia Altit. Poli est Austr. adde [Because the altitude of the pole is South, add]		180	0	0
fit aggregatum [the aggregate is made]		343	54	19
Subtrahe prioris Merid. Ascens. [Subtract the ascension of the former Meridian]		51	4	40
Restat Meridianor. differentia [There remains the difference of the meridians]		292	49	39
Longitudo quaesita [The longitude sought]		103	55	21

The last therefore of the eclipses on Earth was in the Eastern Ocean near the island of S. Petri de Mascarenas; because its longitude is $103^{\circ}.55'.21''$, and its latitude South $3^{\circ}.42'$. Therefore the eclipse ceased upon the Earth, and the lunar shadow left it, in the place where the North pole is elevated $23^{\circ}.55'$; and whose longitude from Palma is $289^{\circ}.1'$, namely near the cape of S. Antoni, on the island of Cuba.

Precept 110. To find the time from when the total solar eclipse first begins with the rising Sun, up to the middle, the true and visible central synod, and from there up to the time at which the total central solar eclipse last occurs with the setting Sun.

With the apparent semidiameter of the Earth's disk, that is, with the horizontal parallax of the Moon, [Margin: Pag. 70.] extract Table 60. The Table will give the degrees and minutes, which are called *Prior*. This same fact, with the Moon's true latitude found for the moment of the true new moon, gathers the degrees and the

Posterior minutes; which subtract from the *Prior*, and with the residue in the area of that same Table 60, gather in the left margin what minutes are divided by the Moon's hourly motion from the Sun: that ex front the seconds; for if you divide them by the Moon's hourly motion from the Sun, you have in the quotient the time apparent, at which the total eclipse first appears on Earth with the rising Sun, that is, the moment at which the eclipse first appears on Earth with the rising Sun; up to the moment at which, at the nonagesimal from sunrise, the true and visible central synod will appear. Therefore from this interval, the time of the apparent synod being subtracted, you have the time of this phase. Likewise if you add to the same time the time of the true synod, you have the time at which the central eclipse last appears with the setting Sun.

Example of the preceding new moon.

Worked computation for Precept 110.

	Sig.	Gr.	'	"
Parallaxis ∽ Horizontal. [Horizontal parallax of the Moon]			61	57
Scrupula priora [Prior minutes]		4	28	58
Latitud. ∽ in vera ♂ [Latitude of the Moon in the true conjunction]		0	30	57
Scrupula posteriora [Posterior minutes]		1	7	33
Residua scrupula [Remaining minutes]		3	21	25
Scrupula dividenda [Minutes to be divided]		0	55	37
Per Horarium ∽ à ☉ [By the hourly motion of the Moon from the Sun]		0	35	20
Ergo Hora [Therefore the hour]	H.	1	34	26
Hora Nouilunij fuit [The hour of the new moon was]	H.	22	58	28
Hora igitur primae centralium Eclipsium [Therefore the hour of the first of the central eclipses]	H.	21	24	2
Et ultima centralium diei 2. Aug. [And the last of the central ones, on day 2 of August]		0	32	54

Precept 111. To find the altitude of the nonagesimal in regions, for the two phases just mentioned.

Take the minutes that you found in the preceding precept by the hourly difference, and subtract them from the argument of the latitude of the true new moon. What remains is the argument of the latitude for the first of the central eclipses, which you must look up; once found, look afterward in the columns of the parallactic Table 56, under the observed horizontal parallax, and against it on the left-hand side you will see the desired altitude of the nonagesimal for this first phase.

But if you add those same minutes to the same argument, you will have the argument of the true latitude for the last of the central eclipses; from this, the latitude — which in the same Table 56, under the horizontal lunar parallax, will show on the left-hand side the altitude of the nonagesimal for this last phase.

Example in the preceding new moon.

	Sig.	Gr.	'	"
Argument of the true latitude in ϕ	5	24	4	18
Argument of the latitude for the 1st central	5	23	8	41
Argument of the latitude for the last central	5	24	59	55
Latitude at the 1st central, North			35	46
Latitude at the last central, North			26	7
Horizontal parallax of $\odot$			61	57
Altitude of the nonagesimal at the 1st central		54	44	0
Altitude of the nonagesimal, last central		64	56	0

Precept 112. To find the altitude of the pole for each of the two aforesaid phases and regions.

Take the mean motion of the Sun corresponding to the time between the 1st of the central eclipses and the true conjunction found by Precept 110. Subtract it from the true place of the Sun for the 1st central; add it for the last central; and with the signs and degrees of the place of the Sun thus corrected, observed in the side-columns of the Tables, and against the altitude of the nonagesimal of those, acquired by the preceding precept, you will find at the head of the Table the desired altitude of the pole, according to the procedure of Precept 109.

Example in the preceding new moon.

	Sig.	Gr.	'	"
Place of $\odot$ in the true ϕ	ϕ	19	33	45

	Sig.	Gr.	'	"
Time between $\odot$ and the 1st central	H.	1	34	26
Mean motion of $\odot$ for this time			3	53
Place of $\odot$ for the 1st central	∂	19	29	52
Place of $\odot$ for the last central	∂	19	37	38
Altitude of the nonagesimal, 1st		54	44	0
Altitude of the nonagesimal, last		64	56	0
Altitude of the pole for the 1st central, North		51	9	0
Altitude of the pole for the last central, North		6	26	0

But this is found with the place of the Sun opposite.

Precept 113. To determine the regions themselves by their longitude.

Given the place of the Sun and the altitude of the pole found by the preceding precept, the oblique ascensions are to be sought, and everything else is to be carried out that you performed in Precept 109 — so that for the 1st and the last of the central eclipses you may have the difference of meridians from the meridian of the Tables, and thereby the longitude of each of the two regions sought. This you will learn by a brief example.

Example in the preceding new moon.

	Sig.	Gr.	'	"
Pro 1. centralium [For the 1st central]				
Altitude of the pole, North		51	9	0
Place of the Sun then	∂	19	29	52
Its oblique ascension		122	26	6
Right ascension of the chosen meridian		32	26	6
Right ascension of the place of the Sun		141	56	38
Hour of this phase	H.	21	24	2
Their parts of the equator		321	0	30
Right ascension of the meridian of the Tables		102	57	8
Difference of meridians		70	33	2
And the longitude of the region sought		326	11	58

Accordingly, the 1st of the central eclipses occurred on the northern seacoast of Nuremberg, where the altitude of the pole is degrees 51, 9', and the longitude degrees 326, 11', 58".

	Sig.	Gr.	'	"
Pro vltima Centralium [For the last central]				
Altitude of the pole, North		6	26	0
Place opposite the place of the Sun	☾	19	37	38
Its oblique ascension		323	17	48
Right ascension of the chosen meridian		233	17	48
Place of the Sun	☉	19	37	38
Its right ascension		142	3	38
Hour of this phase	H.	0	32	54
Their parts of the equator		8	13	30
Right ascension of the meridian of the Tables		150	17	8
Difference of meridians		276	59	20
Longitude sought		119	45	40

Therefore the last of the central eclipses occurred in the Indian Ocean toward the east, at the entrance of the Gulf of Ganges [Sinus Gangeticus], where the altitude of the pole is degrees 6, 26', and the longitude degrees 119, 45', 40".

Precept 114. To find the region to which, at the nonagesimal — the true and the apparent conjunctions coinciding, and at the visible conjunction — the eclipse appears central.

First, by Precepts 101, 102, and 103, find both the altitude of the Earth's disk and that of the nonagesimal, and likewise of the pole, for the region to which such a phase belongs. Then, with the place of the Sun in the true new moon at 90 degrees, increased under the said altitude of the pole, seek the oblique ascension; subtract from this 90 degrees, and you will have the right ascension of the meridian, under which this phase occurs. Finally, to the right ascension of the place of the Sun add the parts of the equator answering to the apparent hours of the true new moon, and you will produce the right ascension of the meridian of the Tables; comparing this with the right ascension of the previous meridian, you will have the difference of longitude, and thereby the longitude of the region sought, in which this phase occurs.

Example for the preceding new moon.

	Sig.	Gr.	'	"
Semidiameter of the Earth's disk	0	0	61	57
In the true σ , true latitude of $\mathcal{D}$			30	57
Altitude of the nonagesimal		60	2	0
And the altitude of the pole, North		43	6	0
Place of $\odot$ in σ	σ	19	33	45
With 90 added		90	0	0
Ascending degree	$\mathfrak{M}$	19	33	45
Its oblique ascension		244	27	19
Subtract 90		90	0	0
Right ascension of the chosen meridian		154	27	19
Right ascension of the place of $\odot$ in σ		141	59	48
Hour of the apparent new moon	H.	22	58	28
Their parts of the equator		344	37	0
Right ascension of the meridian of the Tables		126	36	48
Difference of meridians		332	9	29
Longitude sought		64	35	31

Therefore in that place where the north pole stands elevated degrees 43, 6', and whose longitude is degrees 64, 35', 31", there the new moon was true and the central conjunction was visible — that is, on the seacoast of the Black Sea [Euxine] near Amasia, and the river Thermodon, just as throughout that whole tract which the Moon's shadow occupied; for the eclipse was of 12, 43' digits.

Precept 115. To find the regions of the Earth, above which the shadow of the Moon is carried during the whole time of a solar eclipse.

Once five places of the five phases are found — those obtained from Precept 106 to 114 — it is easy, on globes or geographical maps, to mark out the tract of the Earth which the Moon's shadow traversed throughout the whole time of the solar eclipse. Thus, in the preceding eclipse, after the rising Sun was eclipsed at the Fortunate Islands [Fagudae insulae] of the Atlantic, it began on the western side of the Moon to be covered by the interposed disk; gradually, with the rising Sun, the growing defect was first wholly raised to its northern extreme at Nuremberg, where the Moon was touched by its center. From there, the center of the lunar

shadow passed into the east, and first wandered across the land of the Laboratores, then the Caledonian Ocean, Scotland, the Danes, the Cimbri, and the rest; and through Poland and Podolia it crossed the Black Sea, where at the true nonagesimal, and with the conjunction visibly central, it appeared. Further it advanced to Armenia, and to the southern coasts of Persia; and from there, in the eastern mouth of the Gulf of Ganges, it last hid the whole Sun in the west. At last, leaving the Sun setting at the Island of St. Peter of Mascareñas [Insula S. Petri de Mascarenas], it left the Moon free, and its shadow forsook the Earth.

Precept 116. To find the place of Saturn in longitude in its orbit.

When the work requires it, fit it to the precepts of Part I, or follow the order written below.

1. First, by Precepts 55 or 56, find the true place of the Sun, and its equated anomaly.
2. Second, from Table 62, which is held at page 72, elicit the mean motion of Saturn from the equinox; the apogee; and the northern node.
3. Third, subtract the motion of the apogee from the motion of Saturn from the equinox, and you will have the simple anomaly, which is in Table 63 at page 73. Seek there the centric equation, that is, of Saturn's first inequality, to be added to, or subtracted from, his mean motion from Υ , so that you may have the eccentric place of Saturn — that is, his place first equated, or seen from the Sun.
4. Fourth, subtract Saturn's centric place from the true place of the Sun, and the anomaly of the orb [*Anomalia Orbis*] is left.
5. Fifth, with the simple anomaly, of which number 3, seek in Table 64, which is at page 73, the *Anomalium Aequatam* of Saturn [the equated anomaly of Saturn].
6. Sixth, with the equated anomaly of the Sun, and with the equated anomaly of Saturn, seek in Table 65, which page 74 gives, the maximum equation of Saturn's orb [*Maximam Aequationem Orbis Saturni*].
7. Seventh, finally, with the maximum equation of Saturn's orb, applying the general prosthaphaeresis Table of the orb, which is 95, page 94, observe at the head, or foot, of the Table, and with the anomaly of the orb, of number 4, descending downward, or ascending upward, seek in the common area the prosthaphaeresis of the orb, to be added to, or subtracted from, the centric place of Saturn (the Moon being seen from the Earth). Here, this same order, to be observed, will hold for Jupiter and for Mars, with the proper Tables of each applied, as will be said below.

Example for ♄.

In the year of Christ 1604, September 27, about the 8th hour, at Prague, from observations Saturn and Mars were thought to be in the same longitude. Here Saturn's place is sought; the order of calculation is as follows.

	Sig.	Gr.	'	"	
☉ True place	6	4	47	44	Tab. 36
☉ Anomaly 99	2	27	4	44	38
♄ Mean motion from ♄	8	13	49	13	Tab. 62
Motion of the apogee	8	26	6	51	Pag. 72
Motion of the node ☾	3	20	32	5	
Simple anomaly	11	17	42	22	
Equation 1, to be added	0	1	18	33	Tab. 63
♄ Eccentric place	8	15	7	46	Pag. 73
Anomaly of the orb	9	19	39	58	
Anomaly of ♄ equated	0	11	35	30	Tab. 64
Maximum equation of the orb	0	5	41	30	Pag. 73
					Tab. 65
					Pag. 74
Equation of the orb, to be subtracted	0	5	10	30	Tab. 95
♄ Place in the orbit	8	9	57	16	Pag. 94

Therefore Saturn was then in Sagittarius, degrees 9, 58', 16".

Precept 117. To compute the latitude of Saturn.

1. First, with the equated anomaly of the eccentric of Saturn, observe at the head, or foot, of Table 66, which begins at page 75; and with the anomaly of the orb of Saturn, on the left, or right, side of the same Table, seek in the common angle the proportional minutes of the latitude.
2. Second, with the anomaly of the orb observed in the sides of the same Table 66, seek the scruples in the next-to-last column, whose title is: *Scrup. Prop. Incr. & Decr.* [proportional scruples, increasing & decreasing].
3. Third, if the increment-scruples, or the decrement-scruples, are in the next-to-last column, in the upper part, whose title is A, that is, what answers to the anomaly of the orb in the first three, or the last, signs — then one must take, with the equated anomaly of the Sun, the increment in the

antepenultimate column, whose title is: *Increm. in ☿* [increment in conjunction]. But if the scruples of increment, or decrement, are in the lower part, whose title is B, take the scruples of decrement in ☿^o [opposition] in their proper columns; that is to say, when the equated anomaly of the Sun is at the head, or foot, of Table 66, and with the equated anomaly of the eccentric of Saturn on the left, or right, side.

4. Fourth, as 60 is to the scruple of increment, or of decrement, of which I spoke as number 3, so is the scruple of increment, or decrement, of the penultimate column, of which number 2 — to a fourth proportional number; this number, or rather this quotient, add — if it is increment — to the first number found; or, if it is decrement, subtract it — and you will have the scruples of latitude corrected.
5. Fifth, go to Table 67, page 76, and in it, with the distance of the eccentric place of Saturn from the northern node sought, at the head or foot, as to the signs, and with the degrees of the signs on the left or right side, seek in the latitude-columns the right sine of the latitude, of what radius is 60.
6. Sixth, finally, make, as 60 is to the right sine of the latitude, so the scruple of latitude corrected, of which number 5, to another, and there will result a certain sine, which is the general latitude, which is 96 at page 107, and will exhibit the latitude of Saturn, of its affection — how far distant from the node ☿ — the signs in Table 67 indicate.

Example.

The same case, of which in the preceding precept's example.

	Sig.	Gr			
		.	'	"	
Anomaly of ♄ equated	0	11	35	30	Tab. 66
Anomaly of the orb	9	19	9	58	
Therefore proportional scruples of latitude		51	44		
And scruple of increment or decrement		17	52		
Which, because they are upper, indicate <i>Increment</i>					
Anomaly of ☉ was equated	2	26	34	44	
Therefore increment in ☿		6	30		As 60 [Vt 60.]

(continued)	Sig.	Gr.	'	"	
As 60 is to 6½, so is 17, 52', to			1	49	
Which, added to the scruples of latitude			51	44	
Gives the corrected scruples of latitude			53	33	
Eccentric place of ♄ was	8	15	7	46	
Place of the node ☿ was	3	20	32	50	
Therefore distance of ♄ from the node ☿	4	24	34	56	
And the sine of the latitude			1	43	
As 60 is to 143, so is 53, 33, to			1	29	3
					0
To which, in the General Table, under degree 1, answers the latitude			1	33	3
					0
Which, from the distance of ♄ from the node ☿, is gathered to have been northern.					

Precept 118. To reduce the place of Saturn from the orbit to the ecliptic, and to complete its curtation.

1. First, with the distance of Saturn's eccentric place — that is, his place first equated — from the northern node, from Table 67, which is held at page 76, extract both the reduction [*Reductionem*] and the curtation [*Curtationem*].
2. Second, add the reduction to the place of Saturn in the orbit, if the planet approaches the node receding from the limit; but subtract it, if it recedes from the node, approaching the limit; and you will have the place of Saturn reduced to the ecliptic.
3. Third, let it be done that, as the maximum equation of the orb is to the curtation, so the equation of the orb answering to the anomaly of the orb is to a proportional part of the curtation, which is always to be subtracted from the equation of the orb. Therefore, if the equation of the orb was additive, subtract the proportional part of the curtation from the place of the planet reduced to the ecliptic; but if it was subtractive, add the proportional part of the curtation to the place of the planet on the ecliptic, but curtated, as is fitting.

Example.

In the case of Precepts 116 and 117, and of the same example.

	Sig.	Gr.	'	"	
Distance of the eccentric place of ♄ from the node ☿	4	24	34	56	Tab. 96
Therefore reduction			1	35	Tab. 67
And curtation				12	

Because Saturn was receding from the northern limit, and approaching the southern node, therefore the reduction is to be added to the place in the orbit found, which was $\text{♄ } 8^{\circ}, 9', 57'', 16'''$. Therefore the place of Saturn on the ecliptic was $\text{♄ } 8^{\circ}, 9', 58'', 51'''$. Now the maximum equation of the orb was degrees 5, 41', 30"; and the equation of the orb answering to the anomaly was degrees 5, 10', 30". And the equation of the orb's anomaly answering was degrees 5, 10', 30", and was subtractive; therefore, as degrees 5, 41', 30" are to the curtation 12", so degrees 5, 10', 30" are to the curtation 11", which, being subtracted, would make the equation more subtractive. But it is nonetheless the same if you add the 11" to the place of Saturn on the ecliptic, curtated. And in the year 1604, September 26, at the 8th hour past noon, at Prague, Jupiter was at $\text{♃ } 9^{\circ}, 59', 2''$.

Similarly one must operate in the reduction, and the curtation of Jupiter, as of Mars; and let there be curtation in Saturn and Jupiter, though it could be neglected — not, however, in Mars.

Precept 119. To compute the place of Jupiter in longitude.

Do everything as in Precept 116, but use the proper Tables of Jupiter, which begin at Table 68, page 77, and end at page 80.

Example for ♃.

In the year of Christ 1634, Jupiter was observed on April 11, at the 12th hour after noon at Bologna, in degrees 25, 45', 40" of Gemini. There the place of Jupiter is sought from our Tables, computed.

	Sig.	Gr.	'	"	
☉ True place	0	22	3	45	Tab. 36
☉ Anomaly equated	9	14	50	11	& 38
♃ Mean motion from ♈	3	0	7	15	
Motion of the apogee	6	8	50	39	

	Sig.	Gr.	'	"	
Motion of the northern node	3	8	50	44	
Anomaly of ♈, simple	8	21	16	36	Tab.
Equation 1, to be added	0	5	32	39	96
♈ Eccentric place	3	5	39	54	
Anomaly of the orb	9	16	24	0	Tab.
Anomaly of ♈ equated	3	6	0	0	70
Maximum equation of the orb	0	11	9	0	71
Equation of the orb, to be subtracted	0	9	58	27	95
♈ Place in the orbit	2	25	41	27	

Therefore the place of Jupiter in the orbit was in ♊ degrees 25, 41', 27". But because it was observed with respect to the ecliptic, it is to be reduced, and the place is to be curtated here, as below.

Precept 120. To compute the latitude of Jupiter.

Do everything as in Precept 117, but use the proper Tables of Jupiter.

Example.

For the year 1634, April 11, at the 12th hour after noon at Bologna, of which above.

	Sig.	Gr.	'	"	
Anomaly of ♈ equated	3	6	0	0	
Anomaly of the orb	9	16	24	0	
Therefore proportional scruple of latitude		45	12	0	Tab. 72
And scruple of increment or decrement		22	23	0	
Which, because they are upper, indicate <i>Increment.</i>					
Anomaly of ☉ was equated	9	14	50	11	
Therefore increment in ☊			4	30	
As 60 is to 4½, so is 22, 23, to			1	40	
Which, added to the scruples of latitude		scru.	45	12	
Gives the corrected scruples of latitude			46	52	

	Sig.	Gr.	'	"	
Eccentric place of ♃	3	5	39	54	Tab.
Place of the node ♄	3	8	50	44	Tab. 73
Distance of ♃ from the node ♄	0	3	10	50	
Therefore sine of the latitude			0	6	
As 60 is to 0, 6, so is the corrected scruple of latitude 46, 52', to 0, 47'; to which, in the General Table of Latitude, answers the latitude, North, of degrees 0, 49'.					Tab. 96

Precept 121. To reduce the place of Jupiter from the orbit to the ecliptic, and to complete its curtation.

Do everything as in Precept 118, but use the proper Tables of Jupiter, which are 73, at page 80.

	Sig.	Gr.	'	"
Distance of the eccentric place of ♃ from the node ♄	0	3	10	50
Therefore reduction				4
And curtation				0

But Jupiter was approaching the node; therefore the reduction is to be added to the place of Jupiter in the orbit, which was Π 2, 25, 41', 27", so that on the ecliptic it is Π 2, 25, 41', 31"; nor is there need of curtation. But the Tables appear to fall short of the observation by 4', 9"; yet the greater part of the discrepancy can, not without reason, be referred back to the observation.

Precept 122. To compute the location of Mars in longitude.

Carry out everything as in Precept 116, but use the tables proper to Mars, which begin at Table 74, page 81, and end at page 84.

Example.

In the year 1604, on October 9, a little before noon, from observations made at Prague, there was a conjunction of Jupiter and Mars. At that time, by my reckoning, the hour was 23 [hours] 15' 17" after the noon of the 8th, with Jupiter at $19^{\circ} 15' 17''$. The location of Mars is now sought; the calculation runs as follows:

	Sig.	Gr.	'	"	Tab.
☉ True location	6	16	18	20	36 &
☉ Equated anomaly	3	8	35	4	38
♂ Mean motion	10	3	36	22	Tab.
Motion of the apogee	4	29	17	49	74
Motion of the northern node	1	15	37	54	
Simple anomaly	5	4	18	33	Tab.
Equation 1, of the inequality, subtr.	0	5	8	11	75
♂ Eccentric location	9	28	28	11	
Anomaly of the orb	8	17	50	9	Tab.
Anomaly of Mars, equated	5	2	0	3	76 &
Maximum equation of the orb	0	45	15	0	77
Equation of the orb, subtr.	1	9	13	49	&
♂ Location in the orbit	8	19	14	22	95

Precept 123. To compute the latitude of Mars.

Do everything as in Precept 117, but use the tables proper to Mars, which begin at page 81.

Example, the one in the preceding precept.

	Sig.	Gr.	'	"	Tab.
Anomaly of Mars, equated	5	2	0	3	
Anomaly of the orb	8	17	50	9	
Therefore the scruples of latitude	0	14	20	0	Tab.
And the scruples of increment or decrement	0	11	37	0	78
Which are the upper ones					
And they indicate increment					
☉ Anomaly, equated	3	8	35	4	
Scruples of increment in Mars	0	0	4	0	

As 60 is to 14° 20', so 4' is to 57" 20"', which is to be added to the scruples of latitude, so that the corrected ones come to 15° 17' 20".

	Sig.	Gr.	'	"	Tab.
Distance of the eccentric location of Mars from the node ☿	8	12	50	17	Tab.
Sine of the latitude	0	7	4	0	80

As 60 is to $15^{\circ} 17' 20''$, so the sine $7^{\circ} 4'$ is to the sine $1^{\circ} 47'$. This, in the General Table of Latitude, gives the latitude as $1^{\circ} 52'$, southern, as the signs of the distance from the node ☿ indicate.

Precept 124. To reduce the location of Mars from the orbit to the ecliptic, and to complete its curtation.

Do everything as in Precept 118, but use the tables proper to Mars, Table 80, which is found at page 84.

Example of the case above.

	Sig.	Gr.	'	"	Tab.
Distance of the eccentric location from the node ☿	8	12	50	17	
Therefore the curtation	0	0	1	7	Tab.
And the reduction, subtr.	0	0	0	32	80
Because it was approaching the limit					
Location in the orbit was	8	19	14	22	
Therefore location in the ecliptic	8	19	13	50	
Maximum equation of the orb	0	45	15	0	
Equation of the orb, subtr.	0	49	13	49	

Therefore: as $45^{\circ} 15'$ is to the curtation $1' 7''$, so $49^{\circ} 13' 49''$ is to the curtation $1' 13''$. By this amount the equation of the orb is to be diminished, so that it comes out smaller in its subtraction — but it amounts to the same thing as if you were to add $1' 13''$ to the location reduced to the ecliptic. Hence the location of Mars, reduced and curtated, was in Sagittarius at $19^{\circ} 15' 3''$; and Jupiter was at $19^{\circ} 15' 36''$. So a little after the 23rd hour the conjunction of Jupiter and Mars was completed — namely, at the hour 23 [hours] 50' after the noon of the 8th, just as the observation has it.

Precept 125. To compute the location of Venus in longitude.

First, find the true location of the Sun and its equated anomaly by Precept 55 or 56.

Second, in Table 81, which is found at page 85, extract the mean motion of Venus from the equinox, the motion of the apogee, and the motion of the northern node.

Third, subtract the motion of the apogee from the mean motion of Venus, and you will have the *simple anomaly*. With this, in Table 82 — which is at page 86 — you will have the first *equation*, to be added to or subtracted from the mean motion of Venus, as the headings of the table indicate; and the location of Venus, first equated, will result — that is, the eccentric, or the location as seen from the Sun.

Fourth, subtract the true location of the Sun from the location of Venus seen from the eccentric, and the *anomaly of the orb* will remain.

Fifth, with the simple anomaly — which you seek in Table 83, page 86 — find the equated anomaly of Venus; with this, together with the equated anomaly of the Sun, in the lateral columns, inquire the *maximum equation of the orb* in Table 84, page 87. With the anomaly of the orb in the lateral columns, and the maximum equation of the orb at the head in Table 95, gather the *equation of the orb*, to be added to or subtracted from the location of the Sun, as the headings of the table teach; and you will have the location of Venus seen from the Earth.

Example.

Longomontanus [Christian Longomontanus] reports that he observed Venus at its greatest digression from the Sun in the year 1585, on September 14, by the old style, at the hour 17 [hours] 15' after the meridian, in Leo at 15° 58'. Suppose that, with the Danish tables set aside, the reduction and curtation give 15° 53' 20". The location obtained from Tycho [Tycho Brahe], however, was somewhat in error, because too great a parallax of the Sun was assumed, and the declination too. Let us see what our tables yield.

	Sig.	Gr.	'	"	Tab.
☉ True location	6	1	48	41	Tab.
☉ Equated anomaly	2	24	25	23	36
♀ Mean motion	1	10	37	22	38
Motion of the apogee	10	5	10	4	Tab.
Node ☿	2	13	59	52	81
Simple anomaly	3	5	27	30	Tab.
Equation 1, subtr.	0	0	54	24	82

	Sig.	Gr.	'	"	Tab.
♀ Location from the Sun	1	9	42	58	
Anomaly of the orb	7	7	54	17	Tab.
Anomaly equated	3	4	59	57	83
Maximum equation of the orb	0	46	4	30	84
Equation of the orb, subtr.	1	5	41	50	85
♀ Location in the orbit	4	16	6	30	

It was therefore in Leo at 16° 6' 30".

Precept 126. To compute the latitude of Venus.

First, from Table 85, page 88, seek the scruples of latitude proportional to the equated anomaly of Venus at the head, or at the foot of the table, and to the anomaly of the orb of Venus in the lateral columns; and with these, the lower scruples.

Second, in Table 86, page 89, with the equated anomaly of the Sun at the head — or at the foot of the table — and with the equated anomaly of Venus in the lateral columns, inquire the scruples of decrement, by Table 86.

Third, do as follows. By Table 85, the decremental scruples are found; with this inferior scruple, decrement is found by Table 86. Subtract the inferior scruples from the latitude-scruples found first, so that you may have them corrected.

Fourth, with the distance of the eccentric location of Venus from the northern node — which you seek in Table 87, page 89 — find the sine of the latitude.

Fifth, do as follows. To the sine of the latitude, thus corrected, the scruple of latitude corresponds with the sine of the other [angle], which, in the general table — which is Table 96 — will give the latitude of Venus, of the same kind as the distance from the northern node indicates in Table 87.

Example, in the case above.

	Sig.	Gr.	'	"	Tab.
☉ Anomaly, equated	2	24	25	23	Tab.
♀ Anomaly of the orb	7	7	54	17	85
Scruples of latitude	0	24	18	0	

	Sig.	Gr.	'	"	Tab.
Inferior scruples	0	11	58	0	
♀ Anomaly, equated	3	4	59	57	Tab.
Scruples of decrement	0	1	36	0	86

Now, as 60 is to $11^{\circ} 58'$, so the scruples of decrement are $1^{\circ} 36' 18''$. Subtracting these scruples of latitude, with the latitude-scruples corrected, there remain $24^{\circ} 0'$.

	Sig.	Gr.	'	"
Node ♃, location	2	13	59	52
♀ Location from the Sun	1	9	42	58
Distance of ♀ from the node ♃	1	4	16	53
Sine of the latitude	0	5	45	0

Now, as 60 is to the sine $24^{\circ} 0'$, so the sine $5^{\circ} 45'$ is to the other sine $2^{\circ} 18'$. This, in Table 96, gives the latitude as $2^{\circ} 24'$, northern — if indeed the distance of Venus from the further northern node was at 2 signs 14° . Therefore the latitude is descending.

Precept 127. To reduce the location of Venus from the orbit to the ecliptic, and to complete its curtation.

First, with the distance of the eccentric location of Venus — that is, of Venus seen from the Sun — from the northern node, seek the reduction in Table 87, and the curtation at the foot of the table. If, however, Venus is in conjunction with the orb, there are no reductions, but the curtations are at their maximum.

Conversely, in conjunctions [of Venus with the Sun], the curtations are nil, but the reductions are at their maximum.

Second, do as follows. With the maximum equation of the orb found for the reduction, and with the difference between the maximum equation of the orb and the equation of the orb corresponding to the anomaly of the orb, the reduction is to be added to the location of the orb if the planet is approaching the node by receding from the limit; but it is to be subtracted if it is receding from the node by approaching the limit.

Third, do as follows. With the maximum equation found for the curtation, the curtation corresponding to the anomaly of the orb is to be subtracted from the

equation of the orb; thus, if the equation of the orb was subtractive, subtract less; if additive, add less.

Example, in the preceding case.

	Sig.	Gr.	'	"
♀ Distance from the node ☿ was	1	4	16	53
Therefore the reduction is to be added	0	0	2	48
And the curtation	0	0	3	18
Maximum equation of the orb	0	46	4	30
Equation of the orb	0	45	41	50
Difference of these	0	0	22	40

Now, as $46^{\circ} 4\frac{1}{2}'$ is to the reduction $2' 48''$, so the difference is $22'$. So that it differs by $22' 40''$, that is: as $46^{\circ} 4\frac{1}{2}'$ is to the reduction $1'$, so $16^{\circ} 7' 48''$ is to the reduction for the signs at $16^{\circ} 7' 48''$.

Then, as $46^{\circ} 4\frac{1}{2}'$ is to the curtation $3' 18''$, so $45^{\circ} 41' 50''$ is to the curtation $3' 11''$. To the curtation thus found, with the subtraction of the orb, or with the reduction added to the location of Venus, gives the curtated location in Leo at $16^{\circ} 10' 48''$ — namely a little less than $13'$ further on than the Tychonic, but false on account of too great a parallax of the Sun and the declination, and perhaps also on account of the observations themselves.

Precept 128. To compute the location of Mercury in longitude.

Do everything as in Precept 125 — as you did for Venus — but use the tables proper to Mercury, which begin at Table 88, that is, at page 90, and end at page 94.

Example.

In the year 1481, on October 21, at the hour 18 [hours] $10'$ after noon, Bologna time, Mercury was observed to be more easterly than Saturn, by more than the diameter of the Moon; and Saturn was then for me in Libra at $18^{\circ} 13' 20''$.

Therefore Mercury was very nearly in Libra at $18^{\circ} 46'$. The location is sought as seen from the Earth; the calculation is as follows:

	Sig.	Gr.	'	"	Tab.
☉ True location	7	7	52	30	36
☉ Anomaly, equated	4	2	16	42	38

	Sig.	Gr.	'	"	Tab.
☿ Mean motion	3	9	39	30	Tab.
Motion of the apogee	8	8	10	49	88
Node ☿	1	9	20	48	
Simple anomaly	7	1	28	41	
Equation 1, add.	0	15	31	0	Tab.
☿ Location from the Sun	3	25	10	30	89
Anomaly of the orb	8	17	18	0	
Anomaly equated	7	7	46	34	Tab.
Maximum equation	0	18	59	0	90
Equation of the orb, subtr.	0	18	49	50	91
☿ Location in the orbit	6	19	2	40	95

Therefore the location of Mercury in its orbit was in Libra at 19° 2' 40".

Precept 129. To compute the latitude of Mercury.

First, with the equated anomaly of Mercury in the column opposite at the head — or at the foot of Table 92 — and with the anomaly of the orb of Mercury in the lateral columns, seek the proportional scruples of latitude. If the signs are 7, [use] degree 20; use signs 1, degree 20. Since in the inquiry of the scruples of latitude one must begin at the perigee, the table begins from the apogee.

Second, note that in Table 92 there are two columns of proportional scruples — of increment and of decrement, namely the second and the antepenultimate. The second corresponds to the least distance of Mercury from the Sun, and is to be used with the anomaly of the eccentric — but, as I have said, with the signs transposed: in the first case, if the signs are fewer than 4 signs, or fewer than 10. The antepenultimate, however, is to be used — that is, it is to serve for the greatest distance of Mercury from the Sun — when, with the anomaly of the eccentric (as I said) transposed into the opposite signs, it is greater than 4 signs or greater than 8. When, finally, the equated anomaly is either greater than 2 signs or 4 signs, or less than 4 signs or 10, the numbers of the mean distance are to be used; these you will gather by the proportional part from columns 2 and the antepenultimate compared together. With these well understood, seek in Table 92 the proportional scruples of increment and of decrement, noted with the anomaly of the orb in the lateral columns.

Third, if the scruples of increment and decrement in Table 92, corresponding to the anomaly of the orb, are the upper ones and pertain to the part of the second column, or of the antepenultimate, whose heading is A, then in the same table, in the penultimate column, the scruples of decrement are to be taken in direct conjunction with the equated anomaly of the Sun. But if the scruples of increment

and of decrement are the lower ones, and pertain to the second column or to the antepenultimate part, whose heading is B, then in Table 93, with the anomaly of the eccentric of Mercury equated at the head — or at the foot — and with the equated anomaly of the Sun in the lateral columns, the scruples of decrement are to be taken in opposition, that is, in retrograde conjunction.

Fourth, do as follows. As 60 is to the proportional scruples of decrement in Mars, direct or retrograde, of which I spoke in the third; thus the proportional scruples of increment, found in the second, [are] to the scruple to be adhibited for the correction of the scruples of latitude, and to be subtracted from them.

Fifth, with the distance of the eccentric location of Mercury from the northern node, seek in Table 94 the sine of the latitude; and do as follows. As 60 is to this sine, so the scruple of latitude is to the other sine, which in Table 96 will exhibit the latitude of its kind — which Table 94 indicates as the distance of Mercury from the northern node.

Example, in the preceding case.

	Sig.	Gr.	'	"	Tab.
Anomaly of ☿, equated	7	7	46	34	Tab.
For which the opposites are	1	17	46	34	92
Anomaly of the orb	8	17	18	0	
Anomaly of the Sun, equated	4	2	16	42	
Scruples of latitude	0	22	24	0	
Scruples of increment and decrement	0	2	17	0	Tab.
Which are the lower ones					93
Therefore they are scruples of decrement					
In retrograde conjunction they are	0	0	31	0	

Now, as 60 is to 31', so $2^{\circ} 17'$ is to $1^{\circ} 12'$. With the scruples 22' 24' to be subtracted, there remain corrected $21^{\circ} 12'$.

Then:

	Sig.	Gr.	'	"
Node ☿ location was	1	9	20	48
☿ Eccentric location	3	25	10	30
Distance of ☿ from the node ☿	2	15	49	42
Sine of the latitude in Table 94	0	6	15	0

Now, as 60 is to 6° 15', so 21' 12" is to the sine 2° 13', which in Table 96 gives the latitude as 2° 18', northern — as the signs of the distance from the node, and ascending, indicate, on account of the approach to the northern limit.

Precept 130. To reduce the location of Mercury from the orbit to the ecliptic, and to complete its curtation.

Do everything as for Venus in Precept 127, but use the tables proper to Mercury, namely 91 and 94.

Example, in the preceding case.

	Sig.	Gr.	'	"	Tab.
Distance of the eccentric ☿ from the node ☿	2	15	49	42	Tab.
Reduction, subtr.	0	0	6	3	94
Curtation	0	0	10	3	
Maximum equation	0	18	59	0	91
Equation of the orb	0	18	49	50	95
Difference of these	0	0	9	0	

As 18° 59' is to the reduction 6' 3", so the difference is 9' to 16". Therefore the location of Mercury, reduced to the ecliptic, is in Libra at 19° 2' 24". Then, as the maximum equation of the orb 18° 59' is to the curtation 10' 3", so [the rest is] to the curtation 10'; this, added to the location of Mercury reduced — if indeed the equation of the orb was subtractive — gives the curtated location in the ecliptic, in Libra at 19° 12'. The observer placed it in Libra at 18° 46', around which the eye's estimate is fallible, given the magnitude of the lunar diameter [used] between Saturn and Mercury as seen.

Precept 131. To find the declination and right ascension of a planet by the tables.

By the tables, I say, without the solution of spherical triangles. Therefore first inquire the longitude and latitude of a planet by the precepts given above; then use Precept 54, with Tables 34 and 35, made for that use.

Precept 132. To find the distance of the minor planets from the Sun, in parts of which the mean distance of the Sun from the Earth — that is, the radius of the Sun's annual orb — is 100000.

You have already, from the precepts given above, the equated anomaly of the planet for each individual planet; resolve it into degrees. For if you seek these degrees in the first or second column of Table 97 — which is found at page 108 — opposite them you will have, for each planet, the distance of the planet itself from the Sun, in parts of which the radius of the Sun's annual orb — that is, the greater semidiameter of the solar ellipse, or the mean distance of the Sun from the Earth — is 100000. But if there is need, use the proportional part, as for Saturn.

Example, from Jupiter.

Above, in the example of Precept 116, the equated anomaly of Saturn was 0 signs 11° 35' 30". Resolved into degrees, it comes to 11° 35¾'. To this, in Table 97, Saturn corresponds: the distance from the Sun is 1008340 parts, using the proportional part.

But in the example of Precept 119, the anomaly of Jupiter was 3 signs 6°. This, equated precisely in Table 97, gives a distance of 935927 parts under Jupiter — parts of which the radius of the Sun's annual orb is 100000. And so for the rest.

Precept 133. To find the distance of the minor planets from the Earth, in parts of the radius of the Sun's annual orb.

If you wish the extreme distances from the Earth — when the planet is at apogee or perigee, or at aphelion or perihelion — I have set them out at the foot of Table 97. The rest must be hunted out by trigonometry, from the distance of the Sun from the Earth given by Precept 58, and the distance of the minor planets [from the Sun] by Precept 132, with the equated anomaly's angle being comprehended from these distances.

Precept 134. To find the distance of the planets from the Sun or the Earth, in terrestrial semidiameters.

We have already the distance of a planet in parts of which the radius of the Sun's annual orb is 100000, by Precepts 132 and 133. Multiply this by the terrestrial semidiameters which the mean distance of the Sun from the Earth contains,

according to the opinion you choose to follow here, and divide the product by 100000; for in the quotient you will have the desired distance in terrestrial semidiameters.

Example, for Jupiter.

In the example of Precept 132, for Jupiter we had a distance from the Sun of 935927, in parts of which the radius of the annual orb is reckoned at 100000. Now, since the distance of the Sun from the Earth is 7300 terrestrial semidiameters, if these are multiplied by 935927, the product is divided by 100000: this leaves the distance of Jupiter from the Sun as 68323 terrestrial semidiameters.

Precept 135. To find the longitude and latitude of the fixed stars at any given time.

First, in Table 98 — which is found at page 109 — seek the longitude and latitude of a fixed star, given for the end of the year of Christ 1700; for the latitude, indeed, is found there as perpetual. Then [seek] the intervals of years between the given year and the year 1700, and between the given month and the year 1700; seek

[continued from the preceding page]

look it up in Table 100, the motion of the Fixed Stars corresponding to the expanded and collected Years, and reduce these into a single sum; and if you add this sum to the given time, it exceeds the Years of Christ 1700; or else subtract it, if the time precedes; and what is then left over will be the Longitude of the Fixed Star for the given time.

Example, for Regulus, in the Year 456

In the year 1700 complete since Christ, the Longitude of Regulus is ϱ 25° 38' 32". The perpetual North Latitude is 0° 26' 20".

Now let the year 456 complete since Christ be given, which subtracted from 1700 leaves an interval of 1244 years; the motion corresponding to these years is found from Table 100, namely 15° 30' 29"; for the sum stands thus:

Motion	Gr.	I	II	III
In 1000 years	14	4	26	6
In 200 years	2	48	53	20
In 44 years	0	37	9	20

Motion	Gr.	I	II	III
Sum	15	30	28	46

Since this is to be subtracted (because the given time precedes), subtract it from Regulus's Longitude $\varnothing$ $25^{\circ} 38' 32''$: there remains for Regulus a Longitude of $\varnothing$ $10^{\circ} 8' 3''$, which agrees with what is found at the end of the Year 456. And the North Latitude is $0^{\circ} 26' 20''$.

Precept 136. To find the Right Ascension and Declination of the Fixed Stars for a given time, with a notable warning concerning the bright star in the Shoulder of Ursa Minor, and stars like it.

If a Fixed Star in Table 99 is not the bright star of the Shoulder of Ursa Minor — for which look in Table 99 — then take its Right Ascension and Declination as they stand at the end of the Year 1700 of Christ; and add to these the centennial difference proper to that star. You must add the Right Ascension of 1700 and subtract if it precedes, or for the Declination add or subtract as is there noted, if the time follows — for if it precedes the Year 1700 you do the opposite — and where it says subtract, you add, and where it says add, you subtract.

Furthermore, each difference is to be multiplied by the interval of time between the Year 1700 and the given time, and the sum divided by 100; for there will then come out the difference, to be added to or subtracted from the radix of the Year 1700, as I have said.

Example, for Regulus, in the Year 456

In Table 99, for the Year 1700 complete, the Right Ascension of Regulus is $148^{\circ} 4' 15''$; its centennial difference is $1^{\circ} 22' 30''$. But its North Declination is $13^{\circ} 25' 16''$; and its centennial difference here is $28' 30''$. Now to subtract the preceding interval of time, which was 1244 years: multiplied by the Right Ascension's difference of $1^{\circ} 22' 30''$, and first resolved into seconds, 4950'', this makes a sum of seconds 5157800; which divided by 100 leaves 51578'', that is $14^{\circ} 19' 38''$. Since therefore the given time precedes the Radix, the $148^{\circ} 4' 15''$ of the said Right Ascension and these $14^{\circ} 19' 38''$ are to be drawn apart; and there remains, for the Year 456 of Christ, a Right Ascension of Regulus of $133^{\circ} 44' 37''$.

But for the Declination, the difference to be subtracted afterward — yet here added beforehand — the centennial being $28' 30''$, that is 1710'', which multiplied by the 1244 years makes 2327240''; which divided by 100 leaves 23272'', that is $6^{\circ} 27' 52''$; and these added to the Declination of the Year 1700, namely $13^{\circ} 25' 16''$, give for the Year 456 of Christ the North Declination of Regulus, $19^{\circ} 53' 8''$.

Concerning the bright Shoulder of Ursa Minor, for the Year 456

We once showed, in Book 6, Problem 11, and we have driven home, in the first Volume of the *Astronomia Reformata*, Book 4, that the Right Ascension of all the Stellar Fixed Stars at some point decreases, even while the longitude increases — those whose latitude is greater than 66° , on the supposition (as we suppose) that the obliquity of the Ecliptic is perpetually $23^\circ 30' 20''$. But if there are Boreal Stars, the Right Ascension begins to decrease in the first quadrant of the Ecliptic, and ceases to decrease in the second. Of such Fixed Stars, in the said Problem 11, there are 59 Boreal; and we [also] counted Austral ones. But from these we are able to assign none in Table 99 except the bright Shoulder of Ursa Minor, which at some time was the Cynosura nearest the Pole of the World [Euodoxus]; its North Latitude is, by my reckoning, $72^\circ 48' 40''$. From this it follows that, as its Right Ascension continually decreased from the beginning of the World, and its longitude increased while the Right Ascension decreased, it will come to about the 15th degree of Leo — which happens around the Year 2137 of Christ.

Therefore, since its Right Ascension in the Year 1700 in Table 99 is given as $222^\circ 39' 20''$, and the centennial difference is $1^\circ 15'$ — that is $75'$ — which multiplied by the 1244 years that fall between the Year 456 and 1700 makes 93300; this divided by 100 leaves 933, that is $15^\circ 33''$ [?]; which is not to be subtracted but added — give the difference, $222^\circ 39' 20''$ — and so the Right Ascension of the bright Shoulder of Ursa Minor for the Year 456 of Christ comes to $238^\circ 12' 20''$.

TABVLAE NOVALMAGESTICAE

[The New Almagestic Tables]

Of the Secondary Movables [SECVNDORVM MOBILIVM]

With several Tables of the Primum Mobile necessary to them.

[This page is the divisional title of the *Tabulae Novalmagesticae*. The reverse (verso) of the preceding leaf shows the bleed-through, mirror-reversed, of the running header and the start of the Regulus-example text from p. 451.]

Prima Pars Tabularum Astronomicarum spectans ad Tempus
[First Part of the Astronomical Tables, pertaining to Time]

TABULA 1. Of the parts of the As applied [Partium Assis applicatarum]

The columns give, for each named subdivision of the As [Assis], its equivalent in twelfths [Unciae], in degrees of a circle [Circulo · Grad.], in minutes of a degree or of an hour [Gradui vel Horae · Minuta], and in hours of a day [Diei · Horae].

Parts (Partes) / As (Assis)	Twelfths (Unciae)	Circle, degrees (Circulo, Grad.)	Of a degree or hour, minutes (Gradui vel Horae, Minuta)	Of a day, hours (Diei, Horae)
Uncia	1	30	5	2
Sextans	2	60	10	4
Quadrans	3	90	15	6
Triens	4	120	20	8
Quincunx	5	150	25	10
Semissis	6	180	30	12
Septunx	7	210	35	14
Bes	8	240	40	16
Dodrans	9	270	45	18
Dextans	10	300	50	20
Deunx	11	330	55	22
As Libra	12	360	60	24

TAB. 2. Resolution of an Hour, a Degree, or a Circle into the smaller
fractions [Resolutio Horae, Gradus, aut Circuli in Scrupula]

The left panel gives what one Hour, or one Degree, contains [Hora 1. vel Gradus 1. continet]; the right panel, what one whole Circle contains [Circulus unus continet].

One Hour or one Degree contains	value	One whole Circle contains	value
Minuta (minutes)	60	Gradus (degrees)	360
Secunda (seconds)	3600	Minuta (minutes)	21600

One Hour or one Degree contains	value	One whole Circle contains	value
Tertia (thirds)	216000	Secunda (seconds)	1296000
Quarta (fourths)	12960000	Tertia (thirds)	77760000
Quinta (fifths)	777690000	Quarta (fourths)	4665600000
Sexta (sixths)	46656000000	Quinta (fifths)	279936000000
Septima (sevenths)	279936000000 0	Sexta (sixths)	16796160000000
Octava (eighths)	167961600000 000	Septima (sevenths)	1007769600000000 0
Nona (ninths)	100776960000 00000	Octava (eighths)	6046617600000000 00
Decima (tenths)	604661760000 000000	Nona (ninths)	3627970560000000 0000
		Decima (tenths)	2176782336000000 000000

TAB. 3. Conversion of Hours, and of their fractions [scruples], into First and Second fractions of a Day, etc. [Conversio Horarum, earumque Scrupulorum in Diei Scrupula Prima, et Secunda, etc.]

Two side-by-side panels. The header rows read: Horæ → Dies, I, II; Minuta → I, II, III; Secunda → II, III, IV. (The "I / II / III / IV" symbols are the scruple-order primes.) The first panel runs Hours 1–30, the second Hours 31–60.

Horæ (Minuta / Secunda)	Dies (I / II)	I (II / III)	II (III / IV)
1	0	2	30
2	0	5	0
3	0	7	30
4	0	10	0
5	0	12	30
6	0	15	0
7	0	17	30
8	0	20	0
9	0	22	30

Horæ (Minuta / Secunda)	Dies (I / II)	I (II / III)	II (III / IV)
10	0	25	0
11	0	27	30
12	0	30	0
13	0	32	30
14	0	35	0
15	0	37	30
16	0	40	0
17	0	42	30
18	0	45	0
19	0	47	30
20	0	50	0
21	0	52	30
22	0	55	0
23	0	57	30
24	1	60	0
25	1	2	30
26	1	5	0
27	1	7	30
28	1	10	0
29	1	12	30
30	1	15	0
31	1	17	30
32	1	20	0
33	1	22	30
34	1	25	0
35	1	27	30
36	1	30	0
37	1	32	30
38	1	35	0
39	1	37	30
40	1	40	0

Horæ (Minuta / Secunda)	Dies (I / II)	I (II / III)	II (III / IV)
41	1	42	30
42	1	45	0
43	1	47	30
44	1	50	0
45	1	52	30
46	1	55	0
47	1	57	30
48	2	0	0
49	2	2	30
50	2	5	0
51	2	7	30
52	2	10	0
53	2	12	30
54	2	15	0
55	2	17	30
56	2	20	0
57	2	22	30
58	2	25	0
59	2	27	30
60	2	30	0

TAB. 4. Conversion of the [first] fractions of a Day into Equal Hours, and Hourly fractions [Conversio Scrupulorum Diei in Horas Aequales, et Horaria scrupula]

Two side-by-side panels. Header rows: Scrupula Diei → Prima, Hore, I; Secunda → I, II; Tertia → II, III. The first panel runs entries 1–30, the second 31–60. (Each entry of the first day-fraction [Scrupula Diei Prima] is converted into Hours [Hore], minutes [I], and seconds [II/III].)

Scrupula Diei (Prima / Secunda / Tertia)	Hore (I / II)	I (II / III)
1	0	24
2	0	48

Scrupula Diei (Prima / Secunda / Tertia)	Hore (I / II)	I (II / III)
3	1	12
4	1	36
5	2	0
6	2	24
7	2	48
8	3	12
9	3	36
10	4	0
11	4	24
12	4	48
13	5	12
14	5	36
15	6	0
16	6	24
17	6	48
18	7	12
19	7	36
20	8	0
21	8	24
22	8	48
23	9	12
24	9	36
25	10	0
26	10	24
27	10	48
28	11	12
29	11	36
30	12	0
31	12	24
32	12	48

Scrupula Diei (Prima / Secunda / Tertia)	Hore (I / II)	I (II / III)
33	13	12
34	13	36
35	14	0
36	14	24
37	14	48
38	15	12
39	15	36
40	16	0
41	16	24
42	16	48
43	17	12
44	17	36
45	18	0
46	18	24
47	18	48
48	19	12
49	19	36
50	20	0
51	20	24
52	20	48
53	21	12
54	21	36
55	22	0
56	22	24
57	22	48
58	23	12
59	23	36
60	24	0

TABLE 5. Collection of the Days of the Common and Bissextile Roman Year [*Collectio Dierum Anni Romani Communis, & Bissextilis*]

The first two columns give the bissextile (leap-year) day-count and the common-year day-count; the remaining twelve columns give the cumulative day-number reached at the corresponding day of each named month. The two cross-symbols (✕) in the lower rows of the Bissextile, Common, January, and February columns mark cells with no entry (days that do not occur, e.g. 29–31 February in the common-year reckoning).

		Ia	Fe	M									
Biss	Cō	nu	br	ar	Ap	Ma	Iuni	Iuli	Augu	Septē	Oct	Nou	Dec
ex.	m.	.	.	t.	ril.	ius.	us.	us.	stus	b.	ob.	ēb.	ēb.
	1	1	32	60	91	121	152	182	213	244	274	305	335
1	2	2	33	61	92	122	153	183	214	245	275	306	336
2	3	3	34	62	93	123	154	184	215	246	276	307	337
3	4	4	35	63	94	124	155	185	216	247	277	308	338
4	5	5	36	64	95	125	156	186	217	248	278	309	339
5	6	6	37	65	96	126	157	187	218	249	279	310	340
6	7	7	38	66	97	127	158	188	219	250	280	311	341
7	8	8	39	67	98	128	159	189	220	251	281	312	342
8	9	9	40	68	99	129	160	190	221	252	282	313	343
9	10	10	41	69	100	130	161	191	222	253	283	314	344
10	11	11	42	70	101	131	162	192	223	254	284	315	345
11	12	12	43	71	102	132	163	193	224	255	285	316	346
12	13	13	44	72	103	133	164	194	225	256	286	317	347
13	14	14	45	73	104	134	165	195	226	257	287	318	348
14	15	15	46	74	105	135	166	196	227	258	288	319	349
15	16	16	47	75	106	136	167	197	228	259	289	320	350
16	17	17	48	76	107	137	168	198	229	260	290	321	351
17	18	18	49	77	108	138	169	199	230	261	291	322	352
18	19	19	50	78	109	139	170	200	231	262	292	323	353
19	20	20	51	79	110	140	171	201	232	263	293	324	354

Biss	Ia	Fe	M										
ex.	Cō	nu	br	ar	Ap	Ma	Iuni	Iuli	Augu	Septē	Oct	Nou	Dec
m.	.	.	t.	ril.	ius.	us.	us.	stus	b.	ob.	ēb.	ēb.	
20	21	21	52	80	111	141	172	202	233	264	294	325	355
21	22	22	53	81	112	142	173	203	234	265	295	326	356
22	23	23	54	82	113	143	174	204	235	266	296	327	357
23	24	24	55	83	114	144	175	205	236	267	297	328	358
24	25	25	56	84	115	145	176	206	237	268	298	329	359
25	26	26	57	85	116	146	177	207	238	269	299	330	360
26	27	27	58	86	117	147	178	208	239	270	300	331	361
27	28	28	59	87	118	148	179	209	240	271	301	332	362
28	29	29	60	88	119	149	180	210	241	272	302	333	363
29	30	30	⌘	89	120	150	181	211	242	273	303	334	364
30	31	31	⌘	90	121	151	182	212	243	274	304	335	365
31	⌘	⌘	⌘	91	—	—	—	213	—	—	305	—	366

TABLE 6. Collection of the Days of the Egyptian Year
[Collectio Dierum Anni Aegyptiaci]

Twelve 30-day months (Thoth through Messori) followed by the five epagomenal days (*Epagomenae*). Each column gives the cumulative day-number reached at the corresponding day of the named Egyptian month. The cross-symbol (⌘) marks cells with no entry (the months run only to 30, so there is no day 31).

	Th	At	Ch	T	Me				Pac	Pa	Ep	Me	
Di	ot	Pao	hy	oea	y	chy	Pham	Phar	Pac	Pa	Ep	Me	Epago
es.	h	phi	r	c	i	r	enoth	muti	ho	yn	hi	i	menae
1	1	31	61	91	1	151	181	211	241	27	301	331	361
					2					1			
					1								
2	2	32	62	92	1	152	182	212	242	27	302	332	362
					2					2			
					2								
3	3	33	63	93	1	153	183	213	243	27	303	333	363
					2					3			

Di es.	Th ot h	Pao phi	At hy r	Ch oea c	T y b i	Me chy r	Pham enoth	Phar muthi	Pac ho n	Pa yn i	Ep ep hi	Me sor i	Epago menae
					3								
4	4	34	64	94	1	154	184	214	244	27	304	334	364
					2					4			
					4								
5	5	35	65	95	1	155	185	215	245	27	305	335	365
					2					5			
					5								
6	6	36	66	96	1	156	186	216	246	27	306	336	
					2					6			
					6								
7	7	37	67	97	1	157	187	217	247	27	307	337	
					2					7			
					7								
8	8	38	68	98	1	158	188	218	248	27	308	338	
					2					8			
					8								
9	9	39	69	99	1	159	189	219	249	27	309	339	
					2					9			
					9								
10	10	40	70	100	1	160	190	220	250	28	310	340	
					3					0			
					0								
11	11	41	71	101	1	161	191	221	251	28	311	341	
					3					1			
					1								
12	12	42	72	102	1	162	192	222	252	28	312	342	
					3					2			
					2								
13	13	43	73	103	1	163	193	223	253	28	313	343	
					3					3			
					3								
14	14	44	74	104	1	164	194	224	254	28	314	344	

Di es.	Th ot h	Pao phi	At hy r	Ch oea c	T y b i	Me chy r	Pham enoth	Phar muthi	Pac ho n	Pa yn i	Ep ep hi	Me sor i	Epago menae
					3					4			
					4								
15	15	45	75	105	1	165	195	225	255	28	315	345	
					3					5			
					5								
16	16	46	76	106	1	166	196	226	256	28	316	346	
					3					6			
					6								
17	17	47	77	107	1	167	197	227	257	28	317	347	
					3					7			
					7								
18	18	48	78	108	1	168	198	228	258	28	318	348	
					3					8			
					8								
19	19	49	79	109	1	169	199	229	259	28	319	349	
					3					9			
					9								
20	20	50	80	110	1	170	200	230	260	29	320	350	
					4					0			
					0								
21	21	51	81	111	1	171	201	231	261	29	321	351	
					4					1			
					1								
22	22	52	82	112	1	172	202	232	262	29	322	352	
					4					2			
					2								
23	23	53	83	113	1	173	203	233	263	29	323	353	
					4					3			
					3								
24	24	54	84	114	1	174	204	234	264	29	324	354	
					4					4			
					4								

Di es.	Th ot h	Pao phi	At hy r	Ch oea c	T y b i	Me chy r	Pham enoth	Phar muthi	Pac ho n	Pa yn i	Ep ep hi	Me sor i	Epago menae
25	25	55	85	115	1 4 5	175	205	235	265	29 5	325	355	
26	26	56	86	116	1 4 6	176	206	236	266	29 6	326	356	
27	27	57	87	117	1 4 7	177	207	237	267	29 7	327	357	
28	28	58	88	118	1 4 8	178	208	238	268	29 8	328	358	
29	29	59	89	119	1 4 9	179	209	239	269	29 9	329	359	
30	30	60	90	120	1 5 0	180	210	240	270	30 0	330	360	

TABLE 7. Conversion of the Hours of the Primum Mobile into Parts of the Equator, with the Equation to be Added for the Hours of the Solar Day [*Conversio Horarum Primi Mobilis in Partes Aequatoris, cum Aequatione Addenda pro Horis Diei Solaris*]

This table has three panels. The first panel converts whole hours (1–24) of the primum mobile; the second and third panels convert minutes (1–30 and 31–60). The "Add for the Sun ☉" column gives the equation (the excess of the solar day over the sidereal rotation) to be added.

Panel 1 — Hours. Column headings: Primum Mobile, Hours (*Pri. Mob. / Horae* — units: Minutes ', Seconds "); Equator, Degrees (*Æquat. / Gr.* — units: ', "); Add for the Sun ☉ (*Adde pro ☉* — sub-columns I and II, units ", ', ").

Pri. Mob. Horae	Æquat. Gr.	Add ⊙ I	Add ⊙ II
1	15	2	28
2	30	4	56
3	45	7	24
4	60	9	52
5	75	12	20
6	90	14	47
7	105	17	15
8	120	19	43
9	135	22	11
10	150	24	39
11	165	27	7
12	180	29	35
13	195	32	3
14	210	34	31
15	225	36	59
16	240	39	26
17	255	41	54
18	270	44	22
19	285	46	50
20	300	49	18
21	315	51	46
22	330	54	14
23	345	56	42
24	360	59	10

Panel 2 — Minutes 1–30. Column headings: Primum Mobile, Minutes (*1. Mob. / Min.* — units: Seconds ', Thirds "'); Equator (*Æquatoris* — Degrees G., Minutes I — units ", '''); Add for the Sun ⊙ (*Adde pro* ⊙ — sub-columns I and II, units ''', ''').

1. Mob. Min.	Æquat. G.	Æquat. I	Add ⊙ I	Add ⊙ II
1	0	15	0	2
2	0	30	0	5
3	0	45	0	7

1. Mob. Min.	Æquat. G.	Æquat. I	Add ☉ I	Add ☉ II
4	1	0	0	10
5	1	15	0	12
6	1	30	0	15
7	1	45	0	17
8	2	0	0	20
9	2	15	0	22
10	2	30	0	25
11	2	45	0	27
12	3	0	0	30
13	3	15	0	32
14	3	30	0	35
15	3	45	0	37
16	4	0	0	39
17	4	15	0	42
18	4	30	0	44
19	4	45	0	47
20	5	0	0	49
21	5	15	0	52
22	5	30	0	54
23	5	45	0	57
24	6	0	0	59
25	6	15	1	2
26	6	30	1	4
27	6	45	1	7
28	7	0	1	9
29	7	15	1	11
30	7	30	1	14

Panel 3 — Minutes 31–60. Column headings: Primum Mobile, Minutes (*1. Mob. / Minut.* — units: Seconds ', Thirds "); Equator (*Æquatoris* — Degrees G., Minutes I — units ", '''); Add for the Sun ☉ (*Adde pro* ☉ — sub-columns I and II, units ''', ''').

1. Mob. Minut.	Æquat. G.	Æquat. I	Add $\odot$ I	Add $\odot$ II
31	7	45	1	16
32	8	0	1	19
33	8	15	1	21
34	8	30	1	24
35	8	45	1	26
36	9	0	1	29
37	9	15	1	31
38	9	30	1	34
39	9	45	1	36
40	10	0	1	39
41	10	15	1	41
42	10	30	1	44
43	10	45	1	46
44	11	0	1	48
45	11	15	1	51
46	11	30	1	53
47	11	45	1	56
48	12	0	1	58
49	12	15	2	1
50	12	30	2	3
51	12	45	2	6
52	13	0	2	8
53	13	15	2	11
54	13	30	2	13
55	13	45	2	16
56	14	0	2	18
57	14	15	2	21
58	14	30	2	23
59	14	45	2	25
60	15	0	2	28

TABLE 8. Conversion of the Parts of the Equator into Time of the Primum Mobile, with the Equation to be Subtracted for the Times of the Solar Day [*Conversio Partium Aequatoris in Tempus Primi Mobilis, cum Aequatione Subtrahenda pro Diei Solaris Temporibus*]

Three panels. The first converts degrees of the equator (1–30), the second 31–60, the third the round tens 70–360. Column headings: Equator, Degrees (*Æquat. / Grad.* — units: Minutes I, Seconds II); Time of the Primum Mobile (*Tép. 1. Mob.* — Hours, Minutes I — units I/II, II/III); Subtract for the Sun ☉ (*Subtr. pro ☉* — sub-columns I and II, units II/III, III/IV).

Panel 1 — Degrees 1–30.

<i>Æquat. Grad.</i>	<i>Tép. 1.Mob. Hor.</i>	<i>Tép. 1.Mob. I</i>	<i>Subtr. ☉ I</i>	<i>Subtr. ☉ II</i>
1	0	4	0	1
2	0	8	0	1
3	0	12	0	2
4	0	16	0	3
5	0	20	0	3
6	0	24	0	4
7	0	28	0	5
8	0	32	0	5
9	0	36	0	6
10	0	40	0	7
11	0	44	0	7
12	0	48	0	8
13	0	52	0	9
14	0	56	0	9
15	1	0	0	10
16	1	4	0	10
17	1	8	0	11
18	1	12	0	12
19	1	16	0	12

Æquat. Grad.	Tép. 1.Mob. Hor.	Tép. 1.Mob. I	Subtr. ⊙ I	Subtr. ⊙ II
20	1	20	0	13
21	1	24	0	14
22	1	28	0	14
23	1	32	0	15
24	1	36	0	16
25	1	40	0	16
26	1	44	0	17
27	1	48	0	18
28	1	52	0	18
29	1	56	0	19
30	2	0	0	20

Panel 2 — Degrees 31–60.

Æquat. Gr.	Tép. 1.Mob. H.	Tép. 1.Mob. I	Subtr. ⊙ I	Subtr. ⊙ II
31	2	4	0	20
32	2	8	0	21
33	2	12	0	22
34	2	16	0	22
35	2	20	0	23
36	2	24	0	23
37	2	28	0	24
38	2	32	0	25
39	2	36	0	25
40	2	40	0	26
41	2	44	0	27
42	2	48	0	27
43	2	52	0	28
44	2	56	0	28
45	3	0	0	29
46	3	4	0	30
47	3	8	0	30

Æquat. Gr.	Tép. 1.Mob. H.	Tép. 1.Mob. I	Subtr. ⊙ I	Subtr. ⊙ II
48	3	12	0	31
49	3	16	0	32
50	3	20	0	32
51	3	24	0	33
52	3	28	0	34
53	3	32	0	34
54	3	36	0	35
55	3	40	0	36
56	3	44	0	36
57	3	48	0	37
58	3	52	0	38
59	3	56	0	38
60	4	0	0	39

Panel 3 — Degrees 70–360 (by tens).

Æquat. Gr.	Tép. 1.Mob. H.	Tép. 1.Mob. I	Subtr. ⊙ I	Subtr. ⊙ II
70	4	40	0	44
80	5	20	0	53
90	6	0	1	1
100	6	40	1	6
110	7	20	1	12
120	8	0	1	19
130	8	40	1	25
140	9	20	1	32
150	10	0	1	38
160	10	40	1	45
170	11	20	1	52
180	12	0	1	58
190	12	40	2	5
200	13	20	2	12
210	14	0	2	18

Æquat. Gr.	Tép. 1.Mob. H.	Tép. 1.Mob. I	Subtr. ⊙ I	Subtr. ⊙ II
220	14	40	2	24
230	15	20	2	31
240	16	0	2	37
250	16	40	2	44
260	17	20	2	50
270	18	0	2	57
280	18	40	3	4
290	19	20	3	10
300	20	0	3	17
310	20	40	3	23
320	21	20	3	30
330	22	0	3	36
340	22	40	3	43
350	23	20	3	49
360	24	0	3	56

TABLE 9. Conversion of Hours into other Hours, reckoned from a different beginning of the Day [*Conversionis Horarum in alias Horas, à diverso Diei initio numeratas*]

This is a rule-table (not numeric): the left column names the hours to be converted (*Horae convertendae*), the right column states into what they are converted (*Convertuntur*).

Hours to be converted: Babylonian, or from Sunrise [*Babylonicae, seu ab Ortu Solis*], into:

- **Astronomical** — to be numbered from the preceding noon, by adding the Babylonian half-day quantity and the night quantity.
- **European** — from noon; by subtracting the half-day quantity from the Babylonian hours, if the Babylonian hours exceed it; but if they do not exceed it, once the subtraction is made, the remainder is taken from the residue of 12 hours, and there will remain the European hours from midnight.

- **Italian, or from Sunset** [*Italicas, seu ab Occasu*] — by adding the Babylonian night quantity.

Hours to be converted: Italian, or from Sunset [*Italicæ, seu ab Occasu Solis*], into:

- **Astronomical** — by adding the Italian half-day quantity.
- **European** from noon (if the Italian hours do not exceed the night quantity) — by adding the Italian half-day quantity.
- **European** from midnight (if the Italian hours exceed the half-night quantity) — by subtracting the Italian half-night quantity.
- **Babylonian** — by subtracting the night-time from the Italian hours.

Hours to be converted: Astronomical, or from noon to noon [*Astronomicæ, seu à meridie ad meridiem*], into:

- **European** from noon — if they do not exceed 12, adding or subtracting nothing.
- **European** from midnight — if the astronomical hours exceed 12, let 12 be taken away.
- **Babylonian** — by adding the half-day quantity to the astronomical hours.
- **Italian** — by subtracting the half-day quantity from the astronomical hours.

Hours to be converted: European from midnight — for from midnight to noon they coincide with the astronomical [*Europææ à media nocte, namque à meridie coincidunt cum Astronomicis*], into:

- **Astronomical** — by adding 12 hours to the European hours.
- **Babylonian** — by subtracting the half-night quantity from the European hours.
- **Italian** — by adding the half-night quantity to the European hours.

Whenever the subtraction cannot be made, add the 24 given hours, and subtract from the sum what is required. Whenever from the addition more than 24 result, throw away 24 and keep the rest. [Quoties subtractio fieri nequit, adde 24. horis datis, & à summa subtrahe, quod imperatur. Quoties ex Additione fiunt plusquam 24. abijce 24. & reliquas retine.]

TABLE 10. The Quantity of one Temporal Hour,
Corresponding to the Quantity of the Artificial Day
[*Quantitas Horae unius Temporalis, Respondens quantitati
Diei Artificialis*]

Six panels arranged across the page. Each panel pairs a column of artificial-day quantity (*Minuta Diei Artific. / Artific. Diei*, given in minutes and hours) with the corresponding twelfth-part (*Duodecima pars / Duodecimaeorū pars*), i.e. the length of one temporal hour. The leading panels run by minutes (0–60), the later panels by hours (H.). The minute-block at the head of the first two panels gives the twelfth-part in I, II (minutes, seconds), while the hour-blocks give it in H., I, II (hours, minutes, seconds).

Panels 1–2 (minutes 1–60). Headings: *Minuta Diei Artific.* (Min. — units I, II), *Duodecimaeorū pars* (units I/II, II/III); then *Minuta Diei Artific.* (Min. — units I, II), *Duodecimaeorū pars* (units I/II, II/III).

Min. Diei Artific.	Duodec. pars I	Duodec. pars II	Min. Diei Artific.	Duodec. pars I	Duodec. pars II
1	0	5	31	2	35
2	0	10	32	2	40
3	0	15	33	2	45
4	0	20	34	2	50
5	0	25	35	2	55
6	0	30	36	3	0
7	0	35	37	3	5
8	0	40	38	3	10
9	0	45	39	3	15
10	0	50	40	3	20
11	0	55	41	3	25
12	1	0	42	3	30
13	1	5	43	3	35
14	1	10	44	3	40
15	1	15	45	3	45
16	1	20	46	3	50

Min. Diei Artific.	Duodec. pars I	Duodec. pars II	Min. Diei Artific.	Duodec. pars I	Duodec. pars II
17	1	25	47	3	55
18	1	30	48	4	0
19	1	35	49	4	5
20	1	40	50	4	10
21	1	45	51	4	15
22	1	50	52	4	20
23	1	55	53	4	25
24	2	0	54	4	30
25	2	5	55	4	35
26	2	10	56	4	40
27	2	15	57	4	45
28	2	20	58	4	50
29	2	25	59	4	55
30	2	30	60	5	0

Panels 3–6 (artificial-day hours 1–24). Each block heads with *Artific. Diei* (H. — units I, II) and *Duodecima pars* (H., I, II). The hour-of-the-artificial-day appears once at the top of each five-row group (the five rows being its minutes 0, 10, 20, 30, 40, 50); the corresponding twelfth-part is given in hours, minutes, seconds.

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
1	0	0	5	0
1	10	0	5	50
1	20	0	6	40
1	30	0	7	30
1	40	0	8	20
1	50	0	9	10
2	0	0	10	0
2	10	0	10	50
2	20	0	11	40
2	30	0	12	30

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
2	40	0	13	20
2	50	0	14	10
3	0	0	15	0
3	10	0	15	50
3	20	0	16	40
3	30	0	17	30
3	40	0	18	20
3	50	0	19	10
4	0	0	20	0
4	10	0	20	50
4	20	0	21	40
4	30	0	22	30
4	40	0	23	20
4	50	0	24	10
5	0	0	25	0
5	10	0	25	50
5	20	0	26	40
5	30	0	27	30
5	40	0	28	20
5	50	0	29	10
6	0	0	30	0
6	10	0	30	50
6	20	0	31	40
6	30	0	32	30
6	40	0	33	20
6	50	0	34	10
7	0	0	35	0
7	10	0	35	50
7	20	0	36	40
7	30	0	37	30

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
7	40	0	38	20
7	50	0	39	10
8	0	0	40	0
8	10	0	40	50
8	20	0	41	40
8	30	0	42	30
8	40	0	43	20
8	50	0	44	10
9	0	0	45	0
9	10	0	45	50
9	20	0	46	40
9	30	0	47	30
9	40	0	48	20
9	50	0	49	10
10	0	0	50	0
10	10	0	50	50
10	20	0	51	40
10	30	0	52	30
10	40	0	53	20
10	50	0	54	10
11	0	0	55	0
11	10	0	55	50
11	20	0	56	40
11	30	0	57	30
11	40	0	58	20
11	50	0	59	10
12	0	1	0	0
12	10	1	0	50
12	20	1	1	40
12	30	1	2	30

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
12	40	1	3	20
12	50	1	4	10
13	0	1	5	0
13	10	1	5	50
13	20	1	6	40
13	30	1	7	30
13	40	1	8	20
13	50	1	9	10
14	0	1	10	0
14	10	1	10	50
14	20	1	11	40
14	30	1	12	30
14	40	1	13	20
14	50	1	14	10
15	0	1	15	0
15	10	1	15	50
15	20	1	16	40
15	30	1	17	30
15	40	1	18	20
15	50	1	19	10
16	0	1	20	0
16	10	1	20	50
16	20	1	21	40
16	30	1	22	30
16	40	1	23	20
16	50	1	24	10
17	0	1	25	0
17	10	1	25	50
17	20	1	26	40
17	30	1	27	30

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
17	40	1	28	20
17	50	1	29	10
18	0	1	30	0
18	10	1	30	50
18	20	1	31	40
18	30	1	32	30
18	40	1	33	20
18	50	1	34	10
19	0	1	35	0
19	10	1	35	50
19	20	1	36	40
19	30	1	37	30
19	40	1	38	20
19	50	1	39	10
20	0	1	40	0
20	10	1	40	50
20	20	1	41	40
20	30	1	42	30
20	40	1	43	20
20	50	1	44	10
21	0	1	45	0
21	10	1	45	50
21	20	1	46	40
21	30	1	47	30
21	40	1	48	20
21	50	1	49	10
22	0	1	50	0
22	10	1	50	50
22	20	1	51	40
22	30	1	52	30

Artific. Diei H.	Artific. Diei min.	Duodec. pars H.	Duodec. pars I	Duodec. pars II
22	40	1	53	20
22	50	1	54	10
23	0	1	55	0
23	10	1	55	50
23	20	1	56	40
23	30	1	57	30
23	40	1	58	20
23	50	1	59	10
24	0	2	0	0

TABULAE NOVALMAGESTICAE — Part II (Primum Mobile)

TAB. 11. — Semidiurnal and Seminocturnal Time

TAB. 11. Of Semidiurnal Time, when the Sun is in the Northern Signs; but of Seminocturnal Time, when the Sun is in the Southern Signs, at the Pole Altitudes written below. [*Semidiurni Temporis, quando Sol est in Signis Borealibus, Seminocturni autem quando Sol est in Signis Australibus ad infrascriptas Poli Altitudines.*]

This single table (TAB. 11) runs continuously across the opening, tabulating the semidiurnal/seminocturnal arc as time, by pole altitude [*Poli Altitudines*]. The leftmost columns give the Southern sign [*Sign. Aust.*], the Northern sign [*Sign. Bor.*], and the degree within the sign [*Gradus*]; the same degree-row labels recur in every block. Each pole-altitude column is a pair: **H.** = hours [*horae*], ' = minutes [*scrupula prima / minutes*]. The Northern signs (read top-to-bottom with the left **Gradus** scale ascending 0→30) are Aries ♈, Taurus ♉, Gemini ♊; the Southern signs (right-hand **Gradus** scale, descending) are Virgo ♍, Leo ♌, Cancer ♋ on one side, and Libra ♎, Scorpio ♏ [*Scorpius, here the printer's woodcut "comet/insect" mark stands for ♏*], Sagittarius ♐ on the other, with Pisces ♓ and Capricorn ♐ at the foot. The row-label scheme is identical in all blocks; it is given in full in the first block and abbreviated thereafter to the degree value.

The row labels, in order, are:

Sign. Aust.	Sign. Bor.	Gradus (left)	Gradus (right)	Sign. (right)
♈	♈ Aries	0	30	♈ / X(✕)
		3	27	
		6	24	
		9	21	
		12	18	
		15	15	
		18	12	
		21	9	
		24	6	
		27	3	
♉	♉ Taurus	0	♈ / X	
		3	27	
		6	24	
		9	21	
		12	18	
		15	15	
		18	12	
		21	9	
		24	6	
		27	3	
♊	♊ Gemini	0	♈ / ♎	
		3	27	
		6	24	
		9	21	
		12	18	
		15	15	
		18	12	
		21	9	
		24	6	
		27	3	
♋		30	♈ / ♎	

In the value tables below, the leftmost column reproduces the running degree-label (Northern-sign degree) for orientation; sign boundaries are marked. Every block has the same 31 data rows.

Block 1 — Pole altitudes 6 to 37

Sign / Gr.	6 H	6 '	1 H	1 '	1 H	1 '	2 H	2 '	2 H	2 '	2 H	2 '	2 H	2 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '
Υ 0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0
3	6	0	6	1	6	1	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3	6	3	6	4
6	6	1	6	2	6	3	6	4	6	4	6	5	6	6	6	6	6	6	6	7	6	7	6	7	6	7
9	6	1	6	3	6	4	6	5	6	6	6	6	7	6	8	6	9	6	1	6	1	6	1	6	1	1
12	6	2	6	4	6	5	6	7	6	8	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1
15	6	2	6	5	6	7	6	9	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1
18	6	3	6	6	6	8	6	1	6	1	6	1	6	1	6	1	6	1	6	2	6	2	6	2	6	2
21	6	3	6	7	6	9	6	1	6	1	6	1	6	1	6	2	6	2	6	2	6	2	6	2	6	2
24	6	4	6	8	6	1	6	1	6	1	6	1	6	2	6	2	6	2	6	2	6	2	6	2	6	2
27	6	4	6	9	6	1	6	1	6	1	6	2	6	2	6	2	6	2	6	3	6	3	6	3	6	3
⋈ 0	6	5	6	1	6	1	6	1	6	2	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3
3	6	5	6	1	6	1	6	1	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3	6	3
6	6	6	6	1	6	1	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3	6	4	6	4
9	6	6	6	1	6	1	6	2	6	2	6	3	6	3	6	3	6	4	6	4	6	4	6	4	6	4
12	6	7	6	1	6	1	6	2	6	2	6	3	6	3	6	4	6	4	6	4	6	4	6	4	6	4

Sign / Gr.	6 H	6 '	1 H	1 '	1 H	1 '	2 H	2 '	2 H	2 '	2 H	2 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '	3 H	3 '
15	6	7	6	1	6	1	6	2	6	3	6	3	6	3	6	4	6	4	6	4	6	4	6	4	6	5
				4		9		4		0		4		9		2		6		8		9		1		
18	6	7	6	1	6	2	6	2	6	3	6	3	6	4	6	4	6	4	6	5	6	5	6	5	6	5
				5		0		6		2		6		1		5		9		0		2		4		
21	6	8	6	1	6	2	6	2	6	3	6	3	6	4	6	4	6	5	6	5	6	5	6	5	6	5
				6		1		7		3		8		3		7		1		2		5		7		
24	6	8	6	1	6	2	6	2	6	3	6	4	6	4	6	4	6	5	6	5	6	5	6	5	7	0
				7		2		8		5		0		5		9		3		5		7				
27	6	8	6	1	6	2	6	3	6	3	6	4	6	4	6	5	6	5	6	5	6	5	7	0	7	2
				7		3		0		6		2		7		1		6		7						
II 0	6	9	6	1	6	2	6	3	6	3	6	4	6	4	6	5	6	5	7	0	7	2	7	2	7	4
				8		4		1		8		3		9		3		8								
3	6	9	6	1	6	2	6	3	6	3	6	4	6	5	6	5	7	0	7	2	7	4	7	6		
				9		5		2		9		5		1		5										
6	6	9	6	1	6	2	6	3	6	4	6	4	6	5	6	5	7	2	7	4	7	6	7	8		
				9		6		3		0		6		2		6										
9	6	1	6	2	6	2	6	3	6	4	6	4	6	5	6	5	7	4	7	6	7	8	7	1		
		0		0		6		4		1		7		4		8								0		
12	6	1	6	2	6	2	6	3	6	4	6	4	6	5	6	5	7	5	7	7	7	9	7	1		
		0		0		7		4		2		8		5		9								1		
15	6	1	6	2	6	2	6	3	6	4	6	4	6	5	7	0	7	6	7	9	7	1	7	1		
		0		0		7		5		3		9		6								1		3		
18	6	1	6	2	6	2	6	3	6	4	6	5	6	5	7	1	7	7	7	9	7	1	7	1		
		0		0		8		5		5		0		6								2		4		
21	6	1	6	2	6	2	6	3	6	4	6	5	6	5	7	2	7	8	7	1	7	1	7	1		
		0		1		8		6		4		0		7						0		3		5		
24	6	1	6	2	6	2	6	3	6	4	6	5	6	5	7	3	7	8	7	1	7	1	7	1		
		0		1		8		6		4		1		8						0		4		6		
27	6	1	6	2	6	2	6	3	6	4	6	5	6	5	7	3	7	8	7	1	7	1	7	1		
		0		1		9		6		5		1		8						1		4		6		
30	6	1	6	2	6	2	6	3	6	4	6	5	6	5	7	3	7	8	7	1	7	1	7	1		
		0		1		9		6		5		1		8						1		4		7		

Block 2 — Pole altitudes 38 to 49

Sign / Gr.	3 8 H	3 8 '	3 9 H	3 9 '	4 0 H	4 0 '	4 1 H	4 1 '	4 2 H	4 2 '	4 3 H	4 3 '	4 4 H	4 4 '	4 5 H	4 5 '	4 6 H	4 6 '	4 7 H	4 7 '	4 8 H	4 8 '	4 9 H	4 9 '
Υ 0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0
3	6	4	6	4	6	4	6	4	6	4	6	4	6	5	6	5	6	5	6	5	6	6	6	6
6	6	8	6	8	6	8	6	8	6	9	6	9	6	9	6	1	6	1	6	1	6	1	6	1
																0		0		0		1		1
9	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1
		1		2		2		2		3		3		4		4		5		5		6		6
12	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	2	6	2	6	2
		5		5		6		7		7		8		8		9		9		0		1		2
15	6	1	6	1	6	2	6	2	6	2	6	2	6	2	6	2	6	2	6	2	6	2	6	2
		9		9		0		1		1		2		3		4		0		6		7		7
18	6	2	6	2	6	2	6	2	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3
		2		3		4		5		6		7		8		0		0		1		2		3
21	6	2	6	2	6	2	6	2	6	3	6	3	6	3	6	3	6	3	6	3	6	3	6	3
		6		7		8		9		0		1		2		3		4		6		7		8
24	6	3	6	3	6	3	6	3	6	3	6	3	6	3	6	3	6	3	6	4	6	4	6	4
		0		1		2		3		4		5		6		8		9		1		2		4
27	6	3	6	3	6	3	6	3	6	3	6	4	6	4	6	4	6	4	6	4	6	4	6	4
		3		4		6		7		8		0		1		3		3		6		7		9
ϣ 0	6	3	6	3	6	3	6	4	6	4	6	4	6	4	6	4	6	4	6	5	6	5	6	5
		7		8		9		1		2		4		5		7		7		0		2		4
3	6	4	6	4	6	4	6	4	6	4	6	4	6	5	6	5	6	5	6	5	6	5	6	5
		0		1		3		5		6		8		0		1		3		5		7		9
6	6	4	6	4	6	4	6	4	6	5	6	5	6	5	6	5	6	5	7	0	7	2	7	4
		3		5		7		8		0		2		4		6		6						
9	6	4	6	4	6	5	6	5	6	5	6	5	6	5	7	0	7	0	7	5	7	7	7	9
		7		8		0		2		4		6		8										
12	6	5	6	5	6	5	6	5	6	5	7	0	7	2	7	4	7	7	7	9	7	1	7	1
		0		2		4		6		8											2		4	
15	6	5	6	5	6	5	6	5	7	1	7	4	7	6	7	8	7	1	7	1	7	1	7	1
		3		5		7		9									1		3		6		9	
18	6	5	6	5	7	0	7	3	7	5	7	7	7	1	7	1	7	1	7	1	7	2	7	2

Sign / Gr.	3 8 H	3 8 '	3 9 H	3 9 '	4 0 H	4 0 '	4 1 H	4 1 '	4 2 H	4 2 '	4 3 H	4 3 '	4 4 H	4 4 '	4 5 H	4 5 '	4 6 H	4 6 '	4 7 H	4 7 '	4 8 H	4 8 '	4 9 H	4 9 '
	6		8										0		2		5		8		1		4	
21	6	5	7	1	7	3	7	6	7	8	7	1	7	1	7	1	7	1	7	2	7	2	7	2
	9											1		3		6		9		2		5		8
24	7	2	7	4	7	6	7	9	7	1	7	1	7	1	7	2	7	2	7	2	7	2	7	3
										1		4		7		0		3		6		9		2
27	7	4	7	7	7	9	7	1	7	1	7	1	7	2	7	2	7	2	7	2	7	3	7	3
								2		4		7		0		3		6		9		3		6
II 0	7	7	7	9	7	1	7	1	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4
						2		5		7		0		3		6		0		3		6		0
3	7	9	7	1	7	1	7	1	7	2	7	2	7	2	7	2	7	3	7	3	7	3	7	4
				2		4		7		0		3		6		9		3		6		9		3
6	7	1	7	1	7	1	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4
		1		4		6		9		2		5		8		2		6		9		3		7
9	7	1	7	1	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	5
		3		6		8		1		4		7		0		4		8		2		6		0
12	7	1	7	1	7	2	7	2	7	2	7	2	7	3	7	3	7	4	7	4	7	4	7	5
		5		7		0		3		6		9		2		6		0		4		8		2
15	7	1	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	5	7	5
		6		9		2		5		8		1		5		8		2		6		0		5
18	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	4	7	5	7	5
		7		0		3		6		0		3		6		0		4		8		2		6
21	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	4	7	5	7	5
		8		1		4		7		1		4		8		2		5		9		4		8
24	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	5	7	5	7	5
		8		2		5		8		2		5		9		2		6		0		5		9
27	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	5	7	5	8	0
		9		2		5		9		2		6		9		3		7		1		6		
30	7	1	7	2	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	5	7	5	8	0
		9		2		6		9		2		6		9		3		7		1		6		

Sign / Gr.	50 H	50 '	51 H	51 '	52 H	52 '	53 H	53 '	54 H	54 '	55 H
55 '	56 H	56 '	57 H	57 '	58 H	58 '	59 H	59 '			
---	---	---	---	---	---	---	---	---	---	---	Υ 0
6	0	6	0	6	0	6	0	6	0	6	6
6	6	6	6	6	7	6	7	6	8	6	8
6	12	6	13	6	13	6	14	6	14	6	15
6	6	18	6	19	6	20	6	20	6	21	6
6	24	6	24	6	25	6	26	6	27	6	28
6	28	6	29	6	31	6	32	6	33	6	34
6	6	34	6	35	6	37	6	38	6	39	6
6	21	6	40	6	41	6	43	6	44	6	46
6	56	6	24	6	45	6	47	6	49	6	50
6	7	4	27	6	51	6	53	6	55	6	57
6	7	12	6	58	6	58	7	0	7	3	7
6	7	19	6	3	7	1	7	4	7	6	7
6	7	27	6	6	7	7	7	9	7	12	7
6	31	7	35	6	9	7	12	7	15	7	17
6	7	38	7	43	6	12	7	17	7	20	7
6	41	7	45	7	50	6	15	7	22	7	25
6	7	48	7	52	7	57	6	18	7	27	7
6	49	7	54	7	59	8	4	21	7	31	7
6	56	8	0	8	6	8	11	24	7	36	7
6	8	2	8	7	8	12	8	18	8	25	6
6	2	8	7	8	12	8	18	8	24	8	31
6	6	8	12	8	17	8	23	8	30	8	37
6	10	8	16	8	22	8	28	8	35	8	43
6	14	8	20	8	26	8	33	8	40	8	48
6	15	8	17	8	23	8	30	8	37	8	44
6	8	15	8	20	8	26	8	33	8	40	8
6	8	17	8	23	8	29	8	36	8	43	8
6	14	8	20	8	26	8	32	8	39	8	47
6	8	15	8	21	8	27	8	33	8	40	8
6	10	8	15	8	21	8	27	8	34	8	41

Block 4 — Pole altitudes 60 to 68

The 66½ column is printed as **66½** in the heading; transcribed verbatim as printed — see anomaly (a).

Sign / Gr.	6 H	6 '	6 H	6 '	6 H	6 '	6 H	6 '	6 H	6 '	6 H	6 '	6 H	6 '	66 ½ H	66 ½ '	6 H	6 '	6 H	6 '
Υ 0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0
3	6	8	6	9	6	9	6	9	6	1	6	1	6	1	6	11	6	1	6	1
										0		0		1				1		2
6	6	1	6	1	6	1	6	1	6	2	6	2	6	2	6	22	6	2	6	2
		7		7		8		9		0		0		2				3		4
9	6	2	6	2	6	2	6	2	6	2	6	3	6	3	6	33	6	3	6	3
		5		6		7		8		9		0		2				4		5
12	6	3	6	3	6	3	6	3	6	3	6	4	6	4	6	44	6	4	6	4
		3		5		6		8		9		1		3				5		7
15	6	4	6	4	6	4	6	4	6	4	6	5	6	5	6	55	6	5	6	5
		2		3		5		7		9		1		3				6		9
18	6	5	6	5	6	5	6	5	6	5	7	1	7	4	7	6	7	7	7	1
		0		2		4		7		9										1
21	6	5	7	0	7	3	7	6	7	9	7	1	7	1	7	18	7	2	7	2
		8										2		5				0		3
24	7	6	7	9	7	1	7	1	7	1	7	2	7	2	7	29	7	3	7	3
						2		6		9		2		6				1		6
27	7	1	7	1	7	2	7	2	7	2	7	3	7	3	7	40	7	4	7	4
		5		7		1		5		9		2		7				2		8
⋈ 0	7	2	7	2	7	3	7	3	7	3	7	4	7	4	7	51	7	5	8	1
		3		6		0		4		8		3		8				4		
3	7	3	7	3	7	3	7	4	7	4	7	5	7	5	8	3	8	6	8	1
		1		4		9		4		8		3		9						3
6	7	3	7	4	7	4	7	5	7	5	8	4	8	1	8	14	8	1	8	2
		9		3		8		3		8				1				8		6
9	7	4	7	5	7	5	8	3	8	8	8	1	8	2	8	26	8	3	8	3
		7		2		7						4		2				0		9
12	7	5	8	0	8	6	8	1	8	1	8	2	8	3	8	38	8	4	8	5

Sign / Gr.	6 0 H	6 0 '	6 1 H	6 1 '	6 2 H	6 2 '	6 3 H	6 3 '	6 4 H	6 4 '	6 5 H	6 5 '	6 6 H	6 6 '	66 $\frac{1}{3}$ H	66 $\frac{1}{3}$ '	6 7 H	6 7 '	6 8 H	6 8 '
		5						2		8		5		4				2		3
15	8	3	8	8	8	1	8	2	8	2	8	3	8	4	8	50	8	5	9	7
						4		1		8		5		5				5		
18	8	1	8	1	8	2	8	3	8	3	8	4	8	5	9	2	9	7	9	2
		0		6		3		0		8		6		6						0
21	8	1	8	2	8	3	8	3	8	4	8	5	9	9	9	14	9	2	9	3
		8		4		1		9		7		6						0		4
24	8	2	8	3	8	4	8	4	8	5	9	7	9	1	9	27	9	3	9	4
		5		2		0		8		7				9				3		9
27	8	3	8	3	8	4	8	5	9	7	9	1	9	3	9	39	9	4	1	5
		2		9		8		6				7		1				6	0	
II 0	8	3	8	4	8	5	9	5	9	1	9	2	9	4	9	52	1	0	1	2
		8		7		5				6		8		2				0		2
3	8	4	8	5	9	2	9	1	9	2	9	3	9	5	10	4	1	1	1	4
		4		4				3		5		8		4				0	3	0
6	8	5	9	2	9	9	9	2	9	3	9	4	1	5	10	16	1	2	1	0
		0						1		3		8	0					0	6	1
9	8	5	9	7	9	1	9	2	9	4	9	5	1	1	10	29	1	3	1	3
		6				5		8		1		7	0	6				0	8	1
12	9	1	9	1	9	2	9	3	9	4	1	6	1	2	10	42	1	5	—	—
				2		1		4		8	0		0	7				0	5	
15	9	5	9	1	9	2	9	4	9	5	1	1	1	3	10	55	1	1	—	—
				6		6		0		5	0	4	0	7				1	6	
18	9	9	9	2	9	3	9	4	1	1	1	2	1	4	11	8	1	4	—	—
				0		1		5	0		0	1	0	6				1	1	
21	9	1	9	2	9	3	9	4	1	5	1	2	1	5	11	21	—	—	—	—
		2		3		5		9	0		0	7	0	5						
24	9	1	9	2	9	3	9	5	1	9	1	3	1	3	—	—	—	—	—	—
		4		5		7		2	0		0	1	1							
27	9	1	9	2	9	3	9	5	1	1	1	3	1	7	—	—	—	—	—	—
		5		6		9		4	0	1	0	4	1							
30	9	1	9	2	9	4	9	5	1	1	1	3	1	9	12	0	—	—	—	—

	6	6	6	6	6	6	6	6	6	6	6	6	6				6	6	6	6
Sign /	0	0	1	1	2	2	3	3	4	4	5	5	6	6	66	66	7	7	8	8
Gr.	H	'	H	'	H	'	H	'	H	'	H	'	H	'	$\frac{1}{3}$ H	$\frac{1}{3}$ '	H	'	H	'
		5		7		0		5	0	2	0	5	1							

[illegible]

	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	
Sign /	9	9	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	0	0
Gr.	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'
	9				4		1		1	0	8	1												
12	9	4	9	1	9	3	9	5	1	1	1	5	—	—	—	—	—	—	—	—	—	—	—	—
				8		3		3	0	9	0	9												
15	9	2	9	3	9	5	1	1	1	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	0		5		4	0	8	0	5															
18	9	3	9	5	1	1	1	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	6		3	0	6	0	0																	
21	9	5	1	1	1	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	2	0	3	0	4																			
24	1	1	1	3	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	0	0	0	7	1	5																		
27	1	3	1	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	0	0	1																					
II 0	1	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	0	2																						
3	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1	6																						

Block 6 — Pole altitudes 81 to 89

The 89° column heads only a single value column labelled **90** in the body (a quarter is reached); transcribed as printed. The rightmost data column is headed **89** with sub-head **90** — see anomaly (b).

	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
Sign /	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	89
Gr.	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	(90)
Υ 0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	6	0	—
3	6	3	6	3	6	4	6	5	7	9	7	3	8	2	—	—	—
		0		4		6		5				4		6			
6	7	1	7	9	7	3	7	5	8	2	9	3	—	—	—	—	—
						5		4		6		1					
9	7	3	7	4	8	2	9	2	1	1	—	—	—	—	—	—	—
		3		6		6			0	3							

Sign /	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	89
Gr.	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	(90)
	H	'	H	'	H	'	H	'	H	'	H	'	H	'	H	'	
12	8	6	8	2	9	2	1	4	—	—	—	—	—	—	—	—	—
				5		9	0	8									
15	8	4	9	1	1	2	—	—	—	—	—	—	—	—	—	—	—
		4		0	1	2											
18	9	2	1	8	—	—	—	—	—	—	—	—	—	—	—	—	—
		6	0														
21	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	0																
24 (8)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Appendix to TAB. 11

Appendix TAB. 11. — For the Greatest Day, where the Pole is elevated more than $66\frac{1}{2}$ degrees, after the *Sphaera* of Clavius [Christophorus Clavius], chap. 4, not taking refraction into account; for which see our *Geographia Reformata*. [Appendix TAB. 11. pro Maxima Die, ubi Polus elevatur plus Gradibus $66\frac{1}{2}$. ex *Sphaera* Clavij cap. 4. non considerantis Refractiones, pro quibus vide nostram *Geographiam Reformatam*.]

The table gives, for each elevation of the pole [*Elevatio Poli*, in degrees, **Gr.**], the **arc that is always apparent** [*Arcus semper apparens*, in degrees **Gr.** and minutes **M.** — the circumpolar arc never setting] and the **continuous day** [*Dies continuus*, in days **D.**, hours **H.**, and minutes **M.** — the span during which the Sun does not set]. It is printed as two side-by-side panels (poles 67–78 on the left, 79–90 on the right).

Elevatio Poli (Gr.)	Arcus semper apparens (Gr.)	Arcus semper apparens (M.)	Dies continuus (D.)	Dies continuus (H.)	Dies continuus (M.)
67	22	52	22	1	40
68	40	0	52	1	16
69	52	0	54	16	25
70	61	26	64	13	46
71	70	26	74	0	0
72	78	22	82	6	39

Elevatio Poli (Gr.)	Arcus semper apparens (Gr.)	Arcus semper apparens (M.)	Dies continuus (D.)	Dies continuus (H.)	Dies continuus (M.)
73	84	56	89	4	58
74	92	12	90	7	0
75	96	20	104	1	4
76	105	16	110	7	27
77	114	20	116	14	22
78	117	6	122	17	6
79	122	46	127	9	55
80	128	22	134	4	58
81	133	50	139	31	36
82	139	6	145	6	43
83	144	22	151	2	6
84	149	36	156	3	3
85	154	42	161	5	23
86	159	50	166	11	23
87	164	52	171	21	47
88	169	58	176	5	29
89	174	58	181	21	58
90	180	10	187	6	39

Tomus II — Tabulae Novalmagesticae (continued)

[Note: the handoff expected the Primum Mobile tables (TAB. 12 onward, declination / right & oblique ascension). The pages actually present in this opening are the equation-of-time tables **TAB. 12** and **TAB. 13** and the geographic gazetteer **TAB. 14 — Catalogus Locorum Insigniorum**. Printed page numbers are 8, 9, 10.]

TAB. 12 — Equation of Time at the Sun, per Tycho, but with a different obliquity

TAB. 12. The Equation of Time at the Sun [aequatio temporis in ☉] according to Tycho [Tychone Braheo, Tycho Brahe], but with the obliquity of the ecliptic [obliquitas eclipticae] set at 23° 30' 20". Subtract from the Apparent, Add to the equal time [aequalis tempus].

The argument is the degree of the ecliptic (Gr.). The three sign-pairs share columns of minutes and seconds. Column-head sign-groups (top): ♈ & ♎ & — | ♊ & — | ♋ & ♏ [as printed; the running sign symbols are partly worn]. The right-hand margin repeats the degree (counting downward 30→0) for the complementary entry; the foot legend reads **Add to the Apparent, Subtract from the Equal** [Adde Apparenti, Subtrahe Aequali].

The first sign-group head is ♈ & ♎ & ♊ (Aries & Libra & Aquarius region), then ♊ & ♋ & ♏, then ♋ & ♌ & ♏; the symbols are abraded — read the three columns as the three sign-triplets of the standard equation-of-time layout.

Gr .	♈♎...'	"	♊...'	"	♋♏...'	"	Gr .
0	0 0	0	8 23	8	8 45	29	30
1	0 19	52	8 33	31	8 45	10	29
2	0 39	41	8 39	29	8 24	24	28
3	0 59	30	8 52	44	8 12	50	27
4	1 19	11	9 1	30	8 0	24	26
5	1 38	51	9 9	29	7 47	7	25
6	1 58	16	9 16	48	7 33	37	24
7	2 17	50	9 23	34	7 19	36	23
8	2 37	7	9 29	46	7 4	54	22
9	2 56	12	9 34	20	6 49	41	21
10	2 15	4	9 39	40	6 33	58	20
11	3 33	42	9 44	3	6 17	34	19
12	3 52	10	9 47	22	6 0	56	18
13	4 10	2	9 51	22	5 43	51	17
14	4 27	55	9 52	54	5 25	30	16
15	4 46	44	9 53	10	5 7	53	15

Gr	ᚷᚢ...'	ᚹ...'	ᚷᚢ...'	ᚹ...'	ᚷᚢ...'	ᚹ...'	Gr
16	5 2	53	9 55	45	4 49	16	14
17	5 19	59	9 53	42	4 30	18	13
18	5 36	40	9 52	50	4 10	54	12
19	5 53	2	9 50	29	3 51	18	11
20	6 8	43	9 48	46	3 31	17	10
21	6 23	37	9 45	27	3 11	9	9
22	6 39	22	9 41	59	2 50	33	8
23	6 53	59	9 37	20	2 29	48	7
24	7 8	2	9 32	9	2 8	23	6
25	7 21	43	9 26	1	1 47	14	5
26	7 29	6	9 23	22	1 26	18	4
27	7 51	38	9 11	52	1 4	54	3
28	8 0	28	9 3	50	0 43	12	2
29	8 12	2	8 54	51	0 21	41	1
30	8 23	8	8 45	29	0 0	0	0
Gr	ᚷ & ᚷ ...	ᚷ & ᚷ ...	ᚷ & ᚷ ...	ᚷ & ᚷ ...	ᚷ & ᚷ ...	Gr	

Residuum TAB. 12 — Remainder of TAB. 12 (Sun's equated anomaly, signs)

Anom. (Gr.)	0.Subtr/VI.Add	I.Subtr/VII.Add	II.Subtr/VIII.Ad	Anom. (Gr.)
0	0	0 2	3 3	3 30 2

Anom. (Gr.)	0.Subtr/VI.Add '	I.Subtr/VII.Add " '	II.Subtr/VIII.Ad " '	Anom. (Gr.)
1	0	4 2	7 3	3 29
				4
2	0	8 2	1 3	3 28
			0	6
3	0	1 2	1 3	3 27
		3	4	8
4	0	1 2	1 3	4 26
		7	7	0
5	0	2 2	2 3	4 25
		1	1	2
6	0	2 2	2 3	4 24
		6	4	4
7	0	3 2	2 3	4 23
		0	8	6
8	0	3 2	3 3	4 22
		4	1	7
9	0	3 2	3 3	4 21
		8	4	9
10	0	4 2	3 3	5 20
		2	7	0
11	0	4 2	4 3	5 19
		6	1	2
12	0	5 2	4 3	5 18
		0	4	3
13	0	5 2	4 3	5 17
		5	7	4
14	0	5 2	5 3	5 16
		9	0	6
15	1	3 2	5 3	5 15
			3	7
16	1	7 2	5 3	5 14
			6	8
17	1	1 2	5 3	5 13

Anom. (Gr.)	0.Subtr/VI.Add '	I.Subtr/VII.Add " ' "	II.Subtr/VIII.Ad ' "	Anom. (Gr.)
		1	9	9
18	1	1 3 5	2 4	0 12
19	1	1 3 9	5 4	1 11
20	1	2 3 4	8 4	2 10
21	1	2 3 8	1 4 0	2 9
22	1	3 3 2	1 4 3	3 8
23	1	3 3 6	1 4 6	3 7
24	1	4 3 0	1 4 8	4 6
25	1	4 3 4	2 4 1	4 5
26	1	4 3 7	2 4 3	4 4
27	1	5 3 1	2 4 6	5 3
28	1	5 3 5	2 4 8	5 2
29	1	5 3 9	3 4 0	5 1
30	2	3 3	3 4 2	5 0
	V. Subtr. XI. Adde	IV. Subtr. X. Adde	III. Subtr. IX. Add.	

Foot legend (full width): **Equated Anomaly of the Sun, Signs [Anomalia Solis Coaequata Signal].**

TAB. 13 — Temporary Equation of Civil (Natural) Days

13. TAB. The Temporary Equation of Civil, or Natural, Days [Temporaria Aequatio Dierum Civilium seu Naturalium], compounded from the two preceding, and serving for the year of Christ 1504, for the conversion of Apparent Time into Equal [pro conversione Temporis Apparentis in Aequale].

Argument: **Loci** ☉ (place of the Sun) in degrees (Gr., 0–30). Twelve zodiac-sign columns, each labelled **Adde** or **Subtr.**, each entry '":

Υ Adde · ϣ Subtr. · Π Subtr. · ☿ Adde · ♈ Adde · ♊ Adde · ♎ Subtr. · ♍ Subtr. · ♊ Subtr. · ♎ Subtr. · ♋ Adde · ♏ Adde.

ΥA'			☿A'	♈A'	♊A'			♎S'''	♍S'''	♊S'''	♋S'''	♏A'	♎A'
"	ϣS'''	ΠS'''	"	"	"	♎S'''	♍S'''	♊S'''	♋S'''	"	"	"	"
4 4	4 41	6 23	0 26	7 7	5 7	4 4	12 9	11	0 26	10	11		
								11		27	43		
3 44	4 54	6 16	0 43	7 13	4 53	4 24	12	10	0 A.	10	11		
							18	58	0	41	35		
3 24	5 5	6 9	1 0	7 19	4 39	4 44	12	10	0 26	10	11		
							25	43		53	25		
3 6	5 17	6 1	1 18	7 23	4 24	5 4	12	10	0 52	11 5	11		
							33	29			16		
2 46	5 28	5 53	1 35	7 26	4 9	5 24	12	10	1 19	11	11 5		
							40	13		17			
2 26	5 38	5 43	1 52	7 29	3 54	5 44	12	9 57	1 44	11	10		
							46			27	54		
2 6	5 47	5 33	2 9	7 31	3 38	6 4	12	9 39	2 9	11	10		
							51			37	42		
1 47	5 56	5 23	2 27	7 33	3 22	6 23	12	9 21	2 35	11	10		
							56			47	30		
1 27	6 4	5 12	2 43	7 34	3 5	6 43	13 0	9 2	2 59	11	10		
										54	17		
1 8	6 11	5 1	2 59	7 34	2 47	7 2	13 3	8 43	3 25	12 2	10 4		
0 48	6 11	4 49	3 16	7 33	2 31	7 20	13 5	8 23	3 50	12 8	9 51		
0 29	6 25	4 36	3 32	7 32	2 13	7 39	13 7	8 4	4 14	12	9 37		
										14			

ΥΑ' "	ϠS'''	ΠS'''	ϠΑ' "	ϠΑ' "	ΠΑ' "	ϠS'''	ΠS'''	ϠS'''	ϠS'''	ϠΑ' "	ϠΑ' "
0 10	6 31	4 23	3 47	7 31	1 54	7 58	13 8	7 43	4 38	12 19	9 22
0 S. 9	6 36	4 10	4 2	7 28	1 36	8 15	13 7	7 22	5 2	12 24	9 8
0 27	6 41	3 56	4 17	7 25	1 18	8 33	13 7	7 0	5 25	12 27	8 52
0 45	6 46	3 42	4 32	7 22	0 59	8 49	13 6	6 38	5 48	12 30	8 34
1 3	6 48	3 27	4 46	7 17	0 40	9 7	13 4	6 15	6 10	12 32	8 20
1 21	6 51	3 13	5 0	7 11	0 20	9 23	13 1	5 51	6 32	12 33	8 4
1 38	6 53	2 57	5 13	7 6	0 1	9 38	12 57	5 27	6 53	12 34	7 47
1 56	6 54	2 42	5 25	6 59	0 S. 19	9 54	12 52	5 4	7 15	12 33	7 29
2 13	6 55	2 26	5 37	6 52	0 40	10 9	12 47	4 40	7 35	12 32	7 20
2 29	6 55	2 9	5 49	6 44	1 0	10 23	12 41	4 15	7 55	12 30	6 54
2 45	6 54	1 52	6 0	6 36	1 20	10 37	12 34	3 50	8 14	12 28	6 36
3 2	6 53	1 36	6 11	6 27	1 41	10 50	12 27	3 26	8 33	12 25	6 17
3 17	6 50	1 19	6 21	6 16	2 1	11 3	12 18	3 1	8 51	12 22	5 59
3 32	6 47	1 2	6 31	6 6	2 22	11 16	12 9	2 34	9 9	12 17	5 40
3 47	6 44	0 45	6 39	5 55	2 43	11 27	11 58	2 9	9 27	12 12	5 21
4 1	6 40	0 27	6 47	5 44	3 3	11 38	11 48	1 43	9 43	12 5	5 2
4 15	6 35	0 A.	6 54	5 32	3 23	11	11	1 17	9 58	11	4 43

ΥΑ'			ϠΑ'	ϠΑ'	ⓂΑ'					≈Α'	×Α'
"	ϣS'''	ⓂS'''	"	"	"	ⒺS'''	ⓂS'''	ϣS'''	ϣS'''	"	"
		8				49	37			58	
4 28	6 29	0 A.	7 1	5 20	3 43	11	11	0 50	10	11	4 23
		8				59	25		11	52	
4 41	6 23	0 26	7 7	5 7	4 4	12 9	11	0 26	10	11	4 4
							11		27	43	

Altera TAB. — Another Table of the Temporary Equation of Civil Days (for 1736)

Altera TAB. Another Table of the Temporary Equation of Civil Days, serving exactly for the year of Christ 1736, for the conversion of Apparent into Equal [pro conversione Apparentis in Aequale].

Argument: **Loci** ☉ in degrees (Gr.). Same twelve sign-columns and Adde/Subtr. labels as TAB. 13:

Υ Adde · ϣ Subtr. · Ⓜ Subtr. · Ϡ Adde · Ϡ Adde · Ⓜ Adde · Ⓔ Subtr. · Ⓜ Subtr. · ϣ Subtr. · ϣ Subtr. · ≈ Adde · × Adde.

ΥΑ'			ϠΑ'	ϠΑ'	ⓂΑ'					≈Α'	×Α'
"	ϣS'''	ⓂS'''	"	"	"	ⒺS'''	ⓂS'''	ϣS'''	ϣS'''	"	"
4 2	4 31	6 4	0 46	7 24	5 15	4 2	12	11	0 42	10 9	11
							13	22			31
3 40	4 43	5 58	1 4	7 27	5 2	4 22	12	11 0	0 16	10	11
							23			23	23
3 23	4 51	5 50	1 21	7 32	4 47	4 43	12	10	0 A.	10	11
							29	59	9	36	13
3 5	5 6	5 42	1 39	7 36	4 36	5 3	12	10	0 35	10	11 8
							39	41		48	
2 44	5 16	5 32	1 56	7 43	4 11	5 23	12	10	1 1	11 3	10
							46	24			46
2 25	5 25	5 23	2 13	7 44	4 1	5 53	12	10 8	1 24	11	10
							51			10	43
2 6	5 35	5 13	2 29	7 45	3 45	6 2	12	9 51	1 51	11	10
							57			19	31
1 46	5 44	5 3	2 47	7 46	3 28	6 23	13 2	9 34	2 17	11	10

ΥΑ' "	ϺS'''	ΠS'''	ϠΑ' "	ϺΑ' "	ϺΑ' "	ϺS'''	ϺS'''	ϺS'''	ϺS'''	ϺΑ' "	ϺΑ' "
										28	20
1 28	5 52	4 55	3 4	7 47	3 11	6 42	13 5	9 15	2 43	11 37	9 57
1 9	5 58	4 40	3 19	7 46	2 54	7 1	13 8	8 57	3 7	11 44	9 54
0 50	6 4	4 27	3 35	7 46	2 37	7 20	13 8	8 37	3 31	11 52	9 41
0 31	6 12	4 15	3 51	7 43	2 19	7 42	13 14	8 17	3 54	11 57	9 27
0 13	6 17	4 2	4 7	7 42	1 57	7 57	13 15	7 56	4 19	12 2	9 13
0 S. 6	6 23	3 49	4 22	7 40	1 42	8 15	13 16	7 35	4 43	12 8	8 58
0 23	6 27	3 35	4 36	7 39	1 23	8 32	13 16	7 13	5 6	12 13	8 43
0 43	6 30	3 21	4 51	7 34	1 5	8 49	13 15	6 52	5 29	12 14	8 29
0 59	6 35	3 5	5 7	7 28	0 44	9 7	13 14	6 29	5 52	12 17	8 12
1 16	6 36	2 50	5 18	7 23	0 24	9 23	13 10	6 6	6 14	12 19	7 56
1 34	6 37	2 35	5 31	7 16	0 5	9 40	13 6	5 43	6 35	12 18	7 39
1 50	6 38	2 19	5 44	7 10	0 S. 15	9 55	13 0	5 19	6 56	12 18	7 23
2 7	6 39	2 3	5 56	7 3	0 35	10 11	12 57	4 55	7 16	12 17	7 5
2 20	6 37	1 47	6 19	6 53	0 56	10 25	12 50	4 30	7 36	12 15	6 48
2 38	6 37	1 32	6 30	6 46	1 16	10 39	12 44	4 6	7 55	12 14	6 30
2 54	6 35	1 15	6 39	6 37	1 36	10 53	12 36	3 41	8 15	12 11	6 12

ΥΑ'			ϠΑ'	ϠΑ'	ΜΑ'					≈Α'	×Α'
"	ϣS'''	ΠS'''	"	"	"	⋮S'''	ℳS'''	ϠS'''	ϣS'''	"	"
3 9	6 33	0 57	6 48	6 27	1 58	11 6	12 28	3 15	8 33	12 7	5 54
3 24	6 30	0 40	6 57	6 16	2 18	11 19	12 19	2 50	8 50	12 2	5 36
3 32	6 30	0 23	7 6	6 6	2 39	11 35	12 13	2 25	9 7	11 58	5 17
3 56	6 22	0 6	7 13	5 54	2 59	11 46	11 59	2 0	9 24	11 52	4 59
4 6	6 17	0 A. 12	7 20	5 37	3 20	11 53	11 48	1 33	9 39	11 42	4 40
4 19	6 11	0 28	7 22	5 29	3 41	12 4	11 36	1 8	9 54	11 39	4 21
4 31	6 4	0 46	7 24	5 15	4 2	12 13	11 22	0 8	10 9	11 31	4 2

Foot legend (full width): **If the Equal is to be converted into the Apparent, do the contrary of the Titles [Si Aequale vertendum sit in Apparens, Fac contrarium Titulis].**

Catchword: **TAB. 14.**

TAB. 14 — Catalogue of the More Notable Places

TAB. 14. CATALOGUE OF THE MORE NOTABLE PLACES [Catalogus Locorum Insigniorum].

With the Difference of Time to be Added, or Subtracted, to the Time of the Bolognese Italic Meridian [Tempus Meridiani Bononiensis Italici], and the Altitude of the North Pole [Altitudo Poli Borealis], where A is not added; taken from Book 9 of our *Reformed Geography* [Geographia Reformata], in which it is given much more fully.

Column structure (each half-page): **Names of Places [Nomina Locorum] | Difference of Time [Differentia Temporis]: H. ' '' (ad. = add / sub. = subtract) | Altitude of the Pole [Altitudo Poli]: G. ' ''** (where "A." after the altitude marks a southern/austral latitude). Place names give the Latin form, often followed by the vernacular in italic.

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Abbavilla Picardiae · <i>Abbeville</i>	0 41 27 sub.	50 0 0
Aberdona Scotiae	0 55 28 sub.	57 7 0
Alba Graeca Hungariae · <i>Belgrado</i>	0 42 0 ad.	46 28 0
Alba Iulia Transilvani · <i>Vueissemburg</i>	0 48 16 ad.	48 10 0
Alba Regalis Hungariae · <i>Alba regal</i>	0 30 40 ad.	47 5 0
Agra Mogoris	4 46 0 ad.	26 · 50
Alcmaria Hollandiae	0 26 36 sub.	52 4 39
Alepus Syriae	2 10 20 ad.	36 46 0
Alexandria Aegypti	1 32 40 A.	30 58 0
Alexandria Liguriaie	0 11 34 sub.	44 44 0
Algerium Africae	0 37 20 sub.	35 13 0
Amaguccium Iapponis	7 50 22 ad.	34 5 0
Amara Aethiopiae	1 46 0 ad.	0 30 0
Ambacia · <i>Amboise</i>	0 45 0 sub.	47 39 0
Amberga Bavariae	0 2 24 sub.	49 29 0
Ambianum <i>Amiens</i>	0 40 8 sub.	49 51 0
Amsterodamum Holland.	0 26 20 sub.	52 21 30
Ancona Italiae	0 9 44 ad.	43 54 0
Andegavi · <i>Angiers</i>	0 51 16 sub.	48 15 0
Angelopolis novae Hispan.	7 44 0 sub.	19 38 0
Angola Africae	0 16 0 ad.	9 30 A.
Angra Tertiariae Insul.	2 45 28 sub.	38 50 0
Antiochia Syriae	2 0 0 ad.	36 11 0
Antiochia ad Taurum	2 9 0 ad.	35 30 0
Antuerpia Brabantiae	0 24 40 sub.	51 12 0
Aquapulchum Mexici · <i>Aquapulcho</i>	7 22 28 sub.	15 30 0
Aquila Samnitem	0 10 52 ad.	42 42 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Aquae Sextiae · <i>Aix</i>	0 26 0 sub.	43 33 0
Aquisgranum · <i>Aken</i>	0 21 0 sub.	50 46 0
Aracta Syriae	2 12 0 ad.	36 0 0
Arbela Assyriae · <i>Erbel</i>	2 32 48 ad.	35 0 0
Argentina · <i>Straesburg</i>	0 16 4 sub.	48 31 0
Argentomagum · <i>Argenton</i>	0 41 12 sub.	46 54 0
Arelatum · <i>Arles</i>	0 29 20 sub.	43 36 0
Ariminum Cisalpinae · <i>Rimini</i>	0 4 56 ad.	44 14 0
Armutia · <i>Ormuz</i>	3 20 0 ad.	27 35 0
Astracenum	3 10 0 ad.	49 30 0
Athenae Graeciae · <i>Sethines</i>	0 55 0 ad.	37 40 0
Atrebatum · <i>Arras</i>	0 38 24 sub.	50 9 0
Avenio · <i>Avignon</i>	0 29 12 sub.	43 52 0
Augusta Vindelicorum · <i>Augsburg</i>	0 2 30 sub.	48 24 0
Aurelianum · <i>Orleans</i>	0 43 16 sub.	47 55 0
Aurantia · <i>Oranges</i>	0 29 0 sub.	44 6 0
Babylon vetus · <i>Baldac</i>	2 27 0 ad.	34 30 0
Babylon nova · <i>Bagded</i>	2 26 0 ad.	33 25 0
Baiona Cantabriae	1 27 40 sub.	42 8 0
Bamberga Franconiae	0 2 44 sub.	49 56 0
Barcino · <i>Barcellona</i>	0 39 20 sub.	41 26 0
Barium Apuliae · <i>Bari</i>	0 25 24 ad.	41 13 0
Basilea Helvetiae · <i>Basel</i>	0 16 40 sub.	47 52 0
Bellovacum · <i>Beauvois</i>	0 40 20 sub.	49 18 0
Bellunum · <i>Ciudaldi Bellun</i>	0 1 44 ad.	46 13 30
Benatica arx Bohemiae	0 13 0 ad.	50 18 30
Bengala Indiae	5 34 0 ad.	21 56 0
Beneventum · <i>Beneuento</i>	0 17 27 ad.	41 18 0
Berga Norvegiae	0 14 40 sub.	61 0 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Bergomum · <i>Bergamo</i>	0 7 28 sub.	45 43 0
Berona, seu Berna · <i>Bern</i>	0 17 28 sub.	47 2 0
Biturix · <i>Bourges</i>	0 39 34 sub.	47 20 0
Blaesae · <i>Bloys</i>	0 43 0 sub.	47 46 0
Bolonia Normadiae · <i>Boulogne</i>	0 41 32 sub.	50 40 0
Bononia Italiae · <i>Bologna</i>	0 0 0	44 30 20
Borbonia Lancysia · <i>Borbon</i> <i>Lancy</i>	0 34 56 sub.	46 57 0
Bracara · <i>Braga</i>	1 24 32 sub.	41 48 0
Brandeburgum	0 8 0 ad.	52 16 0
Bransvicum · <i>Brunsuich</i>	0 1 4 sub.	52 15 0
Brema Saxoniae · <i>Bremen</i>	0 11 4 sub.	53 8 0
Brigantia · <i>Braganza</i>	1 17 40 sub.	41 46 0
Brigantium · <i>Bryaionzon</i>	0 19 48 sub.	44 48 0
Brixia · <i>Brescia</i>	0 4 40 sub.	45 32 0
Brundusium · <i>Brindisi</i>	0 29 46 ad.	40 47 20
Bruxellae · <i>Brusselles</i>	0 25 0 sub.	50 48 0
Buda Hungariae · <i>Ofen</i>	0 33 28 ad.	47 46 0
Burdegala · <i>Bordeos</i>	0 50 48 sub.	45 12 0
Byzantium · <i>Constantinopoli</i>	1 20 0 ad.	42 56 0
Caesaraugusta · <i>Saragoza</i>	0 52 0 sub.	41 48 0
Cadomum · <i>Caën</i>	0 49 20 sub.	49 10 0
Calagurris · <i>Calahorra</i>	0 58 44 sub.	42 40 0
Calecutium · <i>Calicut</i>	2 28 0 ad.	11 0 0
Calecutium · <i>Cales</i>	0 41 20 sub.	51 0 0
Cambaia Indiae	4 14 0 ad.	22 40 0
Camboia Indiae · <i>Cambogia</i>	6 12 40 ad.	11 20 0
Cameracum · <i>Cambray</i>	0 36 44 sub.	50 4 50
Cantabrigia Angliae · <i>Cābrigde</i>	0 47 52 sub.	52 12 0
Canatia Insula	2 7 40 sub.	28 25 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Canton Chinae	6 45 18 ad.	24 0 0
Capua · <i>Capoa</i>	0 15 28 ad.	41 20 0
Caput S. Augustini	3 4 40 sub.	8 10 A.
Caput Anguillati · <i>C. das Agullas</i>	0 38 0 ad.	34 58 A.
Caput Bonae Spei	0 31 20 ad.	34 32 A.
Cap. Blancum Africae	2 13 40 sub.	20 32 0
Cap. Currentium Africae	1 42 0 ad.	24 0 A.
Cap. Desideratu · <i>C. Defeado</i>	6 26 0 sub.	52 58 A.
Cap. Finis Terrae · <i>Celticum Promont.</i>	0 50 48 sub.	43 5 0
Cap. Gardafuis · <i>Promôt. Aromata</i>	3 1 40 ad.	12 0 0
Cap. Lisardum Angliae · <i>C. Lezardo</i>	1 9 40 sub.	50 4 0
Caput Mendocinum	10 35 20 sub.	42 42 0
Cap. Viride · <i>C. Verde</i>	2 13 48 sub.	14 27 0
Carmutum · <i>Chartres</i>	0 44 0 sub.	48 30 0
Carthago Africae	0 0 28 ad.	35 10 0
Casale S. Evasii	0 12 8 sub.	44 54 30
Cassellae Hassiae · <i>Casselen</i>	0 10 0 sub.	51 19 40
Catana Siciliae · <i>Catania</i>	0 15 32 ad.	37 36 32
Catacium · <i>Catanzaro</i>	0 23 0 ad.	39 5 6

Catchword (foot of p. 9): **Cau-**

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Caucincina	6 18 0 ad.	18 55 0
Cayrum · <i>Memphis</i>	1 37 0 ad.	29 50 0
Ceilanum · <i>Zeilan</i>	4 46 0 ad.	7 50 0
Cephalaenia · <i>Cefalonia</i>	0 40 24 ad.	37 12 0
Cesena · <i>Cesena</i>	0 3 24 ad.	44 13 0
Chios Scio Insulae urbs	1 9 0 ad.	38 30 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Cibinium · <i>Hermenstatt</i>	0 51 20 ad.	48 16 0
Claramontium Auerniae · <i>Clermont</i>	0 38 8 sub.	46 11 0
Claudiopolis · <i>Claussemburg</i>	0 46 0 ad.	48 25 0
Clivia <i>Clives</i>	0 21 44 sub.	51 48 30
Coccinum · <i>Cochin</i>	3 2 28 ad.	9 25 0
Colonia Agrippina · <i>Coln</i>	0 18 0 sub.	50 54 50
Comorinum	4 26 8 ad.	8 0 0
Complurum · <i>Alcalà d'Henares</i>	1 2 52 sub.	4 28 0
Compostella	1 26 0 sub.	42 58 0
Comum · <i>Como</i>	0 9 56 sub.	45 43 0
Coceptionis Urbs Chilensis regni	6 2 0 sub.	36 38 A.
Confluentia Mosae & Rheni · <i>Coblens</i>	0 19 40 sub.	50 22 0
Conimbrica · <i>Coimbra</i>	1 25 52 sub.	40 30 0
Constantia · <i>Costniz</i>	0 10 12 sub.	47 42 0
Constantinopolis	1 20 26 ad.	42 56 0
Corcyra · <i>Corfu</i>	0 34 32 ad.	39 37 0
Corduba · <i>Cordoua</i>	1 10 24 sub.	37 56 0
Corona Transilu. · <i>Cronstatt</i>	0 56 12 ad.	48 28 50
Corui Insula Azoridum	3 3 20 sub.	40 3 0
Cosentia Apuliae · <i>Cosenza</i>	0 21 35 ad.	39 28 0
Cracovia · <i>Cracauu</i>	0 34 0 ad.	50 10 0
Crema · <i>Crema</i>	0 6 52 sub.	45 16 0
Cremona	0 5 52 sub.	45 1 0
Creta · <i>Candia urbs Insulae</i>	1 8 8 ad.	34 40 0
Crosna Silesiae · <i>Crossen</i>	0 14 40 ad.	52 6 30
Curia Heluet. <i>Coira, & Chur</i>	0 7 20 sub.	46 28 0
Cuscum Peruvii · <i>Cuzco</i>	5 42 0 sub.	12 25 A.
Damascus Syriae · <i>Damasco</i>	2 6 0 ad.	33 10 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Dantiscum · <i>Danziga</i>	0 32 0 ad.	54 22 0
Deppa Normandiae · <i>Dieppe</i>	0 44 22 sub.	49 34 0
Dauentia · <i>Deuenter</i>	0 18 0 sub.	53 11 0
Dertona · <i>Tortona</i>	0 10 30 sub.	44 5 0
Dertosa · <i>Tortosa</i>	0 46 48 sub.	40 46 0
Dillinga Germaniae · <i>Dillingen</i>	0 13 20 sub.	48 30 0
Dinia Provinciae · <i>Digne</i>	0 22 0 sub.	44 5 45
Diuiio · <i>Digion</i>	0 28 0 sub.	47 28 0
Dola Burgundiae · <i>Dole</i>	0 27 0 sub.	47 20 0
Drepanum · <i>Trapani</i>	0 4 4 ad.	37 32 0
Dresda Misniae · <i>Dresden</i>	0 10 16 ad.	51 5 0
Duacum · <i>Duay</i>	0 37 28 sub.	50 15 0
Dublynum Hiberniae · <i>Dublyn</i>	1 16 0 sub.	53 11 0
Dyrrhachium · <i>Durazzo</i>	0 34 33 ad.	41 58 0
Ebora · <i>Euora</i>	1 34 0 sub.	38 22 0
Eboracum Scotie · <i>Yorch</i>	0 52 40 sub.	53 57 0
Ebroica · <i>Eurex</i>	0 43 40 sub.	48 42 0
Edemburgum Scotiae	1 1 12 sub.	55 47 0
Egra Bohemiae	0 1 1 ad.	50 1 0
Emuda · <i>Embdem</i>	0 17 4 sub.	53 5 40
Emerita · <i>Merida</i>	1 18 16 sub.	38 54 0
Epidaurus · <i>Ragusa</i>	0 27 12 ad.	42 33 0
Erefordia Turingie · <i>Erfurd</i>	0 0 28 ad.	51 6 0
Eugubium · <i>Agubio</i>	0 5 28 ad.	43 8 0
Eycstadium Bavariae · <i>Eycstad</i>	0 4 0 sub.	48 53 30
Famagusta Cypri · <i>Salamin</i>	0 48 0 ad.	35 18 0
Fanum Fortunae · <i>Fano</i>	0 6 46 ad.	44 4 0
Fauentia · <i>Faenza</i>	0 1 56 ad.	44 33 15
Ferraria Italiae · <i>Auctoris</i>	0 1 3 ad.	44 54 15

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
<i>Patria</i>		
Ferri Insula Fortunata · <i>Is. del Ferro</i>	2 18 0 sub.	28 10 0
Fessa Mauritaniae · <i>Fez</i>	1 11 0 sub.	33 10 0
Florentia Hetruriae · <i>Fiorenza</i>	0 0 30 ad.	43 41 0
Flensburgum Iutlandiae	0 5 8 sub.	54 58 0
Florum Insula · <i>Flores Azoridum</i>	3 3 24 sub.	39 35 0
Forum Cornelij · <i>Imola</i>	0 1 26 ad.	44 26 40
Forum Iulij · <i>Friuli</i>	0 6 44 ad.	46 17 0
Forum Liuij · <i>Forli</i>	0 2 40 ad.	44 17 0
Forum Sempronij · <i>Fossambruno</i>	0 6 20 ad.	43 52 0
Francofurtum Moeni · <i>Francfort</i>	0 13 16 sub.	50 4 0
Francofurtum Oderae	0 14 0 ad.	52 20 0
Franequera Frisiae · <i>Franeker</i>	0 23 0 sub.	53 12 30
Friburgum Brisgoiae	0 15 28 sub.	48 16 0
Fruemburgum Prussiae	0 36 20 ad.	54 29 0
Fulda Hassiae · <i>Fuld</i>	0 11 12 sub.	50 42 0
Fulgina · <i>Foligno</i>	0 6 8 ad.	42 48 30
Gades · <i>Cadiz</i>	1 16 56 sub.	36 16 0
Gandauum · <i>Gant</i>	0 33 36 sub.	51 2 30
Gaugamela Assiriae	2 33 0 ad.	35 2 0
Geldria · <i>Gelder</i>	0 21 12 sub.	51 30 0
Geneua · <i>Geneura</i>	0 22 56 sub.	46 20 0
Genua · <i>Genoua</i>	0 9 0 sub.	44 27 0
Geilolum · <i>Gilolo</i>	7 28 20 ad.	1 0 0
Gerunda · <i>Girona</i>	0 36 48 sub.	42 8 0
Glacium · <i>Glatz</i>	0 20 8 ad.	50 28 0

Name (Latin · vernacular)	Diff. Time H ' "	Alt. Pole G ' "
Goa Indiae	4 18 0 ad.	15 30 0
Goësa Zelandiae	0 31 0 sub.	51 30 30
Gorliciu Silesiae · <i>Gorlitz</i>	0 14 48 ad.	51 14 0
Gratiana Croatiae · <i>Gradisca</i>	0 7 32 ad.	46 8 0
Gratianopolis · <i>Granoble</i>	0 25 0 sub.	45 11 30
Gratium Styriae · <i>Gratz</i>	0 20 40 ad.	47 2 0
Grodnum Samogitiae · <i>Grodñ</i>	0 47 20 ad.	53 25 0
Grinnis, seu Groninga · <i>Groningen</i>	0 19 36 sub.	53 8 0
Grypsuualdia Pomeraniae · <i>Grypsuald</i>	0 11 4 ad.	54 14 0
Hafnia · <i>Copenhauen</i>	0 5 32 ad.	55 43 0
Halaria Islandiae · <i>Halar</i>	1 58 40 sub.	67 26 0
Halberstadiu Saxoniae · <i>Halberstatt</i>	0 0 44 ad.	51 56 0
Halla Saxoniae · <i>Hall</i>	0 4 48 ad.	51 32 0
Hamburgum Holsatiae · <i>Hamburg</i>	0 5 44 sub.	53 42 50
Heidelberga <i>Heidelberg</i>	0 12 8 sub.	49 22 0
Herbipolis · <i>Vuirtzburg</i>	0 7 0 sub.	49 45 0
Hildesemium Saxoniae · <i>Hildesem</i>	0 4 12 sub.	52 8 0
Hierosolyma · <i>Gierusalemme</i>	1 56 0 ad.	32 0 0
Hispalis · <i>Siuiglia</i>	1 15 44 sub.	37 36 0

Catchword (foot of p. 10): **Hyro-**

TAB. 14 — *Catalogus Locorum Insigniorum* (Catalogue of Notable Places) [continued]

This is a gazetteer giving, for each place, the **difference of time** [Differentia Temporis] from the Bologna meridian (hours H. / minutes ' / seconds ", with ad. = *to be added* and sub. = *to be subtracted*) and the **altitude of the pole** [Altitudo Poli] (degrees G. / minutes ' / seconds "). A trailing A. in the pole-altitude column

marks a southern (austral) latitude; where no A. appears, the northern hemisphere is implied. The vernacular name follows the Latin in *italic* where given. The columns run across the page in two panels (left and right); they are transcribed here as a single continuous list, left panel first, then right panel, page by page.

Left panel:

Place name [Nomina Locorum]	H				G		
	.	'	"	ad./sub.	.	'	"
Hurones nouæ Franciæ (Hurons of New France)	6	9	0	sub.	4	40	0
Hydruntum. <i>Otranto</i>	0	31	20	ad.	4	18	0
S. Iacob. Inf. Hesperid. <i>S. Iago</i> (St. James, of the Cape Verde Islands)	2	39	20	sub.	1	50	0
Iauæ maioris medium (middle of Greater Java)	6	18	16	ad.	6	30	A.
Iauæ minoris medium (middle of Lesser Java)	6	30	56	ad.	7	40	A.
Ieroslauiā Massouiæ. <i>Ieroslaui</i> (Yaroslavl of Mazovia)	0	42	48	ad.	5	40	0
Ilerda. <i>Lerida</i>	0	46	0	sub.	4	30	0
Imperialis, vrbs Chilensis Regni (Imperial, a city of the Kingdom of Chile)	5	34	0	sub.	3	0	A.
Ingolstadium Bauariæ. <i>Ingstad</i> (Ingolstadt of Bavaria)	0	0	30	sub.	4	40	0
Iuliacum Giuliech, & <i>Giuliers</i> (Jülich)	0	16	14	sub.	5	54	54
Kebekum nouæ Franciæ. <i>Quebec</i> (Quebec of New France)	5	16	0	sub.	4	0	0
Lancastria Angliæ (Lancaster, England)	0	58	56	sub.	5	3	0
Lancerotta Insula Fortunatarum (Lanzarote, of the Fortunate Isles)	1	55	20	sub.	2	50	0

Place name [Nomina Locorum]	H				G			
	.	'	"	ad./sub.	.	'	"	
Landishutum Bauariæ. <i>Landshut</i> (Landshut of Bavaria)	0	13	28	sub.	4 2	28	0	
Lausanna Heluetiæ. <i>Losanna</i> (Lausanne, Switzerland)	0	16	40	sub.	4 6	40	0	
Lauretum. <i>Loreto</i>	0	10	26	ad.	4 3	41	0	
Legio Hispaniæ. <i>Leon</i> (León, Spain)	1	13	12	sub.	4 2	54	0	
Leodiū. <i>Liege</i> , & <i>Luych</i> (Liège)	0	23	0	sub.	5 0	40	0	
Lemouices. <i>Lemoges</i> (Limoges)	0	48	0	sub.	4 6	0	0	
Leopolis Russiæ. <i>Leburg</i> (Lviv, Ruthenia)	0	48	0	ad.	5 0	6	0	
Leouardia Frisiæ. <i>Leuuayden</i> (Leeuwarden, Friesland)	0	22	16	sub.	5 3	13	40	
Liburnum. <i>Porto di Liorno</i> (Livorno)	0	4	0	ad.	4 3	18	0	
Lilybeū. <i>Capo di Marsalla</i> (Marsala)	0	3	56	ad.	3 7	20	53	
Lima Peruuij. <i>Città de los Reies</i> (Lima, Peru)	6	11	0	sub.	1 2	20	A.	
Lingones Lágres. <i>Lini</i> [?] (Langres)	0	26	40	sub.	4 8	10	0	
Lincium Austriæ (Linz, Austria)	0	13	0	ad.	4 8	20	0	
Lindauia Sueuiæ. <i>Lindau</i> (Lindau, Swabia)	0	7	40	sub.	4 7	28	0	
Lipsia Misniæ. <i>Lipsi</i> , & <i>Leipsig</i> (Leipzig, Meissen)	0	6	0	ad.	5 1	19	15	
Lodunum. <i>Lodum</i> , seu Iuliodunum (Loudun)	0	48	0	sub.	4 8	1	0	
Londinum. <i>Londra</i> (London)	0	48	0	sub.	5	32	0	

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
						1		
Louanium. <i>Louagno</i> (Leuven)	0	27	20	sub.		5	50	0
						0		
Lubecca Holsatiæ. <i>Lubek</i> (Lübeck, Holstein)	0	1	52	sub.		5	1	0
						4		
Lublinum Lituaniæ (Lublin, Lithuania)	0	42	0	ad.		5	8	0
						1		
Luca Hetruriæ. <i>Lucca</i> (Lucca, Tuscany)	0	3	12	sub.		4	40	0
						3		
Lucenburgū. <i>Luxemburg</i> (Luxembourg)	0	20	20	sub.		4	38	0
						9		
Lucerna Heluetiæ. <i>Lucern</i> (Lucerne, Switzerland)	0	14	28	sub.		4	59	0
						6		
Lugdunum Batauorum. <i>Leyda</i> (Leiden)	0	28	0	sub.		5	12	0
						2		
Lugdunum Galliæ. <i>Lion di Francia</i> (Lyon)	0	28	0	sub.		4	48	0
						5		
Macaū Chinæ, & Amacaum. <i>Macao</i> (Macau, China)	6	45	0	ad.		2	13	0
						2		
Machlinia. <i>Machelen</i> (Mechelen)	0	28	0	sub.		5	59	50
						0		
Macerata Piceni (Macerata, the Marches)	1	9	32	ad.		4	33	0
						3		
Maciana Insula Moluca. <i>Macian</i> (Makian, of the Moluccas)	7	18	16	ad.		0	12	0
Magdeburgum (Magdeburg)	0	3	28	ad.		5	14	0
						2		
Maij Inf. Hesperidum. <i>Is. del Maio</i> (Maio, of the Cape Verde Islands)	2	36	40	sub.		1	48	0
						4		
Maiorica <i>Mallorca</i> [Majorca]	0	37	0	sub.		3	35	0
						9		

Right panel:

Place name [Nomina Locorum]	H			ad./sub.	G		
	.	'	"		.	'	"
Malacca Indiæ (Malacca, the Indies)	5	5	4	ad.	2	2	0
		4	0			0	
Malaca Hispaniæ. <i>Malaga</i> (Málaga, Spain)	1	1	1	sub.	3	3	0
		0	2		6	7	
Maclouium. <i>S. Malò</i> (Saint-Malo)	0	5	4	sub.	4	3	0
		6	0		8	0	
Manicongum Africæ (Manikongo, Africa)	0	2	2	ad.	6	0	A.
		7	0				
Manila Luzoniæ (Manila, Luzon)	7	6	0	ad.	1	4	0
					4	6	
Mansfeldia Saxonæ. <i>Mansfeld</i> (Mansfeld, Saxony)	0	2	2	ad.	5	4	0
			4		1	0	
Mantua. <i>Mantua</i> (Mantua)	0	3	0	sub.	4	1	0
					5	1	
S. Maria Insula Azoridū (St. Mary, of the Azores)	3	3	0	sub.	3	8	0
		2			7		
Marigalanta Isola (Marie-Galante)	4	5	0	sub.	1	4	0
		6			5	8	
Maurocum. <i>Marrocco</i> (Marrakesh)	1	2	0	sub.	3	1	0
		8			1	2	
Martinina Inf. <i>Martinina</i> (Martinique)	4	5	0	sub.	1	1	0
		5			4	4	
Massilia. <i>Marsilia</i> (Marseilles)	0	2	0	sub.	4	2	0
		6			3	0	
Masisco. <i>Mascon</i> (Mâcon)	0	2	2	sub.	4	2	0
		9	0		6	0	
Matritum. <i>Madrid</i> (Madrid)	1	5	0	sub.	4	2	0
					0	6	
Meacū Iapponiæ. <i>Meaco</i> (Miyako/Kyoto, Japan)	8	1	3	ad.	3	0	0
		1	2		6		
Mecha Arabiæ. <i>Meccah</i> (Mecca, Arabia)	2	2	0	ad.	2	4	0
		6			3	0	
Mediolanum. <i>Milano</i> (Milan)	0	9	0	sub.	4	1	0

Place name [Nomina Locorum]	H			ad./sub.	G		
	.	'	"		.	'	"
					5	4	
Meldæ. <i>Meaulx</i> (Meaux)	0	3	3	sub.	4	5	30
		7	6		8	6	
Mechuacania nouæ Hispaniæ (Michoacán, New Spain)	7	5	4	sub.	2	1	0
		6	8		0	6	
Meliapora. <i>Città di S. Tomaso</i> (Mylapore / San Thomé)	4	3	1	ad.	1	3	0
		8	6		3	0	
Melinda Africæ (Malindi, Africa)	1	5	4	[ad. or sub.?] [?]	2	4	A.
		4	0			5	
Melodunum. <i>Melung</i> (Melun)	0	3	4	sub.	4	2	0
		8			8	8	
Melita. <i>Malta</i> (Malta)	0	1	0	ad.	3	4	0
		3			5	0	
Messana Siciliæ. <i>Messina</i> (Messina, Sicily)	0	1	4	ad.	3	2	0
		7	4		8	1	
Metæ. <i>Metz</i> (Metz)	0	2	2	sub.	4	1	0
		1	0		9	0	
Mexicum. <i>Messico</i> (Mexico City)	7	4	0	sub.	2	1	0
		8			0	0	
S. Michael Archangelus in Russia (St. Michael the Archangel, in Russia — Arkhangelsk)	2	8	4	ad.	6	3	0
			0		5	0	
S. Michaelis Insula Azoridum (St. Michael, of the Azores)	2	3	8	sub.	3	4	0
		9			7	0	
Middelburgū Zelandiæ (Middelburg, Zeeland)	0	3	0	sub.	5	3	0
		1			1	0	
Mindanao Insula (Mindanao)	7	1	2	ad.	7	1	0
		9	0			0	
Minorica. <i>Minorca</i> (Minorca)	0	3	0	sub.	3	5	0
		0			9	3	
Mirandula. <i>Mirandola</i> (Mirandola)	0	1	1	sub.	4	5	30
			3		4	4	

Place name [Nomina Locorum]	H			ad./sub.	G		
	.	'	"		.	'	"
Moguntia. <i>Mogonza</i> (Mainz)	0	1	0	sub.	5	2	0
		4			0		
Monachium Bauariæ. <i>Munchen</i> (Munich, Bavaria)	0	0	1	ad.	4	5	0
			0		8	8	
Monæcus Liguriæ. <i>Monaco</i> (Monaco)	0	1	2	sub.	4	3	30
		7	4		3	9	
Monasteriū Vuestphaliæ. <i>Munster</i> (Münster, Westphalia)	0	1	2	sub.	5	0	0
		4	5		2		
Mons Albanus. <i>Montalbano</i> (Montauban)	0	4	1	sub.	4	2	0
		2	6		4	2	
Mons Pessulanus. <i>Mompelier</i> (Montpellier)	0	3	2	sub.	4	3	0
		2	0		3	8	
Mons Regis Prussiæ. <i>Konisberg</i> (Königsberg, Prussia)	0	3	0	ad.	5	4	0
		8			4	3	
Mons Serratus. <i>Montserrat</i> (Montserrat)	0	4	2	sub.	4	4	0
		2	0		1	0	
Moscua. <i>Moscouia</i> (Moscow)	2	0	0	ad.	5	1	0
					5	8	
Mutina. <i>Modena</i> [Modena]	0	1	3	sub.	4	3	50
			4		4	8	
Mussipons, seu Mosæpons. <i>Portamuson</i> (Pont-à-Mousson)	0	2	4	sub.	4	5	0
		1	8		8	4	
Namurcum. <i>Namur</i> (Namur)	0	2	4	sub.	5	2	0
		6	8		0	6	
Nanchinum Sinarum. <i>Nanking</i> (Nanjing, China)	6	5	0	ad.	3	4	0
		6			2	0	
[continued name — see below]				ad.	3	1	0
					2	5	
Nanceium. <i>Nansy</i> (Nancy)	0	2	4	sub.	4	3	0
		0	8		8	9	
Nannetes. <i>Nantes</i> (Nantes)	0	5	4	sub.	4	1	0
		4	8		8	3	
Nangasachium Ipponiæ.	7	4	3	ad.	3	5	0

Place name [Nomina Locorum]	H				G		
	.	'	"	ad./sub.	.	'	"
<i>Nangasachi</i> (Nagasaki, Japan)	4	2			2	3	
Nanquinum Chinæ (Nanjing, China)	6	5	4	ad.	3	1	0
		5	4		2	5	
vel (or)	7	1	1	ad.	3	4	0
		0	6		2	0	
Narbona Galliæ. <i>Narbona</i> (Narbonne)	0	3	4	ad.	4	2	0
		6	0		3	2	
Narsinga Indiæ (Narsinga / Vijayanagara, India)	4	4	4	ad.	1	1	0
		6	0		8	5	
Natua Liuoniæ (Narva, Livonia)	1	1	0	ad.	5	6	0
		0			9		

Left panel:

Place name [Nomina Locorum]	H				G		
	.	'	"	ad./sub.	.	'	"
Neapolis. <i>Napoli</i> (Naples)	0	16	0	ad.	4	5	0
					1		
Neoburgum Bauariæ (Neuburg, Bavaria)	0	1	32	sub.	4	39	30
					8		
Nigropolis Russiæ	0	51	20	ad.	4	14	0
					9		
Nicosia Cypri (Nicosia, Cyprus)	1	45	20	ad.	3	32	0
					5		
Nicea Prouinciæ. <i>Nizza di Prouenza</i> (Nice, Provence)	0	18	8	sub.	4	38	0
					3		
Niuernium. <i>Niuers</i> (Nevers)	0	38	16	sub.	4	19	0
					7		
Nuceria Vmbriæ. <i>Nocera</i> (Nocera, Umbria)	0	16	44	ad.	4	55	0
					0		
Nola Campaniæ (Nola, Campania)	0	16	28	ad.	4	7	30
					1		
Norimberga Franconiæ. <i>Nurinberg</i> [Nuremberg, Franconia]	0	2	40	sub.	4	26	0
					9		

Place name [Nomina Locorum]	H				G			
	.	'	"	ad./sub.	.	'	"	
Nouatia. <i>Nouara</i> (Novara)	0	11	58	sub.	4	10	0	
					5			
Oldenburgum Vuestphaliæ (Oldenburg, Westphalia)	0	13	4	sub.	5	9	0	
					3			
Olinda Brasilæ (Olinda, Brazil)	3	6	0	sub.	7	48	A.	
Oenipontum Norici. <i>Ispruck</i> (Innsbruck, Noricum)	0	0	5	sub.	4	10	0	
					7			
Olomuntium Morauïæ. <i>Olmitz</i> (Olomouc, Moravia)	0	20	32	ad.	4	35	0	
					9			
Omura Iapponiæ (Ōmura, Japan)	7	45	12	ad.	3	0	0	
					3			
Ottosia. <i>Tortosæ Sytiæ</i> (Tortosa, Syria)	2	3	0	ad.	3	0	0	
					5			
Otopitum. <i>Oruieto</i> (Orvieto)	0	4	0	ad.	4	36	0	
					2			
Osca. <i>Huesca</i> (Huesca)	0	50	0	sub.	4	10	0	
					2			
Ostenda Flandriæ. (Ostend, Flanders)	0	36	56	sub.	5	16	0	
					1			
Osnabruga. <i>Osnebruga</i> (Osnabrück)	0	12	44	sub.	5	25	0	
					2			
Oxonium. <i>Oxford</i> (Oxford)	0	53	0	sub.	5	46	0	
					1			
Ozaca Iapponiæ (Osaka, Japan)	8	4	52	ad.	3	5	0	
					5			
Pachinum Promontoriū. <i>Capo Passero</i> (Cape Passero)	0	16	24	ad.	3	32	50	
					6			
Paderbona Vuestphaliæ. <i>Palborn</i> (Paderborn, Westphalia)	0	9	0	sub.	5	40	0	
					1			
Palantia. <i>Palenza</i> (Palencia)	1	9	8	sub.	4	5	0	
					2			
Palma Vrbs Insulæ Fortun. (Palma, city of the Fortunate Isle)	2	18	0	sub.	2	55	0	
					8			

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
Palma noua Venetorum (Palmanova, of the Venetians)	0	6	46		ad.	4 6	4	0
Pampelon. <i>Pamplona</i> (Pamplona)	0	53	36		sub.	4 3	20	0
Panama Americæ (Panama, America)	6	23	0		sub.	9	10	0
Panormus. <i>Palermo</i> (Palermo)	0	7	0		ad.	3 8	10	0
Papia, & Ticini. <i>Pauia</i> (Pavia)	0	9	4		sub.	4 4	58	0
Parisij, & Lutetia. <i>Parigi</i> (Paris)	0	40	0		sub.	4 8	50	0
Parma Lombardiæ	0	4	14		sub.	4 4	44	50
Patauia Norica. <i>Passau</i> (Passau, Noricum)	0	8	40		ad.	4 8	30	0
Patauium. <i>Padoua</i> (Padua)	0	2	4		ad.	4 5	31	0
Pelusium. <i>Damiata</i> (Pelusium / Damietta)	1	44	40		ad.	3 1	25	0
Peguuium Indiæ. <i>Pegù</i> (Pegu, the Indies)	5	46	0		ad.	2 0	0	0
Pequinum. <i>Peking</i> , & Quinsai Sinarum (Beijing, & Quinsai, China)	7	4	32		ad.	4 0	0	0
vel (or)	6	57	12			3 9	59	0
Pernambucum Brasiliæ (Pernambuco, Brazil)	3	37	20		sub.	7	40	A.
Persepolis. <i>Siras</i> , vel Siraz (Persepolis / Shiraz)	3	2	0		ad.	3 4	14	0
Petrogorium. <i>Perigux</i> (Périgueux)	0	43	12		sub.	4 5	34	0
Perpinianū. <i>Perpignano</i> (Perpignan)	0	34	48		sub.	4 2	52	0

Place name [Nomina Locorum]	H			ad./sub.	G		
	.	'	"		.	'	"
Perusia, & Petusium. <i>Perugia</i> (Perugia)	0	4	40	ad.	4	56	0
					2		
Petouio Styriæ. <i>Pettauu</i> (Ptuj, Styria)	0	24	40	ad.	4	40	0
					0		
Picus Insula Azoridum (Pico, of the Azores)	2	53	0	sub.	3	46	0
					8		
Pictauia. <i>Poictiers</i> (Poitiers)	0	46	8	sub.	4	7	0
					7		
Pisarum. <i>Pisa</i> (Pisa)	0	1	40	sub.	4	9	0
					3		
Pistorium. <i>Pistoia</i> (Pistoia)	0	1	42	sub.	4	42	0
					3		
Placentia Lombardiæ. <i>Piacenza</i> (Piacenza)	0	6	58	sub.	4	52	40
					4		
Placentia Cantabriæ. <i>Placenza</i> (Plasencia)	1	1	4	sub.	4	38	0
					3		
Placentia Castellæ (Plasencia, Castile)	1	14	48	sub.	4	4	0
					0		
Plescouia Russiæ. <i>Plescouu</i> (Pskov, Russia)				ad.	5	2	0
					9		
Pola Istriæ. <i>Pola. Pietas Iulia</i> (Pula, Istria)	0	12	4	ad.	4	20	0
					5		

Right panel:

Place name [Nomina Locorum]	H			ad./sub.	G		
	.	'	"		.	'	"
Polosckum. <i>Polozzko</i> (Polotsk)	1	6	40	ad.	5	28	0
					5		
Pons Mosellanus. <i>Pontamuson</i> (Pont-à-Mousson)	0	17	48	sub.	4	54	0
					8		
Portus Bellus Americæ (Portobelo, America)	6	21	20	sub.	9	55	0
Portus Desiderij. <i>Porto Desire</i> (Port	5	48	40	sub.	4	50	A.

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
Desire / Puerto Deseado)						7		
Portus Gratianus. <i>Haure de Grace</i> (Le Havre)	0	48	16	sub.		4	7	0
Portus vetus. <i>Porto veio</i> (Portovecchio)	6	25	0	sub.		1	10	A.
Posoniū. <i>Presburg</i> . Hungariæ (Bratislava / Pressburg, Hungary)	0	47	12	ad.		4	19	0
Posnania Poloniæ. <i>Poznan</i> (Poznań, Poland)	0	25	0	ad.		5	20	0
Potoseum. <i>Potosi</i> (Potosí)	5	29	20	sub.		2	40	A.
Praga Bohemiæ. <i>Prag</i> [Prague, Bohemia]	0	11	30	ad.		5	40	30
Promontorium Aromata. <i>Capo di Cardasuy</i> (Cape Aromata / Cape Guardafui)	3	1	40	ad.		1	0	0
Promontoriū Bonæ Spei (Cape of Good Hope)	0	31	20	ad.		3	32	A.
Promontoriū Corodaipum. <i>C. Ras Algate</i> (Cape Ras al-Hadd / Ras Algate)	3	34	0	ad.		2	10	0
Promontoriū Sammonicum. <i>C. Salomone</i> (Cape Sammonium / Cape Salomon)	1	14	48	ad.		3	10	0
Promontorium Saitum. <i>Capo di S. Vincenzo</i> (Cape St. Vincent)	1	29	20	sub.		3	35	0
Promontoriū Celticum, vel Attabrū. <i>Capo di Finis terra</i> (Celtic Cape / Cape Finisterre)	0	50	52	sub.		4	8	0
Promontorium Tenarum. <i>Capo Martapam</i> (Cape Taenarum / Cape Matapan)	0	50	44	ad.		3	8	0
Promotorium Guanaama. <i>Capo Non</i> (Cape Guanaama / Cape Non)	1	40	24	sub.		2	32	0

Place name [Nomina Locorum]	H				G			
	.	'	"	ad./sub.	.	'	"	
Quebec, & Kebek nouæ Franciæ (Quebec & Kebek, of New France)	5	16	0	sub.	4	0	0	
Quiloa Africæ (Kilwa, Africa)	1	47	40	ad.	9	0	A.	
S. Quintini Fanum. <i>S. Quintin</i> (Saint- Quentin)	0	34	12	sub.	4	46	0	
Ratisbona. <i>Rigensburg</i> (Regensburg)	0	2	8	ad.	4	59	0	
Rauenna Flaminiae (Ravenna, Aemilia)	0	3	32	ad.	4	26	20	
Regium Lepidi. <i>Reggio di Lombardia</i> (Reggio Emilia)	0	2	56	sub.	4	43	0	
Rethelium. <i>Rethel</i> (Rethel)	0	29	12	sub.	4	28	0	
Reate. <i>Rieti</i> (Rieti)	0	9	12	ad.	4	29	0	
Regius Mons Prussiæ. <i>Konisberga</i> (Königsberg, Prussia)	0	38	0	ad.	5	43	0	
Reualia Liuoniæ. <i>Reuel</i> (Reval / Tallinn, Livonia)	0	54	0	ad.	5	12	0	
Rhedones. <i>Rennes</i> (Rennes)	0	54	48	sub.	4	48	0	
Rhegium. <i>Reggio di Calabria</i> (Reggio Calabria)	0	18	12	ad.	3	15	0	
Rhemiorum. <i>Rems</i> (Reims)	0	31	4	sub.	4	12	0	
Rhodus vrbs Ins. Rhodi (Rhodes, city of the island of Rhodes)	1	24	40	ad.	3	22	0	
Rhodigium. <i>Rouigo</i> (Rovigo)	0	1	24	ad.	4	9	0	
Riga Liuoniæ (Riga, Livonia)	0	51	12	ad.	5	52	0	
Roma. <i>Roma</i> (Rome)	0	7	15	ad.	4	54	0	

Place name [Nomina Locorum]	H					G		
	.	'	"	ad./sub.		.	'	"
Roscianum. <i>Rossano</i> (Rossano)	0	22	36	ad.		3	49	0
						9		
Rostochium. <i>Rostok</i> (Rostock)	0	4	48	ad.		5	10	0
						4		
Roterodamum. <i>Roterdam</i> (Rotterdam)	0	28	12	sub.		5	55	0
						1		
Rothomagum. <i>Rouen</i> Normandiæ (Rouen, Normandy)	0	43	20	sub.		4	0	0
						9		
Rupellæ. <i>Rocchelle</i> (La Rochelle)	0	53	52	sub.		4	22	0
						6		
Ruscino. <i>Ronciglione</i> (Ronciglione)	0	34	44	sub.		4	48	0
						2		
Sabalæ Galliæ. <i>Sable</i> (Sablé)	0	49	52	sub.		4	26	0
						8		
Salmantica. <i>Salamanca</i> (Salamanca)	1	12	48	sub.		4	56	0
						0		
Salernum. <i>Salerno</i> (Salerno)	0	17	12	ad.		4	51	0
						0		
Salisburgum. <i>Salzburg</i> (Salzburg)	0	7	44	ad.		4	44	0
						7		
Salomonis Insula IESV (Solomon Island of Jesus)	9	18	0	sub.		8	0	A.
Samarkanda vetus. <i>Samarkand</i> & noua (Old Samarkand & new)	4	6	0	ad.		4	0	0
						5		
	4	3	4	ad.		3	37	23
						9		

Left panel:

Place name [Nomina Locorum]	H					G		
	.	'	"	ad./sub.		.	'	"
Sancianum Insula (Sancian / Shangchuan Island)	6	32	0	ad.		2	30	0
						1		
Santonas. <i>Santogne</i> (Saintonge)	0	51	32	sub.		4	38	0

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
						5		
Sardes Lydiæ. <i>Sardi</i> (Sardis, Lydia)	1	21	0		ad.	3	20	0
						8		
Sassarum. <i>Sassari</i> (Sassari)	0	11	16		sub.	4	23	0
						0		
Sauo Sabata. <i>Sauona</i> (Savona)	0	12	28		sub.	4	18	0
						4		
Segobia. <i>Segouia</i> (Segovia)	1	6	32		sub.	4	56	0
						0		
Segontia. <i>Siguenza</i> (Sigüenza)	1	0	0		sub.	4	57	0
						0		
Sendomira Poloniæ (Sandomierz, Poland)	0	41	32		ad.	5	42	0
						0		
Sena Hetruriæ. <i>Siena</i> (Siena, Tuscany)	0	0	54		ad.	4	11	0
						3		
Septimancæ. <i>Simancas</i> (Simancas)	0	45	8		sub.	4	38	0
						1		
Sipuntum. <i>Siponto</i> (Siponto)	0	21	21		ad.	4	50	0
						1		
Siracusæ. <i>Siracusa</i> (Syracuse)	0	14	20		ad.	3	3	57
						7		
Smolenskum Moscouiæ (Smolensk, Muscovy)	0	27	20		ad.	5	26	0
						5		
Smyrna. <i>Le Smyrne</i> (Smyrna / Izmir)	1	16	0		ad.	3	22	0
						8		
Soccotorra. <i>Zocotora</i> , à <i>Zocatra</i> (Socotra)	3	10	0		ad.	1	0	0
						3		
Spahani Persidis. <i>Ispahan</i> (Isfahan, Persia)	3	36	0		ad.	3	14	0
						6		
Spira. <i>Speir</i> (Speyer)	0	12	48		sub.	4	12	0
						9		
Spoletium. <i>Spoleti</i> (Spoleto)	0	7	30		ad.	4	43	0
						2		

Place name [Nomina Locorum]	H				G			
	.	'	"	ad./sub.	.	'	"	
Stettinum Pomeraniæ. <i>Stettin</i> (Szczecin, Pomerania)	0	14	0	ad.	5 3	34	0	
Stokolmia Suetiæ. <i>Stokolm</i> (Stockholm, Sweden)	0	26	40	ad.	5 9	30	0	
Strigonium Hungariæ. <i>Gran</i> (Esztergom, Hungary)	0	31	28	ad.	4 7	57	0	
Susæ Persidis. <i>Susa</i> (Susa, Persia)	3	20	0	ad.	3 3	20	0	
Sytacusæ. <i>Siracusa</i> (Syracuse)	0	16	0	ad.	3 7	3	37	
Tarentum. <i>Taranto</i> (Taranto)	0	27	2	ad.	4 0	40	0	
Tarraco. <i>Tarragona</i> (Tarragona)	0	43	0	sub.	4 1	6	0	
Tartacina. <i>Terracina</i> (Terracina)	0	11	6	ad.	4 1	31	0	
Taruisium. <i>Treviso</i> (Treviso)	0	1	48	ad.	4 5	45	0	
Taurinum. <i>Torino</i> (Turin)	0	14	59	sub.	4 4	9	0	
Teneriffa Insula Fortunatarum (Tenerife, of the Fortunate Isles)	2	10	24	sub.	2 8	50	0	
Ternate Insula Molucca (Ternate, of the Moluccas)	7	26	0	ad.	0	42	A.	
Tergeste. <i>Trieste</i> (Trieste)	0	8	48	ad.	4 5	57	0	
Tettiaria. <i>Isola Terzera</i> (Terceira)	2	47	0	sub.	3 9	4	0	
Texelia. <i>Tessel</i> (Texel)	0	25	40	sub.	5 3	3	0	
Thionis Villa. <i>Thionuille</i> (Thionville)	0	21	16	sub.	4 9	29	0	
Tessalonica. <i>Salonichi</i> (Thessalonica)	0	51	27	ad.	4	28	0	

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
						1		
Tholosa Galliæ. <i>Tolosa</i> (Toulouse)	0	42	24	sub.		4	0	0
						4		
Tidora Insula Molucca. <i>Tidor</i> (Tidore, of the Moluccas)	7	26	24	ad.		0	36	0
Tingis Mauritaniae. <i>Tāger</i> (Tangier, Mauretania)	1	36	0	sub.		3	25	0
						5		
Tirolium. <i>Tirola</i> (Tyrol)	0	3	20	sub.		4	38	0
						6		
Toletum. <i>Toledo</i> (Toledo)	1	6	0	sub.		3	52	0
						9		
Tolone. <i>Telo Martius</i> (Toulon)	0	23	36	sub.		4	5	0
						3		
S. Thomæ Insula (St. Thomas Island / São Tomé)	0	19	0	sub.		0	10	0
Tornacum. <i>Tornay</i> (Tournai)	0	35	20	sub.		5	32	0
						0		

Right panel:

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
Trapezus — untis. <i>Trebisonda</i> (Trebizond / Trabzon)	2	14	0	ad.		4	11	0
						3		
Traianopolis. <i>Traianopoli</i> (Trajanopolis)	1	9	44	ad.		4	34	0
						3		
Traiectum. <i>Mastrich</i> (Maastricht)	0	22	48	sub.		5	49	50
						0		
Triuer. <i>Trier</i> (Trier)	0	19	36	sub.		4	50	30
						9		
Tridentum. <i>Trento</i> (Trent)	0	2	0	sub.		4	10	0
						6		
Tripolis Syriae. <i>Tripoli</i> (Tripoli, Syria)	2	3	4	ad.		3	37	0
						4		

Place name [Nomina Locorum]	H				G			
	.	'	"	ad./sub.	.	'	"	
Tubinga. <i>Tobinga</i> (Tübingen)	0	10	30	sub.	4	34	0	
					8			
Tuder. <i>Todin</i> (Todi)	0	5	28	ad.	4	41	0	
					2			
Tunetum. <i>Tunisi</i> (Tunis)	0	8	0	sub.	3	18	0	
					5			
Turonum. <i>Tours</i> (Tours)	0	46	8	sub.	4	35	0	
					7			
Turriaso. <i>Tarrazona</i> (Tarazona)	0	57	48	sub.	4	9	0	
					2			
Tybene Persidis. <i>Tiben</i> (Tiben, Persia)	2	47	36	ad.	3	0	0	
					8			
Valentia Hispaniæ. <i>Valenza</i> (Valencia, Spain)	0	50	0	sub.	3	30	0	
					9			
Valentia Galliæ. <i>Valence</i> (Valence)	0	28	52	sub.	4	58	0	
					4			
Valentiane. <i>Valencenes</i> (Valenciennes)	0	35	44	sub.	5	20	0	
					0			
Valisoletum. <i>Valladolid</i> (Valladolid)	1	9	12	sub.	4	42	0	
					1			
Vangiones. <i>Vormatia</i> (Worms)	0	13	20	sub.	4	39	50	
					9			
Varsauia Poloniæ (Warsaw, Poland)	0	39	0	ad.	5	14	0	
					2			
Venetia. <i>Venetia</i> (Venice)	0	2	40	ad.	4	33	0	
					5			
Venetes Britannia. <i>Vannes</i> (Vannes, Brittany)	0	59	0	sub.	4	22	0	
					7			
Vercellæ. <i>Vercelli</i> (Vercelli)	0	12	32	sub.	4	3	15	
					5			
Verodunum Burgundiæ. <i>Verdun</i> (Verdun-sur-le-Doubs, Burgundy)	0	29	20	sub.	4	59	0	
					6			
Verodunum Lotharingiæ (Verdun,	0	24	44	sub.	4	5	0	

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
Lorraine)						9		
Verona. <i>Verona</i> (Verona)	0	2	12	sub.		4	33	0
						5		
Vesontio. <i>Besanzon</i> (Besançon)	0	24	0	sub.		4	34	0
						7		
Vicentia Cisalpinæ. <i>Vicenza</i> (Vicenza)	0	1	12	sub.		4	39	0
						5		
Victoria. <i>Vittoria</i> (Vitoria)	1	2	0	sub.		4	10	0
						3		
Vienna Austriæ (Vienna, Austria)	0	22	0	ad.		4	22	0
						8		
Vienna Allobrogum (Vienne, of the Allobroges)	0	28	48	sub.		4	32	0
						5		
Vilna Lituaniæ (Vilnius, Lithuania)	0	53	40	ad.		5	38	30
						4		
Viterbum. <i>Viterbo</i> [Viterbo]	0	5	0	ad.		4	21	0
						2		
Vladislauia Poloniæ (Włocławek, Poland)	0	33	20	ad.		5	48	0
						3		
Vlma Sueuiæ. <i>Vlma</i> (Ulm, Swabia)	0	6	16	sub.		4	20	0
						8		
Vlysippo. <i>Lisbona</i> (Lisbon)	1	30	0	sub.		3	40	0
						8		
Vltraiectum. <i>Vtrecht</i> (Utrecht)	0	25	52	sub.		5	4	30
						2		
Volaterræ. <i>Volterra</i> (Volterra)	0	1	12	sub.		4	9	0
						3		
Volodomira Poloniæ (Volodymyr, Poland)	0	49	0	ad.		5	2	0
						4		
Vpsalia. <i>Vpsala</i> (Uppsala)	0	24	48	ad.		5	0	0
						9		
Vraniburgum Daniæ [Uraniborg, Denmark]	0	5	36	ad.		5	54	40
						5		

Place name [Nomina Locorum]	H				ad./sub.	G		
	.	'	"			.	'	"
Vrbinum. <i>Vrbino</i> (Urbino)	0	5	34		ad.	4	53	0
						3		
Vratislauia. <i>Breslau</i> (Wrocław / Breslau)	0	22	0		ad.	5	14	0
						1		
Vuitteberga Saxoniae (Wittenberg, Saxony)	0	8	4		ad.	5	48	30
						1		
Volsembutilia <i>Vuolsenbutel</i> (Wolfenbüttel)	0	0	56		sub.	5	9	30
						2		
Vuologda Russiæ (Vologda, Russia)	2	8	40		ad.	5	12	0
						9		

Closing note of the table (full-width, below both panels):

We have omitted many places, once famous, because now there is scarcely anyone willing to carry an astronomical calculation to them, or to transfer one from there to us. But since the longitude of Bologna is — as we demonstrated in our *Geographia Reformata* — 34° 30' from the Fortunate Isle of Palma, the longitude of the other places listed in this catalogue can readily be gathered from the difference of time. Convert that difference into degrees and minutes of the equator by means of Table 7 given above, then add 34° 30' where the mark is *ad.*, or subtract it where the mark is *sub.*

TAB. 15. Of the Bissextile (Leap) Years before the Common Era of Christ.

[TAB. 15. *Annorum Bissextilium ante Epocham vulgarem Christi.*]

Expanded Years	Hundredth-First and Thousandth-First Years		
1	101	2701	5301
5	201	2801	5401
9	301	2901	5501
13	401	3001	5601
17	501	3101	5701
21	601	3201	5801
25	701	3301	5901

Expanded Years	Hundredth-First and Thousandth-First Years		
29	801	3401	6001
33	901	3501	6101
37	1001	3601	6201
41	1101	3701	6301
45	1201	3801	6401
49	1301	3901	6501
53	1401	4001	6601
57	1501	4101	6701
61	1601	4201	6801
65	1701	4301	6901
69	1801	4401	7001
73	1901	4501	
77	2001	4601	
81	2101	4701	
85	2201	4801	
89	2301	4901	
93	2401	5001	
97	2501	5101	
101	2601	5201	

TAB. 16. Of the Bissextile Years in the Era of Christ, in the form of the Julian Year.

[TAB. 16. Annorum Bissextilium Epochæ Christi, in forma Anni Iuliani.]

Expanded Years	Hundredth and Thousandth Years	
4	100	2600
8	200	2700
12	300	2800
16	400	2900
20	500	3000
24	600	3100

Expanded Years	Hundredth and Thousandth Years	
28	700	3200
32	800	3300
36	900	3400
40	1000	3500
44	1100	3600
48	1200	3700
52	1300	3800
56	1400	3900
60	1500	4000
64	1600	4100
68	1700	4200
72	1800	4300
76	1900	4400
80	2000	4500
84	2100	4600
88	2200	4700
92	2300	4800
96	2400	4900
100	2500	5000

TAB. 17. Of the Hundredth Years — Common or Bissextile — in the form of the Gregorian Year, with the Excess of Days over the Julian Days.

[TAB. 17. Annorum Centesim. Communium, vel Bissextilium in forma Anni Gregoriani, cum Dierum excessu supra Dies Iulianos.]

(Column heads: leap-marker B/C | Years | Days)

	Years	Days		Years	Days
B	1600	10	C	4100	29
C	1700	11	C	4200	30
C	1800	12	C	4300	31
C	1900	13	B	4400	31

	Years	Days		Years	Days
B	2000	13	C	4500	32
C	2100	14	C	4600	33
C	2200	15	C	4700	34
C	2300	16	B	4800	34
B	2400	16	C	4900	35
C	2500	17	C	5000	36
C	2600	18	C	5100	37
C	2700	19	B	5200	37
B	2800	19		&c.	
C	2900	20			
C	3000	21			
C	3100	22			
B	3200	22			
C	3300	23			
C	3400	24			
C	3500	25			
B	3600	25			
C	3700	26			
C	3800	27			
C	3900	28			
B	4000	28			

It is assumed that the intercalation was made in the years before [the era], and thenceforward always just as Julius Caesar had ordered — this present Year of Confusion being passed over, together with the error of the ancients in intercalating. *[Supponitur intercalatio facta Annis ante, & porrò semper prout iusserat Iulius Cæsar, dissimulato hoc Anno Confusionis, & errore Priscorum in intercalando.]*

TAB. 18. Of the Cycles of the Sun.

[TAB. 18. Cyclorum Solis.]

28	1008	1960	2968	3976
56	1036	1988	2996	4004
84	1064	2016	3024	4032
112	1092	2044	3052	4060
140	1120	2072	3080	4088
168	1148	2100	3108	4116
196	1176	2128	3136	4144
224	1204	2156	3164	4172
252	1232	2184	3192	4200
280	1260	2212	3220	4228
308	1288	2240	3248	4256
336	1316	2268	3276	4284
364	1344	2296	3304	4312
392	1372	2324	3332	4340
420	1400	2352	3360	4368
448	1428	2380	3388	4396
476	1456	2408	3416	4424
504	1484	2436	3444	4452
532	1512	2464	3472	4480
560	1540	2492	3500	4508
588	1568	2520	3528	4536
616	1596	2548	3556	4564
644	1624	2576	3584	4592
672	1652	2604	3612	4620
700	1680	2632	3640	4648
728	1708	2660	3668	4676
756	1736	2688	3696	4704
784	1764	2716	3724	4732
812	1792	2744	3752	4760
848	1820	2772	3780	4788
868	1848	2800	3808	4816

896	1876	2828	3836	4844
924	1904	2856	3864	4872
952	1932	2884	3892	4900
980		2912	3920	The cycles are 175
		2940	3948	<i>[Cycli sunt 175]</i>

TAB. 19. Weekly Table of the Days (Feriae).

[TAB. 19. Hebdomatica Feriarum.]

(The seven day-columns are headed with their Greek names and the planetary symbols.)

I	II	III	IV	V	VI	VII
Κυριακή [Greek: Kyriakē, "the Lord's day" — Sunday]	Δευτέρα [Greek: Deutera, "second" — Monday]	Τρίτη [Greek: Tritē, "third" — Tuesday]	Τετράς [Greek: Tetras, "fourth" — Wednesd ay]	Πέμπτη [Greek: Pemptē, "fifth" — Thursday]	Προσάββ ατον [Greek: Prosabba ton, "eve of the Sabbath" — Friday]	Σάββατον [Greek: Sabbaton , "Sabbath " — Saturday]
☉ (Sun)	☾ (Moon)	♂ (Mars)	☿ (Mercury)	♃ (Jupiter)	♀ (Venus)	♄ (Saturn)
Iunius [June]	Septemb er	April		1	2	3
4	Decembe r	5	6	7	8	Mattius [March]
9	10	11	12	Maius [May]	13	14
15	16	Iulius [July]	17	18	19	20
Febr. seq. [followin g	21	22	23	24	August.	25

I	II	III	IV	V	VI	VII
February]						
26	27	28	Octob.	Ianu. seq. [followin g January]		Novembe r

TAB. 20. Of the Feriae in the Vague Arabic (Hegira) Year.

[TAB. 20. Feriarum in Anno Arabico vago Hegiræ.]

I	II	III	IV	V	VI	VII	Arabic Cycle
	180		150		120		
90		60		30		0	210 0
	2			1		Muchar ram 3	420 0
5	Sep har	Rabie I	4	Rabie II	6		630 0
		7				8	840 0
	10			9	Giumadi I.II		1050 0
13			12		14		1260 0
Giuma di II	Reg eb	15					1470 0
21	18		Sahaben	17		16	1680 0
Dulkad ati		23	20	Ram adhe n	19	Scheual	1890 0
29	26	Dulha cati	28	25	22	24	2100 0
			30 curr. [current]		27		

TAB. 21. Of the Collected Years, and the Months of Various Nations.

[TAB. 21. *Annorum Collectorum, & Mensium Diversarum Nationum.*]

Roman (Julian) Years; Collected Days of the Common Months; and the months of various nations

Roman (Julian) Years	Collected Days of the Common Months	Bis sex tile	Macedonia n & Antiochene Months	Athenian Months (less fixed)	Other Greek Month-Names	Syrian & Jewish Months
1 / 365	Ianuar. [January] — 31	31	Αὐδυναῖος [Audynaio s]	Γαμηλιῶν [Gamēliōn]	Αἰγῶν [Aigōn] ♊ (Capricorn)	Canun II. Thebet
2 / 730	Februar. [February] — 59	60	Περίτιος [Peritios]	Ἀντεστηριῶν [Antestēriō n]	Ὑδρῶν [Hydrōn] ♓ (Aquarius)	Schebat
3 / 1095	Martius [March] — 90	91	Δύστρος [Dystros]	Ἐλαφηβολιῶν [Elaphēbol iōn]	Ἰχθυῶν [Ichthyōn] ♓ (Pisces)	Adar
—	Aprilis [April] — 120	121	Ξανθικός [Xanthikos]	Μουνυχιῶν [Mounychi ōn]	Κριῶν [Kriōn] ♈ (Aries)	Nisan
4 / 1461	Maij [May] — 151	152	Ἀρτεμίσιος [Artemisio s]	Θαργηλιῶν [Thargēliō n]	Ταυρῶν [Taurōn] ♉ (Taurus)	Iiar
8 / 2922	Iunij [June] — 181	182	Δαίσιος [Daisios]	Σκιρροφοριῶν [Skirropho riōn]	Διδυμῶν [Didymōn] ♊ (Gemini)	Haziran. Siuan
12 / 4383	Iulij [July] — 212	213	Πάνεμος [Panemos]	Ἑκατομβαιῶν [Hekatomb aiōn]	Καρκινῶν [Karkinōn] ♋ (Cancer)	Tamuz

Roman (Julian) Years	Collected Days of the Common Months	Bis sex tile	Macedonia n & Antiochen e Months	Athenian Months (less fixed)	Other Greek Month- Names	Syrian & Jewish Months
16 / 5844	August. — 243	244	Λῶος [Lōos]	Μεταγειτνι ών [Metageitn iōn]	Λεοντῶν [Leontōn] ♌ (Leo)	Ab
20 / 7305	Septemb. — 273	274	Γορπιαῖος [Gorpiaios]	Βοηδρομιώ ν [Boēdromi ōn]	Παρθενῶν [Parthenō n] ♍ (Virgo)	Ilacs [Elul]
24 / 8766	Octob. — 304	305	ὔπερβερετ αῖος [Hyperber etaios]	Μαιμακτηρ ιών [Maimaktē riōn]	Ζυγῶν [Zygōn] ♎ (Libra)	Tisrin I. (uan [recte: Canun]
28 / 10277	Nouembr. — 334	335	Δῖος [Dios]	Πυανεψιών [Pyanepsiō n]	Σκορπιῶν [Skorpiōn] ♏ (Scorpio)	Tisrin II. Marchesua n
32 / 11688	Decemb. — 365	366	Ἀπελλαῖος [Apellaios]	Ποσειδεών [Poseideōn]	Τοξῶν [Toxōn] ♐ (Sagittariu s)	Canun I. Casleu [Kislev]
36 / 13149						
40 / 14610						

The Syrians, Jews, and Macedonians begin certain of their months on the seventh of the Julian months; the Athenian and Greek months for the greater part run concurrently with the Julian months, marked off by region. [*Syrorum, Iudæorum, ac Macedonum Menses, quidam ineunt à septimis diebus Iulianorum Mensium Athenienses, & Græcorum Menses potiori sui parte concurrunt cum Iulianis Mensibus è regione notatis.*]

Of the Egyptians and Persians. — Months of 30 days, and their beginnings.

Collected Years	Collected Days of the Years	Days of the Egyptian Months	Days of the Persian Months	Alexandrian (modern)	Coptic & Abyssinian	In the Julian Year (Bissextile / Common)
1	365	Thoth	30 D Pharuardi . n	Thuth	Mascar am	Aug. 30 / 29
2	730	Paophi	60 Artipeheft	Pape	Tikmith	Sept. 29 / 28
3	1095	Athyr	90 Chortat	Hathur	Hagar	Octob. 29 / 28
4	1460	Chœac	120 Tyrma	Chiac	Tachsam	Nouemb. 28 / 27
5	1825	Tybi	150 Mertat	Tube	Tir	Decemb. 28 / 27
6	2190	Mechir	180 Sacheriur	Amschir	Iachath ith	Ianuar. 27 / 26
7	2555	Phamenoth	210 Mechem a	Parmah ath	Magalith	Februar. 26 / 25
8	2920	Pharmuthi	240 Apanma	Parmud e	Miazia	Mart. 27 / 27
9	3285	Pachon	270 cum Vuahak	Paschunes	Ginbot h	April. 26 / 26
10	3650	Paymi	30 Aderma	Paune	Sene	Maij 26 / 26

Collected Years	Collected Days of the Years	Days of the Egyptian Months	Days of the Persian Months	Alexandrian (modern)	Coptic & Abyssinian	In the Julian Year (Bissextile / Common)
			0			
		Epephi	3 Dima	Epip	Hamle	Iunij 25 / 25
			3			
			0			
		Mesori	3 Peltan	Mufri	Nahase	Iulij 25 / 25
			6			
			0			
		Epagomenē	3 Asphandar	Elnisi	Pagomen	August. 24 / 24
			6			
			5			

Vuahak signifies the addition of 5 days. [*Vuahak significat additionem dier. 5.*]

Of the Collected Days of the Arabic (Hegira) Years.

Y e a r s	Y De c s	Y De c s	Y De c s	Y De c s	Colle cted Days	Arabic Months — Collected Days	Months began in Year 1 of the Hegira	(in the Year of Christ)	Armenia n Months of 30 days	Begin in the Julian (Year)
1	3	1	5	3	1063 1	Muharra m	16 Iulij		Nauazard	Aug. 11
	5	6	6	0						
	4		7							
			0							
2	7	1	6	6	2126 2	Sephar	15 Aug.	(Anno Chr. 622)	Hori	Sept. 10
	0	7	0	0						
	9		2							
			4							
3	1	1	6	9	3189 3	Rabie I.	13 Sept.		Sahmi	Octob. 10
	0	8	3	0						
	6		7							
	3		8							

Y e a r s	Y e a r s	Y e a r s	Y e a r s	Y e a r s	Colle cted Days	Arabic Months — Collected Days	Months began in Year 1 of the Hegira	(in the Year of Christ)	Armenia n Months of 30 days	Begin in the Julian (Year)
4	1	1	6	1	4252	Rabie II.	13 Octob.		Dre Theri	Nou. 9
	4	9	7	2	4					
	1		3	0						
	7		3							
5	1	2	7	1	5311	Giumadi	11 Nou.		Kagots	Dec. 9
	7	0	0	5	5	I.				
	7		8	0						
	2		7							
6	2	2	7	1	6378	Giumadi	11 Dec.		Aracz	Ianu. 8
	1	1	4	8	6	II.				
	2		4	0						
	6		2							
7	2	2	7	2	7441	Regeb			Mahegi	Febr. 7
	4	2	7	1	7					
	8		9	0						
	0		6							
8	2	2	8	2	8504	Sahaben	9 Ian.		Arcki	Mart. 9
	8	3	1	4	8					
	3		5	0						
	5		0							
9	3	2	8	2	9567	Ramadha	8 Febr.	(623)	Ahgi.	April. 8
	1	4	5	7	9	n			Aheli	
	8		0	0						
	9		5							
1	3	2	8	3	1063	Sheual	9 Mart.		Mariri	Maij 8
0	5	5	8	0	10					
	4		5	0						
	4		9							
1	3	2	9			Dulkadat	8 April.		Marcacz	Iunij 7
1	8	6	2			e				
	9		1							
	8		3							

Y e a r s	Y D e c e m b e r	Y D e c e m b e r	Y D e c e m b e r	Y D e c e m b e r	Colle cted Days	Arabic Months — Collected Days	Months began in Year 1 of the Hegira	(in the Year of Christ)	Armenia n Months of 30 days	Begin in the Julian (Year)
1	4	2	9			Dulhaiati	7 Maij		Herodicz	Iulij 7
2	2	7	5							
	5		6							
	2		8							
1	4	2	9			in Anno	7 Iunij		Aieliacz	August. 6
3	6	8	9			abundant			intercalar	
	0		2			i [in an			.	
	7		2			abundant year]			[intercala ry]	
1	4	2	1							
4	9	9	0							
	6		2							
	1		7							
			2							
1	5	3	1							
5	3	0	0							
	1		6							
	5		3							
			1							

TAB. 22. A Synopsis of the Notable Epochs, beginning in the Year before — or after — the Common Era of Christ, marked in the left margin.

[TAB. 22. Synopsis Epocharum Insigniorum ineuntium Anno ante, vel post Epocham vulgarem Christi in sinistro margine, notato.]

(Two-column table: a left column "Years before Christ" / "Years of Christ" giving the epoch year, and a right column giving the epoch's description.)

Years before Christ

5509 — Of the WORLD, its beginning on the Calends of September [1 September], according to the Greeks, in the Patriarchate of Constantinople; and they fix this year as the first of the fifteen-year cycle of Indictions.

4713 — The JULIAN PERIOD, taken from the Greeks by Joseph Scaliger [Josephus Scaliger], which consists of 7980 years. For when 28 (the Cycle of the Sun) is multiplied by 19 (the Cycle of the Moon), 532 years result; and these multiplied by 15 (the Cycle of Indictions) make 7980. In this year was the first year of each of these cycles. Hence in the first year of the Christian Era the Julian Period was 4714, and the Cycle of the Sun was 10, the Moon's [Cycle] 2, the Roman Indiction 4.

776 — The first year of the first OLYMPIAD, in which Coroebus of Elis [Coroebus Elidensis] was the first entered into the Catalogue of the Olympic victors — granted that earlier Iphitus had restored the Olympic games after they had been discontinued. The Athenians, however, began these years from the new moon nearer the summer solstice, namely from some day in June or July, others reckoning otherwise. It was year 3938 of the Julian Period. The Cycle of the Sun 18, of the Moon 5, the Indiction 8.

753 — The CITY OF ROME Founded, on the Palilia [festival of Pales], that is, 21 April; thus Varro [reckons] of this year, [as do] the Censorinus[es] and most of the learned, and they themselves, and the magistrates in the secular games. Granted that the City may be thought founded in the year 752 before the Christian Era, after Cato [Catonem], [from] the Tarentine [Fasti] [and] the Capitoline Fasti, and a few others. But the aforesaid year 753 [is] of the 6th Olympiad, a third year, not yet completed; and it [is] year 3961 of the Julian Period. The Cycle of the Sun 13, [of the Moon] 9, the Indiction 1.

747 — Of NABONASSAR, whose years begin astronomically at the meridian of the 26th day of February, from which the first day of the month Thoth begins, the Egyptian [year] consisting of 365 days. The beginning of its completed cycle [is] year 1460, which is the *great Dog-Star year*, or the *Sothic Period* [Periodus Sothiacal]; in the year 1461 it returns to the same day of the same Julian month. It was year 3967 of the Julian Period, ferial day 4. Cycle of the Sun [☉] 19, of the Moon 15, the Indiction 7; [and] of the founding of the City 6, [these years] still running.

529 — CAMBYSES I, son of Cyrus, began to reign in the year of Nabonassar 219; he entered upon [his reign over] the Egyptians on the 4th [day] of January.

433 — METON, from the 26th of June, devised his Nineteen-Year Cycle, granted that, together with Euctemon, he observed the solstice for establishing that cycle, in the year before Christ 432, on 27 June.

330 — Of the CALIPPIC Period, consisting of 76 years, beginning from the summer solstice in the Greek manner, but in the Egyptian manner from 15 November, when it was the year 419 of Nabonassar. The second Calippic Period began in the year 254 before Christ, and the third in the year 178.

324 — The death of ALEXANDER the Great, in the year of the Julian Period 4390, and of Nabonassar 424 completed, and 425 beginning, at the meridian of the 12th day of November. For the Egyptians, with Ptolemy [Ptolemæo] and Theon [Theone], and with these Albategnius [al-Battānī], likewise begin from there the Years of Alexander, and the Egyptians [from] those of Nabonassar. Granted that Alexander the Great died with the preceding May, or in June.

312 — The Era of the SELEUCIDS begins, also called [the Era] *of the Greeks*, or *of the Contracts* [Contractuum]; or [the Era] of Alexander *Dhilkarnayn* [Dhū al-Qarnayn], that is, of the Kingdom of Alexander divided into the Two Great Horns of Seleucus — namely [...]

(The left column continues lower with further "Years before Christ":)

311 — ...indeed, and the Arabs [reckon] [this era] after Christ, but from the Calends of October of the Julian year. The Chaldeans, however, began it in the following year from the Ides of October.

285 — Of DIONYSIUS the Mathematician, the Years [reckoned] in the manner of Ptolemy; they begin on 27 June.

45 — Of the JULIAN Years, that is, [the years] ordered by Julius Caesar after the confusion [of the calendar]; the first of these is [reckoned] from the Calends of January, ferial day 6, extended back [*extensam*] according to the Augustan correction.

38 — The Spanish Era [Aera Hispanica], begun from the Calends of January, and in common use in the Councils.

Years of Christ [*Christi Anni*]

The first year in the Roman Calendar begins from the Circumcision of the Lord, or from the Calends of January; and Ecclesiastically indeed from midnight of the preceding night, with the ancient Romans, and in these Tables, and in the Prutenic [Tables], and in the Medicean [Tables], and in the Magino [Tables] it

begins at the last midnight of the preceding December; in the Rudolphine [Tables], however, [and in] the Danish, Tychonic, [and] Philolaic [Tables] at the very midday of the first day of January. Civilly, however, others [reckon] from the Nativity, others from the Annunciation, others otherwise; concerning which there is more in our *Chronologia Reformata*.

The first year, then, of the CHRISTIAN Era was year 4714 of the Julian Period. The Cycle of the Sun 10, of the Moon 2, the Roman Indiction 4. And it was year 46 of the Julian Years; and from 21 April it ran concurrently with the year 753 of the founding of the City in the Varronian [reckoning]; besides, before 754; moreover, before the new moon nearest the summer solstice it ran concurrently with Olympiad 194, year 4; and thereafter with Olympiad 195, year 1. Finally also, from 13 August, of the Nabonassar [years] [...]

28 — VICTOR of Capua's Paschal Cycle begins from the October of this year.

81 — Of DOMITIAN, year 1, from 13 September.

96 — Of NERVA, year 1, from 19 September, as in our *Chronologia*.

98 — Of TRAJAN, year 1, from 10 January.

117 — Of HADRIAN, year 1, from 24 July, at the meridian of the following [day] 25.

137 — Of ANTONINUS, year 1, from 10 July, the following [day] 11.

222 — Of HIPPOLYTUS, the Paschal Cycle begins on the Calends of January.

238 — CENSORINUS in this year writes to Quintus Caerellius, [dedicating to him] a golden booklet *On the Birthday* [De Die Natali], illustrating this year with notable epochs, and [says] that it is [the year] 283 from the Calends of January, from which [year] the Consulship of Ulpian and Pontianus had begun — [the year] 1014 from the Olympiad, that is, from 21 April; and [the year] 986 of Nabonassar, the beginning of this Year [...]

Tomus II — Tabulae Novalmagesticae

TAB. 23 — Epoch synopsis (concluded)

[The two-column synopsis of eras continues. The left column gives the Year of Christ [Anni Christi]; the right column gives the corresponding event, era, or epoch.]

Year of Christ	Era / epoch
[continued]	...on the day before [the calends], on the VI Kalends of July — that is, from the meridian of the 25th day of June — from which one adds that the year of Alexander the Great began at 562. For so the corrected manuscripts have it. It was the year 4951 of the Julian Period.
284	The year 1 of DIOCLETIAN, from the 29th of August, with the Solar Cycle ☉ 13, the Lunar [Cycle] 19, Indiction 2. From this point begin the Paschal Cycles of Dionysius of Alexandria [Dionysius Exiguus], and the years of the Diocletianic [era], or the <i>Era of the Martyrs</i> ; likewise the <i>Elkupti</i> [al-Qibṭī], or <i>Coptic</i> [reckoning], and also that of the <i>Abyssinians</i> [<i>Abassinorum</i>] — although the Alexandrian Church, for the head of the Era of the Martyrs, chose the Kalends of April of the year 285, which was then the month of Easter.
312	The INDICATIONS of Constantine, usurped in the courts of the emperors, begin from the 25th of September. The Greek emperors, however, and the Church of Constantinople, [reckon them] from the Kalends of September.
313	[From] September. But the Roman Church, and its Pontiffs, [reckon] from the Kalends of January; and Ignatius the Patriarch of Antioch [reckons] from the Kalends of May, or [the feast] of Artemis — likewise this year 313.
552	The Era of the ARMENIANS begins from the 1st of August, of which the months are Persian, but the months are fixed [stationary], and the intercalation purely Roman.
622	Of the HEGIRA, that is, of the flight of Mahomet from Mecca. This year [is] the first repetition of the lunar [years], and it begins on the 16th day of July, feria 6, with the Solar Cycle 23, the Lunar [Cycle] 15, the Roman Indiction 10 — [continued]

Year of Christ	Era / epoch
	in the year 5335 of the Julian Period, the Nabonassar [year] 1370 still running, inasmuch as it began on the 21st day of March. This Era is used by the Mahometans, Arabs, and Turks; though there is another sect of the Arabs, which the <i>Alphonsine</i> [tables] follow, which places the beginning of the Hegira at July 15, [the month of] Choeac 27, feria 5.
632	Of IESDAGIRDIS [Yazdegerd], King of the Persians, on the 16th day of June; from which the Persian Era is reckoned, and it is used with a wandering year, which recedes after the manner of the Egyptian year.
800	CHARLEMAGNE [Carolus Magnus] begins to be Emperor.
1079	The GELALEAN [Jalālī] Epoch of the Persians, from the year restored by the equinox observed on the 14th of March.
1453	CONSTANTINOPLE captured on feria 2 of Pentecost by Mahomet the Ottoman, on the 29th of May, from which [comes] the beginning of the Ottoman Empire.
1582	The GREGORIAN correction of the calendar, fully completed, promulgated, and accepted by the greatest part of the Christian world, whose year [reckoned] the 5th of October to be called the 15th. It was the year 6295 of the Julian Period.

For the remaining epochs, and a fuller treatment and confirmation of the preceding [ones], see our *Chronologia Reformata* — should it come to light, God granting — in whose hands are the Years, both *Temporal* and *ETERNAL*; to Him be glory unto the ages of ages. *Amen*.

TAB. 23 — Nabonassar years beginning before or after the Epoch of Christ

TAB. 23. The Nabonassar years beginning in a year before or after the Epoch of CHRIST, and on the day of the Julian or Gregorian month noted below.

[TAB. 23. Nabonassari Anni Incipientes Anno ante, vel post Epocham CHRISTI, dieq; Mensis Iuliani, aut Gregoriani infranotato.]

[The table is laid out in three side-by-side panels. The first panel covers the years before Christ; the second and third cover the years after Christ, the third giving the beginning of the month *Thoth* in both Old (Julian) and Gregorian style. "B." marks a bissextile (leap) year. The notations *posterior* / *prior* indicate the later / earlier of two beginnings in a span where the start-day repeats.]

Panel 1 — Nabonassar years before Christ

Year of Nabonassar	Year before Christ	Beginning of the month <i>Thoth</i>
1	747	Febr. 26
2	746	26
3	B. 745	25
4	744	25
5	743	25
6	742	25
7	B. 741	<i>posterior</i> 24
8	740	<i>prior</i> 24
9	739	24
10	738	24
11	B. 737	<i>prior</i> 24
12	736	23
99	B. 649	Febr. 2
100	648	Febr. 1
103	B. 645	Febr. 1
104	644	Ian. 31
223	B. 525	Ian. 2
224	524	Ian. 1
227	B. 521	Ian. 1

Year of Nabonassar	Year before Christ	Beginning of the month <i>Thoth</i>
228	<i>idem</i> 521	Dec. 31
229	520	31
230	519	31
231	518	31
232	B. 517	30
348	B. 401	Dec. 1
351	398	Dec. 1
352	397	Nou. 30
468	281	Nou. 1
471	278	Nou. 1
472	B. 277	Oct. 31
592	B. 157	Oct. 1
595	154	Oct. 1
596	B. 153	Sept. 30
712	B. 37	Sept. 1
715	34	Sept. 1
716	B. 33	Aug. 31
744	B. 5	24
745	4	24
746	3	24
747	2	24
748	B. 1	23

Panel 1 (continued) — Nabonassar years after Christ

Year of Nabonassar	Year of Christ	Beginning of <i>Thoth</i>
749	1	Aug. 23
750	2	23
751	3	23
752	B. 4	22
836	B. 88	Aug. 1
839	91	Aug. 1

Year of Nabonassar	Year of Christ	Beginning of <i>Thoth</i>
840	B. 92	Iulij 31
960	B. 212	Iul. 1
963	215	Iul. 1
984	216	Iunij 30
985	B. 236	Iun. 25
986	✠ 237	25
987	238	25
988	239	Iun. 25
1080	B. 240	Iun. 24
1083	B. 332	Iun. 1
1084	335	Iun. 1
1204	B. 336	Maij 31
1207	456	Maij 1
1208	459	Maij 1
—	B. 460	April. 30

Panel 2 — Nabonassar years after Christ (Epoch of Christ)

Year of Nabonassar	Year of Christ (Epoch)	Beginning of the month <i>Thoth</i>
1324	B. 576	April. 1
1327	579	April. 1
1328	B. 580	Mart. 31
1448	B. 700	Mart. 1
1451	703	Mart. 1
1452	B. 704	Febr. 28
1467	719	Febr. 25
1468	B. 720	<i>posterior</i> 24
1469	721	24
1470	722	24
1471	723	24
1472	B. 724	<i>prior</i> 24
1473	725	23

Year of Nabonassar	Year of Christ (Epoch)	Beginning of the month <i>Thoth</i>
1561	813	Febr. 1
1564	B. 816	Febr. 1
1569	817	Ian. 31
1685	837	Ian. 1
1688	B. 940	Ian. 1
1689	<i>idem</i> 940	Dec. 31
1809	B. 1060	Dec. 1
1812	1063	Dec. 1
1813	B. 1064	Nou. 30
1929	B. 1180	Nou. 1
1932	1183	Nou. 1
1933	B. 1184	Oct. 31
2053	B. 1304	Oct. 1
2056	1307	Oct. 1
2057	B. 1308	Sept. 30
2173	B. 1424	Sept. 1
2176	1427	Sept. 1
2177	B. 1428	Aug. 31
2297	B. 1548	Aug. 1
2300	1551	Aug. 1
2301	B. 1552	Iul. 31
2329	B. 1580	Iul. 24
2330	1581	Iul. 24
2331	1582	Iul. 24

Panel 2 (continued) — beginning of *Thoth* in Old and Gregorian style

Year of Nabonassar	Year of Christ (Epoch)	Beginning of <i>Thoth</i> — Old style (<i>Veteri</i>)	Gregorian style (<i>Gregor.</i>)
2332	1583	Iul. 24	Aug. 3
2333	B. 1584	Iul. 23	Aug. 2
2337	B. 1588	Iul. 22	Aug. 1

Year of Nabonassar	Year of Christ (Epoch)	Beginning of <i>Thoth</i> — Old style (<i>Veteri</i>)	Gregorian style (<i>Gregor.</i>)
2341	B. 1592	Iul. 21	Iul. 31
2345	B. 1596	Iul. 20	Iul. 30
2349	B. 1600	Iul. 19	Iul. 29
2421	1672	Iul. 1	Iul. 11
2424	1675	Iul. 1	Iul. 11
2425	B. 1676	Iun. 30	Iul. 10
2448	1699	Iun. 25	Iul. 5
2449	B. 1700	Iun. 24	Iul. 5
2465	1716	Iun. 20	Iul. 1
2468	1719	Iun. 20	Iul. 1
2469	B. 1720	Iun. 19	Iun. 30
2544	1795	Iun. 1	Iun. 12
2545	B. 1796	Maij 31	Iun. 11
2548	1799	Maij 31	Iun. 11
2549	B. 1800	Maij 30	Iun. 11
2589	B. 1840	Maij 20	Iun. 1
2593	B. 1844	Maij 19	Maij 31
2649	B. 1900	Maij 5	Maij 18
2665	B. 1916	Maij 1	Maij 14
2669	B. 1920	April. 30	Maij 13
2717	B. 1968	April. 18	Maij 1
2721	B. 1972	April. 17	April. 30
2749	B. 2000	April. 10	April. 23
2785	B. 2036	April. 1	April. 14

Panel 3 — Nabonassar years after Christ (continued)

Year of Nabonassar	Year of Christ (Epoch)	Beginning of <i>Thoth</i> — Old style (<i>Veteri</i>)	Gregorian style (<i>Gregor.</i>)
2789	B. 2040	Mart. 31	April. 13
2737	B. 2088	Mart. 19	April. 1
2841	B. 2092	Mart. 18	Mart. 31

Year of Nabonassar	Year of Christ (Epoch)	Beginning of <i>Thoth</i> — Old style (<i>Veteri</i>)	Gregorian style (<i>Gregor.</i>)
2849	B. 2100	Mart. 16	Mart. 30
2909	B. 2160	Mart. 1	Mart. 15
2913	B. 2164	Febr. 28	Mart. 14
2917	B. 2168	Febr. 27	Mart. 13
2921	B. 2172	Febr. 26	Mart. 12
2925	B. 2176	Febr. 25	Mart. 11
2929	B. 2180	<i>posterior</i> 24	Mart. 10
2930	2181	Febr. 24	Mart. 10
2931	2182	Febr. 24	Mart. 10
2932	2183	Febr. 24	Mart. 10
2933	B. 2184	<i>prior</i> 24	Mart. 9
2934	2185	Febr. 23	Mart. 9
2935	2186	Febr. 23	Mart. 9
2936	2187	Febr. 23	Mart. 9
2937	B. 2188	Febr. 23	Mart. 9
2938	2189	Febr. 22	Mart. 8
2942	2193	Febr. 21	Mart. 7
2945	B. 2196	Febr. 21	Mart. 7
2946	2197	Febr. 20	Mart. 6
2947	2198	Febr. 20	Mart. 6
2948	2199	Febr. 20	Mart. 6
2949	B. 2200	Febr. 20	Mart. 6
2950	2201	Febr. 19	Mart. 6
3144	2395	Ianu. 2	Ianu. 18
3145	B. 2396	Ianu. 2	Ianu. 18
3146	2397	Ianu. 1	Ianu. 17
3147	2398	Ianu. 1	Ianu. 17
3148	2399	Ianu. 1	Ianu. 17
3149	B. 2400	Ianu. 1	Ianu. 17
3150	<i>idem</i> 2400	Dec. 31	Ianu. 16

Note (right column, beneath the table)

Since 1460 Julian years make 1461 Egyptian years, and by this period [cycle] the Great Year of the Canicular [Dog-star], or Sothic [year], is completed, the beginning of *Thoth* returns to the same day of the Julian year. For this reason, from the year before Christ 737 — at which the beginning of *Thoth* fell in February, before the 24th day of the Julian [reckoning] — no change of the Julian day occurs until the year 1 before Christ, after the bissextile, and so on to the year 521 before Christ, at which point a double Nabonassar year begins. From there, indeed, the change occurs at the very year of the bissextile, and on to the Year of Christ 724, at which point the beginning of *Thoth* once again returns to February the 24th, the earlier [*priorem*]. Thereafter, indeed, the change is again made always on the first day after the bissextile, and so on to the Year of Christ 940, at which point a double Nabonassar year again begins.

(C) From here onward the change [is made] at the very year of the bissextile, and so on, and to the Year of Christ 1184, at which the beginning of *Thoth* a third time recedes to February the 24th, the earlier. From there, however, the change is made in the year immediately after the bissextile, and on to the Year of Christ 2400, at which a third time a double Nabonassar year begins.

(C) ...and on to the Year of Christ 2400, at which for the third time a double Nabonassar year begins, and from this point the change of day must be made in the very bissextile year itself — but will the World last so long?

God knows. [Deus novit.]

SECOND PART OF THE TABLES, SELECTED FROM THE PRIMUM MOBILE

[SECVNDA PARS TABVLARVM EX PRIMO MOBILI SELECTARVM.]

TAB. 24 — Conversion of the degrees of the signs into degrees of the zodiac

TAB. 24. Conversion of the degrees of the signs into degrees of the zodiac.

[TAB. 24. Conuersio Graduum Signorum in Gradus Zodiaci.]

[Each column is one zodiacal sign (I–XII, with its symbol); the leftmost column is the degree within the sign. The body gives the cumulative zodiacal longitude in degrees (Gr.). Each successive sign adds 30°.]

D e g r e e	♈ I	♉ II	♊ III	♋ IV	♌ V (Gr.)	♍ VI (Gr.)	♎ VII (Gr.)	♏ VIII (Gr.)	♐ IX (Gr.)	♑ X (Gr.)	♒ XI (Gr.)	♓ XII (Gr.)
1	1	31	61	91	121	151	181	211	241	271	301	331
2	2	32	62	92	122	152	182	212	242	272	302	332
3	3	33	63	93	123	153	183	213	243	273	303	333
4	4	34	64	94	124	154	184	214	244	274	304	334
5	5	35	65	95	125	155	185	215	245	275	305	335
6	6	36	66	96	126	156	186	216	246	276	306	336
7	7	37	67	97	127	157	187	217	247	277	307	337
8	8	38	68	98	128	158	188	218	248	278	308	338
9	9	39	69	99	129	159	189	219	249	279	309	339
10	10	40	70	100	130	160	190	220	250	280	310	340
11	11	41	71	101	131	161	191	221	251	281	311	341
12	12	42	72	102	132	162	192	222	252	282	312	342
13	13	43	73	103	133	163	193	223	253	283	313	343
14	14	44	74	104	134	164	194	224	254	284	314	344
15	15	45	75	105	135	165	195	225	255	285	315	345
16	16	46	76	106	136	166	196	226	256	286	316	346
17	17	47	77	107	137	167	197	227	257	287	317	347

D e g r e e			Ⅱ	ⅴ V		⅚	⅟Ⅲ	⅘ X		⅘ XII		
	Ⅰ I (G.)	Ⅱ II (G.)	III (G.)	Ⅳ IV (Gr.)	(Gr.)	Ⅵ VI (Gr.)	VII (Gr.)	VIII (Gr.)	Ⅸ IX (Gr.)	(Gr.)	XI (Gr.)	XII (Gr.)
18	18	48	78	108	138	168	198	228	258	288	318	348
19	19	49	79	109	139	169	199	229	259	289	319	349
20	20	50	80	110	140	170	200	230	260	290	320	350
21	21	51	81	111	141	171	201	231	261	291	321	351
22	22	52	82	112	142	172	202	232	262	292	322	352
23	23	53	83	113	143	173	203	233	263	293	323	353
24	24	54	84	114	144	174	204	234	264	294	324	354
25	25	55	85	115	145	175	205	235	265	295	325	355
26	26	56	86	116	146	176	206	236	266	296	326	356
27	27	57	87	117	147	177	207	237	267	297	327	357
28	28	58	88	118	148	178	208	238	268	298	328	358
29	29	59	89	119	149	179	209	239	269	299	329	359
30	30	60	90	120	150	180	210	240	270	300	330	360

TAB. 25 — Degrees of the zodiac and of the signs diametrically opposite

TAB. 25. The degrees of the zodiac and of the signs diametrically opposite.

[TAB. 25. Gradus Zodiaci, & Signorum diametraliter oppositi.]

[The first column ("Gr. có.") is the common degree within a sign. Each following pair gives a sign-symbol and its zodiacal longitude (Gr.); the upper symbol of each pair and the lower are diametrically opposite (180° apart): ♈/♏, ♉/♍, ♊/♎, ♋/♑, ♌/♒, ♍/♏, ♎/♊. The two header symbols printed per pair share one column of values.]

Gr. có.	♈ · ♏	♉ · ♍	♊ · ♎	♋ · ♑	♌ · ♒	♍ · ♏
1	1 · 181	31 · 211	61 · 241	91 · 271	121 · 301	151 · 331
2	2 · 182	32 · 212	62 · 242	92 · 272	122 · 302	152 · 332
3	3 · 183	33 · 213	63 · 243	93 · 273	123 · 303	153 · 333
4	4 · 184	34 · 214	64 · 244	94 · 274	124 · 304	154 · 334
5	5 · 185	35 · 215	65 · 245	95 · 275	125 · 305	155 · 335
6	6 · 186	36 · 216	66 · 246	96 · 276	126 · 306	156 · 336
7	7 · 187	37 · 217	67 · 247	97 · 277	127 · 307	157 · 337
8	8 · 188	38 · 218	68 · 248	98 · 278	128 · 308	158 · 338
9	9 · 189	39 · 219	69 · 249	99 · 279	129 · 309	159 · 339
10	10 · 190	40 · 220	70 · 250	100 · 280	130 · 310	160 · 340
11	11 · 191	41 · 221	71 · 251	101 · 281	131 · 311	161 · 341
12	12 · 192	42 · 222	72 · 252	102 · 282	132 · 312	162 · 342
13	13 · 193	43 · 223	73 · 253	103 · 283	133 · 313	163 · 343
14	14 · 194	44 · 224	74 · 254	104 · 284	134 · 314	164 · 344
15	15 · 195	45 · 225	75 · 255	105 · 285	135 · 315	165 · 345
16	16 · 196	46 · 226	76 · 256	106 · 286	136 · 316	166 · 346
17	17 · 197	47 · 227	77 · 257	107 · 287	137 · 317	167 · 347
18	18 · 198	48 · 228	78 · 258	108 · 288	138 · 318	168 · 348
19	19 · 199	49 · 229	79 · 259	109 · 289	139 · 319	169 · 349
20	20 · 200	50 · 230	80 · 260	110 · 290	140 · 320	170 · 350
21	21 · 201	51 · 231	81 · 261	111 · 291	141 · 321	171 · 351
22	22 · 202	52 · 232	82 · 262	112 · 292	142 · 322	172 · 352
23	23 · 203	53 · 233	83 · 263	113 · 293	143 · 323	173 · 353

Gr. có.	Υ · Ϛ	ϣ · ϛ	Π · Ϙ	Ϟ · ϙ	Ϡ · ϡ	Ⓜ · Ⓢ
24	24 · 204	54 · 234	84 · 264	114 · 294	144 · 324	174 · 354
25	25 · 205	55 · 235	85 · 265	115 · 295	145 · 325	175 · 355
26	26 · 206	56 · 236	86 · 266	116 · 296	146 · 326	176 · 356
27	27 · 207	57 · 237	87 · 267	117 · 297	147 · 327	177 · 357
28	28 · 208	58 · 238	88 · 268	118 · 298	148 · 328	178 · 358
29	29 · 209	59 · 239	89 · 269	119 · 299	149 · 329	179 · 359
30	30 · 210	60 · 240	90 · 270	120 · 300	150 · 330	180 · 360

TAB. 26 — Declination of the Sun and of the ecliptic at obliquity 23°30'20"

TAB. 26. Declination of the Sun ☉, and of the ecliptic, at the obliquity 23°30'20". [TAB. 26. Decl. ☉, & Eclipt. ad Obliq. Gr. 23.30'.20".]

[The obliquity of the ecliptic [obliquitas eclipticae] here is 23°30'20". The leftmost "Gr." counts the degree of the sign (0→30 reading downward); the rightmost "Gr." counts the complementary degree (30→0). Each of the three paired columns gives degrees · minutes · seconds of declination. Header pairs (read top-down): Υ Bor. / Ϛ Austr.; ϣ Bor. / ϛ Austr.; Π Bor. / Ϙ Austr. Read bottom-up with the right "Gr." column, the column footers apply: Ⓜ Bor. / Ⓢ Austr.; Ϡ Bor. / ϡ Austr.; Ϟ Bor. / ϙ Austr.]

G r . ")	Υ Bor. / Ϛ Austr. (Gr '")	ϣ Bor. / ϛ Austr. (Gr '")	Π Bor. / Ϙ Austr. (Gr '")	G r . "
0	0 0 0	11 30 11	20 12 23	3 0
1	0 23 55	11 51 14	20 24 57	2 9
2	0 47 51	12 12 5	20 37 3	2 8
3	1 11 46	12 32 46	20 48 57	2 7
4	1 35 39	12 44 13	21 0 24	2 6

G r .	Υ Bor. / $\triangle$ Austr. (Gr '")	♂ Bor. / $\approx$ Austr. (Gr '")	Π Bor. / ♂ Austr. (Gr '")	G r .
5	1 59 31	13 13 28	21 11 26	2 5
6	2 23 22	13 33 30	21 22 6	2 4
7	2 47 10	13 53 16	21 32 20	2 3
8	3 10 54	14 12 51	21 42 10	2 2
9	3 34 38	14 32 12	21 51 38	2 1
1 0	3 58 17	14 51 16	22 0 40	2 0
1 1	4 21 51	15 10 7	22 9 18	1 9
1 2	4 45 24	15 28 44	22 17 29	1 8
1 3	5 8 50	15 47 1	22 25 16	1 7
1 4	5 39 59	16 5 6	22 32 38	1 6
1 5	5 55 30	16 22 51	22 39 32	1 5
1 6	6 18 41	16 40 21	22 46 2	1 4
1 7	6 41 46	16 57 33	22 52 8	1 3
1 8	7 4 47	17 14 29	22 57 44	1 2
1 9	7 27 40	17 31 6	23 2 54	1 1
2 0	7 50 24	17 47 23	23 7 40	1 0

G r .	Ꝣ Bor. / ⚳ Austr. (Gr '")	Ꝥ Bor. / ⚳ Austr. (Gr '")	⚲ Bor. / ⚶ Austr. (Gr '")	G r .
2 1	8 13 4	18 3 23	23 11 58	9
2 2	8 35 33	18 19 5	23 15 48	8
2 3	8 58 4	18 34 25	23 19 10	7
2 4	9 20 9	18 49 26	23 22 9	6
2 5	9 42 14	19 4 10	23 24 39	5
2 6	10 4 10	19 18 30	23 26 40	4
2 7	10 25 56	19 32 30	23 27 39	3
2 8	10 47 31	19 46 10	23 29 4	2
2 9	11 8 57	19 59 26	23 30 6	1
3 0	11 30 11	20 12 23	23 30 20	0
G r .	Ꝯ Bor. / ⚶ Austr.	ꝯ Bor. / ⚳ Austr.	ꝰ Bor. / ꝱ Austr.	

TAB. 27 — The angle of the eastern ecliptic and of the meridian at the obliquity of the ecliptic $23^{\circ}30'1\frac{1}{2}$

TAB. 27. The angle of the eastern ecliptic and of the meridian, at the obliquity of the ecliptic $23^{\circ}30'1\frac{1}{2}$. [TAB. 27. Angulus Orientalis Eclipt. & Meridiani ad Obliquitatem Eclipt. Gr. $23.30'1\frac{1}{2}$.]

[The leftmost "Gr." counts the degree (0→30 downward); the rightmost "Gr." counts the complement (30→0). Each paired column gives degrees · minutes of the

angle. Header pairs (top-down): Υ Boreal / $\trianglelefteq$ Austr.; $\forall$ Bor. / $\approx$ Austr.; Π Bor. / $\times^7$ Austr. Footers (bottom-up): $\mathfrak{M}$ Austr. / $\times$ Bor.; $\mathfrak{O}$ Austr. / $\approx$ Bor.; $\mathfrak{S}$ Austr. / $\mathfrak{V}$ Bor.]

G r .	Υ Boreal / $\trianglelefteq$ Austr. (Gr ')	$\forall$ Bor. / $\approx$ Austr. (Gr ')	Π Bor. / $\times^7$ Austr. (Gr ')	G r .
0	66 30	69 22	77 43	30
1	66 30	69 33	78 5	29
2	66 31	69 45	78 27	28
3	66 32	69 57	78 49	27
4	66 33	70 10	79 12	26
5	66 35	70 23	79 35	25
6	66 37	70 37	79 58	24
7	66 40	70 51	80 21	23
8	66 42	71 5	80 45	22
9	66 46	71 20	81 8	21
10	66 49	71 35	81 32	20
11	66 53	71 50	81 57	19
12	66 57	72 6	82 21	18
13	67 2	72 22	82 45	17
14	67 6	72 38	83 10	16

G r .	Υ Boreal / ϐ Austr. (Gr)	ϣ Bor. / ϣ Austr. (Gr)	Π Bor. / ϣ Austr. (Gr)	G r .
1 5	67 13	72 55	83 35	1 5
1 6	67 19	73 12	84 0	1 4
1 7	67 26	73 29	84 25	1 3
1 8	67 33	73 47	84 50	1 2
1 9	67 40	74 5	85 16	1 1
2 0	67 47	74 23	85 41	1 0
2 1	67 55	74 42	86 7	9
2 2	68 3	75 0	86 32	8
2 3	68 11	75 20	86 58	7
2 4	68 20	75 40	87 24	6
2 5	68 30	76 0	87 51	5
2 6	68 40	76 20	88 17	4
2 7	68 50	76 41	88 42	3
2 8	68 59	77 1	89 8	2
2 9	69 11	77 22	89 34	1
3 0	69 22	77 43	90 0	0

G																			G	
r	♈	Boreal	/	♎	Austr.	(Gr													r	
.	')						♊	Bor.	/	♋	Austr.	(Gr	')	♈	Bor.	/	♏	Austr.	(Gr	')
G	♐	Austr.	/	♋	Bor.		♌	Austr.	/	♋	Bor.		♎	Austr.	/	♏	Bor.		G	
r																			r	
.																			.	

TAB. 28. Right Ascension of the Sun, at the Obliquity 23°30'20"

TAB. 28. *Ascensio Recta* ☉ [the right ascension of the Sun], at the Obliquity 23°30'20".

The table gives the right ascension corresponding to each degree of ecliptic longitude. The leftmost column is the sign-degree (Sign. / Gr.), running 1–30 within each zodiacal sign; the six paired columns give, for each of the six signs of the first half of the zodiac, the right ascension in degrees (Gr.), minutes ('), and seconds (").

G	♈			♊			♈			♈			♊			♈			♊		
r	Gr	♈	♈	Gr	♊	♊	Gr	♈	♈	Gr	♊	♊	Gr	♊	♊	Gr	♈	♈	Gr	♊	♊
.	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"
1	0	55	1	28	51	21	58	50	56	91	5	26	12	14	0	15	3	16			
													3			3					
2	1	50	3	29	49	51	59	53	38	92	10	50	12	16	5	15	0	22			
													4			4					
3	2	45	5	30	46	32	60	56	32	93	17	16	12	18	16	15	58	19			
													5			4					
4	3	40	9	31	44	20	61	59	39	94	21	38	12	20	9	15	53	40			
													6			5					
5	4	35	13	32	42	20	62	2	49	95	26	53	12	21	49	15	50	49			
													7			6					
6	5	30	19	33	40	30	64	6	12	96	32	11	12	23	21	15	47	23			
													8			7					
7	6	25	27	34	38	48	65	9	43	97	37	33	12	24	39	15	43	52			
													9			8					
8	7	20	37	35	37	19	66	13	24	98	42	45	13	25	49	15	40	12			

G r	Gr	γ	γ	ϣ Gr	ϣ	ϣ	Π Gr	Π	Π	Ϝ Gr	Ϝ	Ϝ	ρ Gr	ρ	ρ	η Gr	η	η
.	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"
													0			9		
9	8	15	50	36	36	6	67	17	13	99	47	55	13	26	41	16	36	25
													1			0		
1	9	11	6	37	34	46	68	21	9	10	52	58	13	27	31	16	32	31
0										0			2			1		
1	10	6	26	38	33	40	69	25	16	10	57	59	13	27	57	16	28	35
1										1			3			2		
1	11	1	48	39	32	50	70	29	26	10	2	59	13	28	32	16	24	29
2										3			4			3		
1	11	57	14	40	31	50	71	33	43	10	7	51	13	28	45	16	20	18
3										4			5			4		
1	12	52	45	41	31	37	72	38	19	10	12	36	13	29	16	16	16	1
4										5			6			5		
1	13	48	2	42	31	23	73	42	44	10	17	36	13	28	37	16	11	58
5										6			7			6		
1	14	43	59	43	30	44	74	47	24	10	21	41	13	28	23	16	7	15
6										7			8			7		
1	15	39	42	44	31	15	75	52	9	10	26	17	13	28	10	16	2	46
7										8			9			8		
1	16	35	31	45	31	28	76	57	1	10	30	34	14	27	10	16	58	12
8										9			0			8		
1	17	31	25	46	32	3	78	2	1	11	34	44	14	26	20	16	53	34
9										0			1			9		
2	18	27	29	47	32	29	79	7	2	11	38	51	14	25	14	17	48	54
0										1			2			0		
2	19	23	35	48	33	19	80	12	5	11	42	47	14	23	54	17	44	10
1										2			3			1		
2	20	19	48	49	34	11	81	17	5	11	46	36	14	22	45	17	39	23
2										3			4			2		
2	21	16	8	50	35	21	82	22	7	11	50	17	14	21	12	17	34	33
3										4			5			3		
2	22	12	37	51	36	39	83	27	49	11	53	48	14	19	30	17	29	41

G ♀				♊				♊				♊				♊			
r Gr	♀	♀	♀	Gr	♊	♊	Gr	♊	♊	Gr	♊	♊	Gr	♊	♊	Gr	♊	♊	♊
. .	'	"		.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	
4										5			6			4			
2 23	9	11		52	38	11	84	33	7	11	57	11	14	17	40	17	24	47	
5										6			7			5			
2 24	7	20		53	38	51	85	38	22	11	0	21	14	15	40	17	19	51	
6										8			8			6			
2 25	1	41		54	41	44	86	43	44	11	3	28	14	13	28	17	14	55	
7										9			9			7			
2 25	59	38		55	43	45	87	49	10	12	6	22	15	10	9	17	9	57	
8										0			0			8			
2 26	56	44		56	46	0	88	54	34	12	9	4	15	8	39	17	4	59	
9										1			1			9			
3 27	53	57		57	48	21	90	0	0	12	11	39	15	6	3	18	0	0	
0										2			2			0			

Residuum Tabulae 28. [Remainder of Table 28]

The remainder of the table covers the second half of the zodiac (signs ♎ Libra through ♓ Pisces). The leftmost column is again the sign-degree 1–30; the six paired columns give right ascension (degrees, minutes, seconds) for each of the remaining six signs.

G ♎				♏				♏				♏				♏			
r Gr	♎	♎	♎	Gr	♏	♏	Gr	♏	♏	Gr	♏	♏	Gr	♏	♏	Gr	♏	♏	♏
. .	'	"		.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	
1 18	55	1		20	51	21	23	50	56	27	5	26	30	13	0	33	3	16	
0				8			8			1			3			3			
2 18	50	3		20	49	51	23	53	38	27	10	50	30	16	15	33	0	22	
1				9			9			2			4			4			
3 18	45	5		21	46	32	24	56	32	27	17	16	30	18	16	33	58	19	
2				0			0			3			5			4			
4 18	40	9		21	44	20	24	59	39	27	21	38	30	20	9	33	53	40	
3				1			1			4			6			5			
5 18	35	13		21	42	20	24	2	49	27	22	53	30	21	49	33	50	49	
4				2			3			5			7			6			

G $\underline{\circ}$				ℓ			↗			↘			≈			⋈		
r Gr	$\underline{\circ}$	$\underline{\circ}$		Gr	ℓ	ℓ	Gr	↗	↗	Gr	↘	↘	Gr	≈	≈	Gr	⋈	⋈
.	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"
6 18	30	19		21	40	30	24	6	12	27	32	11	30	23	21	33	47	23
5				3			4			6			8			7		
7 18	25	27		21	38	48	24	9	43	27	37	33	30	24	39	33	43	52
6				4			5			7			9			8		
8 18	20	37		21	37	15	24	13	24	27	42	45	31	25	49	33	40	12
7				5			6			8			0			9		
9 18	15	50		21	36	16	24	17	13	27	47	55	31	26	41	34	36	25
8				6			7			9			1			0		
1 18	11	6		21	34	46	24	21	9	28	52	58	31	27	31	34	32	31
0 9				7			8			0			2			1		
1 19	6	26		21	33	40	24	25	16	28	57	59	31	27	57	34	28	35
1 0				8			9			1			3			2		
1 19	1	48		21	32	50	25	29	26	28	2	59	31	28	32	34	24	29
2 1				9			0			3			4			3		
1 19	57	14		22	31	50	25	33	43	28	7	51	31	28	45	34	20	18
3 1				0			1			4			5			4		
1 19	52	45		22	31	37	25	38	19	28	12	36	31	29	16	34	16	1
4 2				1			2			5			6			5		
1 19	48	2		22	31	23	25	42	44	28	17	36	31	28	37	34	11	58
5 3				2			3			6			7			6		
1 19	43	59		22	30	44	25	47	24	28	21	41	31	28	23	34	7	15
6 4				3			4			7			8			7		
1 19	39	42		22	31	15	25	52	9	28	26	17	31	28	10	34	2	46
7 5				4			5			8			9			8		
1 19	35	31		22	31	28	25	57	1	28	30	34	32	27	10	34	58	12
8 6				5			6			9			0			8		
1 19	31	25		22	32	3	25	2	1	29	34	44	32	26	20	34	53	34
9 7				6			8			0			1			9		
2 19	27	29		22	32	29	25	7	2	29	38	51	32	25	14	35	48	54
0 8				7			9			1			2			0		
2 19	23	35		22	33	19	26	12	5	29	42	47	32	23	54	35	44	10
1 9				8			0			2			3			1		

G $\cap$				$\cap$			$\nearrow$			$\cap$			$\approx$			$\times$		
r Gr	$\cap$	$\cap$	Gr	$\cap$	$\cap$	Gr	$\nearrow$	$\nearrow$	Gr	$\cap$	$\cap$	Gr	$\approx$	$\approx$	Gr	$\times$	$\times$	
.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	
2 20	19	48	22	34	11	26	17	15	29	46	36	32	22	45	35	39	23	
2 0			9			1			3			4			2			
2 20	16	8	23	35	21	26	22	27	29	50	17	32	21	12	35	34	33	
3 1			0			2			4			5			3			
2 20	12	37	23	36	39	26	27	49	29	53	48	32	19	30	35	29	41	
4 2			1			3			5			6			4			
2 20	9	11	23	38	11	26	33	7	29	57	11	32	17	40	35	24	47	
5 3			2			4			6			7			5			
2 20	7	20	23	38	51	26	38	22	29	0	21	32	15	40	35	19	51	
6 4			3			5			8			8			6			
2 20	1	41	23	41	44	26	43	44	29	3	28	32	13	28	35	14	55	
7 5			4			6			9			9			7			
2 20	59	38	23	43	45	26	49	10	30	6	22	33	10	9	35	9	57	
8 5			5			7			0			0			8			
2 20	56	44	23	46	0	26	54	34	30	9	4	33	8	39	35	4	59	
9 6			6			8			1			1			9			
3 20	53	57	23	48	21	27	0	0	30	11	39	33	6	3	36	0	0	
0 7			7			0			2			2			0			

TAB. 29. Table of the Ascensional Differences, at the Obliquity of the Ecliptic 23°30'

TAB. 29. *Differentiarum Ascensionalium: ad Obliq. Eclipt. Grad. 23. 30'.* [Of the Ascensional Differences: at the Obliquity of the Ecliptic 23°30'.]

Subheading: *Altitudo Poli, si in latere sumatur Declinatio Sideris; vel Declinatio Sideris, si in latere sumatur Alt. Poli.* [The Altitude of the Pole, if the Declination of the star is taken at the side; or the Declination of the star, if the Altitude of the Pole is taken at the side.]

[Left side-label, rotated: *Declinatio Sideris, aut Altitudo Poli, &c.* — the Declination of the star, or the Altitude of the Pole, etc.]

The argument runs along the top (the value 1–25 in degrees, here the pole-altitude columns 1–10) and down the left (the value 1–60, the declination of the star). Each entry gives the ascensional difference in degrees (G.), minutes ('), and seconds ("). The right-hand margin carries a complementary index running 89 down to 30 (for reading the table with the alternate entry-argument).

											1	(c
(de	1	2	3	4	5	6	7	8	9	0	1	o
cl./	1	2	3	4	5	6	7	8	9	0	1	m
pol	G	G	G	G	G	G	G	G	G	G	0	pl
e)	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	.)
1	0 1 3	0 2 6	0 3 9	0 4 1	0 5 1	0 6 1	0 7 2	0 8 2	0 9 3	0 1 3	8	
				2	5	9	2	6	0	0	5	9
2	0 2 6	0 4 1	0 6 1	0 8 2	0 1 3	0 1 3	0 1 4	0 1 5	0 1 1	0 2 1	8	
		1	7	4	0 0	2 7	4 5	6 2	9	1	0	8
3	0 3 9	0 6 1	0 9 2	0 1 3	0 1 4	0 1 5	0 2 7	0 2 1	0 2 3	0 3 4	8	
		7	7	2 6	5 6	8 6	2	5 9	8 2	1	6	7
4	0 4 1	0 8 2	0 1 3	0 1 4	0 2 2	0 2 1	0 2 3	0 3 4	0 3 4	0 4 2	8	
	2	4	2 6	6 9	1	5 6	9 1	3 7	8	2	3	6
5	0 5 1	0 1 3	0 1 4	0 2 2	0 2 1	0 3 3	0 3 5	0 4 1	0 4 3	0 5 2	8	
	5	0 0	5 6	1	6 9	1 7	6 6	2 6	7 8	3	5	
6	0 6 1	0 1 3	0 1 5	0 2 1	0 3 3	0 3 5	0 4 2	0 5 4	0 5 1	1 3 4	8	
	9	2 7	8 6	5 6	1 7	7 9	4 2	0 7	7 4	3	4	
7	0 7 2	0 1 4	0 2 7	0 2 3	0 3 5	0 4 2	0 5 5	0 5 2	1 6 5	1 1 2	8	
	2	4 5	2	9 1	6 6	4 2	1 0	9 0	2	4	6	3
8	0 8 2	0 1 5	0 2 1	0 3 4	0 4 1	0 5 4	0 5 2	1 7 5	1 1 3	1 2 1	8	
	6	6 2	5 9	3 7	2 6	0 7	9 0	4	6 2	5	2	2
9	0 9 3	0 1 1	0 2 3	0 3 4	0 4 3	0 5 1	1 6 5	1 1 3	1 2 1	1 3 2	8	
	0	9	8 2	8	7 8	7 4	2	6 2	6 5	6	1	
10	0 1 3	0 2 1	0 3 4	0 4 2	0 5 2	1 3 4	1 1 2	1 2 1	1 3 2	1 4 5	8	
	0 5	1 0	1 6	2 3	3	3	4 6	5 2	6	6	4	0
11	0 1 3	0 2 2	0 3 1	0 4 4	0 5 2	1 1 1	1 2 5	1 3 5	1 4 5	1 5 3	7	
	1 9	3 0	5	6 4	8 8	0 4	3	3 6	5 1	7	1	9
12	0 1 4	0 2 3	0 3 1	0 5 9	1 3 5	1 1 4	1 2 4	1 4 4	1 5 4	2 8 5	7	
	2 5	5 1	8 8	1	6	6 8	9 4	2 3	5 5	3	8	
13	0 1 5	0 2 4	0 4 3	0 5 3	1 9 2	1 2 2	1 3 2	1 5 3	2 5 4	2 1 5	7	

(de cl./ pol e)	1 1 G .	2 1 G '	3 2 G "	4 2 G .	5 3 G '	6 3 G "	7 4 G .	8 4 G '	9 5 G "	0 5 G .	1 6 G '	0 6 G "	(c o m p l e t e)						
	3	1	7	3	1	6	5	0	6	3	6	7	8	1	4	4	9	9	7
14	0	1	5	0	2	5	0	4	5	0	5	5	1	1	1	1	3	6	1
	4	8	9	6	4	5	9	7	5	0	5	5	2	9	2	2	1	4	2
15	0	1	5	0	3	1	0	4	1	1	4	2	1	2	3	1	3	5	1
	6	2	0	8	7	5	0	6	6	0	3	9	5	6	2	9	5	7	6
16	0	1	1	0	3	2	0	5	4	1	8	5	1	2	1	1	4	3	2
	7	3	4	5	1	0	6	6	5	3	7	8	4	6	1	3	3	4	7
17	0	1	2	0	3	4	0	5	5	1	1	3	1	3	5	1	5	3	2
	8	1	6	2	5	3	0	1	8	0	1	7	5	6	2	5	3	7	7
18	0	1	3	0	3	0	0	5	3	1	1	7	1	3	4	1	5	2	2
	9	0	9	8	2	8	7	4	7	4	7	1	7	7	7	3	1	4	7
19	0	2	4	0	4	2	1	2	2	1	2	4	1	4	3	2	4	4	2
	0	0	1	0	2	7	3	5	7	5	3	6	5	5	8	1	1	7	7
20	0	2	5	0	4	4	1	5	3	1	2	3	1	4	2	2	1	3	4
	1	1	3	2	5	7	0	9	9	1	3	3	1	5	6	8	7	0	7
21	0	2	2	0	4	5	1	9	1	1	3	1	1	5	2	2	1	4	2
	3	5	0	2	7	5	8	8	5	2	3	9	2	2	9	6	3	5	6
22	0	2	1	0	4	3	1	1	4	1	3	8	2	1	3	2	2	4	6
	4	5	8	0	2	8	7	3	6	0	7	5	8	0	4	5	7	6	8
23	0	2	2	0	5	5	1	1	2	1	4	3	2	7	4	2	3	2	5
	5	8	0	7	6	9	2	2	3	6	9	5	5	1	1	1	7	3	7
24	0	2	4	0	5	2	1	2	1	1	4	3	2	1	5	2	4	5	3
	6	3	3	7	0	3	7	3	7	0	6	5	5	7	0	6	9	6	6
25	0	2	5	0	5	5	1	2	1	1	5	6	2	2	1	2	4	3	3
	7	9	5	9	4	2	0	7	8	3	6	6	5	7	4	2	9	5	6
26	0	2	1	0	5	3	1	2	5	1	2	2	4	2	5	1	3	2	0
	9	6	8	3	7	2	7	6	6	4	6	8	6	5	0	5	0	6	4
27	0	3	3	1	1	1	1	3	4	2	2	3	1	3	4	1	3	3	1
	0	5	0	1	8	1	3	8	2	5	3	3	7	4	7	3	6	3	7
28	0	3	5	1	3	5	1	3	4	2	7	5	2	3	5	3	1	1	3

(de	1			2			3			4			5			6			7			8			9			1			(c	
cl./	1	1		2	2		3	3		4	4		5	5		6	6		7	7		8	8		9	9		0	1	0	m	
pol	G			G			G			G			G			G			G			G			G			G	0		pl	
e)	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.	'	"	.)	
	1	5					0		5	8			1		9	9		2	3		4	5		7			9	1		2	7	2
29	0	3	1	1	6	3	1	3	5	2	1	1	2	4	4	3	2	2	3	5	1	4	2	5	5	2	1	5	3	3	6	
	3	6				3		9	3		3	7		6	7		0	4		4	0		8			2		6	3	1		
30	0	3	3	1	9	1	1	4	2	2	1	5	2	5	4	3	2	4	4	3	5	4	3	1	5	1	4	5	5	3	6	
	4	9				9		4			8	0		3	3		8	4			5		9	5		4	8		0	5	0	
31	0	3	4	1	1	8	1	4	1	2	2	2	3	0	4	3	3	1	4	1	5	4	5	3	5	2	3	6	4	5	5	
	6			2				8	6		4	8			8		7	5		3	2		0	9		7	9			5	9	
32	0	3	3	1	1	1	1	5	3	2	3	1	3	8	2	3	4	5	4	2	1	5	2	1	5	4	4	6	1	3	5	
	7	0		5				2	6		0	6					5	7		4				8		8	8		9	3	8	
33	0	3	5	1	1	5	1	5	1	2	3	1	3	1	9	3	5	5	4	3	2	5	1	1	5	5	1	6	3	3	5	
	8	8		7	8		7			6	0		5			4	0		4	5		4	2		4	4		4	1	7		
34	0	4	2	1	2	5	2	1	3	2	4	1	3	2	5	4	3	5	4	4	3	5	2	2	6	7	5	6	4	5	5	
	0	9		0	9			3		2	2		2	9			5		5			6	3		8		9	0	6			
35	0	4	1	1	2	4	2	6	1	2	4	2	3	3	4	4	1	1	4	5	5	5	3	5	6	2	3	7	5	3	5	
	2			4				1		8	3		0	4		3	4		5	6		8	1		2				2	5		
36	0	4	3	1	2	1	2	1	5	2	5	4	3	3	4	4	2	4	5	7	5	5	5	3	6	3	2	7	2	3	5	
	3	6		7	4		0	6		4	4		8	0		2	7					1	9		6	9		1	8	4		
37	0	4	1	1	3	2	2	1	4	3	1	1	3	4	4	4	3	3	5	1	3	6	4	4	6	5	1	7	3	8	5	
	5	3		0	8		5	8			4		6	8		2	4		8	2			6		1	8		8		3		
38	0	4	5	1	3	4	2	2	4	3	7	5	3	5	1	4	4	3	5	3	1	6	1	1	7	6	3	7	5	6	5	
	6	2		3	8		0	8			4		5	0		2	7		0	8		8	5		0		5		2			
39	0	4	3	1	3	1	2	2	5	3	1	4	4	3	4	4	5	5	5	4	2	6	3	6	7	2	9	8	1	3	5	
	8	5		7	4		5	6		4	6			6		2	7		2	3		2			2			2	3	1		
40	0	5	2	1	4	4	2	3	1	3	2	5	4	1	3	5	3	3	5	5	4	6	4	2	7	3	1	8	3	3	5	
	0	1		0	5		1	4		1	0		2	6			5		4	9		6	2		8	5		0	1	0		
41	0	5	1	1	4	2	2	3	4	3	2	4	4	2	4	5	1	3	6	7	3	7	1	1	7	5	5	8	4	2	4	
	2	0		4	2		6	0		9			1	2		4	2			8					4	0		9		9		
42	0	5	2	1	4	7	2	4	1	3	3	3	4	3	5	5	2	4	6	2	5	7	1	1	8	1	4	9	8	7	4	
	4			8			2	6		6	8		1			5	9		0	1		6	2		1				8			
43	0	5	5	1	5	5	2	4	4	3	4	4	4	4	4	5	3	2	6	3	2	7	3	5	8	2	3	9	2	5	4	

(de	1	2	3	4	5	6	7	8	9	1	(c
cl./	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	0 1	o
pol	G	G	G	G	G	G	G	G	G	G 0	pl
e)	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	.)
	5 8	1 8	8	6 8	0 7	7 0	4 9	1 1	9 7	7 1	7
44	0 5 5	1 5 5	2 5 4	3 5 1	4 5 4	5 4 3	6 4 3	7 4 1	8 4 5	9 4 1	4
	7 7	5 7	4	2 9	0 7	9 2	8 5	8	7 3	8 5	6
45	1 0 1	2 0 5	3 0 1	4 0 3	5 1 9	6 2 0	7 3 9	8 4 4	9 6 4	1 9 2	4
			5	5				5	8 0	2 5	
46	1 2 8	2 4 2	3 6 3	4 9 9	5 1 5	6 1 6	7 1 1	8 2 6	9 2 2	1 3 1	4
		1	9		1 3	5	8 7	2	6 4	0 1	5 4
47	1 4 2	2 8 4	3 1 1	4 1 2	5 2 0	6 2 1	7 3 1	8 4 6	9 4 4	1 5 5	4
	1	6	3 8	8	3	8 8	3 8	0	6 4	0 3	9 3
48	1 6 3	2 1 2	3 2 1	4 2 1	5 3 3	6 4 1	7 5 1	8 5 4	1 7 5	1 1 3	4
	9	3 2	0 2	7 5	4 4	2 2	0 6	8 6 0	3 1 7	7 2	
49	1 9 2	2 1 8	3 2 2	4 3 5	5 4 3	6 5 4	8 7 1	9 1 1	1 2 5	1 4 1	4
		8	7 3	6 0	6 1	6 1	3	8 5	0 9 4	1 2 2	1
50	1 1 3	2 2 7	3 3 5	4 4 4	5 5 5	7 1 2	8 2 5	9 3 2	1 5 4	1 7 5	4
	1 1	3	4 1	6 9	9	1 4	4 2	8 2	0 2 9	2 0 0	
51	1 1 6	2 2 1	3 4 3	4 5 2	6 1 9	7 2 2	8 4 1	9 5 4	1 1 4	1 3 3	3
	4	8 8	2 9	7 1	2	7 8	3 7	9 1	1 6 6	2 4 6	9
52	1 1 4	2 3 4	3 5 4	5 8 6	6 2 4	7 4 5	9 2 3	1 2 4	1 4 4	1 2 3	3
	6 2	3 2	0 7		5 6	3 3	1 0	1 7	1 1 7	3 7	8
53	1 1 3	2 3 2	3 5 1	5 1 2	6 4 2	8 1 4	9 2 4	1 4 5	1 8 0	1 3 5	3
	9 9	9 2	9 7	9 8	0		2 0	0 4	6 2	3 1	7 7
54	1 2 3	2 4 1	4 8 1	5 3 2	6 5 5	8 1 4	9 4 4	1 9 1	1 3 3	1 2 4	3
	2 6	5 8	2	1 3	4 9	9	3 7	1	3 2	5 0	4 5 6
55	1 2 4	2 5 1	4 1 1	5 4 5	7 1 4	8 3 5	1 5 5	1 3 4	1 4 2	1 3 8	3
	5 2	1	7 3	3 3	0 0	7 9	0	8 1	4 5	3 4	4 5 5
56	1 2 5	2 5 4	4 2 2	5 5 2	7 2 1	8 5 5	1 2 1	1 1 3	1 3 5	1 9 1	3
	8 9	8	7 3	7	7 0	7 3	0 9	8 2	5 3	4 1	5 5 4
57	1 3 2	3 4 5	4 3 4	6 1 5	7 4 3	9 1 5	1 5 5	1 2 5	1 7 0	1 4 1	3
	2 5	7	7 4	0 3	4 3	8 1	0 3	6 2	9 5	4 5	5 8 3
58	1 3 3	3 1 1	4 4 4	6 2 3	8 2 5	9 4 0	1 1 5	1 5 5	1 4 5	1 2 2	3

											1		(c			
(de	1	2	3	4	5	6	7	8	9	0	1	o				
cl./	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	1 0	0 m					
pol	G	G	G	G	G	G	G	G	G	G 0	pl					
e)	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	.)					
	6	2 3	8 0	5 1		1	1 9	6 2	9 3	4 0	9 6	3 6	2			
59	1 3	5 3	1 5	5 0	1 6	4 5	8 2	2 1	4 2	1 3	3 1	1 2	1 4	5 3		
	9 3	9 7	4 0	9 2	1 0	7 1	7 9	3 1	4 5	7 7			1			
60	1 4	5 3	2 4	5 1	2 6	4 2	8 4	5 1	2 2	1 1	4 2	5 2	1 5	2 1	4 5	3
	3 7	8 2	9 7	4 2	7 0	9 1	2 6	4 4	0 5	5 1	7 6	9 0				

[Bottom column-foot index (verbatim, beneath the data, reading left to right): 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 80]

[Margin foot: H]

Resid. Tab. 29. Differentia Ascensionalium. [Remainder of Table 29. Ascensional Difference.] — continuation, pole-altitudes 1–10, declination 61–90

[Left side-label, rotated: *Declinatio Sideris, in fronte sumatur Altr. Poli; vel Altit. Poli si in fronte Declinatio.* — The Declination of the star (taken in the top); or the Altitude of the Pole, if the Declination is taken in the top.]

This continues the same ten pole-altitude columns for declination arguments 61–90. The complementary right-hand index runs 29 down to 0.

											1	(c				
(de	1	2	3	4	5	6	7	8	9	0	1	o				
cl./	1 1	2 2	3 3	4 4	5 5	6 6	7 7	8 8	9 9	1 0	0 m					
pol	G	G	G	G	G	G	G	G	G	G 0	pl					
e)	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	. ' "	.)					
61	1 4	1 3	3 4	5 2	3 7	1 5	9 4	5 1	5 4	1 4	5 1	4 1	1 3	1 1	3 5	2
	8 7	6 3	5 1	4 0	3 0	5 9	2 7	3 4	1 5	6 6	1 8	2 5	9			
62	1 5	5 3	4 5	5 3	2 7	3 2	9 2	1 1	2 4	1 2	6 1	1 3	1 1	5 1	2 4	2
	2 3	5 7	9 4	3 6	8 4	1 4	3 1	5 9	6 7	9 0	9 2	8				
63	1 5	4 3	5 4	5 5	1 7	5 1	9 5	1 1	5 1	1 5	4 1	0 4	1 6	3 2	1 3	2
	7 8	5 8	4 3	3 8	3 4	1 4	6 3	6 0	6 2	8 8	0 4	9 7				
64	2 3	4 4	6 2	6 1	6 8	1 3	1 2	1 1	2 4	1 3	5 1	4 5	1 5	0 2	1 3	2

(de cl./ pol e)	1 1 G .	2 1 G '	3 2 G '	4 2 G '	5 3 G '	6 3 G '	7 4 G '	8 4 G '	9 4 G '	0 1 G '	1 0 G '	(c o m p l e t e)
			1 0		4 5 0 0		2 6 1 4 4 1 6 4 1 8 7		1 1 9 6			
65	2 8 4 4 1 4 6 2 1 8 3 2 1 4 5 1 1 3 1 1 1 1 3 2 1 5 2 2 1 6 2		3 7 1 7 1 7 8 0 8 0 3 5 5 6 7 2 9 9 1 3 2 3									5
66	2 1 4 4 2 5 6 4 3 9 2 1 1 1 5 1 3 1 1 0 3 1 2 8 2 5 2 2 1 5 2		4 9 9 5 5 6 0 1 9 7 3 9 7 6 1 8 4 0 0 7 3 9 1 4									
67	2 2 2 4 4 8 7 5 3 9 2 5 1 5 1 1 2 1 1 4 5 1 2 8 2 5 3 2 3 4 2		1 5 3 3 8 6 1 3 9 4 0 0 6 8 1 9 0 1 4 3 4 2 1 3									
68	2 2 3 4 5 3 7 2 1 9 5 0 1 3 2 1 4 4 1 4 3 2 2 2 2 2 4 4 2 5 3 2		8 4 7 0 7 1 8 2 0 2 5 3 7 1 3 0 1 8 3 9 5 2 5 2									
69	2 3 2 5 1 1 7 5 4 1 2 4 1 1 2 1 5 2 1 3 1 2 2 3 2 2 1 2 2 5 2		6 3 3 0 0 9 0 9 6 3 0 8 5 3 8 8 9 8 1 8 7 4 3 7 7 0 7 1									
70	2 4 5 5 3 2 8 1 4 1 4 3 1 5 3 1 4 5 1 4 5 2 4 5 2 4 4 2 5 4 2		4 5 0 1 6 4 1 6 3 4 1 6 7 9 2 6 2 2 6 5 7 5 8 5 7 0									
71	2 5 2 5 4 1 8 4 1 1 4 2 1 4 1 1 1 2 2 5 2 2 1 5 2 2 1 3 4 1 1		4 1 9 5 5 7 1 3 4 3 0 7 6 3 0 3 9 3 3 7 3 1 0 8 3 9									
72	3 4 4 6 1 1 9 1 5 1 2 4 1 3 1 1 5 2 2 0 1 2 1 2 2 3 1 3 5 5 1		3 0 1 6 6 2 5 1 5 7 4 8 2 5 2 2 4 8 0 9 0 0 2 2 8									
73	3 1 2 6 3 3 9 5 1 1 1 1 1 3 4 2 6 2 2 4 4 2 2 4 3 7 4 3 1 1 1		6 3 3 1 2 3 3 3 9 6 7 3 0 7 3 0 5 7 2 9 2 9 5 3 9 7									
74	3 2 2 6 5 4 1 3 5 1 6 5 1 4 5 2 3 1 2 2 1 2 3 1 3 5 1 3 1 2 1		9 4 9 2 0 1 2 4 3 7 5 4 1 0 0 5 1 3 9 0 0 4 1 9 0 7 6									
75	3 4 7 7 2 1 1 1 4 1 7 4 1 3 2 2 5 4 2 1 2 3 3 1 3 1 9 4 0 1 1		4 9 9 1 6 5 5 0 9 6 3 2 7 6 6 1 8 3 6 4 1 8 5									
76	4 0 5 8 3 5 1 8 2 1 1 1 2 3 3 2 5 5 2 3 1 3 1 4 3 2 0 4 0 3 1		3 2 6 7 6 0 2 2 4 5 8 9 0 0 4 8 0 9 6 5 2 4									
77	4 2 1 8 4 0 1 7 6 1 3 5 2 1 8 2 4 5 3 7 4 3 3 0 4 1 9 4 4 5 1		0 1 2 3 7 7 3 2 6 7 4 2 9 7 0 3 9 9 7 0 3									
78	4 4 3 9 2 2 1 1 2 1 1 5 2 1 1 2 3 8 3 1 1 4 2 3 4 1 1 5 3 1 1		2 8 7 4 4 6 7 9 2 3 4 8 0 9 8 5 7 1 1 3 0 8 0 9 6 4 2									
79	5 9 8 1 2 5 1 3 2 2 3 5 2 4 5 3 4 5 3 1 2 4 1 1 5 3 1 6 6 4 1											

(de	1	2	3	4	5	6	7	8	9	1	(c																				
cl./	1	2	3	4	5	6	7	8	9	0	1	o																			
pol	G	G	G	G	G	G	G	G	G	G	0	m																			
e)	.	'	"	.	'	"	.	'	"	.	'	"	pl.)																		
		0	0	8	5	8	8	1		1	6	4	9	2	3	7	9	0	7	6	8	9	4	4	4	5		4	1		
80	5	4	5	1	2	2	1	1	2	2	1	5	2	4	5	3	3	2	4	8	7	5	5	1	6	5	1	9	0	0	1
		0	3	1	5	2	7	7	7	3	9	0	9	4	0	6	5	3	4		2	1		3	5	3	0			0	
81	6	1	1	1	4	1	1	1	2	2	1	5	3	3	5	4	3	3	5	4	3	6	2	2	9	0	0			9	
	9	9	2	4	5	9	9	2	6	1	9	3	1	1	1	4	2	0	9	7	2	3	3	0							
82	7	8	6	1	2	5	2	5	4	2	5	4	3	3	1	4	2	2	6	5	1	9	0	0					8		
			4	3	4	1	3	1	9	0	7	8	0		8	4	0	0	3	3	0										
83	8	1	2	1	3	2	2	1	5	3	2	1	4	5	2	5	5	2	9	0	0								7		
	0	4	6	1	5	5	5	9	4	6	3	5	2	0	8	2	0	0													
84	9	3	3	1	2	2	2	5	3	4	4	2	5	2	4	9	0	0											6		
	3	7	9	4	0	9	4	4	1	1	3	6	0	7	0																
85	1	3	3	2	3	3	3	4	4	5	3	3	9	0	0														5		
	1	0	3	3	1	0	6	8	7	3		8	0																		
86	1	2	2	2	5	3	4	3	4	9	0	0																	4		
	4	7	1	9	7	5	8	2	0	0																					
87	1	2	2	4	4	5	9	0	0																				3		
	9	7	1	1	7		0																								
88	3	5	4	9	0	0																							2		
	9	0	9	0																											
89	9	0	0																										1		
	0																														
90																													0		

[Bottom column-foot index (verbatim): 89 | 88 | 87 | 86 | 85 | 84 | 83]

[Margin foot: H]

[Note printed in the lower-right area of the table (verbatim):] *Ubi desunt numeri areales, signum est aggregatum ex numero frontali, & marginis sinistri excedere quadrantem, quod intelligendum est de sequentibus quoque; spatiis areis vacuis in residuis partibus Tabulae, mox secuturis. Vel certe superflue ibi quaeruntur cum in alia huius partis reperiri possint.*
— Where the area-numbers are lacking, it is a sign that the sum of the

column-head (frontal) number and the left-margin number exceeds a quadrant [90°]; and this is to be understood of the following [entries] too, the area-spaces being left blank in the remaining parts of the Table that follow shortly. Or else they are sought there in vain, since they can be found in another part of this [Table].

Residuum Tab. 29. Differentiarum Ascensionalium.

[Remainder of Table 29. Of the Ascensional Differences.] — pole-altitudes 11–25, declination 1–30

Subheading: *Altitudo Poli si in latere sinistro sumatur Declinatio; vel Declinatio si in latere sinistro Alt. Poli.* [The Altitude of the Pole, if the Declination is taken at the left side; or the Declination, if the Altitude of the Pole is at the left side.]

[Left side-label, rotated: *Declinatio, si in fronte sumatur Alt. Poli; vel Alt. Poli si in fronte Declinatio.* — The Declination, if the Altitude of the Pole is taken in the top; or the Altitude of the Pole, if the Declination is in the top.]

This part of the table extends the argument to pole-altitudes 11°–25°. Each column here gives degrees (G.) and minutes (') only (no seconds column). The declination argument runs 1–30 down the left; the complementary right-hand index runs 88 down to 59. (The table continues in the following part.)

																(
																c
	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	o
(de	1	1	2	1	3	1	4	1	5	1	6	1	7	1	8	1
cl./	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	m
pol	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	l.
e)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	)
1	0	1	0	1	0	1	0	1	0	1	0	2	0	2	0	2
	2	3	4	5	6	7	8	0	1	2	3	4	5	7	8	8
2	0	2	0	2	0	2	0	3	0	3	0	3	0	3	0	4
	3	6	8	0	2	4	7	9	1	4	6	9	3	7		7
3	0	3	0	3	0	4	0	4	0	5	0	5	1	2	1	6
	5	8	2	5	8	2	5	9				3				4
4	0	4	0	5	0	5	1	0	1	4	1	9	1	1	1	2
	7	1	6				4	8	3	8	2	7	2	7	2	5

																	(
	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	o
(de	1 1	2 1	3 1	4 1	5 1	6 1	7 1	8 1	9 1	0 2	1 2	2 2	3 2	4 2	5 2	m	
cl./	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	p	
pol	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	l.	
e)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
5	0 5	1 4	1 9	1 1	1 2	1 2	1 3	1 3	1 4	1 4	1 5	2 2	2 8	2 1	2 2	8	
	8			5	1	6	2	8	4	9	5			4	0	4	
6	1 1	1 1	1 2	1 3	1 3	1 4	1 5	1 5	2 5	2 1	2 1	2 2	2 3	2 4	2 4	8	
	0	7	3	0	7	4	1	7		2	9	6	3	1	9	3	
7	1 2	1 3	1 3	1 4	1 5	2 1	2 9	2 1	2 2	2 3	2 4	2 5	2 5	3 8	3 1	8	
	3	0	7	5	3			7	6	4	2	1	9		7	2	
8	1 3	1 4	1 5	2 0	2 9	2 1	2 2	2 3	2 4	2 5	3 6	3 1	3 2	3 3	3 4	8	
	4	3	2			9	8	7	6	6		5	5	5	5	1	
9	1 4	1 5	2 6	2 1	2 2	2 3	2 4	2 5	3 8	3 1	3 2	3 4	3 5	4 3	4 1	8	
	6	6		6	6	6	7	7		8	9	0	1		4	0	
10	1 5	2 9	2 2	2 3	2 4	2 5	3 5	3 1	3 2	3 4	3 5	4 5	4 1	4 3	4 4	7	
	8		0	1	2	4		7	9	1	3		8	0	3	9	
11	2 1	2 2	2 3	2 4	2 5	3 1	3 2	3 3	3 5	4 3	4 1	4 3	4 4	4 5	5 1	7	
	0	2	4	7	9	2	4	7	0		7	0	4	8	2	8	
12	2 2	2 3	2 4	3 2	3 1	3 3	3 4	3 5	4 1	4 2	4 4	4 5	5 1	5 2	5 4	7	
	2	5	9		6	0	4	8	2	6	1	6	1	6	1	7	
13	2 3	2 4	3 3	3 1	3 3	3 4	4 3	4 1	4 3	4 4	5 5	5 2	5 3	5 5	6 1	7	
	4	9		8	3	8		8	4	9		1	7	4	1	6	
14	2 4	3 2	3 1	3 3	3 5	4 7	4 2	4 3	4 5	5 1	5 3	5 4	6 5	6 2	6 4	7	
	7		8	6	0		2	9	5	2	0	7		2	1	5	
15	2 5	3 1	3 3	3 5	4 7	4 2	4 4	5 0	5 1	5 3	5 5	6 1	6 3	6 5	7 1	7	
	9	6	3	0		4	2		8	6	4	3	2	1	1	4	
16	3 1	3 3	3 4	4 6	4 2	4 4	5 2	5 2	5 4	5 5	6 1	6 3	7 6	7 3	8 0	7	
	2	0	8		4	3		1	0	9	9	9		3		3	
17	3 2	3 4	4 3	4 2	4 4	5 2	5 2	5 4	6 3	6 2	6 4	7 6	7 2	7 4	8 2	7	
	4	4		2	2		2	2		3	4		7	9	4	2	
18	3 3	3 5	4 1	4 3	5 0	5 2	5 4	6 4	6 2	6 4	7 1	7 3	7 5	8 2	8 5	7	
	7	8	8	9		1	2		5	7	0	3	6	8	5	1	
19	3 5	4 1	4 3	4 5	5 1	5 4	6 3	6 2	6 4	7 1	7 3	8 0	8 2	8 4	9 1	7	

	(c o m p l e)															
	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
(de	1	1	2	1	3	1	4	1	5	1	6	1	7	1	8	1
cl./	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6
pol	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
e)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
	0	2	4	5	8	0		5	9	2	6		4	9	4	0
20	4	3	4	2	4	4	5	1	5	3	5	5	6	2	6	4
			6	9	2	6	9	3	7	2	7		7	3	0	6
21	4	1	4	4	5	5	5	3	5	5	6	1	6	4	7	1
	7	1			0	4	9	4	0	6		8	5	4	2	0
22	4	3	4	5	5	2	5	4	6	1	6	3	7	6	7	3
	0	6	1	7	3	9			3		7	5	4	2	0	2
23	4	4	5	1	5	3	6	5	6	3	6	5	7	2	7	5
	4	1	7			3	9	7	6	4	3	3	2	0	3	0
24	4	5	5	2	5	5	6	2	6	5	7	2	7	4	7	5
	8	6	4	2	1	0	9	9	9	0	0	0	2	0	4	1
25	5	1	5	4	6	1	6	4	7	1	7	4	8	1	8	4
	2	1	1	1	1	1	2	3	4	6	0	9	0	2	1	5
26	5	2	5	5	6	2	6	5	7	3	8	2	8	3	9	7
	6	7	8	9	1		5		0	0	4	0	7	1	2	1
27	5	4	6	1	6	4	7	1	7	5	8	2	8	5	9	3
	1	3	5	8	1	4	8	2	0	0	1	1	7	1	3	2
28	5	5	6	2	7	3	7	3	8	1	8	4	9	2	9	5
	6	9			7	1	6	1	7	0	3	1	0	1	7	2
29	6	1	6	4	7	2	7	5	8	3	9	9	9	4	1	2
	1	6	1	7	2		5	0	3	1	1	8	2	7	2	6
30	6	2	7	3	7	4	8	1	8	5	9	3	1	1	4	1
	7		0	7	4	2	0	0	0	9	1	8	2	2	9	3

[Bottom column-foot index (verbatim): 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65]

Remainder of TABLE 29. Of Ascensional Differences.

The Altitude of the Pole, if the Declination be taken on the left-hand side; or the Declination, if on the same side the Altitude of the Pole be taken.

Each pole-altitude column (headed 11 through 25) gives the ascensional difference in degrees (G. = *gradus*) and minutes ('). The left-hand column is the declination (running 31–79); the right-hand column is the complementary declination (running 59 down to 11).

D ec l.	11 G./ '	12 G./ '	13 G./ '	14 G./ '	15 G./ '	16 G./ '	17 G./ '	18 G./ '	19 G./ '	20 G./ '	21 G./ '	22 G./ '	23 G./ '	24 G./ '	25 G./ '	(c o m pl)
31	6 42	7 20	7 58	8 37	9 16	9 55	10 35	11 15	11 56	12 38	13 20	14 3	14 47	15 31	16 16	59
32	6 59	7 38	8 18	8 58	9 38	10 19	11 1	11 43	12 25	13 9	13 53	14 37	15 22	16 9	16 56	58
33	7 15	7 56	8 37	9 19	10 1	10 44	11 27	12 11	12 55	13 40	14 26	15 13	16 0	16 48	17 38	57
34	7 32	8 15	8 57	9 41	10 25	11 9	11 54	12 40	13 26	14 13	15 0	15 49	16 38	17 29	18 20	56
35	7 49	8 34	9 18	10 3	10 49	11 45	12 22	13 9	13 57	14 46	15 36	16 26	17 17	18 10	19 3	55
36	8 7	8 53	9 39	10 26	11 13	12 1	12 50	13 39	14 29	15 20	16 12	17 4	17 58	18 53	19 48	54
37	8 25	9 13	10 1	10 50	11 39	12 29	13 19	14 10	15 2	15 55	16 49	17 44	18 39	19 36	20 34	53
38	8 44	9 34	10 23	11 14	12 5	12 57	13 49	14 42	15 36	16 31	17 27	18 24	19 22	20 21	21 22	52
39	9 3	9 55	10 46	11 39	12 32	13 26	14 20	15 15	16 11	17 8	18 6	19 6	20 6	21 8	22 11	51
40	9 23	10 16	11 10	12 5	13 0	13 55	14 51	15 49	16 48	17 47	18 47	19 49	20 52	21 56	23 2	50
41	9 44	10 39	11 35	12 31	13 28	14 26	15 25	16 24	17 25	18 27	19 30	20 34	21 39	22 46	23 55	49

D ec l.	11 G./ '	12 G./ '	13 G./ '	14 G./ '	15 G./ '	16 G./ '	17 G./ '	18 G./ '	19 G./ '	20 G./ '	21 G./ '	22 G./ '	23 G./ '	24 G./ '	25 G./ '	(c o m pl)
42	10 5	11 2	12 0	12 58	13 58	14 58	15 59	17 1	18 4	19 8	20 13	21 20	22 28	23 38	24 50	48
43	10 27	11 26	12 26	13 27	14 28	15 31	16 34	17 38	18 44	19 50	20 59	22 8	23 19	24 33	25 46	47
44	10 49	11 51	12 53	13 56	15 0	16 5	17 10	18 18	19 25	20 35	21 45	22 58	24 12	25 28	26 45	46
45	11 13	12 16	13 21	14 26	15 33	16 40	17 48	18 58	20 8	21 21	22 34	23 50	25 7	26 26	27 48	45
46	11 37	12 43	13 50	14 58	16 7	17 16	18 27	19 40	20 53	22 9	23 26	24 44	26 5	27 27	28 52	44
47	12 2	13 11	14 20	15 30	16 42	17 54	19 8	20 23	21 40	22 58	24 18	25 40	27 3	28 31	30 0	43
48	12 28	13 39	14 51	16 5	17 19	18 34	19 51	21 9	22 29	23 51	25 14	26 40	28 8	29 38	31 11	42
49	12 55	14 9	15 24	16 40	17 57	19 16	20 36	21 57	23 20	24 45	26 12	27 42	29 14	30 49	32 26	41
50	13 24	14 40	15 58	17 17	18 37	19 59	21 22	22 47	24 15	25 42	27 13	28 47	30 23	32 3	33 46	40
51	13 53	15 13	16 34	17 56	19 19	20 44	22 11	23 39	25 10	26 43	28 17	29 56	31 37	33 21	35 9	39
52	14 24	15 47	17 11	18 37	20 3	21 32	23 2	24 34	26 9	27 46	29 26	31 8	32 54	34 44	36 39	38
53	14 47	16 23	17 50	19 19	20 50	22 22	23 56	25 33	27 11	28 53	30 37	32 25	34 17	36 13	38 14	37
54	15 31	17 5	18 32	20 4	21 38	23 15	24 53	26 34	28 17	30 4	31 54	33 47	35 45	37 48	39 56	36
55	16 7	17 40	19 13	20 52	22 30	24 10	25 53	27 39	29 27	31 19	33 14	35 14	37 17	39 29	41 45	35
56	16 45	18 22	20 1	21 42	23 24	25 9	26 57	28 48	30 42	32 39	34 41	36 48	38 59	41 18	43 44	34
57	17	19	20	22	24	26	28	30	32	34	36	38	40	43	45	33

D	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	(c o m p l .)
ec	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	G./	
l.	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	
	25	6	49	35	22	12	5	1	1	5	14	28	47	17	53	
58	18	19	21	23	25	27	29	31	33	35	37	40	42	45	48	32
	7	52	41	31	23	19	17	19	26	37	54	17	47	27	16	
59	18	20	22	24	26	28	30	32	34	37	39	42	44	47	50	31
	53	43	36	31	29	30	35	44	58	17	42	16	57	49	54	
60	19	21	23	25	27	29	31	34	36	39	41	44	47	50	53	30
	40	36	34	35	39	47	59	15	37	5	40	25	19	27	52	
61	20	22	24	26	28	31	33	35	38	41	43	46	49	53	57	29
	32	33	37	44	54	9	28	53	24	3	50	48	59	26	16	
62	21	23	25	27	30	32	35	37	40	43	46	49	52	56	61	28
	27	34	44	58	16	38	6	40	22	12	12	27	58	52	17	
63	22	24	26	29	31	34	36	39	42	45	48	52	56	60	66	27
	26	39	57	18	44	15	52	37	31	35	53	28	25	54	14	
64	23	25	28	30	33	36	38	41	44	48	51	55	60	65	72	26
	29	50	15	45	19	0	49	46	54	15	55	55	29	54	57	
65	24	27	29	32	35	37	40	44	47	51	55	60	65	72	90	25
	38	7	41	10	4	56	58	12	38	19	23	3	31	42	0	
66	25	28	31	34	37	40	43	46	50	54	59	65	72	90		24
	53	31	14	3	0	6	22	52	39	50	34	9	26	0		
67	27	30	32	35	39	42	46	49	54	59	64	72	90			23
	15	3	57	58	8	30	4	56	13	2	44	8	0			
68	28	31	34	38	41	45	49	53	58	64	71	90				22
	45	45	51	6	33	13	10	26	27	16	49	0				
69	30	33	36	40	44	48	52	57	63	71	90					21
	25	37	58	30	16	20	48	50	47	28	0					
70	32	35	39	43	47	51	57	63	71	90						20
	17	44	22	14	24	59	16	13	5	0						
71	34	38	42	46	51	56	62	70	90							19
	22	7	6	23	6	23	37	40	0							
72	36	40	45	50	55	61	70	90								18

D ec l.	11 G./ '	12 G./ '	13 G./ '	14 G./ '	15 G./ '	16 G./ '	17 G./ '	18 G./ '	19 G./ '	20 G./ '	21 G./ '	22 G./ '	23 G./ '	24 G./ '	25 G./ '	(c o m pl)
	45	51	17	7	33	57	12	0								
73	39	44	49	54	61	69	90									17
	29	3	2	38	13	42	0									
74	42	47	53	60	69	90										16
	41	50	37	17	8	0										
75	46	52	59	68	90											15
	30	50	30	31	0											
76	51	58	67	90												14
	14	29	49	0												
77	57	67	90													13
	21	2	0													
78	66	90														12
	8	0														
79	90															11
	0															
(c o m pl)	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	

The remainder of the table beginning at 27° on both sides — look for it on the following page.

Remainder of the Table of Ascensional Differences.

The Altitude of the Pole, or the Declination, as above.

(Pole-altitude columns 26 through 40; declination 31–40; right-hand complement column 64 down to 50.)

D ec l.	26 G./ '	27 G./ '	28 G./ '	29 G./ '	30 G./ '	31 G./ '	32 G./ '	33 G./ '	34 G./ '	35 G./ '	36 G./ '	37 G./ '	38 G./ '	39 G./ '	40 G./ '	(c o m pl)
31	17 2	17 50	18 37	19 27	20 18	21 10	22 3	22 58	23 55	24 53	25 53	26 55	28 0	29 7	30 17	59
32	17 45	18 34	19 24	20 16	21 9	22 3	22 59	23 56	24 56	25 57	27 0	28 5	29 13	30 23	31 37	58
33	18 27	19 20	20 12	21 6	22 1	22 58	23 56	24 57	25 59	27 3	28 9	29 18	30 29	31 44	33 1	57
34	19 12	20 6	21 1	21 57	22 55	23 55	24 56	25 59	27 4	28 11	29 21	30 32	31 48	33 6	34 28	56
35	19 58	20 54	21 51	22 50	23 51	24 53	25 57	27 3	28 11	29 22	30 35	31 50	33 10	34 33	35 59	55
36	20 45	21 44	22 44	23 45	24 48	25 53	27 0	28 9	29 21	30 35	31 52	33 12	34 36	36 2	37 33	54
37	21 34	22 35	23 37	24 41	25 47	26 55	28 5	29 18	30 32	31 50	33 12	34 32	36 4	37 36	39 13	53
38	22 24	23 28	24 33	25 40	26 49	28 0	29 13	30 29	31 48	33 10	34 36	36 4	37 37	39 15	40 58	52
39	23 16	24 22	25 30	26 40	27 52	29 7	30 23	31 44	33 6	34 33	36 2	37 36	39 15	40 59	42 49	51
40	24 9	25 19	26 30	27 43	28 59	30 17	31 37	33 1	34 28	35 59	37 33	39 13	40 58	42 49	44 45	50
(c o m pl)	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	

Remainder of the Table of Ascensional Differences.

The Altitude of the Pole, if on the left-hand side you take the Declination; or the Declination, if on the same side you take the Altitude of the Pole.

(Pole-altitude columns 26 through 40; declination 41–64; right-hand complement column 64 down to 50. Empty cells indicate that the value has reached 90° 0' — the half-day arc — in the preceding row.)

D ec l.	26 G./ '	27 G./ '	28 G./ '	29 G./ '	30 G./ '	31 G./ '	32 G./ '	33 G./ '	34 G./ '	35 G./ '	36 G./ '	37 G./ '	38 G./ '	39 G./ '	40 G./ '	(c o m pl)
41	25 5	26 17	27 32	28 48	30 7	31 29	32 54	34 22	35 53	37 30	39 10	40 55	42 47	44 45	46 50	49
42	26 3	27 18	28 36	29 56	31 19	32 45	34 15	35 47	37 23	39 5	40 52	42 44	44 42	46 49	49 4	48
43	27 3	22 22	29 43	31 7	32 34	34 5	35 38	37 16	38 59	40 46	42 39	44 39	46 46	49 2	51 29	47
44	28 6	29 28	30 54	32 22	33 53	35 28	37 7	38 50	40 39	42 33	44 33	46 42	48 59	51 27	54 8	46
45	29 11	30 38	32 7	33 40	35 16	36 56	38 40	40 30	42 25	44 26	46 36	48 54	51 22	54 5	57 2	45
46	30 20	31 51	33 24	35 2	36 43	38 29	40 19	42 16	44 18	46 29	48 48	51 17	54 0	55 57	60 20	44
47	31 32	33 7	34 46	36 28	38 15	40 7	42 4	44 8	46 20	48 40	51 11	53 55	56 48	60 16	64 8	43
48	32 47	34 28	36 11	38 0	39 53	41 52	43 57	46 9	48 31	51 3	53 48	56 49	60 11	64 4	68 44	42
49	34 8	35 53	37 43	39 37	41 37	43 44	45 57	48 20	50 53	53 40	56 49	60 6	64 0	68 41	74 52	41
50	35 33	37 23	39 19	41 21	43 29	45 45	48 11	50 16	53 7	56 1	59 31	63 31	68 19	74 37	90 0	40
51	37 2	38 59	41 2	43 11	45 29	47 54	50 30	53 19	56 24	59 51	63 48	68 31	74 45	90 0		39
52	38 38	40 42	42 53	45 12	47 39	50 16	53 7	56 13	59 42	63 40	68 25	74 42	90 0			38
53	40 20	42 33	44 53	47 21	50 1	52 53	56 1	59 31	63 31	68 19	74 37	90 0				37
54	42	44	47	49	52	55	59	63	68	74	90					36

D ec l.	26 G./ '	27 G./ '	28 G./ '	29 G./ '	30 G./ '	31 G./ '	32 G./ '	33 G./ '	34 G./ '	35 G./ '	36 G./ '	37 G./ '	38 G./ '	39 G./ '	40 G./ '	(c o m pl)
	10	32	4	43	37	48	6	10	2	26	0					
55	44	46	49	52	55	58	63	68	74	90						35
	9	41	35	20	28	48	10	11	19	0						
56	46	49	52	55	58	62	67	74	90							34
	19	4	2	16	52	30	53	19	0							
57	48	51	54	58	62	67	74	90								33
	40	41	58	36	45	42	12	0								
58	50	54	58	62	67	74	90									32
	19	37	19	30	31	4	0									
59	54	58	62	67	73	90										31
	16	0	14	18	55	0										
60	57	61	67	73	90											30
	39	57	4	46	0											
61	61	66	73	90												29
	38	49	35	0												
62	66	73	90													28
	32	23	0													
63	73	90														27
	11	0														
64	90															26
	0															
(c o m pl)	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	

Small completion-block (declinations 27–30)

Beneath the main remainder, a short block completes pole-altitudes 27–33 for the lowest declinations.

Decl. &c. — The Altitude of the Pole, if on the left-hand side you take the Declination; or the Declination, if there the altitude of the Pole.

Decl.	27 G./'	28 G./'	29 G./'	30 G./'	31 G./'	32 G./'	33 G./'	(comp l.)
27	15 3	15 43	16 24	17 6	17 50	18 34	19 20	63
28	15 43	16 25	17 8	17 53	18 33	19 24	20 12	62
29	16 24	17 8	17 54	18 40	19 27	20 16	21 6	61
30	17 6	17 33	18 40	19 28	20 18	21 9	22 1	60
(comp l.)	63	62	61	60	59	58	57	

Small completion-block (declinations 41–49, pole-altitudes 41–45)

The Altitude of the Pole, if on the left-hand side you take the Declination; or the Declination, if there the altitude of the Pole.

Decl.	41 G./'	42 G./'	43 G./'	44 G./'	45 G./'	(compl.)
41	39 5	51 31	54 9	57 5	60 23	49
42	51 31	54 74	57 6	60 24	64 13	48
43	54 9	57 6	60 24	64 14	68 49	47
44	57 5	60 24	64 14	68 13	74 57	46
45	60 23	64 13	68 49	74 57	90 0	45
46	64 10	68 49	74 56	90 0		44
47	68 47	74 55	90 0			43
48	74 54	90 0				42
49	90 0					41
(compl.)	49	48	47	46	45	

TABLE 30. The Ascensional Difference of the Points of the Ecliptic, for an Altitude of the Pole of 44° 30' 20".

Each pair of zodiacal signs shares a column: the upper sign-label applies when the point is *Bor.* (northern, ascending declination); the lower applies when *Austr.* (southern). The value is given in degrees (Gr.), minutes ('), and seconds ("). The left margin gives the degree within the sign (Gr. 0–30); the right margin gives the complementary degree (30 down to 0).

The three columns of this block are headed:

- ♈ Bor. / ♎ Austr. (Aries north / Libra south)
- ♉ Bor. / ♏ Austr. (Taurus north / Scorpio south)
- ♊ Bor. / ♐ Austr. (Gemini north / Capricorn south)

G r .	♈♎ Gr./°"	♉♏ Gr./°"	♊♐ Gr./°"	(compl .)
0	0 0 0	11 32 19	21 12 30	30
1	0 23 54	11 54 22	21 27 34	29
2	0 47 5	12 16 18	21 42 10	28
3	1 10 33	12 38 10	21 56 36	27
4	1 34 3	12 50 12	22 10 30	26
5	1 57 32	13 21 20	22 23 56	25
6	2 21 2	13 42 40	22 37 0	24
7	2 44 30	14 3 52	22 49 35	23
8	3 7 58	14 25 20	23 1 44	22
9	3 31 20	14 45 57	23 13 30	21
1 0	3 51 50	15 6 40	23 24 40	20
1 1	4 18 17	15 27 16	23 35 32	19
1 2	4 41 31	15 47 42	23 45 45	18
1 3	5 4 46	16 7 50	23 55 30	17
1 4	5 35 48	16 27 50	24 4 50	16
1 5	5 51 18	16 47 36	24 13 35	15
1 6	6 14 27	17 7 11	24 21 45	14
1 7	6 36 36	17 26 5	24 29 30	13
1	7 0 46	17 45 38	24 36 38	12

G r .	♍ Gr./'"	♌ Gr./'"	♋ Gr./'"	(compl .)
8				
1	7 23 45	18 4 28	24 41 59	11
9				
2	7 46 42	18 22 58	24 49 19	10
0				
2	8 9 40	18 41 22	24 54 50	9
1				
2	8 32 27	18 59 7	24 59 47	8
2				
2	8 55 26	19 17 6	25 4 5	7
3				
2	9 17 27	19 34 35	25 7 56	6
4				
2	9 40 35	19 51 47	25 11 10	5
5				
2	10 3 6	20 8 35	25 13 45	4
6				
2	10 25 34	20 25 5	25 15 5	3
7				
2	10 47 54	20 41 15	25 16 50	2
8				
2	11 10 27	20 57 0	25 18 10	1
9				
3	11 32 19	21 12 30	25 18 30	0
0				
	♍ Bor. / ♋ Austr.	♌ Bor. / ♎ Austr.	♋ Bor. / ♏ Austr.	

(The foot of each column carries the complementary sign-pair read upward: ♍ Virgo north / ♋ Pisces south for the first column, ♌ Leo north / ♎ Aquarius south for the second, ♋ Cancer north / ♏ Capricorn south for the third.)

TABLE 31. The Oblique Ascensions, for an Altitude of the Pole of 44° 30' 20" and an Obliquity of the Ecliptic of 23° 30' 20".

The first half (signs Aries through Virgo). Each sign-column gives the oblique ascension in degrees (Gr.), minutes ('), and seconds ("); the left margin is the degree within the sign (1–30).

G r . .	♈ Aries G./'/"	♉ Taurus G./'/"	♊ Gemini G./'/"	♋ Cancer G./'/"	♌ Leo G./'/"	♍ Virgo G./'/"
1 0 31 7	16 56 58	37 23 32	65 47 16	102 17 0	141 52 55	
2 1 2 58	17 33 23	38 11 28	66 54 0	103 35 0	143 12 28	
3 1 34 32	18 8 22	38 59 56	68 2 11	104 53 11	144 32 45	
4 2 6 6	18 54 8	39 49 9	69 7 53	106 11 34	145 50 34	
5 2 37 41	19 21 0	40 28 53	70 15 43	107 30 2	147 10 14	
6 3 9 17	19 57 50	41 29 12	71 24 15	108 48 46	148 29 56	
7 3 40 57	20 34 56	42 20 18	72 33 28	110 7 33	149 48 26	
8 4 12 47	21 12 15	43 31 40	73 42 58	111 26 42	151 7 45	
9 4 44 30	21 50 9	44 3 43	74 53 5	112 45 19	152 26 45	
1 5 19 16	22 28 6	44 46 29	76 3 39	114 4 33	153 45 49	
0						
1 5 48 9	23 6 24	45 49 44	77 16 0	115 23 29	155 4 50	
1						
1 6 20 57	23 45 8	46 43 41	78 26 21	116 42 54	156 23 43	
2						
1 6 52 28	24 24 0	47 28 12	79 38 21	118 2 30	157 43 42	
3						
1 7 16 57	25 3 47	48 33 29	80 50 51	119 22 5	159 1 34	
4						
1 7 56 44	25 43 47	49 29 9	82 4 1	120 41 1	160 20 40	
5						
1 8 29 32	26 23 33	50 25 39	83 16 51	122 0 33	161 31 27	
6						
1 9 3 6	27 5 0	51 22 39	84 30 47	123 20 20	162 58 0	
7						

G r . .	♈ Aries G./'"/	♉ Taurus G./'"/	♊ Gemini G./'"/	♋ Cancer G./'"/	♌ Leo G./'"/	♍ Virgo G./'"/
1 8	9 34 45	27 45 50	52 20 23	85 44 49	124 39 28	164 16 41
1 9	10 7 40	28 27 35	53 20 2	86 59 12	125 59 4	165 35 17
2 0	10 40 47	29 9 31	54 17 43	88 14 17	127 18 34	166 57 4
2 1	11 13 55	29 51 57	55 17 15	89 29 17	128 37 57	168 13 50
2 2	11 47 21	30 35 4	56 17 28	90 44 52	129 57 45	169 31 25
2 3	12 20 42	31 18 15	57 18 22	92 0 42	131 17 20	170 50 3
2 4	12 55 10	32 2 4	58 19 53	93 16 48	132 36 50	172 8 39
2 5	13 28 36	32 46 24	59 41 57	94 33 15	133 56 20	174 21 15
2 6	14 4 14	33 30 16	60 24 37	95 49 51	135 25 28	174 45 48
2 7	14 36 7	34 16 39	61 28 39	97 6 52	136 35 18	176 4 22
2 8	15 11 44	35 2 30	62 33 20	97 24 2	137 53 51	177 22 52
2 9	15 46 23	35 49 0	63 36 24	99 41 30	139 14 17	178 41 5
3 0	16 21 38	36 35 51	64 41 30	100 59 9	140 33 44	180 0 0

Remainder of TABLE 31. Of Oblique Ascensions, etc.

The second half (signs Libra through Pisces). Degrees (Gr.), minutes ('), seconds ("); left margin gives the degree within the sign (1–30); right margin gives the complement.

♎ Libra G./'/"	♏ Scorpio G./'/"	♐ Sagittarius G./'/"	♑ Capricorn G./'/"	♒ Aquarius G./'/"	♓ Pisces G./'/"
181 18 55	220 45 42	260 18 30	296 23 36	324 11 0	344 13 37
182 37 8	222 6 9	261 35 48	297 27 40	324 57 30	344 48 16
183 55 38	223 24 42	262 53 8	298 32 21	325 43 21	345 23 53
185 14 16	224 34 32	264 10 9	299 35 23	326 28 44	345 56 46
186 34 45	226 3 40	265 36 45	300 38 3	327 13 36	346 31 24
187 51 21	227 23 10	266 43 12	301 40 7	327 57 56	347 4 50
189 9 57	228 42 40	267 59 18	302 41 38	328 41 45	347 39 18
190 28 27	230 2 15	269 35 8	303 42 32	329 24 56	348 12 39
191 47 10	231 22 3	270 30 43	304 42 45	330 8 3	348 46 5
193 2 56	232 41 26	271 55 49	305 42 17	330 50 29	349 19 13
194 24 43	234 0 56	273 9 48	306 39 58	331 32 25	349 52 20
195 43 19	235 20 32	274 15 11	307 39 37	332 14 10	350 25 15
197 2 0	236 39 40	275 29 13	308 37 21	332 55 0	350 56 54
198 28 33	237 59 27	276 43 9	309 34 21	333 36 27	351 30 28
199 39 20	239 18 59	278 6 19	310 31 11	334 16 13	352 3 16
200 58 26	240 37 55	279 9 9	311 26 31	334 56 13	352 43 3
202 16 18	241 57 30	280 21 39	312 21 47	335 36 0	353 7 32
203 36 17	243 17 6	281 33 39	313 16 19	336 14 52	353 39 43
204 55 10	244 36 31	282 44 0	314 10 16	336 53 36	354 11 51
206 14 11	245 55 27	283 56 21	315 3 31	337 31 54	354 40 44
207 33 15	247 14 41	285 6 55	315 56 17	338 9 51	355 15 30
208 52 15	248 33 18	286 17 20	316 48 20	338 47 45	355 47 21
210 11 34	249 52 27	287 26 32	317 39 52	339 25 4	356 19 3
211 29 54	251 11 14	288 35 45	318 30 48	340 2 10	356 50 43
212 49 46	252 29 58	289 41 17	319 21 7	340 39 0	357 22 15
214 10 26	253 47 26	290 52 7	320 10 51	341 5 52	357 53 54
215 27 15	255 6 49	291 58 49	321 0 4	341 51 38	358 25 28
216 47 32	256 25 0	293 6 0	321 48 32	342 26 27	358 57 2
217 7 5	257 43 0	294 12 44	322 36 38	343 3 1	359 28 53
219 26 16	259 0 51	295 18 30	323 24 9	343 38 23	360 0 0

♎ Libra	♏ Scorpio	♐ Sagittarius	♑ Capricorn	♒ Aquarius	♓ Pisces
G./'/"	G./'/"	G./'/"	G./'/"	G./'/"	G./'/"

TAB. 32 — Oblique Ascension at the several Pole-Altitudes

Page-26 header (p. 478, verbatim): *TAB. 32. Ascensio Obliqua graduum Signor. Borealium in Horizontib. Borealib. Australium in Horiz. Australib. quam subtrahe gradib. 360. fietq; Asc. Obliqua Signor. Austral. in Horiz. Boreal. & Signor. Boreal. in Horiz. Austral. — "TAB. 32. The Oblique Ascension of the degrees of the Northern Signs in the Northern Horizons, and of the Southern in the Southern Horizons; subtract it from 360° and you obtain the Oblique Ascension of the Southern Signs in the Northern Horizon and of the Northern Signs in the Southern Horizon."*

Page-27 header (p. 479, verbatim): *TAB. 32. Ascensio Obliqua pro gradibus Signor. Borealium in Horizontib. Borealib. & pro gradib. Australium in Horizont. Australib. quam subtrahe gradib. 360. & fiet Asc. Obliqua Signor. Australium in Horiz. Boreal. & Boreal. in Horiz. Australib. — "TAB. 32. The Oblique Ascension for the degrees of the Northern Signs in the Northern Horizons, and for the degrees of the Southern in the Southern Horizons; subtract it from 360° and the Oblique Ascension of the Southern Signs in the Northern Horizon, and of the Northern in the Southern Horizon, is obtained."*

Page-28 header (p. 480, verbatim): *Ascensio Obliqua pro gradibus Signorum Borealium in Horizontibus Borealibus, & pro Australium in Horizontibus Australibus. De reliquis vide initium Tabulae. — "The Oblique Ascension for the degrees of the Northern Signs in the Northern Horizons, and for the Southern in the Southern Horizons. For the rest, see the beginning of the Table."*

Sub-header on all three pages: **Altitudines Poli** — "Altitudes of the Pole."

Structure of the table. Each sign-block is a grid of 31 degree-rows (0–30) against twelve pole-altitude columns (headed 2, 4, 6 ... 24). Every column is split into **Gr.** (degrees) and ' (minutes). The leftmost column G. carries the degree-argument 0–30 together with the zodiac-sign symbol for the **direct** reading; the rightmost column G. carries the complementary argument 30→0 together with the mirror-sign symbol for the **reverse** (Southern-sign) reading described in the header.

Both indices are transcribed below. Long-f digit-forms in the source ("f"/"5") have been resolved to the intended numerals.

Aries (♈) — pole-altitudes 2°–24° (p. 478 / fol. 26)

[Left index = ∿ degrees 0–30; right index counts 30→0, mirror sign ✕ at its foot.]

[illegible]

γ°	2	4	6	8	0	1	2	4	6	8	0	1	2	4	6	8	0	2	2	2					
G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	
.	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.
1	1	5	1	4	1	3	1	2	1	1	1	0	9	5	9	4	9	2	9	1	9	6	8	5	1
2	0	2	0	1	0	2	0	1	0	1	0			0		0		8		7			4	8	
1	1	4	1	3	1	2	1	1	1	2	1	5	1	4	1	2	1	1	1	4	9	5	9	3	1
3	1	6	1	5	1	5	1	3	1		0	1	0	0	0	8	0	6	0			3		9	7
1	1	4	1	2	1	1	1	5	1	5	1	4	1	2	1	1	1	4	1	5	1	3	1	2	1
4	2	1	2	9	2	8	2		1	3	1	1	1	9	1	7	1		0	1	0	8	0	4	6
1	1	3	1	2	1	1	1	5	1	4	1	3	1	1	1	6	1	5	1	3	1	2	1	9	1
5	3	6	3	3	3	1	2	8	2	5	2	2	2	9	2		1	2	1	8	1	4	1		5
1	1	3	1	1	1	4	1	5	1	3	1	2	1	8	1	5	1	4	1	2	1	1	1	5	1
6	4	0	4	7	4		3	0	3	6	3	2	3		2	5	2	0	2	5	2	0	1	4	4
1	1	2	1	1	1	5	1	4	1	2	1	1	1	5	1	4	1	2	1	1	1	5	1	3	1
7	5	5	5	1	4	7	4	2	4	8	4	3	3	9	3	4	3	8	3	2	2	6	2	9	3
1	1	2	1	5	1	5	1	3	1	1	1	4	1	4	1	3	1	1	1	0	1	4	1	2	1
8	6	0	6		5	1	5	5	5	9	5		4	9	4	3	4	6	4		3	3	3	5	2
1	1	1	1	5	1	4	1	2	1	1	1	5	1	3	1	2	1	4	1	4	1	2	1	1	1
9	7	5	6	9	6	3	6	7	6	1	5	5	5	9	5	2	5		4	7	4	9	4	0	1
2	1	1	1	5	1	3	1	2	1	3	1	4	1	2	1	1	1	5	1	3	1	1	1	5	1
0	8	0	7	4	7	7	7	0	7		6	6	6	9	6	1	5	3	5	5	5	6	4	6	0
2	1	5	1	4	1	3	1	1	1	5	1	3	1	1	1	0	1	4	1	2	1	3	1	4	9
1	9		8	8	8	1	8	3	7	5	7	7	7	9	7		6	2	6	3	6		5	2	
2	2	1	1	4	1	2	1	6	1	4	1	2	1	1	1	5	1	3	1	1	1	5	1	2	8
2	0		9	3	9	5	9		8	7	8	9	8	0	7	0	7	1	7	1	6	0	6	8	
2	2	5	2	3	2	1	1	5	1	4	1	2	1	0	1	4	1	2	1	5	1	3	1	1	7
3	0	6	0	8	0	9	9	9	9	0	9	0	9		8	0	8	0	7	9	7	7	7	4	
2	2	5	2	3	2	1	2	5	2	3	2	1	1	5	1	3	1	9	1	4	1	2	1	0	6
4	1	2	1	3	1	3	0	2	0	2	0	2	9	1	9	0	9		8	7	8	4	8		
2	2	4	2	2	2	7	2	4	2	2	2	4	2	4	2	2	1	5	1	3	1	1	1	4	5
5	2	8	2	8	2		1	6	1	5	1		0	2	0	0	9	8	9	5	9	1	8	7	
2	2	4	2	2	2	1	2	4	2	1	2	5	2	3	2	1	2	4	2	2	1	5	1	3	4
6	3	4	3	3	3		2	0	2	8	1	6	1	3	1	0	0	7	0	3	9	9	9	4	

Taurus (♉) — pole-altitudes 2°–24° (p. 478 / fol. 26)

[Left index = 8 degrees 0-30; right index counts 30→0, mirror sign $\approx$ at its foot.]

[illegible]

8°	2°		4°		6°		8°		1°		1°		1°		1°		1°		2°		2°		2°		
	G		2		G		6		G		0		G		2		G		0		2		4		
	r		°		r		°		r		°		r		°		r		°		r		°		
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
5	3	1	3	4	3	1	3	4	3	2	2	5	2	2	2	5	2	1	2	4	2	1	2	4	2
	2	4	1	6	1	7	0	8	0	0	9	0	9	0	8	0	8	9	7	8	7	5	6	2	5
6	3	1	3	4	3	1	3	4	3	1	3	4	3	1	2	4	2	1	2	3	2	5	2	3	2
	3	1	2	3	2	3	1	3	1	4	0	4	0	3	9	2	9	0	8	9	8		7	1	4
7	3	9	3	4	3	9	3	3	3	9	3	3	3	7	3	3	3	2	2	3	2	5	2	2	2
	4		3	0	3		2	9	2		1	8	1		0	4	0		9	0	8	5	8	0	3
8	3	7	3	3	3	6	3	3	3	4	3	3	3	0	3	2	3	5	3	2	2	4	2	9	2
	5		4	7	4		3	5	3		2	2	2		1	7	0	4	0	1	9	5	9		2
9	3	5	3	3	3	2	3	3	3	5	3	2	3	5	3	2	3	4	3	1	3	3	2	5	2
	6		5	4	5		4	1	3	9	3	6	2	3	2	0	1	6	1	2	0	5	9	8	1
1	3	3	3	3	3	5	3	2	3	5	3	2	3	4	3	1	3	3	3	3	3	2	3	4	2
0	7		6	1	5	9	5	7	4	4	4	1	3	8	3	3	2	8	2		1	6	0	8	0
1	3	1	3	2	3	5	3	2	3	4	3	1	3	4	3	6	3	3	3	5	3	1	3	3	1
1	8		7	8	6	6	6	3	5	9	5	6	4	2	4		3	0	2	5	2	7	1	8	9
1	3	0	3	2	3	5	3	1	3	4	3	1	3	3	3	5	3	2	3	4	3	8	3	2	1
2	9		8	6	7	3	7	9	6	5	6	1	5	6	4	9	4	3	3	7	3		2	8	8
1	3	5	3	2	3	5	3	1	3	4	3	6	3	3	3	5	3	1	3	3	3	5	3	1	1
3	9	8	9	4	8	0	8	6	7	1	7		6	0	5	3	5	6	4	9	3	9	3	8	7
1	4	5	4	2	3	4	3	1	3	3	3	1	3	2	3	4	3	9	3	3	3	5	3	9	1
4	0	7	0	2	9	7	9	2	8	7	8		7	4	6	7	6		5	1	4	0	4		6
1	4	5	4	2	4	4	4	9	3	3	3	5	3	1	3	4	3	2	3	2	3	4	3	0	1
5	1	6	1	0	0	5	0		9	3	8	6	8	9	7	1	7		6	3	5	2	5		5
1	4	5	4	1	4	4	4	6	4	2	3	5	3	1	3	3	3	5	3	1	3	3	3	5	1
6	2	5	2	9	1	3	1		0	9	9	2	9	4	8	5	7	6	7	6	6	4	5	2	4
1	4	5	4	1	4	4	4	4	4	2	4	4	4	9	3	3	3	5	3	1	3	2	3	4	1
7	3	5	3	8	2	1	2		1	6	0	8	0		9	0	8	0	8	0	7	7	6	4	3
1	4	5	4	1	4	4	4	2	4	2	4	4	4	6	4	2	3	4	3	3	3	2	3	3	1
8	4	4	4	7	3	0	3		2	4	1	5	1		0	6	9	4	9		8	0	7	6	2
1	4	5	4	1	4	3	4	0	4	2	4	4	4	2	4	2	4	3	3	5	3	1	3	2	1
9	5	4	5	6	4	8	4		3	1	2	2	2		1	1	0	9	9	7	9	3	8	8	1

Gemini (♊) — pole-altitudes 2°–24° (p. 479 / fol. 27)

[Left index = $\amalg$ degrees 0–30; right index counts 30→0, mirror sign $\approx$ at its foot.]

Π	2		4		6		8		1		1		1		1		1		2		2		2		
	°		°		°		°		°	1	°	1	°	1	°	1	°	2	°	2	°	2			
	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	
	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	G
.	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.
0	5	4	5	2	5	3	5	5	5	5	5	5	3	5	4	5	5	5	5	6	4	1	4	2	3
	7		6	4	5	5	4	0	4		3	9	2	2	1	5	0	6	0		9	5	8	2	0
1	5	6	5	2	5	3	5	5	5	5	5	1	5	3	5	4	5	5	5	4	5	1	4	1	2
	8		7	2	6	6	5	1	5		4	9	3	1	2	4	1	4	1		0	2	9	8	9
2	5	8	5	2	5	4	5	5	5	6	5	1	5	3	5	4	5	5	5	2	5	9	5	1	2
	9		8	4	7	8	6	2	6		5	9	4	0	3	3	2	2	2		1		0	5	8
3	6	1	5	2	5	3	5	5	5	6	5	1	5	3	5	4	5	5	5	0	5	6	5	1	2
	0	1	9	6	8	9	7	3	7		6	9	5	0	4	2	3	1	3		2		1	2	7
4	6	1	6	2	5	4	5	5	5	7	5	1	5	3	5	4	5	5	5	5	5	4	5	9	2
	1	3	0	8	9	1	8	4	8		7	9	6	0	5	1	4	0	3	8	3		2		6
5	6	1	6	3	6	4	5	5	5	8	5	1	5	3	5	4	5	4	5	5	5	2	5	7	2
	2	6	1	0	0	3	9	6	9		8	9	7	0	6	0	5	9	4	6	4		3		5
6	6	1	6	3	6	4	6	5	6	9	5	2	5	3	5	4	5	4	5	5	5	0	5	5	2
	3	9	2	2	1	5	0	8	0		9	0	8	0	7	0	6	8	5	5	5		4		4
7	6	2	6	3	6	4	6	0	6	1	6	2	5	3	5	4	5	4	5	5	5	5	5	3	2
	4	2	3	5	2	7	2		1	1	0	1	9	1	8	0	7	8	6	4	5	9	5		3
8	6	2	6	3	6	5	6	2	6	1	6	2	6	3	5	4	5	4	5	5	5	5	5	1	2
	5	5	4	8	3	0	3		2	2	1	2	0	2	9	0	8	8	7	4	6	8	6		2
9	6	2	6	4	6	5	6	4	6	1	6	2	6	3	6	4	5	4	5	5	5	5	5	0	2
	6	8	5	1	4	2	4		3	4	2	3	1	2	0	1	9	8	8	3	7	7	7		1
1	6	3	6	4	6	5	6	6	6	1	6	2	6	3	6	4	6	4	5	5	5	5	5	5	2
0	7	2	6	4	5	5	5		4	6	3	5	2	4	1	2	0	8	9	3	8	7	7	9	0
1	6	3	6	4	6	5	6	9	6	1	6	2	6	3	6	4	6	4	6	5	5	5	5	5	1
1	8	6	7	7	6	8	6		5	8	4	7	3	6	2	3	1	9	0	9	9	7	8	9	9
1	6	4	6	5	6	1	6	1	6	2	6	3	6	3	6	4	6	5	6	5	6	5	5	5	1
2	9	0	8	1	8		7	2	6	1	5	0	4	8	3	5	2	0	1	5	0	8	9	9	8
1	7	4	6	5	6	5	6	1	6	2	6	3	6	4	6	4	6	5	6	5	6	5	6	5	1
3	0	4	9	5	9		8	5	7	3	6	2	5	0	4	7	3	1	2	6	1	9	0	9	7
1	7	4	7	5	7	8	6	1	6	2	6	3	6	4	6	4	6	5	6	5	6	1	6	5	1
4	1	8	0	9	0		9	8	8	6	7	5	6	2	5	9	4	3	3	7	3		1	9	6

	2		4		6		8		1	1	1	1	1	1	2	2	2								
Π	°		°		°		°		°	1	°	1	°	1	°	1	°	2	°	2	°	2			
G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4		
G	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	G		
.	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.		
1	7	5	7	3	7	1	7	2	6	2	6	3	6	4	6	5	6	5	6	5	6	1	6	0	1
5	2	3	2		1	2	0	1	9	9	8	8	7	5	6	1	5	5	4	9	4		3		5
1	7	5	7	7	7	1	7	2	7	3	6	4	6	4	6	5	6	5	6	1	6	3	6	1	1
6	3	7	3		2	6	1	5	0	2	9	1	8	8	7	3	6	7	6		5		4		4
1	7	2	7	1	7	2	7	2	7	3	7	4	6	5	6	5	6	0	6	3	6	5	6	3	1
7	5		4	1	3	0	2	9	1	6	0	4	9	1	8	6	8		7		6		5		3
1	7	6	7	1	7	2	7	3	7	4	7	4	7	5	6	5	6	3	6	6	6	7	6	5	1
8	6		5	5	4	4	3	3	2	0	1	8	0	4	9	9	9		8		7		6		2
1	7	1	7	1	7	2	7	3	7	4	7	5	7	5	7	2	7	6	6	8	6	9	6	7	1
9	7	1	6	9	5	8	4	7	3	4	2	1	1	7	1		0		9		8		7		1
2	7	1	7	2	7	3	7	4	7	4	7	5	7	0	7	5	7	9	7	1	6	1	6	9	1
0	8	6	7	4	6	3	5	1	5	8	3	5	3		2		1		0	1	9	1	8		0
2	7	2	7	2	7	3	7	4	7	5	7	5	7	4	7	9	7	1	7	1	7	1	6	1	9
1	9	1	8	9	7	7	6	5	5	2	4	9	4		3		2	2	1	4	0	4	9	2	
2	8	2	7	3	7	4	7	5	7	5	7	3	7	8	7	1	7	1	7	1	7	1	7	1	8
2	0	6	9	4	8	2	7	0	6	6	6		5		4	3	3	6	2	8	1	7	0	5	
2	8	3	8	3	7	4	7	5	7	1	7	7	7	1	7	1	7	2	7	2	7	2	7	1	7
3	1	1	0	9	9	7	8	4	8		7		6	2	5	7	4	0	3	1	2	1	1	8	
2	8	3	8	4	8	5	7	5	7	5	7	1	7	1	7	2	7	2	7	2	7	2	7	2	6
4	2	6	1	4	0	2	9	9	9		8	1	7	6	6	1	5	4	4	5	3	5	2	2	
2	8	4	8	4	8	5	8	4	8	1	7	1	7	2	7	2	7	2	7	2	7	2	7	2	5
5	3	1	2	9	1	7	1		0	0	9	6	8	1	7	5	6	8	5	9	4	9	3	6	
2	8	4	8	5	8	2	8	9	8	1	8	2	7	2	7	3	7	3	7	3	7	3	7	3	4
6	4	6	3	4	3		2		1	6	0	1	9	6	8	0	7	3	6	4	5	3	4	0	
2	8	5	8	5	8	7	8	1	8	2	8	2	8	3	7	3	7	3	7	3	7	3	7	3	3
7	5	1	4	9	4		3	4	2	2	1	7	0	1	9	5	8	8	7	9	6	7	5	5	
2	8	5	8	4	8	1	8	1	8	2	8	3	8	3	8	4	7	4	7	4	7	4	7	4	2
8	6	7	6		5	2	4	9	3	5	2	2	1	6	0	0	9	3	8	4	7	2	6	0	
2	8	2	8	9	8	1	8	2	8	3	8	3	8	4	8	4	8	4	7	4	7	4	7	4	1
9	8		7		6	7	5	4	4	0	3	7	2	1	1	5	0	8	9	9	8	7	7	5	

Cancer (♋) — pole-altitudes 2°–24° (p. 479 / fol. 27)

[Left index = $\textcircled{S}$ degrees 0–30; right index counts 30→0, mirror sign $\textcircled{S}$ at its foot.]

G	2		4		6		8		1		1		1		1		2		2		2		G			
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°					
	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2		G	4	
	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°		r	°	
	.	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.		'	.	'
0	8	8	8	8	1	8	2	8	3	8	3	8	4	8	4	8	5	8	5	8	5	7	5	7	5	3
		9		8	5	7	3	6	0	5	6	4	2	3	6	2	0	1	3	0	4	9	2	8	0	0
1	9	1	8	2	8	2	8	3	8	4	8	3	8	4	8	4	8	5	8	5	8	5	7	5	2	
		0	4	9	1	8	9	7	5	6	2	5	6	4	2	3	6	2	0	1	3	0	4	9	6	9
2	9	1	9	2	8	3	8	4	8	4	8	5	8	5	8	5	8	5	8	5	8	5	8	5	2	
		1	9	0	7	9	5	1	1	7	7	6	3	5	7	4	1	3	5	2	8	1	9	0	8	8
3	9	2	9	3	9	4	8	4	8	5	8	5	8	3	8	5	8	1	8	4	8	4	8	2	2	
		2	5	1	2	0	0	9	6	8	3	7	8	6		5	7	5		4		2		1	7	
4	9	3	9	3	9	5	9	5	8	4	8	4	8	1	8	7	8	7	8	1	8	1	8	1	2	
		3	0	2	8	1	1	0	2	9		8		7	3	6		6		5	0	4	1	3	0	6
5	9	3	9	4	9	5	9	5	9	1	8	1	8	1	8	2	8	1	8	1	8	2	8	1	2	
		4	5	3	3	2	1	1	8	0	0	9	5	8	9	7	2	6	3	6	6	5	3	4	6	5
6	9	4	9	4	9	5	9	3	9	1	9	2	8	2	8	2	8	1	8	2	8	2	8	2	2	
		5	1	4	8	3	7	3		1	6	0	1	9	5	8	8	8	9	7	2	6	9	5	7	4
7	9	4	9	5	9	3	9	9	9	2	9	2	9	3	8	3	8	3	8	2	8	3	8	3	2	
		6	6	5	4	5		4		2	2	1	7	0	1	9	5	9	6	8	9	7	5	6	4	3

[illegible]

S		2		4		6		8		10		12		14		16		18		20		22		24		26		28		30		
		G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	
		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
		'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'
8		7		7		6		5		4		3		2		1		0														
1	1	4	1	5	1	8	1	1	1	2	1	3	1	4	1	5	1	5	1	3	1	7	1	8	1	9	0	6	0	7	0	
9	0	6	0	7	0		0	9	0	8	0	7	0	6	0	3	0	9	0		0		0		1							
9		8		8		7		6		5		4		3		2		2		1		0										
2	1	5	1	2	1	1	1	2	1	3	1	4	1	5	1	0	1	6	1	1	1	1	1	1	1	1	0	1	0	1	0	
0	1	0	1		0	3	0	4	0	4	0	3	0	2	0		0		0	1	0	5	0	6	0							
0		0		9		8		7		6		5		5		4		3		2		1										
2	1	5	1	7	1	1	1	3	1	1	1	1	1	5	1	1	1	1	1	1	1	2	1	2	9	1	1	4	1	1	1	
1	1	4	1		1	8	0	0	1	8	1	4	0		0	0	0	4	0	8	0	3	0	5								
1		1		0		9		0		0		9		8		5		4		3		2										
2	1	5	1	1	1	2	1	3	1	2	1	2	1	1	1	1	1	2	1	2	1	3	1	3	8	2	1	8	1	1	1	
2	1	8	1	1	1	3	1	5	1	3	1	3	1	4	0	9	0	1	0	6	0	1	0	4								
2		2		1		0		1		1		0		9		6		5		4		3										
2	1	2	1	1	1	2	1	4	1	2	1	3	1	2	1	2	1	2	1	3	1	3	1	4	7	3	1	8	1	1	1	
3	1		1	6	1	8	1	0	1	8	1	1	1	2	1	8	0	9	0	4	0	9	0	3								
4		3		2		1		2		2		1		0		7		6		5		4										
2	1	6	1	2	1	3	1	4	1	3	1	3	1	3	1	3	1	3	1	4	1	4	1	5	6	4	1	6	1	1	1	
4	1		1	0	1	3	1	5	1	3	1	7	1	1	1	7	0	6	0	2	0	7	0	2								
5		4		3		2		3		3		2		1		8		7		6		5										
2	1	1	1	2	1	3	1	5	1	4	1	4	1	3	1	4	1	4	1	5	1	5	1	1	5	6	1	1	1	1	1	
5	1	0	1	4	1	7	1	0	1	4	1	4	1	9	1	6	0	3	0	0	0	6	0									
6		5		4		3		4		4		3		2		9		8		7		7										
2	1	1	1	2	1	4	1	5	1	4	1	5	1	4	1	5	1	5	1	5	1	5	1	1	4	7	1	1	1	1	1	
6	1	4	1	8	1	2	1	5	1	2	1	0	1	7	1	5	1	1	0	8	0		0	0								
7		6		5		4		5		5		4		3		0		9		9		8										
2	1	1	1	3	1	4	1	0	1	4	1	5	1	5	1	4	1	5	1	6	1	1	1	1	3	7	1	8	1	1	1	
7	1	8	1	2	1	6	1		1	6	1	7	1	5	1		1	8	1		1	4	0	9								
8		7		6		6		6		6		5		5		1		1		0		9										
2	1	2	1	3	1	5	1	5	1	5	1	4	1	5	1	1	1	1	6	1	1	1	2	1	2	2	8	1	1	1	1	
8	1	1	1	6	1	1	1		1	1	1		1		1	3	1		1	4	1	2	1	8								

	2		4		6		8		1	1	1	1	1	1	2	2	2								
∂	°	°	°	°	°	°	°	°	1	°	1	°	1	°	1	°	2	°	2	°	2				
G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	
G	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	G
.	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.
4	1	3	1	5	1	1	1	3	1	4	1	4	1	2	1	3	1	4	1	1	1	1	1	2	2
	2	8	2	6	2	4	2	1	2	8	2		2	0	2	5	1	8	1		1	2	1	2	6
	5		4		4		3		2		2		1		0		9		9		8		7		
5	1	4	1	5	1	1	1	2	1	5	1	9	1	2	1	4	1	5	1	8	1	2	1	3	2
	2	0	2	9	2	7	2	5	2	2	2		2	5	2	1	2	5	2		1	0	1	1	5
	6		5		5		4		3		3		2		1		0		0		9		8		
6	1	4	1	2	1	2	1	3	1	5	1	1	1	3	1	4	1	2	1	1	1	2	1	4	2
	2	2	2		2	0	2	9	2	6	2	4	2	1	2	7	2		2	6	2	8	1	0	4
	7		7		6		5		4		4		3		2		2		1		0		9		
7	1	4	1	4	1	2	1	4	1	0	1	1	1	3	1	5	1	9	1	2	1	3	1	4	2
	2	4	2		2	3	2	2	2		2	9	2	6	2	3	2		2	3	2	6	2	9	3
	8		8		7		6		6		5		4		3		3		2		1		0		
8	1	4	1	6	1	2	1	4	1	4	1	2	1	4	1	5	1	1	1	3	1	4	1	5	2
	2	5	2		2	6	2	6	2		2	3	2	2	2	9	2	5	2	1	2	4	2	7	2
	9		9		8		7		7		6		5		4		4		3		2		1		
9	1	4	1	8	1	2	1	4	1	8	1	2	1	4	1	5	1	2	1	3	1	5	1	6	2
	3	7	3		2	9	2	9	2		2	8	2	7	2		2	2	2	8	2	2	2		1
	0		0		9		8		8		7		6		6		5		4		3		3		
1	1	4	1	1	1	3	1	5	1	1	1	3	1	5	1	1	1	2	1	4	1	0	1	1	2
0	3	8	3	0	3	1	2	2	2	2	2	2	2	2	2	0	2	8	2	5	2		2	4	0
	1		1		0		9		9		8		7		7		6		5		5		4		
1	1	5	1	1	1	3	1	5	1	1	1	3	1	5	1	1	1	3	1	5	1	8	1	2	1
1	3	0	3	2	3	4	3	5	3	6	2	7	2	7	2	6	2	5	2	3	2		2	3	9
	2		2		1		0		0		9		8		8		7		6		6		5		
1	1	5	1	1	1	3	1	5	1	2	1	4	1	2	1	2	1	4	1	0	1	1	1	3	1
2	3	1	3	4	3	6	3	8	3	0	3	1	3		2	2	2	1	2		2	6	2	2	8
	3		3		2		1		1		0		0		9		8		8		7		6		
1	1	5	1	1	1	3	1	1	1	2	1	4	1	7	1	2	1	4	1	7	1	2	1	4	1
3	3	2	3	5	3	9	3		3	4	3	6	3		3	8	2	8	2		2	4	2	2	7
	4		4		3		3		2		1		1		0		9		9		8		7		
1	1	5	1	1	1	4	1	4	1	2	1	5	1	1	1	3	1	5	1	1	1	3	1	5	1

Q	2		4		6		8		1		1		1		1		1		2		2		2				
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°				
	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4			
	G	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	G	
.	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.
4	3	3	3	7	3	1	3		3	8	3	0	3	2	3	4	3	4	3	4	2	2	2	0	6		
	5		5		4		4		3		2		2		1		0		0		9		8				
1	1	5	1	1	1	4	1	7	1	3	1	5	1	1	1	3	1	0	1	2	1	4	1	5	1		
5	3	4	3	8	3	3	3		3	1	3	4	3	7	3	9	3		3	1	3	0	2	8	5		
	6		6		5		5		4		3		3		2		2		1		0		9				
1	1	5	1	1	1	4	1	9	1	3	1	5	1	2	1	4	1	6	1	2	1	4	1	6	1		
6	3	4	3	9	3	5	3		3	4	3	8	3	2	3	4	3		3	8	3	8	3		4		
	7		7		6		6		5		4		4		3		3		2		1		1				
1	1	5	1	2	1	4	1	1	1	3	1	1	1	2	1	4	1	1	1	3	1	5	1	1	1		
7	3	4	3	0	3	6	3	1	3	7	3		3	6	3	9	3	2	3	4	3	5	3	4	3		
	8		8		7		7		6		6		5		4		4		3		2		2				
1	1	5	1	2	1	4	1	1	1	4	1	5	1	3	1	5	1	1	1	4	1	2	1	2	1		
8	3	4	3	0	3	7	3	3	3	0	3		3	0	3	4	3	7	3	1	3		3	2	2		
	9		9		8		8		7		7		6		5		5		4		4		3				
1	1	5	1	2	1	4	1	1	1	4	1	8	1	3	1	5	1	2	1	4	1	9	1	3	1		
9	4	4	4	1	3	8	3	5	3	3	3		3	4	3	9	3	3	3	7	3		3	0	1		
	0		0		9		9		8		8		7		6		6		5		5		4				
2	1	5	1	2	1	4	1	1	1	4	1	1	1	3	1	3	1	2	1	5	1	1	1	3	1		
0	4	3	4	1	4	9	4	7	3	5	3	1	3	8	3		3	8	3	3	3	6	3	8	0		
	1		1		0		0		9		9		8		8		7		6		6		5				
2	1	5	1	2	1	5	1	1	1	4	1	1	1	4	1	8	1	3	1	0	1	2	1	4	9		
1	4	3	4	2	4	0	4	9	4	8	4	4	3	2	3		3	4	3		3	3	3	6			
	2		2		1		1		0		0		9		9		8		8		7		6				
2	1	5	1	2	1	5	1	2	1	5	1	1	1	4	1	1	1	3	1	6	1	3	1	5	8		
2	4	2	4	2	4	0	4	0	4	0	4	7	4	6	4	3	3	9	3		3	0	3	4			
	3		3		2		2		1		1		0		0		9		9		8		7				
2	1	5	1	2	1	5	1	2	1	5	1	2	1	4	1	1	1	4	1	1	1	3	1	2	7		
3	4	2	4	2	4	1	4	2	4	0	4	0	4	9	4	7	4	5	4	2	3	7	3				
	4		4		3		3		2		2		1		1		0		0		9		9				
2	1	5	1	2	1	5	1	2	1	5	1	2	1	5	1	2	1	5	1	1	1	4	1	1	6		
4	4		4		4		4		4		4		4		4		4		4		4		4				

Virgo (♍) — pole-altitudes 2°–24° (p. 480 / fol. 28)

[Left index = $\mathfrak{M}$ degrees 0–30; right index counts 30→0, mirror sign $\underline{\alpha}$ at its foot.
Row 30 = 180° 0' across all columns (the semicircle terminus).]

	2		4		6		8		1	1	1	1	1	1	2	2	2								
$\mathfrak{mp}$	°		°		°		°		°	°	°	°	°	°	°	°	°								
G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	
G	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	G
.	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.	,	.
0	1	4	1	1	1	5	1	2	1	3	1	3	1	1	1	4	1	1	1	5	1	2	1	5	3
	5	2	5	7	5	2	5	8	5		4	7	4	1	4	5	4	9	4	1	4	3	4	4	0
	1		1		0		0		0		9		9		8		8		7		7		6		
1	1	4	1	1	1	5	1	2	1	4	1	1	1	2	1	4	1	2	1	5	1	2	1	0	2
	5	0	5	6	5	2	5	8	5		5	4	4	4	4	9	4	4	4	7	4	9	4		9
	2		2		1		1		1		0		9		9		9		8		8		8		
2	1	3	1	1	1	5	1	2	1	5	1	4	1	1	1	5	1	2	1	2	1	3	1	8	2
	5	8	5	4	5	1	5	8	5		5	1	5	7	5	2	5	8	5		4	5	4		8
	3		3		2		2		2		1		1		0		0		0		9		9		
3	1	3	1	1	1	5	1	2	1	6	1	4	1	1	1	5	1	3	1	7	1	4	1	1	2
	5	5	5	3	5	1	5	8	5		5	3	5	9	5	6	5	2	5		5	1	5	5	7
	4		4		3		3		3		2		2		1		1		1		0		0		
4	1	3	1	1	1	5	1	2	1	6	1	4	1	2	1	5	1	3	1	1	1	4	1	2	2
	5	3	5	2	5	0	5	8	5		5	5	5	2	5	9	5	6	5	2	5	7	5	2	6
	5		5		4		4		4		3		3		2		2		2		1		1		
5	1	3	1	3	1	5	1	2	1	7	1	4	1	2	1	2	1	4	1	1	1	5	1	2	2
	5	0	5	0	5	9	5	8	5		5	6	5	4	5		5	0	5	7	5	3	5	9	5
	6		6		5		5		5		4		4		4		3		3		2		2		
6	1	2	1	8	1	4	1	2	1	8	1	4	1	2	1	5	1	4	1	2	1	5	1	3	2
	5	8	5		5	8	5	8	5		5	8	5	7	5		5	4	5	2	5	9	5	6	4
	7		7		6		6		6		5		5		5		4		4		3		3		
7	1	2	1	6	1	4	1	2	1	8	1	4	1	2	1	8	1	4	1	2	1	5	1	4	2
	5	5	5		5	7	5	8	5		5	9	5	9	5		5	8	5	7	5		5	3	3
	8		8		7		7		7		6		6		6		5		5		5		4		
8	1	2	1	4	1	4	1	2	1	9	1	5	1	3	1	1	1	5	1	3	1	1	1	4	2
	5	2	5		5	6	5	7	5		5	0	5	1	5	1	5	2	5	2	5	1	5	9	2
	9		9		8		8		8		7		7		7		6		6		6		5		
9	1	1	1	2	1	4	1	2	1	9	1	5	1	3	1	1	1	5	1	3	1	1	1	5	2
	6	9	6		5	5	5	7	5		5	1	5	3	5	4	5	6	5	7	5	7	5	6	1
	0		0		9		9		9		8		8		8		7		7		7		6		
1	1	1	1	0	1	4	1	2	1	9	1	5	1	3	1	1	1	5	1	4	1	2	1	2	2

m°	2°		4°		6°		8°		1°		1°		1°		1°		1°		2°		2°		2°		
	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	
	G	r	°	G	r	°	G	r	°	G	r	°	G	r	°	G	r	°	G	r	°	G	r	°	G
	.	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
0	6	6	6		6	3	6	6	6		5	2	5	5	5	7	5	9	5	1	5	2	5		0
	1		1		0		0		0		9		9		9		8		8		8		8		
1	1	1	1	5	1	4	1	2	1	9	1	5	1	3	1	2	1	3	1	4	1	2	1	9	1
1	6	3	6	8	6	2	6	6	6		6	3	6	7	6	0	6		5	6	5	8	5		9
	2		1		1		1		1		0		0		0		0		9		9		9		
1	1	1	1	5	1	4	1	2	1	9	1	5	1	3	1	2	1	6	1	5	1	3	1	1	1
2	6	0	6	5	6	0	6	5	6		6	4	6	9	6	3	6		6	0	6	3	6	5	8
	3		2		2		2		2		1		1		1		1		0		0		0		
1	1	7	1	5	1	3	1	2	1	9	1	5	1	4	1	2	1	1	1	5	1	3	1	2	1
3	6		6	3	6	9	6	4	6		6	5	6	0	6	5	6	0	6	4	6	8	6	1	7
	4		3		3		3		3		2		2		2		2		1		1		1		
1	1	4	1	5	1	3	1	2	1	9	1	5	1	4	1	2	1	1	1	5	1	4	1	2	1
4	6		6	0	6	7	6	3	6		6	6	6	2	6	8	6	3	6	8	6	3	6	7	6
	5		4		4		4		4		3		3		3		3		2		2		2		
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5	6		6	7	6	5	6	2	6		6	6	6	3	6	0	6	6	6		6	8	6	3	5
	6		5		5		5		5		4		4		4		4		4		3		3		
1	1	5	1	4	1	3	1	2	1	9	1	5	1	4	1	3	1	1	1	6	1	5	1	3	1
6	6	7	6	4	6	3	6	1	6		6	7	6	5	6	3	6	9	6		6	3	6	9	4
	6		6		6		6		6		5		5		5		5		5		4		4		
1	1	5	1	4	1	3	1	2	1	8	1	5	1	4	1	3	1	2	1	1	1	5	1	4	1
7	6	3	6	1	6	1	6	0	6		6	7	6	8	6	5	6	2	6	0	6	8	6	5	3
	7		7		7		7		7		6		6		6		6		6		5		5		
1	1	4	1	3	1	2	1	1	1	8	1	5	1	5	1	3	1	2	1	1	1	3	1	5	1
8	6	9	6	8	6	9	6	8	6		6	8	6	0	6	7	6	5	6	4	6		6	1	2
	8		8		8		8		8		7		7		7		7		7		7		6		
1	1	4	1	3	1	2	1	1	1	8	1	5	1	4	1	3	1	2	1	1	1	8	1	5	1
9	6	5	6	5	6	7	6	7	6		6	8	6	9	6	9	6	8	6	8	6		6	7	1
	9		9		9		9		9		8		8		8		8		8		8		7		
2	1	3	1	3	1	2	1	1	1	7	1	5	1	5	1	4	1	3	1	2	1	1	1	3	1
0	7		7		7		7		7		6		6		6		6		6		6		6		

mp	2		4		6		8		1		1		1		1		1		2		2		2		G
	G	2	G	4	G	6	G	8	G	0	G	2	G	4	G	6	G	8	G	0	G	2	G	4	
	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	r	°	
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	
	0	1	0	2	0	4	0	5	0		9	8	9	0	9	1	9	1	9	2	9	3	9		0
2	1	5	1	2	1	2	1	1	1	7	1	5	1	5	1	4	1	3	1	2	1	1	1	9	9
1	7	7	7	9	7	2	7	4	7		7	9	7	1	7	3	7	4	7	6	7	8	7		
	1		1		1		1		1		0		0		0		0		0		0		0		
2	1	3	1	2	1	2	1	1	1	6	1	5	1	5	1	4	1	3	1	3	1	2	1	1	8
2	7	3	7	6	7	0	7	3	7		7	9	7	2	7	5	7	7	7	0	7	3	7	5	
	2		2		2		2		2		1		1		1		1		1		1		1		
2	1	2	1	2	1	1	1	1	1	6	1	0	1	5	1	4	1	4	1	3	1	2	1	2	7
3	7	9	7	3	7	7	7	1	7		7		7	3	7	7	7	0	7	4	7	8	7	1	
	3		3		3		3		3		3		2		2		2		2		2		2		
2	1	2	1	2	1	1	1	1	1	5	1	0	1	5	1	4	1	4	1	3	1	3	1	2	6
4	7	5	7	0	7	5	7	0	7		7		7	4	7	9	7	3	7	8	7	3	7	7	
	4		4		4		4		4		4		3		3		3		3		3		3		
2	1	2	1	1	1	1	1	8	1	4	1	0	1	5	1	5	1	4	1	4	1	3	1	3	5
5	7	1	7	7	7	2	7		7		7		7	5	7	1	7	6	7	2	7	7	7	2	
	5		5		5		5		5		5		4		4		4		4		4		4		
2	1	1	1	1	1	1	1	7	1	4	1	0	1	5	1	5	1	4	1	4	1	4	1	3	4
6	7	7	7	4	7	0	7		7		7		7	6	7	3	7	9	7	6	7	2	7	8	
	6		6		6		6		6		6		5		5		5		5		5		5		
2	1	1	1	1	1	8	1	5	1	3	1	0	1	5	1	5	1	5	1	5	1	4	1	4	3
7	7	3	7	1	7		7		7		7		7	7	7	5	7	2	7	0	7	7	7	4	
	7		7		7		7		7		7		6		6		6		6		6		6		
2	1	9	1	7	1	5	1	4	1	2	1	0	1	5	1	5	1	5	1	5	1	5	1	4	2
8	7		7		7		7		7		7		7	8	7	7	7	5	7	3	7	1	7	9	
	8		8		8		8		8		8		7		7		7		7		7		7		
2	1	5	1	4	1	3	1	2	1	1	1	0	1	5	1	5	1	5	1	5	1	5	1	5	1
9	7		7		7		7		7		7		7	9	7	9	7	8	7	7	7	6	7	5	
	9		9		9		9		9		9		8		8		8		8		8		8		
3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0
0	8		8		8		8		8		8		8		8		8		8		8		8		
	0		0		0		0		0		0		0		0		0		0		0		0		(

	2	2	3	3	3	3	3	4	4	4	4	4	D
D6	2	8	0	2	4	6	8	0	1	2	3	4	e
e	6	8	0	2	4	6	8	0	1	2	3	4	g
g	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	↓
3	2	1	2	6	2	3	2	0	1	5	1	5	2
	0					6		2		9		5	7
4	2	5	2	4	2	4	2	4	2	3	2	2	2
	3		8		4		0	5		0		5	6
5	3	3	3	3	2	3	2	3	1	3	8	3	2
	7		1		6		0	4					5
6	4	2	4	1	4	7	4	0	3	5	3	4	3
	0		3					3		6		8	4
7	5	4	4	5	4	4	4	4	4	3	4	2	4
			6		8		0	2		4		4	3
8	5	4	5	3	5	3	5	2	5	1	5	2	4
	7		8		0		1	1			1	0	2
9	6	3	6	2	6	1	6	1	5	5	5	4	5
	1		1		1			0		0		7	1
1	7	1	7	3	6	5	6	4	6	3	6	1	6
	0		5			3		2		0		8	0
1	7	5	7	4	7	3	7	2	7	9	6	5	6
	1		8		6		4		2			6	1
1	8			6		4		2					9
1	8	4	8	2	8	1	8	3	7	4	7	3	7
	2		9		6			8		4		8	8
1	9	2	9	1	8	5	8	4	8	2	8	1	8
	3		6		2		8		3		8		7
1	1	1	9	5	9	4	9	2	9	7	8	5	9
	4		0		5		0		4				6
1	1	5	1	3	1	2	1	5	9	4	9	2	9
	5		0		8		0		2		7		5
1	1	3	1	2	1	4	1	4	1	2	1	7	9
	6		1		1		0		6		0		4
1	1	2	1	4	1	4	1	2	1	7	1	4	1
	7		2		1		6		1		0		3

2	2	3	3	3	3	3	4	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓													
1 1 6	1 4	1 2	1 8	1 4	1 2	1 1	1 3	1 2	1 1	9 5	9 4	1	
8 3	2 8	2 8	2	1 7	1 5	1	0 6	0 4	0 0	6	2	2	
1 1 5	1 3	1 1	1 4	1 2	1 4	1 3	1 1	1 5	1 4	1 3	1 1	1	
9 3 1	3 1	3 1	2 9	2 7	2	1 9	1 2	0 9	0 5	0 0	0 5	1	
2 1 3	1 1	1 5	1 3	1 7	1 4	1 1	1 4	1 3	1 2	1 4	1 4	1	
0 4 6	4 5	3 4	3 1	3	2 3	2 7	1 8	1 5	1 0	1	0 9	0	
2 1 2	1 5	1 3	1 1	1 4	1 2	1 5	1 2	1 1	1 5	1 3	1 2	9	
1 5 1	4 9	4 7	4 3	3 8	3 2	2 5	2 5	2 1	1 5	1 9	1 3		
2 1 6	1 4	1 2	1 5	1 2	1 1	1 3	1 2	1 4	1 3	1 1	1 5	8	
2 6	5 3	5 0	4 5	4 9	4	3 3	3	2 7	2 1	2 4	1 7		
2 1 5	1 2	1 3	1 3	1 1	1 4	1 1	1 3	1 2	1 6	1 4	1 3	7	
3 6 1	6 7	6	5 7	5 0	4 1	4 1	3 9	3 3	3	2 9	2 1		
2 1 3	1 1	1 4	1 1	1 5	1 2	1 4	1 1	1 5	1 4	1 2	1 5	6	
4 7 6	7 1	6 6	6 9	5 1	5 1	4 9	4 6	3 9	3 2	3 4	3		
2 1 2	1 5	1 2	1 1	1 3	1 1	1 2	1 5	1 3	1 1	1 5	1 3	5	
5 8 2	7 6	7 9	7	6 2	6	5 8	4 4	4 6	4 8	3 9	3 9		
2 1 8	1 4	1 1	1 4	1 1	1 4	1 7	1 3	1 1	1 5	1 3	1 1	4	
6 9	8 1	8 3	7 4	7 3	6 1	6	5 2	5 3	4 4	4 4	4 4		
2 1 5	1 2	1 5	1 2	1 5	1 2	1 4	1 1	1 5	1 3	1 1	1 4	3	
7 9 4	9 6	8 7	8 7	7 5	7 1	6 6	6 0	5 0	5 1	5 0	4 9		
2 2 4	2 1	1 4	1 1	1 3	1 2	1 2	1 4	1 2	1 7	1 4	1 2	2	
8 0 0	0 1	9 1	9 0	8 7	8	7 5	6 8	6 8	6	5 6	5 4		
2 2 2	2 5	2 2	1 5	1 1	1 4	1 4	1 2	1 5	1 4	1 2	1 5	1	
9 1 6	0 6	0 5	9 3	9 9	8 3	8	7 6	7	6 4	6 2	5 9		
3 2 1	2 4	2 9	2 3	2 1	1 2	1 4	1 4	1 4	1 2	1 5	1 3	0	
0 2 2	1 1	1	0 6	0	9 4	8 5	8	7 3	7 1	6 8	6 4		

[At the foot of the left index column for the next section the sign symbol ♂ (Taurus) is printed; the right index column resumes at 30 with the symbol ♍ (Virgo, "X") marking the complementary southern sign.]

♄ Taurus (page 29 bottom)

	2	2	3	3	3	3	3	4	4	4	4	4	4	D
D6	2	8	0	2	4	6	8	0	1	2	3	4	4	e
e	6	8	0	2	4	6	8	0	1	2	3	4	4	g
g	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	G'	↓
0	2 1	2 4	2 9	2 3	2 1	1 2	1 4	1 4	1 4	1 2	1 5	1 3	3	
	2 2	1 1	1	0 6	0	9 5	8 5	8	7 3	7 1	6 8	6 4	0	
1	2 5	2 2	2 5	2 2	2 4	2 5	1 2	1 4	1 2	1 5	1 3	1 1	2	
	2 9	2 7	1 4	1 0	0 3	0	9 5	8 3	8 1	7 8	7 5	7 0	9	
2	2 4	2 1	2 3	2 4	2 2	2 4	2 5	1 2	1 5	1 3	1 1	1 4	2	
	3 6	3 3	2 9	2	1 6	0 6	0	9 2	8 9	8 6	8 2	7 6	8	
3	2 3	2 5	2 2	2 4	2 9	2 2	2 4	2 1	1 3	1 1	1 4	1 2	2	
	4 3	3 9	3 4	2 8	2	1 8	0 5	0	9 8	9 3	8 9	8 2	7	
4	2 2	2 4	2 9	2 3	2 5	2 1	2 2	2 4	2 1	1 5	1 2	1 5	2	
	5 0	4 5	4	3 2	2 2	2 0	1 6	0 0	0 6	9 1	9 6	8 8	6	
5	2 7	2 3	2 5	2 1	2 3	2 5	2 7	2 2	2 5	2 2	2 3	1 3	2	
	6	5 1	4 4	4 6	3 5	2 2	2	1 0	0 5	0 9	0	9 5	5	
6	2 5	2 1	2 4	2 1	2 1	2 3	2 4	2 0	2 3	2 8	2 4	2 1	2	
	6 5	6 8	5 0	5	4 9	3 5	2 9	2	1 4	1	0 1	0 2	4	
7	2 4	2 5	2 2	2 4	2 3	2 1	2 3	2 4	2 1	2 4	2 2	2 5	2	
	7 3	7	6 6	5 6	5	4 8	3 1	2 1	2 4	1 8	1 0	0 0	3	
8	2 3	2 5	2 1	2 3	2 4	2 1	2 1	2 2	2 5	2 2	2 5	2 2	2	
	8 1	7 3	7 3	6 1	5 7	5	4 3	3 2	2 4	2 7	1 8	1 8	2	
9	2 2	2 4	2 0	2 1	2 3	2 4	2 5	2 3	2 3	2 6	2 3	2 6	2	
	9 0	8 1	8	7 7	6 2	5 5	4 5	4	3 4	3	2 7	2	1	
1	3 9	2 2	2 4	2 3	2 1	2 2	2 3	2 4	2 1	2 4	2 1	2 4	2	
	0 0	9 9	8 7	8	7 7	6 9	5 8	4 4	4 5	3 6	3 6	2 5	0	
1	3 5	3 1	2 3	2 4	2 2	2 1	2 2	2 2	2 5	2 2	2 5	2 2	1	
	1 0 8	0 7	9 4	8 9	8	7 3	6 1	5 6	4 6	4 6	3 6	3 4	9	
1	3 4	3 5	3 2	2 3	2 4	2 5	2 4	2 8	2 3	2 7	2 3	2 3	1	
	2 1 7	1	0 1	9 6	8 9	7 7	7	6	5 8	5	4 6	4	8	
1	3 3	3 5	3 9	3 2	2 3	2 4	2 4	2 5	2 1	2 4	2 1	2 4	1	
	3 2 7	1 4	1	0 2	9 3	8 1	7 7	6 0	6 9	5 8	5 6	4 3	7	
1	3 2	3 4	3 5	3 9	3 1	2 2	2 3	2 3	2 1	2 2	2 5	2 2	1	
	4 3 7	2 3	1 7	1	0 9	9 6	8 1	7 2	7	6 9	5 6	5 2	6	

2	2	3	3	3	3	3	4	4	4	4	4	D
D6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	↓
1 3 1	3 3	3 4	3 5	3 5	3 1	2 1	2 1	2 4	2 1	2 3	2 2	1
5 4 7	3 2	2 5	1 6	1	0 1	9 5	8 4	7 3	7 0	6 7	6	5
1 3 8	3 2	3 3	3 4	3 5	3 5	2 5	2 5	2 2	2 5	2 1	2 4	1
6 5	4 2	3 4	2 4	1 1	0 7	9 9	8 7	8 6	7 2	7 9	6 3	4
1 3 5	3 1	3 2	3 3	3 3	3 4	3 4	2 4	2 1	2 3	2 1	2 2	1
7 5 9	5 2	4 3	3 3	2 9	1 3	0 4	9 1	9 0	8 5	8	7 5	3
1 3 5	3 2	3 1	3 2	3 2	3 3	3 3	3 2	2 5	2 1	2 4	2 6	1
8 6 0	6	5 3	4 1	3 7	2 0	1 0	0 6	9 3	9 8	8 4	8	2
1 3 4	3 5	3 3	3 1	3 1	3 1	3 1	3 1	3 3	3 2	2 2	2 4	1
9 7 1	6 3	6	5 0	4 6	3 7	2 6	1 1	0 7	0	9 6	8 8	1
2 3 3	3 4	3 5	3 0	3 4	3 5	3 2	3 5	3 2	3 4	3 9	2 3	1
0 8 3	7 4	6 3	6	5	4	3	1 6	1 4	0 6	0	9 0	0
2 3 2	3 3	3 4	3 4	3 5	3 5	3 4	3 4	3 6	3 3	3 5	3 1	9
1 9 5	8 5	7 3	6 9	5 2	4 2	3 8	2 1	2	1 0	0 3	0 3	
2 4 1	3 2	3 3	3 3	3 4	3 4	3 3	3 2	3 5	3 1	3 3	3 5	8
2 0 7	9 7	8 4	7 9	6 1	5 0	4 5	3 7	2 2	2 5	1 7	0 7	
2 4 1	4 1	3 2	3 2	3 3	3 2	3 2	3 1	3 3	3 0	3 2	3 4	7
3 1 0	0 9	9 5	8 9	7 0	6 8	5 2	4 3	3 7	3	2 1	1 0	
2 4 3	4 1	4 1	3 1	3 1	3 1	3 1	3 0	3 2	3 4	3 5	3 2	6
4 2	1 1	0 6	9 9	8 9	7 7	6 0	5	4 3	3 5	3	2 4	
2 4 5	4 3	4 8	4 1	3 9	3 6	3 5	3 4	3 9	3 3	3 5	3 8	5
5 2 6	2	1	0 0	9	8	6 8	5 7	5	4 0	3 0	3	
2 4 5	4 5	4 0	4 2	4 0	3 5	3 4	3 3	3 5	3 1	3 3	3 5	4
6 3 0	2 6	2	1	0	8 6	7 7	6 4	5 6	5 6	4 5	3 3	
2 4 4	4 4	4 5	4 5	4 5	3 4	3 3	3 2	3 4	3 3	3 2	3 3	3
7 4 4	3 9	2 3	1 4	0 1	9 6	8 6	7 2	6 4	6	5 1	4 9	
2 4 3	4 4	4 4	4 4	4 4	4 3	3 2	3 1	3 3	3 5	3 8	3 2	2
8 5 8	4 2	3 6	2 6	1 3	0 6	9 6	8 0	7 2	6 0	6	5 5	
2 4 3	4 3	4 3	4 3	4 3	4 2	4 1	3 5	3 2	3 3	3 5	3 1	1
9 6 3	5 7	4 9	3 8	2 4	1 7	0 6	8 9	8 0	7 8	6 6	6 2	

2	2	3	3	3	3	3	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓												
3 4 2	4 3	4 3	4 3	4 2	4 1	4 6	3 4	3 9	3 2	3 4	3 5	0
0 7 8	6 1	5 2	4 1	3 6	2 8	1	9 9	9	8 7	7 4	6 9	

II Gemini (page 30 top)

The left index column is here headed II (Gemini) with the degree sub-column labelled Gr.

2	2	3	3	3	3	3	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓												
0 4 2	4 3	4 3	4 3	4 2	4 1	4 6	3 4	3 9	3 2	3 4	3 5	3
7 8	6 1	5 2	4 1	3 6	2 8	1	9 9	9	8 7	7 4	6 9	0
1 4 2	4 2	4 2	4 2	4 1	4 1	4 5	4 3	3 5	3 1	3 3	3 4	2
8 4	7 6	6 7	5 5	4 9	3 0	1 7	0 9	9 8	9 6	8 3	7 1	9
2 4 2	4 2	4 2	4 1	4 1	4 2	4 4	4 3	4 4	4 6	3 2	3 4	2
9 0	8 1	7 2	6 9	5 2	4	2 8	1 0	0 8	0	9 2	8 6	8
3 5 1	4 1	4 1	4 1	4 6	4 5	4 4	4 2	4 3	4 5	4 1	3 2	2
0 6	9 7	8 7	7 3	6	4 5	3 0	2 1	1 9	0 6	0 2	9 6	7
4 5 1	5 1	4 1	4 7	4 0	4 4	4 3	4 1	4 3	4 4	4 2	4 1	2
1 2	0 3	9 2	8	7	5 8	4 2	3 2	2 0	1 6	1	0 4	6
5 5 9	5 9	5 7	4 2	4 5	4 4	4 2	4 4	4 2	4 3	4 5	4 4	2
2	1	0	9	7 4	6 2	5 5	4	3 2	2 7	1 2	1	5
6 5 6	5 6	5 3	4 5	4 4	4 3	4 1	4 5	4 1	4 2	4 4	4 5	2
3	2	1	9 8	8 9	7 6	6 8	4 6	4 4	3 8	2 3	1 5	4
7 5 4	5 3	5 0	5 5	4 4	4 3	4 1	4 4	4 7	4 2	4 3	4 4	2
4	3	2	0 4	9 4	8 0	7 2	5 9	5	4 0	3 5	2 6	3
8 5 2	5 6	5 5	5 5	5 4	4 2	4 6	4 4	4 0	4 1	4 2	4 3	2
5	4	2 7	1 0	0 0	9 5	8	6 3	6	5 3	4 7	3 8	2
9 5 0	5 5	5 5	5 4	5 3	5 2	4 1	4 3	4 5	4 7	4 2	4 3	2
6	4 8	3 4	2 6	1 6	0 0	9	7 7	6 3	6	5 0	4 0	1
1 5 5	5 5	5 5	5 4	5 3	5 1	4 5	4 3	4 4	4 1	4 1	4 2	2

2	2	3	3	3	3	3	4	4	4	4	4	D
D6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	↓
0 6 9	5 6	4 1	3 3	2 2	1 6	9 7	8 2	7 7	7	6 3	5 3	0
1 5 5	5 5	5 5	5 4	5 2	5 1	5 5	4 2	4 4	4 5	4 7	4 1	1
1 7 8	6 5	5 0	4 0	3 9	2 2	0 3	9 7	8 2	7 6	7	6 7	9
1 5 5	5 5	5 4	5 3	5 2	5 9	5 4	5 2	4 3	4 5	4 2	4 1	1
2 8 8	7 4	6 9	5 8	4 6	3	1 9	0 3	9 8	8 1	8	7 1	8
1 5 5	5 5	5 4	5 3	5 2	5 7	5 4	5 1	5 3	4 4	4 5	4 6	1
3 9 8	8 4	7 8	6 7	5 4	4	2 6	1 9	0 4	9 7	8 7	8	7
1 6 5	5 5	5 4	5 3	5 2	5 5	5 4	5 1	5 3	5 4	4 5	4 1	1
4 0 8	9 4	8 7	7 6	6 3	5	3 3	2 6	1 1	0 3	9 3	9	6
1 6 5	6 5	5 4	5 3	5 2	5 4	5 4	5 1	5 2	5 3	5 4	4 5	1
5 1 8	0 4	9 7	8 6	7 2	6	4 1	3 3	2 7	1 9	0 9	9 7	5
1 6 5	6 5	6 4	5 3	5 2	5 3	5 3	5 1	5 2	5 3	5 4	5 5	1
6 2 9	1 5	0 7	9 6	8 1	7	5 9	4 1	3 5	2 6	1 6	0 3	4
1 6 0	6 5	6 4	6 3	5 2	5 2	5 3	5 9	5 2	5 3	5 4	5 5	1
7 4	2 6	1 8	0 6	9 1	8	6 8	5	4 3	3 4	2 4	1 0	3
1 6 2	6 5	6 4	6 3	6 2	5 1	5 3	5 8	5 2	5 3	5 4	5 4	1
8 5	3 7	2 9	1 7	0 1	9	7 7	6	5 2	4 2	3 2	2 8	2
1 6 4	6 5	6 5	6 3	6 2	6 1	5 3	5 7	5 2	5 3	5 4	5 4	1
9 6	4 8	3 0	2 8	1 2	0	8 7	7	6 1	5 1	4 0	3 7	1
2 6 6	6 0	6 5	6 3	6 2	6 2	5 3	5 7	5 2	5 3	5 3	5 4	1
0 7	6	4 1	3 9	2 3	1	9 8	8	7 0	6 0	5 9	4 6	0
2 6 9	6 2	6 5	6 4	6 2	6 4	6 3	5 7	5 2	5 3	5 3	5 4	9
1 8	7	5 3	4 1	3 4	2	0 9	9	8 0	7 0	6 9	5 5	
2 6 1	6 5	6 5	6 4	6 2	6 6	6 4	6 8	5 2	5 3	5 4	5 4	8
2 9 2	8	6 6	5 3	4 6	3	1 0	0	9 1	8 1	7 0	6 5	
2 7 1	6 8	6 5	6 4	6 2	6 8	6 4	6 1	6 2	5 3	5 4	5 4	7
3 0 5	9	7 9	6 5	5 8	4	2 2	1 0	0 2	9 2	8 1	7 6	
2 7 1	7 1	6 2	6 4	6 3	6 1	6 4	6 1	6 2	6 3	5 4	5 4	6
4 1 8	0 1	9	7 8	6 1	5 0	3 4	2 2	1 4	0 4	9 3	8 8	
2 7 2	7 1	7 5	6 5	6 3	6 1	6 4	6 1	6 2	6 3	6 4	5 5	5
5 2 2	1 5	0	8 1	7 4	6 3	4 7	3 5	2 7	1 7	0 5	9 0	

2	2	3	3	3	3	3	4	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓													
2 7 2	7 1	7 9	6 5	6 3	6 1	6 5	6 1	6 3	6 4	6 4	6 5	6 5	4
6 3 6	2 9	1	9 5	8 8	7 6	5 0	4 8	3 0	2 0	1 8	0 3	0 3	
2 7 3	7 2	7 1	7 5	6 4	6 2	6 5	6 2	6 3	6 4	6 5	6 5	6 5	3
7 4 0	3 3	2 3	0 9	9 2	8 0	6 4	5 2	4 4	3 4	2 1	1 7	1 7	
2 7 3	7 2	7 1	7 4	7 4	6 2	6 5	6 2	6 3	6 4	6 5	6 1	6 1	2
8 5 5	4 8	3 8	2	0 7	9 4	7 8	6 6	5 8	4 8	3 5	3	3	
2 7 4	7 3	7 2	7 9	7 5	7 2	6 3	6 3	6 4	6 5	6 5	6 5	6 5	1
9 6 0	5 3	4 3	3	1 2	0 9	9	7 1	6 2	5 2	4 9	4	4	
3 7 4	7 3	7 2	7 1	7 5	7 3	7 8	6 3	6 4	6 5	6 5	6 1	6 1	0
0 7 5	6 8	5 8	4 4	2 7	1 5	0	8 6	7 7	6 7	6	5 0	5 0	

[Right index column resumes at 70 (the symbol ☿ Cancer marks the complementary sign).]

☿ Cancer (page 30 bottom)

2	2	3	3	3	3	3	4	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓													
0 7 4	7 3	7 2	7 1	7 5	7 3	7 8	6 3	6 4	6 5	6 5	6 1	6 1	3
7 5	6 8	5 8	4 4	2 7	1 5	0	8 6	7 7	6 7	6	5 0	5 0	0
1 7 5	7 4	7 3	7 1	7 3	7 4	7 1	6 4	6 5	6 1	6 1	6 1	6 1	2
8 1	7 4	6 4	5 9	4	2 1	1 4	9 1	8 3	8 3	7 1	6 5	6 5	9
2 7 5	7 5	7 4	7 2	7 9	7 4	7 2	7 4	6 5	6 1	6 1	6 2	6 2	2
9 7	8 0	7 0	6 5	5	3 7	2 0	0 7	9 9	9 9	8 7	7 1	7 1	8
3 8 3	7 5	7 4	7 3	7 1	7 5	7 2	7 5	7 6	7 1	6 2	6 2	6 2	2
1	9 6	8 6	7 1	6 5	4 3	3 7	1 4	1	0 6	9 4	8 8	8 8	7
4 8 9	8 2	7 5	7 3	7 2	7 0	7 3	7 1	7 1	7 2	7 3	6 3	6 3	2
2	1	9 2	8 8	7 1	6	4 4	3	2 3	1 4	0 1	9 6	9 6	6
5 8 1	8 9	8 5	7 4	7 2	7 7	7 4	7 9	7 2	7 3	7 3	7 4	7 4	2
3 6	2	0 9	9 5	8 8	7	5 1	4	3 1	2 1	1 9	0 4	0 4	5
6 8 2	8 1	8 6	8 5	7 3	7 1	7 4	7 1	7 2	7 3	7 4	7 5	7 5	2

[illegible]

2	2	3	3	3	3	3	4	4	4	4	4	4	4	D											
D 6	2	8	2	0	3	2	3	4	3	6	3	8	3	0	4	1	4	2	4	3	4	4	4	e	
e	6		8		0		2		4		6		8		0		1		2		3		4	g	
g	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	↓	
	1	6	0	3	9	9	8	2	7		5	6	4	7	3		2	9	1	3	0	6	9	6	
2	1	3	1	3	1	2	9	2	9	1	9	5	9	4	9	1	9	3	9	4	9	1	9	5	8
2	0	5	0	3	0	9	9	3	8	3	6	8	5	0	4	7	3	3	2	7	2		1		
2		1		0																					
2	1	4	1	4	1	4	1	3	9	2	9	1	9	5	9	3	9	4	9	2	9	1	9	2	7
3	0	4	0	3	0	0	0	4	9	4	8	0	6	3	5	0	4	7	4		3	6	2	7	
3		2		1		0																			
2	1	5	1	5	1	5	1	4	1	3	9	2	9	6	9	4	9	1	9	1	9	3	9	4	6
4	0	3	0	3	0	0	0	5	0	6	9	3	8		6	4	6		5	6	4	0	3	2	
4		3		2		1		0																	
2	1	3	1	3	1	1	1	5	1	4	1	3	9	1	9	5	9	1	9	3	9	4	9	5	5
5	0		0		0	6	0	8	0	6	9	9	7	8	7	6	6	1	5	6	4	8			
6		5		4		2		1		0															
2	1	1	1	1	1	1	1	7	1	0	1	4	1	3	9	1	9	3	9	4	9	2	9	1	4
6	0	2	0	3	0	2	0		0		0	9	0	3	9	3	8	1	7	7	7		6	5	
7		6		5		4		3		1		0													
2	1	2	1	2	1	2	1	1	1	1	1	2	1	4	1	2	9	4	9	3	9	1	9	3	3
7	0	2	0	3	0	3	0	9	0	2	0		0	7	0	8	9	6	9		8	8	7	2	
8		7		6		5		4		3		1		0											
2	1	3	1	3	1	3	1	3	1	2	1	1	1	1	1	4	1	2	1	1	9	3	9	4	2
8	0	2	0	4	0	4	0	1	0	5	0	5	0		0	3	0		0	9	9	5	8	9	
9		8		7		6		5		4		3		1		1		0							
2	1	4	1	4	1	4	1	4	1	3	1	2	1	1	1	5	1	1	1	3	1	5	1	6	1
9	1	2	0	4	0	5	0	3	0	7	0	8	0	5	0	8	0	7	0	5	0	1	0		
0		9		8		7		6		5		4		2		2		1		0		0			
3	1	5	1	5	1	5	1	5	1	5	1	4	1	3	1	1	1	3	1	5	1	8	1	2	0
0	1	2	1	5	0	6	0	5	0	0	0	2	0	0	0	3	0	3	0	1	0		0	3	
1		0		9		8		7		6		5		4		3		2		2		2		1	

♌ Leo (page 31 top)

The left index column is headed ♌ (Leo), degree sub-column g.

2	2	3	3	3	3	3	4	4	4	4	4	4	D												
D6	2	8	2	0	3	2	3	4	3	6	3	8	3	0	4	1	4	2	4	3	4	4	4	e	
e	6		8		0		2		4		6		8		0		1		2		3		4	g	
g	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	↓	
0	1	5	1	5	1	5	1	5	1	4	1	3	1	1	1	3	1	5	1	8	1	2	3		
	1	2	1	5	0	6	0	5	0	0	0	2	0	0	0	3	0	1	0		0	3	0		
	1		0		9		8		8		6		5		4		3		2		2		1		
1	1	2	1	6	1	7	1	6	1	3	1	5	1	4	1	2	1	4	1	7	1	2	1	4	2
	1		1		1		1		0		0	5	0	4	0	8	0	9	0		0	5	0	0	9
	3		2		1		0		9		7		6		5		4		4		3		2		
2	1	1	1	1	1	1	1	1	1	1	9	1	5	1	4	1	5	1	2	1	4	1	5	2	
	1	2	1	6	1	8	1	8	1	5	0		0	8	0	4	0		0	4	0	2	0	8	8
	4		3		2		1		0		9		7		6		6		5		4		3		
3	1	2	1	2	1	2	1	3	1	2	1	2	1	1	1	5	1	2	1	4	1	5	1	1	2
	1	1	1	7	1	9	1	0	1	7	1	2	0	3	0	9	0	1	0	0	0	9	0	6	7
	5		4		3		2		1		0		9		7		7		6		5		5		
4	1	3	1	3	1	4	1	4	1	4	1	3	1	2	1	1	1	3	1	5	1	1	1	3	2
	1	1	1	7	1	0	1	2	1	0	1	6	1	7	0	5	0	7	0	7	0	6	0	4	6
	6		5		4		3		2		1		0		9		8		7		7		6		
5	1	4	1	4	1	5	1	5	1	5	1	5	1	4	1	3	1	5	1	1	1	3	1	5	2
	1	0	1	7	1	1	1	4	1	3	1	0	1	2	1	1	0	3	0	4	0	4	0	2	5
	7		6		5		4		3		2		1		0		9		9		8		7		
6	1	5	1	5	1	2	1	5	1	3	1	3	1	5	1	4	1	9	1	3	1	5	1	1	2
	1	0	1	8	1		1		1		1		1	6	1	6	1		1	1	0	1	0	0	4
	8		7		7		6		5		4		2		1		1		0		9		9		
7	1	5	1	8	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	4	1	9	1	2	2
	1	9	1		1	3	1	7	1	7	1	7	1	1	1		1	5	1	8	1		1	8	3
	9		9		8		7		6		5		4		3		2		1		1		0		
8	1	9	1	1	1	2	1	2	1	3	1	3	1	2	1	1	1	4	1	5	1	2	1	4	2
	2		2	8	1	4	1	9	1	1	1	0	1	6	1	8	1	2	1		1	7	1	7	2
	1		0		9		8		7		6		5		4		3		3		2		1		
9	1	1	1	2	1	3	1	4	1	4	1	4	1	4	1	3	1	5	1	2	1	4	1	5	2
	2	8	2	8	2	5	1	1	1	4	1	4	1	1	1	4	1	8	1	2	1	5	1		1
	2		1		0		9		8		7		6		5		4		4		3		3		
1	1	2	1	3	1	4	1	5	1	5	1	5	1	5	1	5	1	1	1	4	1	3	1	2	2
0	2	7	2	8	2	7	2	3	1	7	1	8	1	6	1	0	1	5	1	0	1		1	4	0

2	2	3	3	3	3	3	4	4	4	4	4	D
D6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	G '	↓
3	2	1	0	9	8	7	6	6	5	5	4	
1 1 3	1 4	1 5	1 5	1 1	1 1	1 1	1 6	1 3	1 5	1 2	1 4	1
1 2 7	2 9	2 8	2	2 0	2 2	1 1	1	1 2	1 7	1 1	1 3	9
4	3	2	2	1	0	9	8	7	6	6	5	
1 1 4	1 5	1 9	1 1	1 2	1 2	1 2	1 2	1 4	1 1	1 3	1 2	1
2 2 7	2 9	2	2 7	2 3	2 6	2 7	1 2	1 9	1 5	1 9	1	8
5	4	4	3	2	1	0	9	8	8	7	7	
1 1 5	1 1	1 2	1 3	1 3	1 4	1 4	1 3	1 6	1 3	1 5	1 2	1
3 2 6	2 0	2 1	2 0	2 7	2 0	2 3	2 9	2	1 2	1 7	1 1	7
6	6	5	4	3	2	1	0	0	9	8	8	
1 1 6	1 2	1 3	1 4	1 5	1 5	1 0	1 5	1 2	1 5	1 1	1 4	1
4 2	2 0	2 2	2 2	2 1	2 6	2	2 5	2 3	2 0	2 6	1 1	6
8	7	6	5	4	3	3	1	1	0	0	9	
1 1 1	1 3	1 4	1 5	1 2	1 9	1 1	1 1	1 4	1 8	1 3	1 0	1
5 2 5	2 0	2 3	2 4	2	2	2 3	2 2	2 0	2	2 5	2	5
9	8	7	6	6	5	4	3	2	2	1	1	
1 1 2	1 4	1 5	1 6	1 1	1 2	1 2	1 2	1 5	1 2	1 5	1 1	1
6 3 4	2 0	2 4	2	2 6	2 3	2 8	2 8	2 7	2 5	2 3	2 9	4
0	9	8	8	7	6	5	4	3	3	2	2	
1 1 3	1 5	1 5	1 1	1 2	1 3	1 4	1 4	1 1	1 4	1 1	1 3	1
7 3 3	3 0	3	2 8	2 9	2 7	2 3	2 5	2 4	2 3	2 1	2 8	3
1	0	0	9	8	7	6	5	5	4	4	3	
1 1 4	1 0	1 1	1 3	1 4	1 5	1 5	1 2	1 3	1 0	1 2	1 5	1
8 3 2	3	3 6	3 0	2 2	2 1	2 8	2	2 1	2	2 9	2 7	2
2	2	1	0	9	8	7	7	6	6	5	4	
1 1 5	1 1	1 2	1 4	1 5	1 5	1 1	1 1	1 4	1 1	1 4	1 1	1
9 3 1	3 0	3 7	3 2	3 5	3	2 3	2 8	2 8	2 8	2 7	2 6	1
3	3	2	1	0	0	9	8	7	7	6	6	
2 1 5	1 1	1 3	1 5	1 7	1 1	1 2	1 3	1 5	1 3	1 6	1 3	1
0 3 9	3 9	3 7	3 3	3	3 9	3 8	2 4	2	2 6	2	2 5	0
4	4	3	2	2	1	0	9	9	8	8	7	
2 1 8	1 2	1 4	1 5	1 2	1 3	1 4	1 5	1 2	1 5	1 2	1 5	9

2	2	3	3	3	3	3	4	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓													
1 3	3 9	3 8	3	3 0	3 3	3 3	3 1	3 2	2 4	2 5	2 4		
6	5	4	4	3	2	1	0	0	9	9	8		
2 1 1	1 3	1 5	1 1	1 3	1 4	1 5	1 7	1 3	1 1	1 4	1 1	8	
2 3 7	3 9	3 9	3 7	3 3	3 7	3 8	3	3 9	3 2	3 3	3 3		
7	6	5	5	4	3	2	2	1	1	0	0		
2 1 2	1 4	1 9	1 2	1 4	1 1	1 1	1 2	1 5	1 3	1 1	1 3	7	
3 3 6	3 8	3	3 9	3 6	3	3 3	3 4	3 7	3 0	3	3 2		
8	7	7	6	5	5	4	3	2	2	2	1		
2 1 3	1 5	1 2	1 4	1 5	1 1	1 2	1 4	1 1	1 4	1 2	1 5	6	
4 3 5	3 8	3 0	3 1	3 9	3 5	3 8	3 0	3 4	3 8	3 1	3 2		
9	8	8	7	6	6	5	4	4	3	3	2		
2 1 4	1 7	1 3	1 5	1 1	1 2	1 4	1 5	1 3	1 5	1 3	1 1	5	
5 4 4	4	3 0	3 2	3 1	3 8	3 3	3 6	3 1	3	3 9	3 1		
0	0	9	8	8	7	6	5	5	5	4	4		
2 1 5	1 1	1 4	1 4	1 2	1 4	1 5	1 1	1 4	1 2	1 5	1 3	4	
6 4 2	4 7	4 1	4	3 4	3 2	3 8	3 2	3 8	3 3	3 8	3 0		
1	1	0	0	9	8	7	7	6	6	5	5		
2 1 0	1 2	1 5	1 1	1 3	1 5	1 1	1 2	1 5	1 4	1 1	1 4	3	
7 4	4 6	4 1	4 5	4 6	3 6	3 3	3 8	3	3 1	3 6	3 9		
3	2	1	1	0	9	9	8	8	7	7	6		
2 1 8	1 3	1 1	1 2	1 4	1 9	1 2	1 4	1 2	1 5	1 3	1 8	2	
8 4	4 5	4	4 6	4 9	4	4 8	3 4	3 2	3 8	3 4	3		
4	3	3	2	1	1	0	9	9	8	8	8		
2 1 1	1 4	1 1	1 3	1 0	1 2	1 4	1 0	1 3	1 1	1 5	1 2	1	
9 4 6	4 4	4 1	4 7	4	4 3	4 3	4	4 9	4 6	3 2	3 7		
5	4	4	3	3	2	1	1	0	0	9	9		
3 1 2	1 5	1 2	1 4	1 1	1 3	1 5	1 1	1 5	1 3	1 1	1 4	0	
0 4 4	4 3	4 1	4 8	4 3	4 6	4 7	4 6	4 5	4 3	4 0	4 6		
6	5	5	4	4	3	2	2	1	1	1	0		

[Right index column resumes at 30 with the symbol ♍ Virgo (mp).]

♄ Virgo (page 31 bottom — concludes the table at 180°)

	2	2	3	3	3	3	3	4	4	4	4	4	4	D											
D6	2	8	2	0	3	2	3	4	3	6	3	8	3	0	4	1	4	2	4	3	4	4	4	4	e
e	6		8		0		2		4		6		8		0		1		2		3		4		g
g	G	'	G	'	G	'	G	'	G	'	G	'	G	'	G	'	G	'	G	'	G	'	G	'	↓
0	1	2	1	5	1	2	1	4	1	1	1	3	1	5	1	1	1	5	1	3	1	1	1	4	3
	4	4	4	3	4	1	4	8	4	3	4	6	4	7	4	6	4	5	4	3	4	0	4	6	0
	6		5		5		4		4		3		2		2		1		1		1		0		
1	1	3	1	2	1	3	1	5	1	2	1	5	1	1	1	3	1	1	1	5	1	2	1	5	2
	4	2	4		4	1	4	9	4	6	4	0	4	2	4	2	4	2	4	1	4	9	4		9
	7		7		6		5		5		4		4		3		3		2		2		2		
2	1	4	1	1	1	4	1	1	1	3	1	3	1	2	1	4	1	2	1	8	1	4	1	2	2
	4	0	4	1	4	1	4	0	4	8	4		4	7	4	8	4	9	4		4	7	4	4	8
	8		8		7		7		6		6		5		4		4		4		3		3		
3	1	4	1	2	1	5	1	2	1	5	1	1	1	4	1	4	1	4	1	2	1	5	1	4	2
	4	8	4	0	4	1	4	1	4	0	4	7	4	1	4		4	5	4	6	4		4	3	7
	9		9		8		8		7		7		6		6		5		5		5		4		
4	1	5	1	2	1	1	1	3	1	2	1	3	1	5	1	2	1	2	1	4	1	2	1	2	2
	5	6	5	9	5		4	2	4		4	0	4	6	4	0	4		4	3	4	3	4		6
	0		0		0		9		9		8		7		7		7		6		6		6		
5	1	4	1	3	1	1	1	4	1	1	1	4	1	1	1	3	1	1	1	0	1	4	1	2	2
	5		5	8	5	1	5	3	5	4	4	3	4	0	4	6	4	8	4		4	1	4	1	5
	2		1		1		0		0		9		9		8		8		8		7		7		
6	1	1	1	4	1	2	1	5	1	2	1	5	1	2	1	5	1	3	1	1	1	5	1	4	2
	5	2	5	7	5	1	5	4	5	6	5	7	5	5	4	2	4	5	4	8	4	9	4	0	4
	3		2		2		1		1		0		0		9		9		9		8		8		
7	1	2	1	5	1	3	1	5	1	3	1	1	1	4	1	8	1	5	1	3	1	1	1	5	2
	5	0	5	6	5	1	5		5	8	5	0	5	0	5		5	2	5	5	5	7	4	9	3
	4		3		3		3		2		2		1		1		0		0		0		9		
8	1	2	1	5	1	4	1	1	1	5	1	2	1	5	1	2	1	8	1	5	1	3	1	1	2
	5	7	5		5	1	5	6	5	0	5	3	5	4	5	3	5		5	2	5	5	5	8	2
	5		5		4		4		3		3		2		2		2		1		1		1		
9	1	3	1	1	1	5	1	2	1	2	1	3	1	9	1	3	1	2	1	9	1	5	1	3	2
	5	5	5	3	5	1	5	7	5		5	6	5		5	9	5	5	5		5	3	5	7	1
	6		6		5		5		5		4		4		3		3		3		2		2		
1	1	4	1	2	1	1	1	3	1	1	1	4	1	2	1	5	1	4	1	2	1	1	1	5	2

2	2	3	3	3	3	3	4	4	4	4	4	D
D 6 2	8 2	0 3	2 3	4 3	6 3	8 3	0 4	1 4	2 4	3 4	4 4	e
e 6	8	0	2	4	6	8	0	1	2	3	4	g
g G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' G ' ↓												
0 5 2	5 1	5	5 7	5 3	5 9	5 3	5 4	5 1	5 6	5 0	5 5	0
7	7	7	6	6	5	5	4	4	4	4	3	
1 1 5	1 3	1 1	1 4	1 2	1 2	1 3	1 1	1 5	1 4	1 2	1 1	1
1 5 0	5 0	5 0	5 8	5 5	5	5 7	5 3	5 8	5 3	5 8	5 4	9
8	8	8	7	7	7	6	6	5	5	5	5	
1 1 5	1 3	1 1	1 5	1 3	1 1	1 5	1 2	1 1	1 0	1 4	1 3	1
2 5 7	5 8	5 9	5 8	5 7	5 5	5 1	5 6	5 4	5	5 6	5 2	8
9	9	9	8	8	8	7	7	7	7	6	6	
1 1 4	1 4	1 2	1 9	1 4	1 2	1 5	1 4	1 3	1 1	1 4	1 5	1
3 6	6 6	6 8	6	5 8	5 8	5	5 1	5 0	5 7	5	5 1	7
1	0	0	0	9	9	9	8	8	8	8	7	
1 1 1	1 5	1 3	1 1	1 0	1 4	1 1	1 5	1 4	1 3	1 2	1 9	1
4 6 1	6 4	6 7	6 9	6	6 1	6 9	5 7	5 6	5 4	5 2	5	6
2	1	1	1	1	0	0	9	9	9	9	9	
1 1 1	1 2	1 4	1 2	1 1	1 5	1 3	1 1	1 2	1 5	1 3	1 2	1
5 6 8	6	6 6	6 9	6 1	6 3	6 3	6 2	6	6 0	6 9	6 7	5
3	3	2	2	2	1	1	1	1	0	0	0	
1 1 2	1 1	1 5	1 4	1 2	1 6	1 4	1 2	1 1	1 7	1 5	1 4	1
6 6 5	6 0	6 5	6 0	6 3	6	6 7	6 8	6 8	6	6 6	6 6	4
4	4	3	3	3	3	2	2	2	2	1	1	
1 1 3	1 1	1 4	1 5	1 3	1 1	1 1	1 4	1 3	1 2	1 1	1 4	1
7 6 2	6 8	6	6 0	6 4	6 8	6	6 3	6 4	6 4	6 3	6	3
5	5	5	4	4	4	4	3	3	3	3	3	
1 1 3	1 2	1 1	1 0	1 4	1 3	1 1	1 5	1 5	1 4	1 3	1 2	1
8 6 9	6 6	6 3	6	6 6	6 1	6 5	6 9	6 0	6 1	6 1	6 2	2
6	6	6	6	5	5	5	4	4	4	4	4	
1 1 4	1 3	1 2	1 1	1 5	1 4	1 2	1 1	1 6	1 5	1 4	1 4	1
9 6 6	6 4	6 2	6 0	6 7	6 4	6 9	6 4	6	6 8	6 8	6 0	1
7	7	7	7	6	6	6	6	6	5	5	5	
2 1 5	1 4	1 3	1 2	1 8	1 5	1 4	1 2	1 2	1 1	1 6	1 5	1
0 6 3	6 2	6 1	6 0	6	6 6	6 2	6 9	6 1	6 4	6	6 8	0
8	8	8	8	8	7	7	7	7	7	7	6	

[illegible]

TABULAE NOVALMAGESTICAE — Part II

TAB. 32 (continued) — Oblique Ascension of the Signs, for Pole-Altitudes 45°–56°

Source page 1 — running number "32"

Top segment: sign ♈ (Aries), 0°–30°. Bottom segment: sign ♉ (Taurus), 0°–30°. Right reverse-index sigla: ♊ (Pisces) for the top segment's complement, ♋ (Aquarius) for the bottom.

Segment ♈ (Aries) — index 0–30

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	(		
Υ	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	Υ
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
																									0
1	0	3	0	3	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	1	2
		1		0		9		8		7		6		5		4		3		2		0		9	9
2	1	2	1	0	0	5	0	5	0	5	0	5	0	5	0	4	0	4	0	4	0	4	0	3	2
						8		6		5		3		0		8		6		4		1		9	8
3	1	3	1	3	1	2	1	2	1	2	1	1	1	1	1	1	1	9	1	6	1	2	0	5	2
		3		0		8		5		2		9		6		3								8	7
4	2	4	2	0	1	5	1	5	1	5	1	4	1	4	1	3	1	3	1	2	1	2	1	1	2
						7		3		0		6		1		7		2		8		3		8	6
5	2	3	2	3	2	2	2	2	2	1	2	1	2	7	2	2	1	5	1	5	1	4	1	3	2
		5		1		7		2		8		3					6		0		4		8	5	
6	3	6	3	1	2	5	2	5	2	4	2	3	2	3	2	2	2	1	2	1	2	5	1	5	2
						6		0		5		9		2		6		9		2				7	4
7	3	3	3	3	3	2	3	1	3	1	3	6	2	5	2	5	2	4	2	3	2	2	2	1	2
		7		2		6		9		3				8		1		3		4		6		7	3
8	4	9	4	2	3	5	3	4	3	4	3	3	3	2	3	1	3	6	2	5	2	4	2	3	2
						5		8		0		2		4		5				7		7		7	2
9	4	4	4	3	4	2	4	1	4	8	3	5	3	5	3	4	3	3	3	1	3	8	2	5	2
		0		3		5		7				9		0		0		0		9				7	1

	4	4	4	4	4	5	5	5	5	5	5	
G.	5	6	7	8	9	0	1	2	3	4	5	6
(	G	4	G	4	G	4	G	4	G	5	G	5
γ	r	5	r	6	r	7	r	8	r	9	r	0
)	.	'	.	'	.	'	.	'	.	'	.	'
	)											
1	5	1	5	4	4	5	4	4	4	3	4	2
0		2			5		6		6		6	
1	5	4	5	3	5	2	5	1	5	4	4	5
1		3		4		5		5			3	2
1	6	1	6	5	5	5	5	4	5	3	5	2
2		5			5		4		2		0	
1	6	4	6	3	6	2	6	1	6	0	5	4
3		7		6		5		3			7	4
1	7	1	7	7	6	5	6	4	6	2	6	1
4		9			5		2		8		4	
1	7	5	7	3	7	2	7	1	6	5	6	4
5		1		8		5		1		7	2	6
1	8	2	8	9	7	5	7	4	7	2	7	9
6		4			5		0		5			2
1	8	5	8	4	8	2	8	1	7	5	7	3
7		5		0		6		0		4	7	9
1	9	2	9	1	8	5	8	3	8	2	8	4
8		7		2		6		9		2		6
1	9	5	9	4	9	2	9	9	8	5	8	3
9		9		3		7			1	2	3	2
2	1	3	1	1	9	5	9	3	9	2	9	0
0	0	2	0	5		8		9		0		8
2	1	5	1	4	1	2	1	9	9	4	9	2
1	1		0	7	0	9	0			9	8	
2	1	3	1	1	1	0	1	4	1	1	9	5
2	1	8	1	9	1		0	9	0	9		7
2	1	1	1	5	1	3	1	1	1	4	1	2
3	2	1	1	2	1	2	1	0	0	8	0	6
2	1	4	1	2	1	3	1	4	1	1	1	5
4	2	4	2	4	2		1	1	1	8	0	5
2	1	1	1	5	1	3	1	1	1	4	1	2

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	(		
Υ	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	⋈
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
5	3	8	2	7	2	5	2	2	1	8	1	4	0	8	0	1	0		2				8		
2	1	5	1	3	1	7	1	4	1	1	1	5	1	2	1	5	1	2	9	5	9	2	8	5	4
6	3	2	3	0	3		2	3	2	8	1	3	1	6	0	8	0	8		7		5		0	
2	1	2	1	3	1	4	1	1	1	4	1	2	1	5	1	2	1	5	1	2	9	4	9	1	3
7	4	6	4		3	0	3	5	2	9	2	3	1	5	1	5	0	4	0	2		9		3	
2	1	1	1	3	1	1	1	4	1	2	1	5	1	2	1	5	1	2	1	4	1	1	9	3	2
8	5		4	7	4	2	3	6	3	0	2	2	2	3	1	3	1	0	0	7	0	3		5	
2	1	3	1	1	1	4	1	1	1	5	1	2	1	5	1	2	1	4	1	1	1	3	9	5	1
9	5	5	5	0	4	5	4	8	3	1	3	2	2	2	2	1	1	7	1	2	0	7		8	
3	1	1	1	4	1	1	1	5	1	2	1	5	1	2	1	4	1	1	1	3	1	1	1	2	0
0	6	0	5	4	5	8	4	0	4	2	3	2	3	1	2	8	2	4	1	8	1		0	1	

Segment ♂ (Taurus) — index 0–30 (right reverse-index siglum ≈ Aquarius)

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	(		
♈	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	≈
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
0	1	1	1	4	1	1	1	5	1	2	1	5	1	2	1	4	1	1	1	3	1	1	1	2	3
	6	0	5	4	5	8	4	0	4	2	3	2	3	1	2	8	2	4	1	8	1		0	1	0
1	1	4	1	1	1	5	1	2	1	5	1	2	1	5	1	1	1	4	1	4	1	2	1	4	2
	6	5	6	8	5	1	5	3	4	3	4	2	3	0	3	6	2	1	2		1	5	0	4	9
2	1	2	1	5	1	2	1	5	1	2	1	5	1	2	1	4	1	8	1	3	1	5	1	7	2
	7	0	6	3	6	5	5	6	5	4	4	3	4	0	3	5	3		2	0	1	0	1		8
3	1	5	1	2	1	5	1	2	1	5	1	2	1	5	1	1	1	3	1	5	1	1	1	3	2
	7	6	7	7	6	8	6	9	5	5	5	4	4	0	4	4	3	6	2	6	2	5	1	1	7
4	1	3	1	2	1	3	1	2	1	2	1	5	1	2	1	4	1	4	1	2	1	4	1	5	2
	8	1	8		7	2	7		6	9	5	5	5	0	4	3	4		3	3	2	0	1	5	6
5	1	7	1	3	1	6	1	3	1	1	1	2	1	5	1	1	1	3	1	5	1	6	1	1	2
	9		8	7	8		7	5	7		6	6	5	0	5	2	4	2	3	0	3		2	9	5
6	1	4	1	1	1	4	1	9	1	3	1	5	1	2	1	4	1	1	1	1	1	3	1	4	2

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	G	5	(
⋈	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	≈
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
	9	3	9	3	8	1	8		7	4	6	8	6	1	5	2	5		4	8	3	2	2	4	4
7	2	2	1	4	1	1	1	4	1	8	1	3	1	5	1	1	1	3	1	4	1	5	1	9	2
	0	0	9	9	9	7	8	3	8		7	1	6	3	6	3	5	0	4	6	3	9	3		3
8	2	5	2	2	1	5	1	1	1	4	1	3	1	2	1	4	1	5	1	1	1	2	1	3	2
	0	7	0	6	9	2	9	8	8	1	8		7	4	6	3	5	9	5	4	4	6	3	4	2
9	2	3	2	2	2	2	1	5	1	1	1	3	1	5	1	1	1	2	1	4	1	5	1	0	2
	1	4	1		0	8	9	2	9	5	8	6	7	6	7	4	6	9	5	2	4	3	4		1
1	2	1	2	3	2	4	2	2	1	4	1	9	1	2	1	4	1	5	1	1	1	2	1	2	2
0	2	2	1	9	1		0	7	9	9	9		8	8	7	5	6	9	6	1	5	0	4	6	0
1	2	5	2	1	2	4	2	2	2	2	1	4	1	1	1	1	1	2	1	4	1	4	1	5	1
1	2	0	2	6	1	0	1		0	4	9	3	9		8	6	7	9	6	0	5	8	4	2	9
1	2	2	2	5	2	1	2	3	2	5	2	1	1	3	1	4	1	0	1	9	1	1	1	1	1
2	3	9	2	4	2	7	1	8	0	7	0	5	9	4	8	8	8		7		6	6	5	9	8
1	2	8	2	3	2	5	2	1	2	3	2	4	2	7	1	2	1	3	1	3	1	4	1	4	1
3	4		3	2	2	4	2	4	1	1	0	8	0		9	0	8	1	7	8	6	4	5	6	7
1	2	4	2	1	2	3	2	5	2	7	2	2	2	4	1	5	1	2	1	7	1	1	1	1	1
4	4	7	4	0	3	1	2	1	2		1	2	0	0	9	2	9		8		7	3	6	3	6
1	2	2	2	4	2	9	2	2	2	4	2	5	2	1	2	2	1	3	1	3	1	4	1	4	1
5	5	6	4	8	4		3	8	2	4	1	8	1	4	0	5	9	4	8	9	7	2	6	1	5
1	2	6	2	2	2	4	2	6	2	2	2	3	2	4	2	5	2	7	1	1	1	1	1	1	1
6	6		5	7	4	7	4		3	3	2	6	1	9	0	9	0		9	1	8	2	7	0	4
1	2	4	2	7	2	2	2	4	2	1	2	1	2	2	2	3	2	4	1	4	1	4	1	3	1
7	6	7	6		5	6	4	5	4		3	5	2	5	1	4	0	0	9	3	8	3	7	9	3
1	2	2	2	4	2	5	2	2	2	3	2	4	2	1	2	1	2	1	2	1	1	1	1	9	1
8	7	8	6	7	6		5	3	4	8	3	9	3		2	2	1	3	0	5	9	4	8		2
1	2	9	2	2	2	4	2	2	2	1	2	2	2	3	2	4	2	4	2	4	1	4	1	3	1
9	8		7	8	6	5	6		5	6	4	6	3	7	2	3	1	7	0	8	9	5	8	9	1
2	2	5	2	9	2	2	2	4	2	5	2	4	2	1	2	1	2	1	2	2	2	1	1	9	1
0	8	0	8		7	6	6	1	5	4	5		4	3	3	8	2		1	1	0	7	9		0

G.	4	4	4	4	4	5	5	5	5	5	5	5													
(	5	6	7	8	9	0	1	2	3	4	5	6													
⌘	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	(		
)	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	≈
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
2	2	3	2	5	2	7	2	2	2	3	2	4	2	5	2	5	2	5	2	5	2	4	1	4	9
1	9	2	8	1	8		7	1	6	3	5	2	4	0	3	4	2	6	1	4	0	9	9	0	
2	3	1	2	3	2	4	2	2	2	1	2	2	2	2	2	3	2	3	2	2	2	2	2	1	8
2	0	5	9	3	8	0	8		7	3	6	1	5	8	4	1	3	1	2	8	1	2	0	2	
2	3	5	3	1	2	3	2	4	2	5	2	0	2	6	2	8	2	7	2	3	2	5	2	4	7
3	0	8	0	5	9	0	8	2	7	2	7		6		5		4		3		1	5	0	4	
2	3	4	3	5	3	1	2	2	2	3	2	3	2	4	2	4	2	4	2	3	2	2	2	1	6
4	1	1	0	7	0	1	9	3	8	2	7	9	6	4	5	5	4	3	3	8	2	9	1	6	
2	3	2	3	4	3	5	3	4	2	1	2	1	2	2	2	2	2	2	2	1	2	4	2	4	5
5	2	5	1	0	0	3	0		9	2	8	9	7	2	6	3	5	0	4	4	3		1	9	
2	3	1	3	2	3	3	3	4	2	5	2	5	2	1	2	2	2	5	2	5	2	3	2	2	4
6	3	0	2	3	1	6	0	6	9	3	8	9	8		7		5	8	4	0	3	9	2	2	
2	3	5	3	7	3	2	3	2	3	3	2	4	2	4	2	4	2	3	2	2	2	1	2	5	3
7	3	6	3		2	0	1	9	0	5	9	0	8	1	7	1	6	6	5	7	4	5	2	6	
2	3	4	3	5	3	4	3	1	3	1	3	2	2	2	2	2	2	1	2	5	2	5	2	3	2
8	4	1	3	2	3		2	2	1	8	0	2	9	2	8	1	7	5	6		4	1	3	1	
2	3	2	3	3	3	4	3	5	3	1	3	4	3	4	2	1	2	5	2	4	2	2	2	7	1
9	5	1	4	8	3	9	2	6	2		1		0		9		7	4	6	3	5	8	4		
3	3	1	3	2	3	3	3	4	3	4	3	4	3	4	2	4	2	3	2	2	2	6	2	4	0
0	6	3	5	4	4	4	3	1	2	5	1	7	0	6	9	2	8	4	7	2	6		4	4	

Source page 2 — running number "33"

Top segment: sign ♊ (Gemini), 0°–30°. Bottom segment: sign ♋ (Cancer), 0°–30°. Right reverse-index sigla: ♐ (Capricorn) for the top, ♐ (Sagittarius) for the bottom.

Segment ♊ (Gemini) — index 0–30

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	(												
Π	r	5	r	6	r	7	r	8	r	9	r	0	5												
)	.	'	.	'	.	'	.	'	.	'	.	'	)												
0	3	1	3	2	3	3	3	4	3	4	3	4	3	4	2	4	2	3	2	2	2	6	2	4	3
	6	3	5	4	4	4	3	1	2	5	1	7	0	6	9	2	8	4	7	2	6		4	4	0
1	3	0	3	1	3	2	3	2	3	3	3	3	3	2	3	2	2	1	2	2	2	4	2	2	2
	7		6	1	5	0	4	6	3	0	2	1	1	9	0	4	9	5	8		6	4	5	1	9
2	3	4	3	5	3	7	3	1	3	1	3	1	3	1	3	7	2	5	2	4	2	2	2	5	2
	7	8	6	8	6		5	2	4	5	3	5	2	3	1		9	7	8	3	7	3	5	9	8
3	3	3	3	4	3	5	3	5	3	1	3	0	3	5	3	5	3	3	2	2	2	3	2	3	2
	8	6	7	6	6	4	5	8	5		4		2	7	1	0	0	9	9	4	8		6	8	7
4	3	2	3	3	3	4	3	4	3	4	3	4	3	4	3	3	3	2	3	6	2	4	2	1	2
	9	5	8	4	7	1	6	5	5	7	4	6	3	2	2	4	1	2	0		8	4	7	8	6
5	4	1	3	2	3	2	3	3	3	3	3	3	3	2	3	1	3	6	3	4	2	2	2	5	2
	0	5	9	3	8	9	7	3	6	4	5	2	4	7	3	8	2		0	9	9	6	7	9	5
6	4	5	4	1	3	1	3	2	3	2	3	1	3	1	3	3	3	5	3	3	3	8	2	4	2
	1		0	2	9	8	8	2	7	2	6	9	5	3	4		2	1	1	2	0		8	0	4
7	4	5	4	2	4	8	3	1	3	1	3	7	3	0	3	4	3	3	3	1	3	5	2	2	2
	1	6	1		0		9	2	8	0	7		6		4	9	3	6	2	6	0	1	9	2	3
8	4	4	4	5	4	5	4	1	3	5	3	5	3	4	3	3	3	2	3	1	3	3	3	5	2
	2	7	1	3	0	8	0		8	9	7	5	6	8	5	6	4	2	3		1	5	0		2
9	4	3	4	4	4	4	4	5	3	4	3	4	3	3	3	2	3	8	3	4	3	2	3	4	2
	3	9	2	5	1	9	0	1	9	9	8	4	7	6	6	4	5		3	7	2	0	0	8	1
1	4	3	4	3	4	4	4	4	4	3	3	3	3	2	3	1	3	5	3	3	3	6	3	3	2
0	4	1	3	7	2	0	1	1	0	9	9	3	8	5	7	2	5	5	4	3	3		1	2	0
1	4	2	4	3	4	3	4	3	4	3	4	2	3	1	3	1	3	4	3	2	3	5	3	1	1
1	5	4	4	0	3	2	2	2	1	0	0	3	9	5	8		6	3	5	0	3	3	2	7	9
1	4	1	4	2	4	2	4	2	4	2	4	1	4	5	3	5	3	3	3	8	3	4	3	3	1
2	6	8	5	4	4	5	3	4	2	2	1	4	0		8	1	7	2	6		4	1	3		8
1	4	1	4	1	4	1	4	1	4	1	4	6	4	5	3	4	3	2	3	5	3	2	3	5	1
3	7	3	6	8	5	9	4	7	3	4	2		0	6	9	2	8	2	6	7	5	9	3	0	7
1	4	7	4	1	4	1	4	1	4	7	4	5	4	4	4	3	3	1	3	4	3	1	3	3	1
4	8		7	3	6	3	5	1	4		2	9	1	8	0	4	9	3	7	8	6	8	4	9	6

	4	4	4	4	4	5	5	5	5	5	5	5	
G.	5	6	7	8	9	0	1	2	3	4	5	6	
(	G	4	G	4	G	4	G	4	G	5	G	5	(
II	r	5	r	6	r	7	r	8	r	9	r	0	υ
)	.	'	.	'	.	'	.	'	.	'	.	'	)
1	4	3	4	8	4	8	4	6	4	1	4	5	4
5	9		8		7		6		5		3	3	2
1	4	5	4	3	4	3	4	1	4	5	4	4	4
6	9	9	9		8		7		5	6	4	7	3
1	5	5	5	0	4	5	4	5	4	5	4	4	4
7	0	6	0		8	9	7	7	6	2	5	2	4
1	5	5	5	5	4	5	4	5	4	4	4	3	4
8	1	3	0	7	9	6	8	3	7	8	6	8	5
1	5	5	5	5	5	5	4	5	4	4	4	3	4
9	2	1	1	5	0	4	9	0	8	5	7	5	6
2	5	5	5	5	5	5	5	4	4	4	4	3	4
0	3	0	2	3	1	2	0	8	9	2	8	2	7
2	5	4	5	5	5	5	5	4	5	4	4	3	4
1	4	9	3	2	2	1	1	7	0	0	9	0	8
2	5	4	5	5	5	5	5	4	5	3	5	2	4
2	5	9	4	2	3	1	2	7	1	9	0	9	9
2	5	5	5	5	5	5	5	4	5	3	5	2	5
3	6	0	5	2	4	1	3	7	2	9	1	9	0
2	5	5	5	5	5	5	5	4	5	4	5	2	5
4	7	2	6	3	5	2	4	8	3	0	2	9	1
2	5	5	5	5	5	5	5	4	5	4	5	3	5
5	8	4	7	5	6	4	5	9	4	1	3	0	2
2	5	5	5	5	5	5	5	5	5	4	5	3	5
6	9	7	8	7	7	6	6	1	5	3	4	2	3
2	6	0	6	0	5	5	5	5	5	4	5	3	5
7	1		0		8	9	7	4	6	6	5	5	4
2	6	4	6	4	6	3	5	5	5	5	5	3	5
8	2		1		0		8	8	7	0	6	8	5
2	6	9	6	9	6	7	6	2	5	5	5	4	5
9	3		2		1		0		8	4	7	2	6
3	6	1	6	1	6	1	6	7	5	5	5	4	5

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	(						
Π	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	ϥ
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)

0 4 4 3 4 2 2 1 9 9 8 7 7 1 6 1 4 6 3 4 1 7 9 2

Segment ☿ (Cancer) — index 0–30 (right reverse-index siglum ♊ Sagittarius)

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	(						
☿	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	♊
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)

0	6	1	6	1	6	1	6	7	5	5	5	4	5	3	5	1	5	4	5	1	5	3	4	5	3
	4	4	3	4	2	2	1		9	9	8	7	7	1	6	1	4	6	3	4	1	7	9	2	0
1	6	2	6	2	6	1	6	1	6	5	5	5	5	3	5	1	5	5	5	2	5	4	5	5	2
	5	0	4	0	3	8	2	3	1		9	3	8	7	7	7	5	2	4	1	2	2	0	8	9
2	6	2	6	2	6	2	6	2	6	1	6	0	5	4	5	2	5	5	5	2	5	4	5	5	2
	6	6	5	7	4	5	3	0	2	1	1		9	4	8	4	6	9	5	8	3	9	2		8
3	6	3	6	3	6	3	6	2	6	1	6	7	6	5	5	3	5	6	5	3	5	5	5	1	2
	7	3	6	4	5	2	4	7	3	8	2		0	1	9	1	8		6	6	4	7	3	3	7
4	6	4	6	4	6	4	6	3	6	2	6	1	6	5	6	3	5	1	5	4	5	6	5	2	2
	8	0	7	1	6	0	5	5	4	6	3	5	1	9	0	9	9	4	7	4	6		4	2	6
5	6	4	6	4	6	4	6	4	6	3	6	2	6	8	6	4	6	2	5	5	5	1	5	3	2
	9	8	8	9	7	8	6	3	5	5	4	3	3		1	8	0	3	8	3	7	6	5	2	5
6	7	5	6	5	6	5	6	5	6	4	6	3	6	1	6	5	6	3	6	3	5	2	5	4	2
	0	6	9	8	8	7	7	2	6	4	5	3	4	8	2	8	1	3	0		8	7	6	3	4
7	7	5	7	8	7	6	6	1	6	5	6	4	6	2	6	9	6	4	6	1	5	3	5	5	2
	2		1		0		9		7	4	6	3	5	9	4		2	4	1	4	9	9	7	5	3
8	7	1	7	1	7	1	7	1	6	4	6	5	6	4	6	2	6	5	6	2	6	5	5	8	2
	3	5	2	8	1	6	0	1	9		7	5	6	0	5	0	3	6	2	6	0	2	9		2
9	7	2	7	2	7	2	7	2	7	1	6	6	6	5	6	3	6	9	6	3	6	5	6	2	2
	4	5	3	8	2	7	1	2	0	6	9		7	2	6	2	5		3	9	2		0	2	1
1	7	3	7	3	7	3	7	3	7	2	7	1	6	4	6	4	6	2	6	5	6	1	6	3	2
0	5	6	4	9	3	8	2	4	1	8	0	8	9		7	5	6	2	4	3	3	9	1	7	0
1	7	4	7	5	7	5	7	4	7	4	7	3	7	1	6	5	6	3	6	8	6	3	6	5	1

G. (S)	4	4	4	4	4	5	5	5	5	5	5	5
	5	6	7	8	9	0	1	2	3	4	5	6
	G	4	G	4	G	4	G	4	G	5	G	5
	r	5	r	6	r	7	r	8	r	9	r	0
	.	'	.	'	.	'	.	'	.	'	.	'
1	6	8	5	1	4	0	3	6	2	0	1	0
1	7	0	7	3	7	2	7	5	7	5	7	4
2	8		7		6		4	9	3	3	2	4
1	7	1	7	1	7	1	7	1	7	6	7	5
3	9	2	8	6	7	5	6	2	5		3	8
1	8	2	7	2	7	2	7	2	7	2	7	1
4	0	4	9	8	8	8	7	6	6	0	5	2
1	8	3	8	4	7	4	7	4	7	3	7	2
5	1	7	0	1	9	2	8	0	7	5	6	7
1	8	5	8	5	8	5	7	5	7	5	7	4
6	2	1	1	5	0	6	9	5	8	1	7	3
1	8	5	8	1	8	1	8	1	8	7	7	0
7	4		3	0	2	1	1	0	0		9	
1	8	2	8	2	8	2	8	2	8	2	8	1
8	5	0	4	5	3	6	2	6	1	4	0	6
1	8	3	8	4	8	4	8	4	8	4	8	3
9	6	4	5	0	4	2	3	2	2	0	1	3
2	8	4	8	5	8	5	8	5	8	5	8	5
0	7	9	6	5	5	8	4	9	3	7	2	1
2	8	4	8	1	8	1	8	1	8	1	8	9
1	9		8	1	7	4	6	6	5	4	4	
2	9	2	8	2	8	3	8	3	8	3	8	2
2	0	0	9	7	8	1	7	4	6	2	5	8
2	9	3	9	4	8	4	8	5	8	5	8	4
3	1	6	0	4	9	8	8	1	7	0	6	6
2	9	5	9	0	9	5	9	8	8	8	8	5
4	2	2	2		1		0		9		8	
2	9	9	9	1	9	2	9	2	9	2	8	2
5	4		3	7	2	3	1	7	0	8	9	6

	4	4	4	4	4	5	5	5	5	5	5	
G.	5	6	7	8	9	0	1	2	3	4	5	6
(	G	4	G	4	G	4	G	4	G	5	G	5
$\mathcal{Q}$	r	5	r	6	r	7	r	8	r	9	r	0
)	.	'	.	'	.	'	.	'	.	'	.	'
	)											
3	1	3	1	4	1	5	1	6	1	1	1	1
	0	2	0	5	0	7	0		0	3	0	8
	4		3		2		2		1		0	
4	1	5	1	4	1	1	1	2	1	3	1	4
	0	0	0		0	7	0	7	0	4	0	0
	5		5		4		3		2		1	0
5	1	9	1	2	1	3	1	4	1	5	1	3
	0		0	4	0	7	0	8	0	6	0	
	7		6		5		4		3		3	2
6	1	2	1	4	1	5	1	9	1	1	1	2
	0	8	0	3	0	7	0		0	8	0	6
	8		7		6		6		5		4	3
7	1	4	1	3	1	1	1	3	1	4	1	4
	0	7	0		0	8	0	0	0	0	9	0
	9		9		8		7		6		5	4
8	1	6	1	2	1	3	1	5	1	3	1	1
	1		1	3	0	8	0	2	0		0	2
	1		0		9		8		8		7	6
9	1	2	1	4	1	5	1	1	1	2	1	3
	1	5	1	3	1	9	1	3	0	5	0	5
	2		1		0		0		9		8	7
1	1	4	1	3	1	2	1	3	1	4	1	5
0	1	4	1		1	0	1	5	1	8	0	8
	3		3		2		1		0		9	9
1	1	3	1	2	1	4	1	5	1	1	1	2
1	1		1	3	1	1	1	7	1	1	1	2
	5		4		3		2		2		1	0
1	1	2	1	4	1	2	1	1	1	3	1	4
2	1	3	1	4	1		1	9	1	4	1	6
	6		5		5		4		3		2	1
1	1	4	1	4	1	2	1	4	1	5	1	1
3	1		1		1		1		1		1	
	1		1		1		1		1		1	

G. (o)	4		4		4		4		4		5		5		5		5		5		5		5		(
	5		6		7		8		9		0		1		2		3		4		5		6		
	G	4	G	4	G	4	G	4	G	4	G	5	G	5	G	5	G	5	G	5	G	5	G	5	
	r	5	r	6	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	r	6	)
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	)
	7	2	7		6	4	5	1	4	7	4	0	3	2	2	0	1	6	0	0	9	0	8	6	7
1	1	2	1	2	1	4	1	3	1	2	1	3	1	4	1	5	1	4	1	8	1	1	1	7	1
4	1		1	5	1	5	1		1	0	1	4	1	7	1	6	1		1		1	0	1		6
	9		8		7		7		6		5		4		3		3		2		1		0		
1	1	2	1	4	1	7	1	2	1	4	1	5	1	1	1	2	1	3	1	3	1	4	1	3	1
5	2	2	1	6	1		1	6	1	4	1	9	1	2	1	3	1	2	1	7	1	0	1	9	5
	0		9		9		8		7		6		6		5		4		3		2		1		
1	1	4	1	6	1	2	1	4	1	7	1	2	1	3	1	4	1	5	1	5	1	1	1	1	1
6	2	2	2		2	8	1	8	1		1	3	1	7	1	9	1	9	1		1	0	1	0	4
	1		1		0		9		9		8		7		6		5		5		4		3		
1	1	2	1	2	1	4	1	1	1	3	1	4	1	2	1	1	1	2	1	3	1	4	1	4	1
7	2		2	7	2	9	2	0	2	0	1	7	1		1	5	1	6	1	4	1	0	1	2	3
	3		2		1		1		0		9		9		8		7		6		5		4		
1	1	2	1	4	1	1	1	3	1	5	1	1	1	2	1	4	1	5	1	3	1	1	1	1	1
8	2	2	2	7	2	1	2	2	2	3	2	1	2	7	1	2	1	4	1		1	0	1	2	2
	4		3		3		2		1		1		0		9		8		8		7		6		
1	1	4	1	8	1	3	1	5	1	1	1	3	1	5	1	8	1	2	1	3	1	4	1	4	1
9	2	2	2		2	2	2	4	2	6	2	5	2	2	2		2	1	1	2	1	0	1	4	1
	5		5		4		3		3		2		1		1		0		9		8		7		
2	1	2	1	2	1	5	1	1	1	3	1	5	1	1	1	3	1	4	1	1	1	1	1	1	1
0	2		2	9	2	4	2	7	2	9	2	9	2	8	2	5	2	9	2		2	0	1	6	0
	7		6		5		5		4		3		3		2		1		1		0		9		
2	1	2	1	5	1	1	1	4	1	2	1	2	1	4	1	2	1	1	1	3	1	4	1	4	9
1	2	2	2	0	2	5	2	0	2		2	3	2	3	2		2	7	2	0	2	0	2	8	
	8		7		7		6		6		5		4		4		3		2		1		0		
2	1	4	1	1	1	3	1	3	1	2	1	4	1	9	1	2	1	4	1	5	1	1	1	2	8
2	2	2	2	0	2	7	2		2	6	2	8	2		2	8	2	5	2	9	2	1	2	0	
	9		9		8		8		7		6		6		5		4		3		3		2		
2	1	3	1	3	1	5	1	2	1	4	1	1	1	3	1	5	1	1	1	2	1	4	1	5	7
3	3		3	1	2	8	2	6	2	9	2	3	2	5	2	5	2	3	2	8	2	2	2	2	
	1		0		9		9		8		8		7		6		6		5		4		3		

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(♌)	G r .	4 5 '	G r .	4 6 '	G r .	4 7 '	G r .	4 8 '	G r .	4 9 '	G r .	5 0 '	G r .	5 1 '	G r .	5 2 '	G r .	5 3 '	G r .	5 4 '	G r .	5 5 '	G r .	5 6 '	(♍)
2 4	1 3 2	2 3 	1 3 1	5 2 	1 3 1	2 0 	1 3 0	4 9 0	1 3 0	1 3 	1 2 9	3 7 	1 2 9	1 	1 2 8	2 2 7	1 2 6	4 1 	1 2 6	5 7 	1 2 6	1 2 	1 2 5	1 2 4	2 4
2 5	1 3 3	4 3 	1 3 3	1 3 	1 3 2	4 2 	1 3 2	1 1 2	1 3 1	1 3 	3 7 1	1 3 	2 3 0	1 2 9	2 1 8	1 2 9	4 8 	1 2 8	2 6 7	1 2 6	2 2 	1 2 7	4 2 6	1 2 5	5 5
2 6	1 3 5	3 	1 3 	3 4 4	1 3 4	4 	1 3 3	3 4 3	1 3 	1 3 3	1 1 2	2 3 7	1 3 1	5 2 	1 3 5	1 3 0	1 3 6	3 5 9	1 2 5	1 2 9	1 3 	1 2 3	1 2 2	2 7 8	4
2 7	1 3 6	2 3 	1 3 3	5 5 	1 3 5	2 6 4	1 3 4	5 6 4	1 3 4	2 4 	1 3 3	5 1 	1 3 3	1 7 2	1 3 	1 4 2	4 1 2	1 3 1	4 3 0	1 2 	1 3 4	4 3 	1 2 9	5 2 3	3 9
2 8	1 3 7	4 3 	1 3 3	1 5 	1 3 4	1 7 6	1 3 6	1 8 5	1 3 8	1 4 5	1 1 5	1 6 8	1 3 4	1 3 	4 3 4	8 3 3	1 3 2	3 1 	1 3 3	5 3 2	1 3 	1 3 3	1 3 3	3 3 0	2
2 9	1 3 9	3 	1 3 	3 6 8	1 3 8	9 0 7	1 3 7	4 0 7	1 3 6	1 1 7	1 3 6	4 0 6	1 3 5	8 	1 3 4	3 4 5	1 3 4	5 9 4	1 3 4	2 2 	1 3 3	4 3 3	1 3 3	2 3 3	1
3 0	1 4 0	2 2 	1 3 9	5 6 	1 3 9	3 0 9	1 3 	2 3 8	1 3 4	3 4 8	1 3 8	4 3 	1 3 7	3 3 	1 3 3	0 3 7	1 3 6	2 3 5	1 3 0	5 3 5	1 3 	1 3 3	1 3 4	3 3 	0

Segment ♍ (Virgo) — index 0–30 (right reverse-index siglum ♎ Libra)

	4	4	4	4	4	5	5	5	5	5	5	5													
G.	5	6	7	8	9	0	1	2	3	4	5	6													
(♎)	G r .	4 5 '	G r .	4 6 '	G r .	4 7 '	G r .	4 8 '	G r .	4 9 '	G r .	5 0 '	G r .	5 1 '	G r .	5 2 '	G r .	5 3 '	G r .	5 4 '	G r .	5 5 '	G r .	5 6 '	(♎)
0	1	2	1	5	1	3	1	2	1	3	1	4	1	3	1	0	1	2	1	5	1	1	1	3	3
	4	2	3	6	3	0	3		3	4	3		3	3	3		3	6	3	0	3	3	3	3	0
	0		9		9		9		8		8		7		7		6		5		5		4		
1	1	2	1	1	1	5	1	2	1	5	1	2	1	5	1	2	1	5	1	1	1	4	1	5	2

G. (m)	4		4		4		4		4		5		5		5		5		5		5		5		(<u>Ω</u>)
	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6			
	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	
	4	2	4	7	4	2	4	5	3	8	3	9	3	9	3	7	3	4	3	9	3	3	3	9	
	1		1		0		0		9		9		8		8		7		7		6		6		
2	1	2	1	3	1	1	1	4	1	2	1	5	1	2	1	5	1	2	1	4	1	1	1	3	2
	4		4	8	4	3	4	7	4	1	4	3	4	4	3	4	3	2	3	8	3	3	3	6	8
	3		2		2		1		1		0		0		9		9		8		8		7		
3	1	2	1	5	1	3	1	1	1	4	1	1	1	5	1	2	1	4	1	1	1	4	1	8	2
	4	1	4	8	4	5	4	0	4	4	4	8	4	0	4	1	4	9	4	7	3	3	3		7
	4		3		3		3		2		2		1		1		0		0		9		9		
4	1	4	1	1	1	5	1	3	1	7	1	4	1	1	1	4	1	1	1	4	1	1	1	3	2
	4	1	4	9	4	6	4	2	4		4	2	4	5	4	7	4	7	4	6	4	3	4	9	6
	5		5		4		4		4		3		3		2		2		1		1		0		
5	1	0	1	3	1	1	1	5	1	3	1	6	1	4	1	1	1	4	1	1	1	4	1	1	2
	4		4	9	4	7	4	4	4	0	4		4	0	4	3	4	4	4	4	4	3	4	0	5
	7		6		6		5		5		5		4		4		3		3		2		2		
6	1	2	1	0	1	3	1	1	1	5	1	3	1	6	1	4	1	1	1	4	1	1	1	4	2
	4	0	4		4	9	4	7	4	4	4	0	4		4	0	4	2	4	3	4	3	4	2	4
	8		8		7		7		6		6		6		5		5		4		4		3		
7	1	4	1	2	1	0	1	3	1	1	1	5	1	3	1	6	1	3	1	1	1	4	1	1	2
	4	0	4	0	4		4	9	4	7	4	4	4	1	4		4	9	4	2	4	3	4	3	3
	9		9		9		8		8		7		7		7		6		6		5		5		
8	1	5	1	4	1	2	1	1	1	4	1	1	1	5	1	3	1	7	1	4	1	1	1	4	2
	5	9	5	1	5	2	5		4	0	4	8	4	6	4	2	4		4	1	4	3	4	5	2
	0		0		0		0		9		9		8		8		8		7		7		6		
9	1	1	1	1	1	4	1	2	1	3	1	4	1	2	1	5	1	3	1	1	1	4	1	1	2
	5	9	5		5	3	5	3	5		5	2	5	1	4	8	4	4	4	0	4	3	4	6	1
	2		2		1		1		1		0		0		9		9		9		8		8		
1	1	3	1	2	1	4	1	4	1	2	1	6	1	4	1	2	1	1	1	3	1	1	1	4	2
0	5	8	5	1	5		5	5	5	6	5		5	6	5	4	5		5	8	5	3	4	7	0
	3		3		3		2		2		2		1		1		1		0		0		9		
1	1	5	1	4	1	2	1	7	1	4	1	3	1	1	1	5	1	2	1	7	1	4	1	1	1
1	5	8	5	2	5	5	5		5	9	5	0	5	1	5	0	5	9	5		5	2	5	8	9

G. (m)	4		4		4		4		4		5		5		5		5		5		5		(		
	5		6		7		8		9		0		1		2		3		4		5			)	
	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r	G	r			
	4	4	4	4	4	4	3	3	3	2	2	2	1	1											
1	1	1	1	2	1	4	1	2	1	1	1	5	1	3	1	1	1	5	1	3	1	1	4	1	
2	5	7	5		5	6	5	9	5	2	5	4	5	6	5	6	5	6	5	5	5	2	5	9	8
	6		6		5		5		5		4		4		4		3		3		3		2		
1	1	3	1	2	1	7	1	5	1	3	1	1	1	1	1	4	1	2	1	3	1	4	1	2	1
3	5	7	5	2	5		5	1	5	5	5	8	5		5	2	5	3	5		5	2	5	0	7
	7		7		7		6		6		6		6		5		5		5		4		4		
1	1	5	1	4	1	2	1	1	1	5	1	4	1	2	1	8	1	5	1	3	1	1	1	5	1
4	5	6	5	2	5	8	5	3	5	8	5	2	5	6	5		5	0	5	1	5	1	5	1	6
	8		8		8		8		7		7		7		7		6		6		6		5		
1	1	1	1	2	1	4	1	3	1	2	1	6	1	5	1	3	1	1	1	5	1	4	1	2	1
5	6	5	6		5	9	5	5	5	1	5		5	0	5	4	5	7	5	9	5	1	5	1	5
	0		0		9		9		9		9		8		8		8		7		7		7		
1	1	3	1	2	1	1	1	5	1	4	1	3	1	1	1	0	1	4	1	2	1	1	1	5	1
6	6	4	6	2	6	0	6	7	6	4	6	0	6	5	6		5	4	5	8	5	1	5	2	4
	1		1		1		0		0		0		0		0		9		9		9		8		
1	1	5	1	4	1	3	1	1	1	7	1	5	1	4	1	2	1	1	1	5	1	3	1	2	1
7	6	3	6	2	6	1	6	9	6		6	4	6	0	6	6	6	1	6	6	6	9	6	3	3
	2		2		2		2		2		1		1		1		1		0		0		0		
1	1	1	1	2	1	5	1	4	1	2	1	1	1	5	1	5	1	3	1	2	1	1	1	5	1
8	6	2	6		6	2	6	1	6	9	6	7	6		6	2	6	8	6	4	6	0	6	4	2
	4		4		3		3		3		3		3		2		2		2		2		1		
1	1	3	1	2	1	1	1	3	1	5	1	4	1	3	1	1	1	5	1	5	1	3	1	2	1
9	6	1	6	2	6	3	6		6	2	6	1	6	0	6	8	6		6	2	6	8	6	5	1
	5		5		5		5		4		4		4		4		4		3		3		3		
2	1	5	1	4	1	3	1	2	1	1	1	4	1	5	1	4	1	3	1	2	1	8	1	5	1
0	6	0	6	2	6	3	6	4	6	4	6		6	4	6	3	6	2	6	0	6		6	5	0
	6		6		6		6		6		6		5		5		5		5		5		4		
2	1	9	1	2	1	5	1	4	1	3	1	2	1	1	1	9	1	5	1	4	1	3	1	2	9
1	6		6		6	4	6	6	6	7	6	8	6	9	6		6	9	6	8	6	8	6	6	
	8		8		7		7		7		7		7		7		6		6		6		6		

[illegible]

TABULAE NOVALMAGESTICAE — Part II

(Primum Mobile)

TAB. 33 — Table of position angles, by altitude of the pole 57° – 67°

This single table is continued across three pages. Each block of 30 argument-degrees corresponds to one zodiacal sign, marked by its sign-symbol in the left-hand argument column (which runs 0→30) and by the complementary sign-symbol in the right-hand argument column (which runs 30→0). The eleven paired data columns are headed by the altitude of the pole [altitudo poli] in degrees — 57, 58, 59, 60, 61, 62, 63, 64, 65, 66½, 67 — and each is subdivided into **Gr**.

(degrees) and ' (minutes). For the highest latitudes the tabulated angle approaches and wraps past 360°, so the 67° column shows values just below 360°.

The left argument header is **G.** (degrees); the per-page sign symbols are reproduced as printed.

Page 1 (source p. 35) — signs ♈ Aries and ♉ Taurus

Left argument header: **G.** / ♈ (Aries). Right argument runs 30→0, ending in the ♏ (Scorpio) symbol; the lower block is ♉ (Taurus) with the ♊ (Aquarius) symbol at the foot of the right column.

G. (Υ)	5 7 G r ,	5 8 G r ,	5 9 G r ,	6 0 G r ,	6 1 G r ,	6 2 G r ,	6 3 G r ,	6 4 G r ,	6 5 G r ,	66 ½ Gr ½	6 7 G r ,									
0	0	0	0	0	0	0	0	0	0	0	—									
1	0	1 8	0	1 6	0	1 5	0	1 3	0	1 2	0	8	0	6	0	4	0	0	3 6 0	
2	0	3 6	0	3 3	0	3 0	0	2 7	0	2 4	0	2 0	0	1 6	0	1 2	0	8	0	3 5 9
3	0	5 4	0	5 0	0	4 5	0	4 0	0	3 6	0	3 0	0	2 4	0	1 8	0	1 1	0	3 5 9

G. (Υ)	5		5		5		6		6		6		6		6		6		6		6	
	7	8	9	0	1	2	3	4	5	66	7	6	7	6	7	6	66	7	6	66	7	
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
4	1	1 2	1	7	1	0	0	5 4	0	4 8	0	4 0	0	3 1	0	2 4	0	1 5	0	0	3 5 9	5 6 9
5	1	3 1	1	2 4	1	1 6	1	8	1	0	0	5 0	0	4 0	0	3 0	0	1 9	0	0	3 5 9	5 3 9
6	1	4 9	1	4 0	1	3 1	1	2 1	1	1 2	1	0	0	4 8	0	3 5	0	2 2	0	0	3 5 9	5 4 9
7	2	7	1	5 7	1	4 6	1	3 5	1	2 4	1	1 0	0	5 6	0	4 1	0	2 4	0	0	3 5 9	5 1 9
8	2	2 6	2	1 4	2	2	1	4 9	1	3 6	1	2 0	1	5	0	4 8	0	2 9	0	0	3 5 9	5 0 9
9	2	4 4	2	3 1	2	1 7	2	3	1	4 8	1	3 0	1	1 5	0	5 4	0	3 3	0	0	3 5 9	4 8 9
10	3	3	2	4 8	2	3 3	2	1 7	2	0	1	4 1	1	2 1	1	0	0	3 7	0	0	3 5 9	4 7 9
11	3	2 1	3	5	2	4 8	2	3 1	2	1 3	1	5 1	1	3 0	1	6	0	4 1	0	0	3 5 9	4 5 9
12	3	4 0	3	2 2	3	4	2	4 5	2	2 5	2	1	1	3 8	1	1 3	0	4 5	0	0	3 5 9	4 4 9
13	3	5 9	3	4 0	3	1 9	2	5 9	2	3 7	2	1 1	1	4 7	1	2 5	0	5 0	0	0	3 5 9	4 3 9
14	4	1 8	3	5 7	3	3 5	3	1 3	2	4 8	2	2 2	1	5 5	1	2 5	0	5 3	0	0	3 5	4

G. (Υ)	5		5		5		6		6		6		6		6		6		66		6	
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
																					9	1
15	4	3	4	1	3	5	3	2	3	1	2	3	2	4	1	3	0	5	0	0	3	4
		7		5		1		7				3				1		7			5	0
																					9	
16	4	5	4	3	4	7	3	4	3	1	2	4	2	1	1	4	1	1	0	0	3	3
		6		2				1		5		4		1		0					5	7
																					9	
17	5	1	4	5	4	2	3	5	3	2	2	5	2	2	1	4	1	6	0	0	3	3
		5		0		3		5		6		5		0		3					5	6
																					9	
18	5	3	5	7	4	3	4	1	3	3	3	6	2	2	1	5	1	9	0	0	3	3
		4				9		0		9				8		0					5	4
																					9	
19	5	5	5	2	4	5	4	2	3	5	3	1	2	3	1	5	1	1	0	0	3	3
		3		5		5		4		2		7		7		6		3			5	3
																					9	
20	6	1	5	4	5	1	4	3	4	5	3	2	2	4	2	3	1	2	0	0	3	3
		3		3		2		9				8		6				0			5	2
																					9	
21	6	3	6	1	5	2	4	5	4	1	3	3	2	5	2	1	1	2	0	0	3	3
		3				9		4		8		9		5		0		3			5	0
																					9	
22	6	5	6	2	5	4	5	9	4	3	3	5	3	4	2	1	1	2	0	0	3	2
		3		0		6				1		0				7		7			5	9
																					9	
23	7	1	6	3	6	3	5	2	4	4	4	2	3	1	2	2	1	3	0	0	3	2
		3		8				4		5				3		4		0			5	7
																					9	
24	7	3	6	5	6	2	5	3	4	5	4	1	3	2	2	3	1	3	0	0	3	2
		3		7		0		9		8		3		3		1		6			5	6
																					9	

[illegible]

	5	5	5	6	6	6	6	6	6	6		6										
G.	7	8	9	0	1	2	3	4	5	66	7											
(	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	½	66	G	6		
γ	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
4	1	6	1	1	9	2	8	2	7	2	6	1	5	4	3	4	2	2	0	0	3	7
	1		0	6		2		4		2		6				7		3			5	
																					9	
5	1	2	1	3	9	4	8	4	7	3	6	2	5	1	3	5	2	2	0	0	3	5
	1	9	0	7		1		1		8		9		5		5		8			5	
																					9	
6	1	5	1	5	1	1	8	5	7	5	6	4	5	2	4	4	2	3	0	0	3	2
	1	2	0	9	0			9		4		3		6				4			5	
																					9	
7	1	1	1	2	1	2	9	1	8	1	6	5	5	3	4	1	2	3	0	0	3	0
	2	6	1	1	0	1		7		0		7		8		2		8			5	
																					9	
8	1	4	1	4	1	4	9	3	8	2	7	1	5	4	4	2	2	4	0	0	3	5
	2	0	1	3	0	2		6		7		1		9		0		4			5	8
																					8	
9	1	4	1	5	1	3	9	5	8	4	7	2	6	1	4	2	2	5	0	0	3	5
	3		2		1			5		4		6				9		0			5	6
																					8	
10	1	2	1	2	1	2	1	1	9	1	7	4	6	1	4	3	2	5	0	0	3	5
	3	9	2	8	1	4	0	5		1		1		3		9		6			5	4
																					8	
11	1	5	1	5	1	4	1	3	9	1	7	5	6	2	4	4	3	2	0	0	3	5
	3	4	2	1	1	5	0	5		8		6		6		8					5	2
																					8	
12	1	1	1	1	1	7	1	5	9	3	8	1	6	3	4	5	3	8	0	0	3	5
	4	9	3	5	2		0	5		6		1		9		8					5	0
																					8	
13	1	4	1	3	1	2	1	1	9	5	8	2	6	5	5	8	3	1	0	0	3	4
	4	5	3	9	2	9	1	5		4		7		2				5			5	7
																					8	
14	1	1	1	3	1	5	1	3	1	1	8	4	7	6	5	1	3	2	0	0	3	4
	5	1	4		2	1	1	5	0	3		3				9		2			5	

G. (Υ)	5		5		5		6		6		6		6		6		6		66		6	
	7	8	9	0	1	2	3	4	5	66	7	6	5	6	6	6	6	6	6	6	6	
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
																					8	5
15	1	3	1	2	1	1	1	5	1	2	8	5	7	1	5	2	3	2	0	0	3	4
	5	7	4	8	3	4	1	5	0	7		8		8		8		9			5	1
																					8	
16	1	4	1	5	1	3	1	1	1	5	9	1	7	3	5	3	3	3	0	0	3	3
	6		4	3	3	8	2	6	0	0		5		2		8		6			5	8
																					8	
17	1	3	1	1	1	2	1	3	1	1	9	3	7	4	5	5	3	4	0	0	3	3
	6	2	5	9	4		2	8	1	0		3		7		0		3			5	6
																					8	
18	1	0	1	4	1	2	1	1	1	3	9	5	8	2	6	1	3	5	0	0	3	3
	7		5	5	4	7	3		1	1		0						0			5	3
																					8	
19	1	2	1	1	1	5	1	2	1	5	1	8	8	1	6	1	3	5	0	0	3	2
	7	8	6	2	4	2	3	4	1	0	0			7		2		6			5	9
																					8	
20	1	5	1	3	1	1	1	4	1	1	1	2	8	3	6	2	4	4	0	0	3	2
	7	7	6	9	5	7	3	8	2	1	0	7		2		4					5	7
																					8	
21	1	2	1	7	1	4	1	1	1	3	1	4	8	4	6	3	4	1	0	0	3	2
	8	6	7		5	3	4	2	2	3	0	5		8		8		3			5	3
																					8	
22	1	5	1	3	1	9	1	3	1	5	1	4	9	5	6	5	4	2	0	0	3	1
	8	6	7	5	6		4	6	2	5	1					0		1			5	9
																					8	
23	1	2	1	4	1	3	1	1	1	1	1	2	9	2	7	3	4	3	0	0	3	1
	9	6	8		6	6	5		3	7	1	4		1				0			5	4
																					8	
24	1	5	1	3	1	3	1	2	1	3	1	4	9	3	7	1	4	3	0	0	3	1
	9	7	8	3	7		5	6	3	9	1	5		8		7		9			5	1
																					8	

G. (Υ)	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	66	6				
	7	8	9	0	1	2	3	4	5	66	7											
	G 5	G 5	G 5	G 6	G 6	G 6	G 6	G 6	G 6	½	66	G 6										
	r 7	r 8	r 9	r 0	r 1	r 2	r 3	r 4	r 5	Gr ½		r 7										
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
25	2	2	1	3	1	3	1	5	1	5	1	7	9	5	7	3	4	4	0	0	3	7
	0	9	9		7	1	5	2	4		2			6		2		8			5	8
26	2	1	1	3	1	0	1	1	1	3	1	2	1	1	7	4	4	5	0	0	3	3
	1		9	3	8		6	9	4	0	2	8	0	4		5		8			5	8
27	2	3	2	4	1	3	1	4	1	4	1	5	1	3	8	0	5	8	0	0	3	5
	1	4	0		8	0	6	7	4	9	2	0	0	4							5	8
28	2	8	2	3	1	0	1	1	1	2	1	1	1	5	8	1	5	1	0	0	3	5
	2		0	6	9		7	5	5	0	3	4	0	3		6		8			5	2
29	2	4	2	9	1	3	1	4	1	4	1	3	1	1	8	3	5	3	0	0	3	5
	2	2	1		9	1	7	3	5	7	3	7	1	4		3		0			5	1
30	2	1	2	4	2	2	1	1	1	1	1	5	1	3	8	5	5	4	0	0	3	4
	3	7	1	3	0		8	2	6	3	4		1	4		0		2			5	6
																					7	

Page 2 (source p. 36) — signs ♊ Gemini and ♋ Cancer

Left argument header: **G.** / ♊ (Gemini, printed **II**). Lower block ♋ (Cancer); right-edge complementary symbols. In the 67° column the source prints the vertical note "**Non occidit**" ("does not set") across several ♋ rows where the sign does not set at that latitude.

	5	5	5	6	6	6	6	6	6	6												
G.	7	8	9	0	1	2	3	4	5	66	7											
(	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	½	66	G	6		
♋	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
0	2	1	2	4	2	2	1	1	1	1	1	5	1	3	8	5	5	4	0	0	3	4
	3	7	1	3	0		8	2	6	3	4		1	4		0		2			5	6

G. (II)	5		5		5		6		6		6		6		6		6		6		6	
	7	8	9	0	1	2	3	4	5	66	7											
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	½	66	G	6		
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
																					7	
1	2	5	2	1	2	3	1	4	1	4	1	2	1	5	9	7	5	5	0	0	3	3
	3	3	2	7	0	4	8	2	6	1	4	5	2	6			4			5	4	
																					7	
2	2	3	2	5	2	7	1	1	1	1	1	5	1	1	9	2	6	7	0	0	3	2
	4	0	2	2	1		9	3	7	0	4	1	2	8		5				5	8	
																					7	
3	2	7	2	2	2	4	1	4	1	4	1	1	1	4	9	4	6	2	0	0	3	1
	5		3	8	1	1	9	5	7	0	5	9	2	2		4		1		5	0	
																					7	
4	2	4	2	5	2	1	2	1	1	1	1	4	1	7	1	4	6	3	0	0	3	1
	5	5	4		2	6	0	8	8	0	5	7	3		0		6			5	6	
																					7	
5	2	2	2	4	2	5	2	5	1	4	1	1	1	3	1	2	6	4	0	0	3	8
	6	4	4	3	2	3	0	3	8	2	6	6	3	2	0	5		8		5		
																					7	
6	2	4	2	2	2	3	2	2	1	1	1	4	1	5	1	4	7	3	0	0	3	0
	7		5	1	3	0	1	8	9	3	6	5	3	7	0	5				5		
																					7	
7	2	4	2	0	2	8	2	4	1	4	1	1	1	2	1	8	7	1	0	0	3	5
	7	5	6		4		2		9	6	7	5	4	4	1		8			5	1	
																					6	
8	2	2	2	4	2	4	2	4	2	2	1	4	1	5	1	3	7	3	0	0	3	4
	8	7	6	0	4	6	2	0	0	0	7	6	4	2	1	2		5		5	1	
																					6	
9	2	9	2	2	2	2	2	1	2	5	1	1	1	2	1	5	7	5	0	0	3	2
	9		7	1	5	5	3	7	0	6	8	8	5	2	1	8		5		5	6	
																					6	
10	2	5	2	3	2	5	2	5	2	3	1	5	1	5	1	2	8	1	0	0	3	1
	9	2	8		6		3	5	1	3	8	3	5	4	2	4		5		5	6	
																					6	

	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	66	66	6	
G.	7	8	9	0	1	2	3	4	5	6	6	6	6	6	6	6	6	6	7	
(	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	½	66	G	6
Π	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
11	3	3	2	4	2	4	2	3	2	1	1	2	1	2	1	5	8	3	0	0
	0	6	8	6	6	6	4	5	2	0	9	7	6	4	2	1		6		
																				3
																				4
																				5
																				6
12	3	2	2	3	2	2	2	1	2	4	2	3	1	5	1	9	8	5	0	0
	1	1	9	0	7	8	5	6	2	8	0		6	6	3		6			
																				3
																				4
																				5
13	3	7	3	1	2	1	2	5	2	2	2	4	1	2	1	4	9	1	0	0
	2		0	5	8	2	5	8	3	8	0	0	7	9	3	8		7		
																				3
																				2
																				5
																				3
14	3	5	3	1	2	5	2	4	2	9	2	1	1	5	1	1	9	4	0	0
	2	4	1		8	7	6	1	4		1	8	8		4	8		0		
																				3
																				6
																				5
15	3	4	3	4	2	4	2	2	2	5	2	5	1	4	1	5	1	7	0	0
	3	3	1	8	9	3	7	5	4	2	1	8	8	3	4	0	0			
																				3
																				2
																				9
																				4
16	3	3	3	3	3	3	2	1	2	3	2	4	1	2	1	2	1	3	0	0
	4	3	2	6	0	0	8	0	5	5	2	0	9	1	5	4	0	6		
																				3
																				4
																				7
																				3
17	3	2	3	2	3	1	2	5	2	2	2	2	2	2	1	2	1	1	0	0
	5	4	3	5	1	8	8	7	6	1	3	4	0		6		1	0		
																				3
																				3
																				3
18	3	1	3	1	3	7	2	4	2	7	2	9	2	4	1	4	1	4	0	0
	6	5	4	6	2		9	5	7		4		0	4	6	1	1	0		
																				3
																				3
																				4
19	3	7	3	8	3	5	3	3	2	5	2	5	2	2	1	2	1	1	0	0
	7		5		2	8	0	4	7	5	4	5	1	8	7	1	2	4		
																				—
																				—
20	3	0	3	1	3	5	3	2	2	4	2	4	2	1	1	1	1	4	0	0
	8		6		3	0	1	5	8	4	5	2	2	2	8		2	9		
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21	3	5	3	5	3	4	3	1	2	3	2	3	2	5	1	4	1	2	0	0
	8	5	6	5	4	3	2	7	9	4	6	1	2	8	8	2	3	4		

	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	66	6				
G.	7	8	9	0	1	2	3	4	5	66	7											
(	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
II	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
22	3	5	3	5	3	3	3	1	3	2	2	2	2	4	1	2	1	1	0	0		
	9	1	7	0	5	7	3	0	0	6	7	1	3	6	9	7	4					
23	4	4	3	4	3	3	3	5	3	2	2	1	2	3	2	1	1	4	0	0	o	
	0	8	8	6	6	3	4		1	0	8	3	4	6	0	4	4	1			c	-
24	4	4	3	4	3	3	3	1	3	1	2	7	2	2	2	3	1	2	0	0		
	1	6	9	3	7	0	5		2	5	9		5	8	1		5	4				
25	4	4	4	4	3	2	3	5	3	1	3	2	2	2	2	5	1	1	0	0		
	2	5	0	2	8	8	5	9	3	1	0		6	1	1	5	6	2				
26	4	4	4	4	3	2	3	5	3	9	3	0	2	1	2	4	1	1	0	0	c	
	3	6	1	2	9	8	6	8	4		1		7	7	2	8	7				i-	
27	4	4	4	4	4	2	3	5	3	8	3	5	2	1	2	4	1	5	0	0		
	4	8	2	3	0	9	7	8	5		1	9	8	5	3	5	7	5				
28	4	5	4	4	4	3	3	0	3	1	3	0	2	1	2	4	1	5	0	0	d	
	5	1	3	5	1	1	9		6	0	3		9	4	4	4	8	4			it	.
29	4	5	4	4	4	3	4	3	3	1	3	3	3	1	2	4	1	5	0	0		
	6	4	4	9	2	4	0		7	3	4		0	8	5	5	9	2				
30	4	5	4	5	4	3	4	8	3	1	3	7	3	2	2	5	2	5	0	0		
	7	8	5	4	3	9	1		8	7	5		1	2	6	0	0	6				
36																						
0	4	5	4	5	4	3	4	8	3	1	3	7	3	2	2	5	2	5	0	0	—	—
	7	8	5	4	3	9	1		8	7	5		1	2	6	0	0	6				
1	4	5	4	0	4	4	4	1	3	2	3	1	3	2	2	5	2	4	2	11	N	
	9		7		4	5	2	4	9	4	6	4	2	9	7	6	2				o	n
2	5	1	4	7	4	5	4	2	4	3	3	2	3	3	2	6	2	1	4	22		
	0	2	8		5	2	3	2	0	2	7	2	3	7	9		3	3				
3	5	2	4	1	4	1	4	3	4	4	3	3	3	4	3	1	2	2	6	32		
	1	0	9	5	7		4	1	1	2	8	1	4	8	0	7	4	8				
4	5	2	5	2	4	1	4	4	4	5	3	4	3	0	3	3	2	4	8	44	o	

G.	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	66	6		
(	7	8	9	0	1	2	3	4	5	6	6	6	6	6	6	6	7	6	
II	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	Gr	6	
)	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	7	
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	
	2	9	0	5	8	1	5	1	2	3	9	3	6		1	1	5	5	c
																			-
5	5	3	5	3	4	2	4	5	4	5	4	5	3	1	3	4	2	5	10 54
	3	9	1	6	9	2	6	3	4		0	6	7	5	2	7	7		
6	5	5	5	4	5	3	4	6	4	1	4	1	3	3	3	5	2	2	13 5
	4	0	2	8	0	4	8		5	9	2	1	8	2	4		8	8	
7	5	2	5	1	5	4	4	2	4	3	4	2	3	5	3	2	2	5	15 15 c
	6		4		1	8	9	0	6	4	3	8	9	1	5	7	9	4	i-
8	5	1	5	1	5	3	5	3	4	5	4	4	4	1	3	5	3	2	17 25
	7	5	5	6	3		0	6	7	1	4	6	1	2	6	1	1	6	
9	5	3	5	3	5	1	5	5	4	1	4	6	4	3	3	1	3	5	19 36 d
	8	0	6	1	4	9	1	3	9	0	6		2	4	8	7	2	9	it
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10	5	4	5	4	5	3	5	1	5	3	4	2	4	5	3	4	3	3	21 46
	9	6	7	7	5	6	3	1	0	0	7	7	3	8	9	5	4	4	
11	6	3	5	4	5	5	5	3	5	5	4	5	4	2	4	1	3	9	23 56
	1		9		6	4	4	0	1	1	8	1	5	4	1	5	6		
12	6	2	6	2	5	1	5	5	5	1	5	1	4	5	4	4	3	4	26 6 1 3
	2	0	0	2	8	3	5	0	3	3	0	5	6	0	2	6	7	5	6 1
13	6	3	6	4	5	3	5	1	5	3	5	4	4	1	4	1	3	2	28 15 2 4
	3	8	1	1	9	3	7	2	4	6	1	0	8	7	4	7	9	3	0 2
14	6	5	6	1	6	5	5	3	5	1	5	7	4	4	4	4	4	0	30 25 2 5
	4	7	3		0	4	8	5	6		3		9	5	5	8	1		3 2
15	6	1	6	2	6	1	5	5	5	2	5	3	5	1	4	2	4	4	32 34 2 4
	6	7	4	2	2	7	9	9	7	7	4	4	1	5	7	3	2	0	6 5
16	6	3	6	4	6	4	6	2	5	5	5	3	5	4	4	0	4	2	34 43 2 2
	7	8	5	4	3	1	1	4	8	2	6		2	7	9		4	2	9 9
17	6	0	6	7	6	5	6	5	6	2	5	3	5	2	5	3	4	6	36 52 3 4
	9		7		5		2	0	0	0	7	3	4	1	0	7	6		2
18	7	2	6	3	6	3	6	1	6	4	5	5	5	5	5	1	4	5	39 1 3 3
	0	3	8	1	6	0	4	7	1	9	9		5	5	2	8	7	4	4 5

	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	66	6				
G.	7	8	9	0	1	2	3	4	5	66	7											
(	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	½	66	G	6		
Π	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
)	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
19	7	4	6	5	6	5	6	4	6	1	6	3	5	3	5	0	4	4	41	9	3	3
	1	6	9	6	7	6	5	5	3	9	0	7	7	2	4		9	4			7	
20	7	1	7	2	6	2	6	1	6	5	6	1	5	1	5	4	5	3	43	17	3	2
	3	0	1	1	9	3	7	3	4	0	2	0	9	0	5	2	1	9			9	7
21	7	3	7	4	7	5	6	4	6	2	6	5	6	4	5	2	5	1	45	25	4	5
	4	4	2	7	0	1	8	2	6	1	3	0	0	7	7	2	3	9			1	0
22	7	5	7	1	7	1	7	1	6	5	6	1	6	2	5	4	5	8	47	33	4	9
	5	9	4	4	2	9	0	2	7	3	5	9	2	5	9		5				4	
23	7	2	7	4	7	4	7	4	6	2	6	5	6	4	6	4	5	5	49	40	4	2
	7	5	5	1	3	8	1	3	9	6	6	5	4		0	7	7	8			6	7
24	7	5	7	9	7	1	7	1	7	5	6	3	6	4	6	3	5	5	51	48	4	4
	8	1	7		5	7	3	5	0	9	8	1	5	4	2	2	8	0			8	3
25	8	1	7	3	7	4	7	4	7	3	7	1	6	2	6	1	6	4	53	55	5	5
	0	8	8	7	6	7	4	7	2	6	0	0	7	5	4	9	0	2			0	9
26	8	4	8	6	7	1	7	2	7	1	7	4	6	8	6	5	6	3	56	0	5	1
	1	6	0		8	8	6	0	4	1	1	8	9		6		2	5			3	3
27	8	1	8	3	7	4	7	5	7	4	7	2	7	4	6	5	6	2	58	7	5	2
	3	4	1	6	9	9	7	3	5	6	3	6	0	9	7	0	4	6			5	7
28	8	4	8	6	8	2	7	2	7	2	7	4	7	3	6	3	6	1	60	12	5	4
	4	3	3		1	1	9	7	7	2	5		2	1	9	6	6	9			7	0
29	8	1	8	3	8	5	8	1	7	5	7	4	7	1	7	2	6	1	62	17	5	5
	6	2	4	6	2	3	1		8	8	6	3	4	4	1	3	8	1			9	2
30	8	4	8	7	8	2	8	3	8	3	7	2	7	5	7	1	7	4	64	23	6	3
	7	1	6		4	6	2	6	0	6	8	4	5	8	3	1	0				0	

Page 3 (source p. 37) — signs ♌ Leo and ♍ Virgo

Left argument header: **G.** / ♌ (Leo, printed **Ω**). Lower block ♍ (Virgo, printed **mp**); the table closes at 180° 0' for every column at argument 30, and the caption **TAB. 33.** stands at the foot.

G. ($\mathcal{Q}$)	5		5		5		6		6		6		6		6		6		6		6	
	7	8	9	0	1	2	3	4	5	66	7	6	5	6	66	7	6	5	6	66	7	
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
0	8	4	8	7	8	2	8	3	8	3	7	2	7	5	7	1	7	4	64	23	6	3
	7	1	6		4	6	2	6	0	6	8	4	5	8	3	1	0				2	
1	8	1	8	3	8	5	8	1	8	1	8	5	7	4	7	0	7	5	66	28	6	1
	9	1	7	8	5	9	4	1	2	4	0		7	2	5		1	7			4	3
2	9	4	8	1	8	3	8	4	8	5	8	4	7	2	7	4	7	5	68	33	6	2
	0	1	9	0	7	3	5	7	3	1	1	5	9	5	6	7	3	0			6	4
3	9	1	9	4	8	7	8	2	8	3	8	2	8	1	7	3	7	4	70	37	6	3
	2	1	0	2	9		7	3	5	0	3	5	1	0	8	5	5	2			8	3
4	9	4	9	1	9	4	8	5	8	9	8	7	8	5	8	2	7	3	72	40	7	4
	3	2	2	4	0	1	8	9	7		5		2	4	0	4	7	7			0	2
5	9	1	9	4	9	1	9	3	8	4	8	5	8	3	8	1	7	3	74	44	7	5
	5	3	3	7	2	5	0	6	8	8	6	0	4	9	2	4	9	1			2	8
6	9	4	9	2	9	5	9	1	9	2	8	3	8	2	8	2	8	2	76	47	7	5
	6	4	5	0	3	0	2	3	0	7	8	2	6	4	4		1	4			4	6
7	9	1	9	5	9	2	9	5	9	6	9	1	8	8	8	5	8	1	78	49	7	3
	8	5	6	3	5	5	3	0	2		0	4	8		5	1	3	7			7	
8	9	4	9	2	9	0	9	2	9	4	9	5	8	5	8	4	8	1	80	52	7	1
	9	7	8	6	7		5	7	3	6	1	6	9	5	7	0	5	1			9	0
9	1	1	9	5	9	3	9	4	9	2	9	3	9	4	8	3	8	5	82	54	8	1
	0	9	9	9	8	5	7		5	6	3	9	1	1	9	1	7				1	6
	1																					
10	1	5	1	3	1	1	9	4	9	6	9	2	9	2	9	1	8	5	84	55	8	1
	0	1	0	3	0	1	8	2	7		5	1	3	6	1	9	8	8			3	7
	2		1		0																	
11	1	2	1	7	1	4	1	2	9	4	9	4	9	1	9	7	9	5	86	56	8	2
	0	3	0		0	7	0	0	8	6	7		5	1	3		0	1			5	6
	4		3		1		0															
12	1	5	1	4	1	2	1	5	1	2	9	4	9	5	9	5	9	4	88	56	8	3
	0	6	0	2	0	3	0	8	0	7	8	7	6	8	4	7	2	5			7	0
	5		4		3		1		0													
13	1	2	1	1	1	5	1	3	1	8	1	2	9	4	9	4	9	3	90	58	8	3

G. ($\mathcal{Q}$)	5		5		5		6		6		6		6		6		6		6		6	
	7		8		9		0		1		2		3		4		5		66		7	
	G		G		G		G		G		G		G		G		G		½		66	
	r		r		r		r		r		r		r		r		r		Gr		½	
	.		'		.		'		.		'		.		'		.		'		.	
	0	9	0	6	0	9	0	6	0		0	9	8	4	6	7	4	9			9	2
	7		6		4		3		2		0											
14	1	2	1	5	1	3	1	1	1	4	1	1	1	2	9	3	9	3	92	58	9	3
	0		0	1	0	5	0	4	0	8	0	2	0	9	8	5	6	2			1	5
	9		7		6		5		3		2		0									
15	1	3	1	2	1	1	1	5	1	2	1	4	1	1	1	2	9	2	94	57	9	3
	1	5	0	6	0	2	0	3	0	8	0	9	0	5	0	4	8	5			3	7
	0		9		8		6		5		3		2		0							
16	1	7	1	0	1	4	1	3	1	8	1	3	1	2	1	1	1	1	96	57	9	4
	1		1		0	8	0	1	0		0	9	0		0	3	0	8			5	0
	2		1		9		8		7		5		4		2		0					
17	1	4	1	3	1	2	1	9	1	4	1	2	1	4	1	2	1	1	98	56	9	4
	1	0	1	4	1	4	1		0	9	0	2	0	7	0		0	0			7	2
	3		2		1		0		8		7		5		4		2					
18	1	1	1	9	1	1	1	4	1	3	1	5	1	3	1	5	1	5	10	55	9	4
	1	3	1		1		1	7	1	9	0		0	2	0	0	0	5	0		9	3
	5		4		3		1		0		9		7		5		3					
19	1	4	1	4	1	3	1	2	1	1	1	4	1	1	1	4	1	4	10	53	1	4
	1	6	1	3	1	7	1	6	1	0	1	8	0	8	0	0	0	7	2		0	4
	6		5		4		3		2		0		9		7		5				1	
20	1	1	1	1	1	1	1	5	1	5	1	3	1	3	1	2	1	4	10	51	1	4
	1	9	1	8	1	4	1		1	1	1	0	1		0	9	0	0	4		0	4
	8		7		6		5		3		2		1		9		7				3	
21	1	5	1	5	1	5	1	4	1	3	1	1	1	4	1	1	1	3	10	48	1	4
	1	2	1	3	1	0	1	4	1	1	1	3	1	9	1	7	0	7	6		0	4
	9		8		7		6		5		4		2		1		9				5	
22	1	2	1	2	1	2	1	2	1	1	1	5	1	3	1	5	1	2	10	46	1	4
	2	5	2	8	1	7	1	3	1	2	1	6	1	4	1		1	8	8		0	3
	1		0		9		8		7		5		4		3		1				7	

G. ($\mathcal{Q}$)	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	66	6						
	7 G r . ' .	8 G r . ' .	9 G r . ' .	0 G r . ' .	1 G r . ' .	2 G r . ' .	3 G r . ' .	4 G r . ' .	5 G r . ' .	6 G r . ' .	66 $\frac{1}{2}$ Gr . ' .	7 G r . ' .	6										
23	1 2 2	5 8 2	1 2 2	3 2 2	1 2 1	4 2 0	1 1 8	1 2 7	5 1 9	1 1 3	1 2 1	3 0 6	2 1 4	1 2 1	5 2 4	1 1 3	2 0 0	11 0 9	43 0 9	1 0 9	4 3 3		
24	1 2 4	3 1 3	1 2 3	2 8 2	1 2 2	4 1 1	3 2 0	1 2 9	3 2 1	1 1 9	2 1 8	1 1 6	4 1 5	1 1 5	4 1 5	1 1 2	11 2 2	39 1 1	1 1 1	4 2 3			
25	1 2 6	5 2 5	1 3 5	1 3 4	1 7 4	1 2 3	1 7 3	1 2 2	1 3 1	1 2 2	1 3 1	5 1 9	1 0 8	1 1 7	2 9 7	1 1 4	2 4 3	11 4 3	36 1 3	1 1 3	4 1 3		
26	1 2 7	3 9 7	1 2 6	4 8 5	1 2 5	5 4 4	1 2 3	5 6 3	1 2 2	5 3 2	1 2 2	4 8 1	1 6 0	1 2 8	1 7 8	1 1 8	5 4 0	11 6 5	32 1 5	1 9 5	3 9 5		
27	1 2 9	1 2 8	1 2 8	2 3 7	1 2 7	3 0 6	1 2 6	3 4 5	1 2 4	3 4 4	1 2 3	3 0 3	2 0 2	1 2 2	5 5 2	1 2 0	4 4 0	11 8 7	27 1 7	1 7 7	3 7 7		
28	1 3 0	4 5 9	1 2 9	5 7 9	1 2 9	6 2 8	1 2 7	1 2 4	1 2 6	1 2 5	1 2 3	1 2 5	5 2 3	1 2 2	5 2 2	1 2 2	3 4 2	12 0 2	23 1 9	1 4 9	3 4 9		
29	1 3 2	1 8 1	1 3 1	3 2 0	1 2 0	4 2 9	1 2 8	5 0 9	1 2 7	5 5 6	1 2 9	5 2 4	1 4 5	1 3 4	3 9 7	1 2 6	2 4 3	12 2 1	18 2 1	1 2 1	3 1 3		
30	1 3 3	5 1 3	1 3 3	6 3 2	1 3 1	1 8 1	1 3 0	2 8 9	1 3 5	3 2 7	1 7 8	3 2 4	1 4 7	3 2 6	1 6 7	2 2 3	1 3 4	12 4 3	12 2 3	1 7 3	2 7 3		
$\mathfrak{M}$																							
0	1 3 3	5 1 3	1 3 3	6 3 2	1 8 2	1 3 1	1 8 1	2 8 0	1 3 5	3 2 7	1 7 8	3 4 7	1 2 7	3 6 7	2 6 6	1 3 6	1 4 6	12 4 6	12 2 3	1 7 3	2 7 3		
1	1 3 5	2 4 5	1 3 4	4 1 3	1 3 5	1 3 3	6 3 3	1 3 2	1 4 2	1 3 1	1 9 1	1 3 0	1 7 9	1 2 8	1 7 8	1 2 6	3 6 8	12 6 8	7 2 5	1 2 5	2 3 5		

G. (o)	5		5		5		6		6		6		6		6		6		6		6	
	7	8	9	0	1	2	3	4	5	66	7											
	G	5	G	5	G	5	G	6	G	6	G	6	G	6	G	6	G	6	½	66	G	6
	r	7	r	8	r	9	r	0	r	1	r	2	r	3	r	4	r	5	Gr	½	r	7
	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'	.	'
2	1	5	1	1	1	3	1	4	1	5	1	0	1	1	1	5	1	5	12	1	1	1
	3	7	3	5	3	1	3	4	3	4	3		3		3	9	2	2	8		2	9
	6		6		5		4		3		3		2		0		9				7	
3	1	3	1	5	1	7	1	2	1	3	1	4	1	4	1	4	1	4	12	55	1	1
	3	0	3	0	3		3	2	3	4	3	2	3	6	3	6	3	2	9		2	5
	8		7		7		6		5		4		3		2		1				9	
4	1	3	1	2	1	4	1	0	1	1	1	2	1	3	1	3	1	3	13	49	1	1
	4		3	4	3	3	3		3	4	3	4	3	0	3	3	3	0	1		3	0
	0		9		8		8		7		6		5		4		3				1	
5	1	3	1	5	1	1	1	3	1	5	1	6	1	1	1	1	1	1	13	42	1	5
	4	5	4	8	4	9	3	7	3	3	3		3	7	3	8	3	9	3		3	
	1		0		0		9		8		8		7		6		5				3	
6	1	8	1	3	1	5	1	1	1	3	1	4	1	5	1	5	1	8	13	35	1	0
	4		4	3	4	5	4	5	4	2	3	7	3	7	3		3		5		3	
	3		2		1		1		0		9		8		8		7				5	
7	1	4	1	7	1	3	1	5	1	1	1	2	1	4	1	5	1	5	13	28	1	5
	4	1	4		4	1	4	3	4	2	4	9	4	1	3	2	3	7	7		3	4
	4		4		3		2		2		1		0		9		8				6	
8	1	1	1	4	1	7	1	3	1	5	1	1	1	2	1	3	1	4	13	21	1	4
	4	4	4	1	4		4	0	4	1	4	0	4	5	4	8	4	5	9		3	9
	6		5		5		4		3		3		2		1		0				8	
9	1	4	1	1	1	4	1	8	1	3	1	5	1	8	1	2	1	3	14	13	1	4
	4	7	4	5	4	3	4		4	0	4	1	4		4	3	4	4	1		4	3
	7		7		6		6		5		4		4		3		2				0	
10	1	1	1	4	1	1	1	4	1	1	1	3	1	5	1	9	1	2	14	5	1	3
	4	9	4	9	4	8	4	5	4	0	4	2	4	2	4		4	2	3		4	7
	9		8		8		7		7		6		5		5		4				2	
11	1	5	1	2	1	5	1	2	1	4	1	1	1	3	1	5	1	1	14	58	1	3
	5	2	5	3	4	4	4	3	4	9	4	3	4	4	4	4	4	0	4		4	1
	0		0		9		9		8		8		7		6		6				4	
12	1	2	1	5	1	2	1	0	1	2	1	5	1	1	1	3	1	5	14	49	1	2
	5		5		5		5		5		4		4		4		4				4	

G. ($\mathcal{Q}$)	5		5		5		6		6		6		6		6		6		6		6	
	7		8		9		0		1		2		3		4		5		66		7	
	G		G		G		G		G		G		G		G		G		$\frac{1}{2}$		66	
	r		r		r		r		r		r		r		r		r		Gr		$\frac{1}{2}$	
	.		'		.		'		.		'		.		'		.		'		.	
13	2	4	1	7	1	9	1		0	8	9	4	9	8	8	9	7	8	6		6	4
	1	5	1	3	1	5	1	3	1	7	1	3	1	0	1	2	1	4	14	41	1	1
	5	7	5	1	5		5	7	5		5	5	5		5	5	4	6	8		4	7
14	3		3		3		2		2		1		1		0		9				8	
	1	2	1	5	1	4	1	1	1	4	1	1	1	4	1	1	1	3	15	33	1	1
	5	9	5		5	0	5	4	5	5	5	6	5	4	5	0	5	3	0		5	0
15	5		5		4		4		3		3		2		2		1				0	
	1	1	1	3	1	1	1	5	1	2	1	5	1	2	1	5	1	2	15	24	1	3
	5		5	9	5	5	5	1	5	4	5	6	5	7	5	4	5	0	2		5	
16	7		6		6		5		5		4		4		3		3				2	
	1	3	1	1	1	5	1	2	1	2	1	3	1	9	1	3	1	7	15	15	1	5
	5	3	5	3	5	1	5	8	5		5	7	5		5	9	5		4		5	6
17	8		8		7		7		7		6		6		5		5				3	
	1	5	1	4	1	2	1	5	1	4	1	1	1	5	1	2	1	5	15	6	1	4
	6		5	6	5	6	5		5	1	5	7	5	2	5	4	5	5	6		5	9
18	0		9		9		9		8		8		7		7		6				5	
	1	3	1	2	1	1	1	4	1	2	1	5	1	3	1	9	1	4	15	57	1	4
	6	7	6	0	6		6	2	6	0	5	7	5	4	5		5	2	7		5	1
19	1		1		1		0		0		9		9		9		8				7	
	1	9	1	5	1	3	1	1	1	5	1	3	1	1	1	5	1	2	15	47	1	3
	6		6	3	6	6	6	9	6	9	6	9	6	6	6	3	6	8	9		5	3
20	3		2		2		2		1		1		1		0		0				9	
	1	4	1	2	1	1	1	5	1	3	1	1	1	5	1	3	1	1	16	38	1	2
	6	1	6	6	6	1	6	5	6	7	6	9	6	8	6	8	6	5	1		6	5
21	4		4		4		3		3		3		2		2		2				1	
	1	1	1	0	1	4	1	3	1	1	1	0	1	4	1	2	1	2	16	28	1	1
	6	3	6		6	6	6	2	6	6	6		6	1	6	8	6		3		6	7
22	6		6		5		5		5		5		4		4		4				3	
	1	4	1	3	1	2	1	9	1	5	1	4	1	2	1	6	1	4	16	19	1	8
	6	5	6	4	6	1	6		6	4	6	0	6	3	6		6	8	5		6	
	7		7		7		7		6		6		6		6		5				5	

[illegible]

(continued)

Eclipticae ab Ascendente numerati (pole-altitude columns 1–14)

Alt. (G. Si.) gives the complementary degree and the descending sign for entering the table from the other direction.

column) run ♋ Pisces, ♒ Aquarius, ♑ Capricorn, ♐ Sagittarius, ♏ Scorpio, ♎ Libra.

[illegible]

S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Alt.
i	(G	(G	(G	(G	(G	(G	(G	(G	(G	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
G	r.	r.)	r.)	r.)	r.)	r.)	r.)	r.)	r.)	.')	.')	.')	.')	.')	(G.
.	)		)	)	)	)	)	)	)						(Si.)
1	66	65	64	63	62	61	60	59	58	57	56	55	54	53	15
5	10	10	10	10	10	10	10	10	10	10	10	10	10	5	
1	66	65	64	63	62	61	60	59	58	57	56	55	54	53	12
8	30	30	30	30	30	30	30	25	25	25	25	25	25	25	
2	66	65	64	63	62	61	60	59	58	57	56	55	54	53	9
1	50	50	50	50	50	50	50	45	45	45	45	45	45	45	
2	67	66	65	64	63	62	61	60	59	58	57	56	55	54	6
4	20	15	15	15	15	15	15	10	10	10	10	10	10	5	
2	67	66	65	64	63	62	61	60	59	58	57	56	55	54	3
7	45	45	45	45	45	40	40	20	40	40	35	35	35	35	
✂	68	67	66	65	64	63	62	61	60	59	58	57	56	55	0 ✂
0	20	20	18	15	15	15	10	10	10	10	5	5	15	5	
3	68	67	66	65	64	63	62	61	60	59	58	57	56	55	27
	55	55	55	50	50	50	45	45	45	45	40	40	40	35	
6	69	68	67	66	65	64	63	62	61	60	59	58	57	56	24
	35	35	30	30	30	25	25	20	20	20	15	15	15	10	
9	70	69	68	67	66	65	64	63	62	61	59	58	57	56	21
	15	15	10	10	10	5	5	5	0	0	55	55	55	50	
1	71	70	69	67	66	65	64	63	62	61	60	59	58	57	18
2	0	0	0	55	55	50	45	45	45	40	40	35	35	30	
1	71	70	69	68	67	66	65	64	63	62	61	60	59	58	15
5	55	55	45	45	40	35	35	30	30	25	25	25	20	15	
1	72	71	70	69	68	67	66	65	64	63	62	61	60	59	12
8	45	40	35	35	30	25	25	20	20	15	15	10	10	5	
2	73	72	71	70	69	68	67	66	65	64	63	62	61	59	9
1	40	35	30	30	25	20	20	15	15	10	5	5	0	55	
2	74	73	72	71	70	69	68	67	66	65	64	63	61	60	6
4	35	35	30	25	20	20	15	10	10	5	0	0	50	55	
2	75	74	73	72	71	70	69	68	67	66	65	63	61	61	3
7	35	35	30	25	20	20	15	10	5	5	0	55	50	50	

S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Alt.
i	(G	(G	(G	(G	(G	(G	(G	(G	(G	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
G	r.	r.	r.	r.	r.	r.	r.	r.	r.	.')	.')	.')	.')	.')	Si.)
.	)	)	)	)	)	)	)	)	)	.	.	.	.	.	
Π	76	75	74	73	72	71	70	69	68	67	66	64	63	62	0 ≈
0	40	35	30	25	25	20	15	10	5	0	0	55	50	45	
3	77	76	75	74	73	72	71	70	69	68	67	66	64	63	27
	45	40	35	30	30	25	20	15	10	5	0	0	55	50	
6	78	77	76	75	74	73	72	71	70	69	68	67	66	64	24
	55	50	45	40	40	35	25	20	15	15	10	5	0	55	
9	80	79	77	76	75	74	73	72	71	70	69	68	67	66	21
	5	0	55	50	45	40	35	30	25	20	15	10	5	0	
1	81	80	79	78	76	75	74	73	72	71	70	69	68	67	18
2	15	10	5	0	55	50	45	40	35	30	25	20	15	10	
1	82	81	80	79	78	77	76	74	73	72	71	70	69	68	15
5	30	25	20	15	10	5	0	55	50	40	35	30	30	20	
1	83	82	81	80	79	78	77	76	75	73	72	71	70	69	12
8	45	40	35	30	25	20	15	5	0	55	50	45	40	35	
2	85	83	82	81	80	79	78	77	76	75	74	73	71	70	9
1	0	55	50	45	40	35	30	25	20	15	10	0	55	50	
2	86	85	84	83	81	80	79	78	77	76	75	74	73	72	6
4	20	15	10	5	55	50	45	40	35	30	25	20	15	5	
2	87	86	85	84	83	82	81	80	78	77	76	75	74	73	3
7	35	30	25	20	15	10	5	0	55	45	40	35	30	25	
⊆	88	87	86	85	84	83	82	81	80	79	78	76	75	74	0 ∽
0	55	50	45	40	30	25	20	15	10	5	0	55	50	40	
3	89	89	88	86	85	89	88	86	85	80	79	78	77	76	27
	45	53	0	55	55	25	0	55	55	25	20	10	5	0	
6	88	89	89	88	87	86	85	84	82	81	80	79	78	77	24
	30	35	20	15	10	5	0	0	55	45	35	30	10	25	
9	87	88	88	89	88	87	86	85	84	82	81	80	79	78	21
	10	15	20	30	25	25	15	10	5	50	55	50	45	40	
1	85	87	88	89	89	88	87	86	85	84	83	82	81	80	18

S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Alt.
i	(G	(G	(G	(G	(G	(G	(G	(G	(G	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
G	r.	r.)	r.	r.)	r.)	r.)	r.)	r.)	r.)	.')	.')	.')	.')	.')	(G.
.	)		)	)	)	)	)	)	)						Si.)
2	55	0	5	10	45	25	35	25	20	15	10	5	5	0	
1	84	85	86	87	89	89	88	87	86	85	84	83	82	81	15
5	40	45	50	55	0	0	55	45	40	35	30	25	15	10	
1	83	84	85	86	87	87	88	89	89	87	86	85	84	83	12
8	25	30	35	40	45	45	50	55	0	50	50	45	40	30	
2	82	83	84	85	86	86	87	88	89	89	88	87	86	85	9
1	10	15	20	25	30	30	35	45	45	10	5	30	25	35	
2	81	82	83	84	85	85	86	87	88	89	89	88	87	86	6
4	5	5	10	15	25	20	25	30	35	40	30	35	20	15	
2	79	81	82	83	84	84	85	86	87	88	89	89	88	87	3
7	55	0	0	15	10	15	20	30	25	20	25	30	25	25	
0	78	79	80	82	83	83	84	85	86	87	88	89	89	88	0 ↗
	45	50	55	0	5	20	25	40	30	20	25	5	30	20	
3	77	78	79	80	82	82	83	84	85	86	87	88	89	88	27
	40	45	50	55	0	25	30	35	10	15	20	20	25	30	
6	76	77	78	79	80	81	82	83	84	85	86	89	89	87	24
	40	45	50	50	55	40	40	50	50	50	55	45	35	20	
														[?]	
9	75	76	77	78	79	80	81	82	83	84	85	87	89	89	21
	45	45	50	55	0	50	55	55	55	50	50	50	40	25	
1	74	75	76	77	79	79	80	81	82	84	85	86	87	89	18
2	50	55	55	55	0	45	50	55	50	5	10	15	20	30	
1	73	75	76	77	78	78	79	80	81	82	83	84	85	86	15
5	55	0	0	0	5	10	30	30	25	15	20	25	40	30	
1	73	74	75	76	77	77	78	79	80	81	82	83	86	87	12
8	25	10	10	15	15	30	20	25	25	25	25	30	40	20	
2	72	73	74	75	76	76	77	78	79	80	81	82	84	85	9
1	20	20	25	25	30	50	50	50	50	55	40	40	45	45	
2	71	72	73	74	75	75	76	77	78	79	80	81	83	84	6
4	35	40	40	45	45	50	50	50	50	50	55	50	0	5	

[illegible]

Residuum TAB. 33. The Altitude of the Nonagesimal,
reckoned from the Ascendant — *Altitudo Nonagesimi ab
Ascendente numerati* (pole-altitude columns 15–28)

S i	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Alt. (G. Si.)
G (Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	(Gr . .)	
Υ	51	50	49	48	47	46	45	44	43	42	41	40	39	38	30
0	30	30	30	30	30	30	30	30	30	30	40	30	30	30	
3	51	50	49	48	47	46	45	44	43	42	41	40	39	38	27
	33	33	32	33	33	33	33	33	33	32	32	33	33	33	
6	51	50	49	48	47	46	45	44	43	42	41	40	39	38	24
	35	35	35	35	35	35	35	35	35	35	35	35	35	35	
9	51	50	49	48	47	46	45	44	43	42	41	40	39	38	21
	45	40	45	45	40	40	40	40	40	40	40	40	40	40	
1	51	50	49	48	47	46	45	44	43	42	41	40	39	38	18
2	55	50	55	55	50	50	50	50	50	50	50	50	50	50	
1	52	51	50	49	48	47	46	45	44	43	42	41	40	39	15
5	5	5	10	5	5	5	5	5	5	5	5	5	5	5	
1	52	51	50	49	48	47	46	45	44	43	42	41	40	39	12
8	25	25	25	25	20	20	20	20	20	20	20	20	20	20	
2	52	51	50	49	48	47	46	45	44	43	42	41	40	39	9
1	45	45	40	40	40	40	40	40	40	35	35	35	35	35	
2	53	52	51	50	49	48	47	46	45	43	42	41	40	39	6
4	5	5	5	5	5	5	0	0	0	55	45	45	55	55	
2	53	52	51	50	49	48	47	46	45	44	43	42	41	40	3
7	35	30	30	30	30	25	25	25	25	20	20	20	20	15	
♄	54	53	52	51	49	48	47	46	45	44	43	42	41	40	0 ♄
0	0	0	0	0	55	55	55	50	50	50	50	45	45	45	
3	54	53	52	51	50	49	48	47	46	45	44	43	42	41	27
	35	35	30	30	30	25	25	25	25	20	20	15	15	10	
6	55	54	53	52	51	50	49	48	46	45	44	43	42	41	24

S i		15	16	17	18	19	20	21	22	23	24	25	26	27	28	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.	
.	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	(Si.)
	10	10	5	5	0	0	0	0	55	50	50	50	45	45		
9	55	54	53	52	51	50	49	48	47	46	45	44	43	42	21	
	50	45	45	40	40	40	35	35	30	25	25	25	20	20		
1	56	55	54	53	52	51	50	49	48	47	46	45	43	42	18	
2	30	25	20	25	20	15	15	10	10	5	5	0	55	55		
1	57	56	55	54	53	52	50	49	48	47	46	45	44	43	15	
5	15	10	5	5	5	0	55	55	50	50	45	40	35	35		
1	58	56	55	54	53	52	51	50	49	48	47	46	45	44	12	
8	5	55	50	55	50	45	40	40	35	30	30	25	10	15		
2	58	57	56	55	54	53	52	51	50	49	48	47	46	45	9	
1	55	50	45	45	40	35	30	30	25	20	20	15	10	5		
2	59	58	57	56	55	54	53	52	51	50	49	48	47	45	6	
4	50	40	45	35	30	30	25	20	20	15	10	5	0	55		
2	60	59	58	57	56	55	54	53	52	51	50	48	47	46	3	
7	45	40	40	30	25	25	20	15	10	5	0	55	50	50		
II	61	60	59	58	57	56	55	54	53	52	50	49	48	47	0 ≈	
0	40	40	35	30	25	20	15	10	5	0	55	50	45	40		
3	62	61	60	59	58	57	56	55	54	53	51	50	49	48	27	
	45	40	35	30	25	20	15	10	5	0	55	50	45	40		
6	63	62	61	60	59	58	57	56	55	54	53	51	50	49	24	
	50	45	40	35	30	25	20	15	10	5	0	55	50	40		
9	64	63	62	61	60	59	58	57	56	55	54	52	51	50	21	
	55	50	45	45	35	30	25	20	15	10	5	55	50	45		
1	66	65	63	62	61	60	59	58	57	56	55	54	53	51	18	
2	5	0	55	50	45	40	35	25	20	15	10	5	0	50		
1	67	66	65	64	62	61	60	59	58	57	56	55	54	53	15	
5	15	10	5	0	55	50	50	35	30	30	20	15	5	0		
1	68	67	66	65	64	63	61	60	59	58	57	56	55	54	12	
8	30	25	20	15	10	0	55	50	45	40	30	25	15	10		
2	69	68	67	66	65	64	63	62	60	59	58	57	56	55	9	

S
i

	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	(Si.)
1	45	40	35	30	20	15	10	5	55	50	45	35	30	25	
2	71	69	68	67	66	65	64	63	62	61	60	58	57	56	6
4	0	45	50	45	40	30	25	20	15	5	0	50	45	35	
2	72	71	70	69	67	66	65	64	63	62	61	60	59	57	3
7	20	15	5	0	55	50	40	35	30	20	15	10	0	35	
5	73	72	71	70	69	68	67	65	64	63	62	61	60	59	0 3
0	35	30	25	20	10	5	0	55	45	45	35	25	20	10	
3	74	73	72	71	70	69	68	67	66	65	63	62	61	60	27
	45	50	45	35	30	25	20	10	5	0	50	45	40	30	
6	76	75	74	72	71	70	69	68	67	66	65	64	63	61	24
	15	10	0	55	50	45	35	30	25	20	10	5	0	50	
9	77	76	75	74	73	72	70	69	68	67	66	65	64	63	21
	35	25	20	15	10	5	55	50	45	35	30	25	15	10	
1	78	77	76	75	74	73	72	71	70	68	67	66	65	64	18
2	50	45	40	35	25	10	15	10	5	45	50	45	35	30	
1	80	79	77	76	75	74	73	72	71	70	69	68	66	65	15
5	5	0	55	50	45	40	35	30	20	15	10	5	55	50	
1	81	80	79	78	77	75	74	73	72	71	70	69	68	67	12
8	25	20	15	5	0	55	50	45	40	35	30	25	15	10	
2	82	81	80	79	78	77	76	75	74	72	71	70	69	68	9
1	40	35	30	25	20	15	10	5	0	50	45	40	35	30	
2	83	82	81	80	79	78	77	76	75	74	73	71	70	69	6
4	55	50	45	40	35	30	25	20	15	10	5	55	50	45	
2	85	84	82	81	80	79	78	77	76	75	74	73	72	71	3
7	5	0	55	55	45	35	30	35	25	25	15	15	10	5	
2	86	85	84	83	82	80	79	78	77	76	75	74	73	72	0 3
0	15	10	10	5	0	55	50	45	40	35	30	25	20	15	
3	87	86	85	84	83	81	80	79	78	77	76	75	74	73	27
	25	20	15	10	2	55	50	55	45	45	40	30	30	25	

S i		15	16	17	18	19	20	21	22	23	24	25	26	27	28	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.	
.	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	(Si.)
6	88	87	86	85	84	83	82	81	80	78	77	76	75	74	24	
	30	25	20	15	15	10	5	0	0	50	50	45	45	35		
9	89	88	87	86	85	84	83	82	81	80	78	77	76	75	21	
	30	30	25	25	10	5	5	0	0	0	55	50	45	45		
1	89	89	88	87	86	85	84	83	82	81	80	79	77	76	18	
2	30	25	25	20	20	15	15	5	5	0	0	0	50	45		
1	88	89	89	88	87	86	85	84	83	82	81	79	78	77	15	
5	35	40	20	15	15	20	5	5	5	0	0	55	50	50		
1	87	88	89	89	88	87	86	85	84	83	82	81	79	78	12	
8	40	45	45	15	10	0	0	0	0	0	0	0	50	45		
2	86	87	88	89	89	88	87	86	85	84	82	81	80	79	9	
1	55	50	55	55	15	15	0	0	0	0	50	45	45	40		
2	86	87	88	89	89	89	87	86	85	84	83	82	81	80	6	
4	5	0	0	10	50	0	45	45	45	40	35	35	35	30		
2	85	86	87	88	89	89	88	87	86	85	84	83	82	81	3	
7	20	20	25	25	25	35	10	30	25	25	25	20	20	20		
np	84	85	86	87	88	89	89	88	87	86	85	84	83	82	0 m	
0	40	40	45	45	45	45	10	10	10	10	5	5	5	0		
3	84	85	86	87	88	89	89	88	87	86	85	84	83	82	27	
	5	5	5	10	10	10	50	0	45	45	45	40	40	40		
6	83	84	85	86	87	88	89	89	88	87	86	85	84	83	24	
	30	30	35	35	35	35	35	25	20	20	20	15	15	15		
9	83	84	85	86	87	88	89	89	88	87	86	85	84	83	21	
	0	5	5	5	5	5	5	55	50	50	50	50	50	50		
1	82	83	84	85	86	87	88	89	89	88	87	86	85	84	18	
2	40	40	40	40	40	40	40	40	15	20	15	15	15	15		
1	82	83	84	85	86	87	88	89	89	88	87	86	85	84	15	
5	20	20	20	20	20	20	20	20	40	35	40	35	35	35		
1	82	83	84	85	86	87	88	89	89	88	87	86	85	84	12	
8	0	0	0	0	0	0	0	6	55	55	55	55	55	55		

S															
i															
.	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	Si.)
2	81	82	83	84	85	86	87	88	89	89	88	87	86	85	9
1	45	45	45	45	45	45	45	45	45	15	15	15	15	15	
2	81	82	83	84	85	86	87	88	89	89	88	87	86	85	6
4	40	40	40	40	40	40	40	40	40	20	20	20	20	20	
2	81	82	83	84	85	86	87	88	89	89	88	87	86	85	3
7	32	32	32	32	32	32	32	32	30	28	30	31	31	32	
3	81	82	83	84	85	86	87	88	89	89	88	87	86	85	0 $\underline{\Omega}$
0	28	28	28	28	28	28	28	28	28	30	28	28	28	28	

Residuum TAB. 33. The Altitude of the Nonagesimal,
reckoned from the Ascendant — *Altitudo Nonagesimi ab*
Ascendente numerati (pole-altitude columns 29–41)

S														
i														
.	29	30	31	32	33	34	35	36	37	38	39	40	41	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	Si.)
Υ	37	36	35	34	33	32	31	30	29	28	27	26	25	30
0	30	29	29	29	29	29	29	29	29	29	29	29	29	
3	37	36	35	34	33	32	31	30	29	28	27	26	25	27
	33	31	31	31	31	31	31	31	31	31	31	31	31	
6	37	36	35	34	33	32	31	30	29	28	27	26	25	24
	35	35	33	35	35	35	35	35	35	35	35	35	34	
9	37	36	35	34	33	32	31	30	29	28	27	26	25	21
	40	40	40	40	40	40	40	40	40	39	39	40	39	
1	37	36	35	34	33	32	31	30	29	28	27	26	25	18
2	50	50	50	50	49	49	49	48	48	47	47	47	46	
1	38	37	36	35	34	32	31	30	29	28	27	26	25	15
5	0	1	1	1	0	59	59	58	58	58	58	57	57	
1	38	37	36	35	34	33	32	31	30	29	28	27	26	12

S														
i														
.	29	30	31	32	33	34	35	36	37	38	39	40	41	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	.)	(Si.)
8	15	16	15	15	14	14	13	12	12	10	9	8	8	
2	38	37	36	35	34	33	32	31	30	29	28	27	26	9
1	35	33	33	32	31	30	29	28	27	26	25	24	23	
2	38	37	36	35	34	33	32	31	30	29	28	27	26	6
4	55	52	51	50	49	48	47	46	45	43	41	40	39	
2	39	38	37	36	35	34	33	32	31	30	29	27	26	3
7	15	14	13	12	11	9	8	6	4	2	1	59	57	
∞	39	38	37	36	35	34	33	32	31	30	29	28	27	0 ∞
0	40	40	39	37	35	33	31	29	27	25	23	21	19	
3	40	39	38	37	36	35	33	32	31	30	29	28	27	27
	10	8	6	4	2	0	58	56	53	51	48	46	44	
6	40	39	38	37	36	35	34	33	32	31	30	29	28	24
	40	39	36	34	32	29	27	24	21	18	15	18	9	
9	41	40	39	38	37	36	34	33	32	31	30	29	28	21
	15	13	10	8	5	2	59	59	53	49	46	42	38	
1	41	40	39	38	37	36	35	34	33	32	31	30	29	18
2	50	50	47	14	5	37	34	30	27	22	19	15	11	
1	42	41	40	39	38	37	36	35	34	32	31	30	29	15
5	30	29	26	23	19	14	11	6	2	57	54	50	45	
1	43	42	41	40	39	37	36	35	34	33	32	31	30	12
8	15	12	8	4	0	55	51	46	42	37	33	28	22	
2	44	42	41	40	39	38	37	36	35	34	33	32	31	9
1	0	56	52	47	43	38	33	29	23	18	13	8	2	
2	44	43	42	41	40	39	38	37	36	35	33	32	31	6
4	50	45	40	35	30	25	20	15	9	3	57	52	45	
2	45	44	43	42	41	40	39	38	36	35	34	33	32	3
7	40	37	32	26	21	16	10	5	59	52	46	39	32	
Π	46	45	44	43	42	41	40	38	37	36	35	34	33	0 ≈
0	35	32	26	19	14	8	2	56	30	42	36	29	21	

S i														
.	29	30	31	32	33	34	35	36	37	38	39	40	41	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	(Si.)
3	47	46	45	44	43	42	40	39	38	37	36	35	34	27
	35	30	24	17	11	4	58	51	45	38	30	23	14	
6	48	47	46	45	44	43	41	40	39	38	37	36	35	24
	35	29	23	17	10	3	47	49	42	35	27	19	10	
9	49	48	47	46	45	44	42	41	40	39	38	37	36	21
	40	32	25	20	13	6	58	51	43	34	26	18	9	
1	50	49	48	47	46	45	44	42	41	40	39	38	37	18
2	45	38	31	2	17	9	0	54	46	37	28	20	11	
1	51	50	49	48	47	46	45	44	43	41	40	39	38	15
5	50	45	38	30	24	15	7	0	59	42	33	25	15	
1	53	51	50	49	48	47	46	45	43	42	41	40	39	12
8	5	55	48	40	33	24	16	8	59	50	41	32	22	
2	54	53	52	50	49	48	47	46	45	44	42	41	40	9
1	15	8	1	53	45	36	28	20	11	2	53	43	33	
2	55	54	53	52	51	49	48	47	46	45	44	42	41	6
4	30	23	16	8	0	51	43	35	26	10	7	57	47	
2	56	55	54	53	52	51	49	48	47	46	45	44	43	3
7	45	40	32	24	16	7	59	50	41	32	22	12	2	
5	58	56	55	54	53	52	51	50	48	47	46	45	44	0
0	5	58	50	42	34	25	16	8	59	49	40	30	19	0
3	59	58	57	56	54	53	52	51	50	49	47	46	45	27
	25	16	8	0	52	43	35	26	17	8	58	48	38	
6	60	59	58	57	56	55	53	52	51	50	49	48	46	24
	45	35	28	20	12	4	55	47	38	28	19	9	59	
9	62	60	59	58	57	56	55	54	52	51	50	49	48	21
	5	56	49	41	32	24	16	8	59	50	41	31	21	
1	63	62	61	60	58	57	56	55	54	53	52	50	49	18
2	25	17	10	2	53	47	38	30	21	12	3	54	44	
1	64	63	62	61	60	59	57	56	55	54	53	52	51	15
5	45	37	30	22	16	7	59	51	43	34	25	17	7	

S i														
.	29	30	31	32	33	34	35	36	37	38	39	40	41	Alt.
G	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(Gr	(G.
.	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	.')	(Si.)
1	66	64	63	62	61	60	59	58	57	55	54	53	52	12
8	5	56	49	42	35	28	20	13	4	55	46	38	29	
2	67	66	65	64	62	61	60	59	58	57	56	55	53	9
1	20	16	9	3	57	49	41	34	26	18	9	2	52	
2	68	67	66	65	64	63	62	60	59	58	57	56	55	6
4	40	33	27	21	16	7	1	53	45	39	30	23	14	
2	69	68	67	66	65	64	63	62	61	59	58	57	56	3
7	55	50	44	38	32	25	19	12	5	18	50	43	35	
∂	71	70	68	67	66	65	64	63	62	61	60	59	57	0 m
0	10	5	59	53	48	42	36	29	23	16	9	2	55	
3	72	71	70	69	68	66	65	64	63	62	61	60	59	27
	20	17	12	7	2	56	50	45	39	32	26	19	12	
6	73	72	71	70	69	68	67	65	64	63	62	61	60	24
	30	28	24	19	14	9	3	58	53	47	41	35	28	
9	74	73	72	71	70	69	68	67	66	64	63	62	61	21
	40	36	32	27	23	18	13	8	3	58	52	48	41	
1	75	74	73	72	71	70	69	68	67	66	65	63	62	18
2	45	40	36	32	28	24	19	13	10	5	1	56	51	
1	76	75	74	73	72	71	70	69	68	67	66	65	63	15
5	45	41	37	34	30	27	22	18	14	9	6	1	57	
1	77	76	75	74	73	72	71	70	69	68	67	66	65	12
8	45	40	36	34	31	26	24	20	17	12	9	5	0	
2	78	77	76	75	74	73	72	71	70	69	68	67	66	9
1	40	35	32	30	27	24	21	18	15	11	8	4	0	
2	79	78	77	76	75	74	73	72	71	70	69	68	66	6
4	30	27	24	22	20	17	15	12	9	6	3	0	57	
2	80	79	78	77	76	75	74	73	71	70	69	68	67	3
7	15	14	12	10	8	6	4	2	59	57	54	52	50	
∇	81	79	78	77	76	75	74	73	72	71	70	69	68	0 m
0	0	58	57	55	53	51	49	47	45	43	41	39	37	

S i	29	30	31	32	33	34	35	36	37	38	39	40	41	Alt.
G (Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(Gr . ')	(G. Si.)
0														
3	81 40	80 38	79 37	78 36	77 34	76 33	75 31	74 30	73 28	72 26	71 25	70 23	69 21	27
6	82 15	81 14	80 13	79 12	78 11	77 10	76 9	75 8	74 6	73 4	72 3	71 2	70 1	24
9	82 45	81 45	80 45	79 44	78 43	77 42	76 41	75 40	74 38	73 38	72 37	71 36	70 35	21
1	82	82	81	80	79	78	77	76	75	74	73	72	71	18
2	15	13	13	13	12	11	10	9	9	8	7	6	6	
1	83	82	81	80	79	78	77	76	75	74	73	72	71	15
5	35	37	37	36	36	35	35	34	34	34	33	32	32	
1	83	82	81	80	79	78	77	76	75	74	73	72	71	12
8	55	56	56	56	55	55	55	54	54	54	53	53	52	
2	86	83	82	81	80	79	78	77	76	75	74	73	72	9
1	10	12	12	12	12	12	11	11	11	10	10	10	9	
2	84	83	82	81	80	79	78	77	76	75	74	73	72	6
4	20	22	22	22	22	22	22	22	22	22	22	22	21	
2	84	83	82	81	80	79	78	77	76	75	74	73	72	3
7	32	29	28	28	28	28	29	29	29	29	29	29	28	
3	84	83	82	81	80	79	78	77	76	75	74	73	72	0 $\pm$
0	28	31	31	31	31	31	31	31	31	31	31	31	31	

TAB. 33 (conclusion) — Altitude of the Nonagesimal Counted from the Ascendant [Altitudo Nonagesimi ab Ascendente]

Residuum (continuation) of Table 33, covering pole-altitudes 42 through 67. The left margin gives the sign and degree of the ascendant (Si. G. = *Signum, Gradus*); the rightmost column (Alt. / G. Si.) gives the complementary degree and sign for entry from the other direction. Each pole-altitude column is headed Gr. ' (degrees and minutes of the nonagesimal's altitude).

Pole-altitudes 42–54

Si														G
.														.
G	42	43	44	45	46	47	48	49	50	51	52	53	54	Si
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.
Υ	24	23	22	21	20	19	18	17	16	15	14	13	12	3
	29	39	29	29	29	29	29	29	29	29	29	29	29	0
3	24	23	22	21	20	19	18	17	16	15	14	13	12	2
	30	30	30	30	31	31	31	30	30	30	30	30	30	7
6	24	23	22	21	20	19	18	17	16	15	14	13	12	2
	33	33	33	33	34	34	34	33	33	33	32	32	32	4
9	24	23	22	21	20	19	18	17	16	15	14	13	12	2
	38	38	38	38	37	37	37	37	37	37	36	36	36	1
1	24	23	22	21	20	19	18	17	16	15	14	13	12	1
	46	46	46	45	44	44	44	44	43	43	42	42	42	8
1	24	23	22	21	20	19	18	17	16	15	14	13	12	1
	55	55	54	53	52	52	51	50	50	49	48	48	48	5
1	25	24	23	22	21	20	19	18	16	15	14	13	12	1
	7	6	5	4	3	2	1	0	59	58	57	56	56	2
2	25	24	23	22	21	20	19	18	17	16	15	14	13	9
	21	20	19	18	17	15	14	12	11	9	8	6	5	
2	25	24	23	22	21	20	19	18	17	16	15	14	13	6
	37	36	34	32	31	29	27	25	23	22	19	17	15	
2	25	24	23	22	21	20	19	18	17	16	15	14	13	3
	56	54	52	49	48	45	43	40	38	35	32	30	30	
ϣ	26	25	24	23	22	21	20	18	17	16	15	14	13	0
	17	15	12	10	7	4	2	58	55	52	49	45	40	✕
3	26	25	24	23	22	21	20	19	18	17	16	15	14	2
	40	38	35	32	29	26	22	18	15	11	7	3	0	7
6	27	26	24	23	22	21	20	19	18	17	16	15	14	2
	6	3	59	56	52	49	45	41	36	32	27	22	15	4
9	27	26	25	24	23	22	21	20	19	17	16	15	14	2
	35	31	27	23	19	14	10	5	0	55	49	44	35	1
1	28	27	25	24	23	22	21	20	19	18	17	16	15	1
2	6	2	57	53	49	43	37	32	27	21	14	8	0	8

Si														G
.														.
G	42	43	44	45	46	47	48	49	50	51	52	53	54	Si
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.
1	28	27	26	25	24	23	22	21	19	18	17	16	15	1
5	40	36	30	26	20	14	7	0	54	46	41	33	25	5
1	29	28	27	26	24	23	22	21	20	19	18	17	15	1
8	17	12	6	0	54	47	40	32	25	17	10	1	50	2
2	29	28	27	26	25	24	23	22	20	19	18	17	16	9
1	56	50	43	37	30	23	15	7	59	50	41	31	20	
2	30	29	28	27	26	25	23	22	21	20	19	18	16	6
4	39	32	25	18	9	2	54	45	37	27	16	5	55	
2	31	30	29	28	26	25	24	23	22	21	19	18	17	3
7	26	18	10	2	53	45	36	27	17	7	55	43	30	
II	32	31	29	28	27	26	25	24	23	21	20	19	18	0
0	15	6	58	49	40	31	21	11	0	48	36	24	10	≈
3	33	31	30	29	28	27	26	24	23	22	21	20	18	2
	7	58	49	40	31	21	10	59	47	34	22	7	55	7
6	34	32	31	30	29	28	27	25	24	23	22	20	19	2
	2	53	43	33	23	13	1	49	37	23	9	54	40	4
9	35	33	32	31	30	29	27	26	25	24	23	21	20	2
	0	51	40	30	19	8	56	43	29	15	0	45	30	1
1	36	34	33	32	31	30	28	27	26	25	23	22	21	1
2	1	52	41	10	18	6	54	41	25	11	55	39	20	8
1	37	35	34	33	32	31	29	28	27	26	24	23	22	1
5	4	55	44	33	20	8	55	42	26	11	54	37	20	5
1	38	37	35	34	33	32	31	29	28	27	25	24	23	1
8	11	1	50	38	26	13	0	46	30	14	57	39	20	2
2	39	38	37	35	34	33	32	30	29	28	27	25	24	9
1	22	11	0	47	34	21	8	53	37	21	4	45	25	
2	40	39	38	37	35	34	33	32	30	29	28	26	25	6
4	30	24	13	0	47	34	20	4	48	32	15	56	35	
2	41	40	39	38	37	35	34	33	32	30	29	28	26	3
7	51	39	28	15	2	48	34	19	3	46	29	9	50	
⊗ 0	43	41	40	39	38	37	35	34	33	32	30	29	28	0 y

Si														G
.														.
G	42	43	44	45	46	47	48	49	50	51	52	53	54	Si
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.
	8	56	45	32	19	6	52	37	20	3	45	26	5	
3	44	43	42	40	39	38	37	35	34	33	32	30	29	2
	27	15	4	51	38	24	10	55	39	22	4	45	25	7
6	45	44	43	42	40	39	38	37	36	34	33	32	30	2
	48	36	25	12	59	46	32	17	1	44	27	8	45	4
9	47	45	44	43	42	41	39	38	37	36	34	33	32	2
	10	59	48	35	22	9	56	41	25	9	52	33	10	1
1	48	46	46	45	43	42	41	40	38	37	36	35	33	1
2	33	23	12	0	48	35	22	8	52	36	19	1	40	8
1	49	47	47	46	45	44	42	41	40	39	37	36	35	1
5	56	47	36	24	12	0	47	33	18	3	46	29	10	5
1	51	49	49	47	46	45	44	43	41	40	39	37	36	1
8	19	10	0	48	36	24	13	0	45	30	14	58	40	2
2	52	50	50	49	48	46	45	44	43	41	40	39	38	9
1	43	34	24	13	2	50	40	27	13	59	44	28	10	
2	54	51	51	50	49	48	47	45	44	43	42	40	39	6
4	6	57	47	37	27	17	5	53	40	27	13	58	40	
2	55	53	53	51	50	49	48	47	46	44	43	42	41	3
7	27	18	10	50	51	41	30	19	7	55	42	27	15	
∂	56	55	54	53	52	51	49	48	47	46	45	43	42	0
0	48	40	32	23	14	5	54	44	33	21	9	57	45	↗
3	58	56	55	54	53	52	51	50	48	47	46	44	44	2
	6	58	50	44	34	26	17	8	57	46	35	10	0	7
6	59	58	57	56	54	53	52	51	50	49	48	46	45	2
	23	16	9	2	54	46	38	29	20	10	0	49	35	4
9	60	59	58	57	56	55	53	52	51	50	49	48	47	2
	36	30	23	17	10	3	55	47	39	30	21	11	0	1
1	61	60	59	58	57	56	55	54	52	51	50	49	48	1
2	45	40	34	28	22	16	9	1	54	46	37	24	20	8
1	62	61	60	59	58	57	56	55	54	52	51	50	49	1
5	52	48	42	38	31	25	18	12	6	59	52	45	35	5

[illegible]

Pole-altitudes 55–67

Si														G
.														.
G	55	56	57	58	59	60	61	62	63	64	65	66	67	Si
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.
Υ	11	10	9	8	7	6	5	4	3	2	1	0	0	3
0	29	30	29	29	29	29	29	28	28	28	28	28	28	0
3	11	10	9	8	7	6	5	4	3	2	1	0	0	2
	31	31	30	30	30	31	29	28	29	28	28	28	28	7
6	11	10	9	8	7	6	5	4	3	2	1	0	0	2
	30	33	32	32	32	33	30	29	32	29	29	29	29	4
9	11	10	9	8	7	6	5	4	3	2	1	0	0	2
	35	35	35	35	35	35	32	31	33	30	29	29	29	1
1	11	10	9	8	7	6	5	4	3	2	1	0	0	1
2	40	40	40	40	37	37	35	34	35	32	30	30	30	8
1	11	10	9	8	7	6	5	4	3	2	1	0	0	1
5	45	45	45	45	40	40	40	35	36	33	32	30	31	5
1	11	10	9	8	7	6	5	4	3	2	1	0	0	1
8	55	50	50	50	50	45	42	39	37	34	33	31	32	2
2	12	11	9	8	7	6	5	4	3	2	1	0	0	9
1	0	0	55	55	55	50	45	45	40	35	34	31	33	
2	12	11	10	9	8	7	6	5	4	3	2	1	0	6
4	10	10	5				55	50	45	39	36	32	34	
2	12	11	10	9	8	7	6	5	4	3	2	1	0	3
7	25	20	15	15	10			55	50	45	40	33	35	
ϣ	12	11	10	9	8	7	6	5	4	3	2	1	0	0
0	40	35	30	25	20	15	10		55	50	42	34	37	✕
3	12	11	10	9	8	7	6	5	4	3	2	1	0	2
	55	50	45	40	35	25	20	10		55	45	35	38	7
6	13	12	11	9	8	7	6	5	4	3	2	1	0	2
	10	5	0	50	45	35	30	20	15		47	36	40	4
9	13	12	11	10	9	8	7	6	5	4	3	2	1	2
	30	20	15	5		50	45	30	15		50	37	42	1
1	13	12	11	10	9	8	7	6	5	4	3	2	1	1
2	50	40	35	25	15		55	40	25	15	55	38	44	8

Si														G			
.														.			
G	55	56	57	58	59	60	61	62	63	64	65	66	67	Si			
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.			
1	14	13	11	10	9	8	7	5	4	3	2	0	0	1			
5	15	5	55	45	30	25	10	50	40	20		40	45	5			
1	14	13	12	11	9	8	7	6	4	3	2	0	0	1			
8	40	30	20	5	55	40	25	10	50	30	10	42	48	2			
2	15	14	12	11	10	9	5	7	6	5	0	3	2	0	0	9	
1	10	0	50	35	20		45	25		45	15	44	50				
2	15	14	13	12	10	9	8	5	6	5	3	2	0	0	0	6	
4	45	30	15	0	45	25		45	15	55	25	46	55				
2	16	15	13	12	11	9	8	7	5	4	2	0	1	0	3		
7	20	5	50	30	15	55	30	10	40	10	35	50					
Π	16	15	14	13	11	10	9	0	7	6	0	4	2	0	1	0	0
0	55	40	20	5	45	20		30		25	45	55					≈
3	17	16	15	13	12	10	9	8	0	6	4	3	0	1	0	1	2
	45	20	0	40	20	55	30		25	45				15		7	
6	18	17	15	14	13	11	10	8	6	5	3	1	1	1	2		
	20	5	45	20	0	35	5	30	55	10	15	10	35		4		
9	19	17	16	15	13	12	10	9	5	7	5	3	1	1	2		
	10	50	30	5	40	10	40		20	35	30	15	55		1		
1	20	18	17	15	14	12	11	9	8	0	6	5	3	1	1	1	
2	1	40	20	55	25	55	25	40				55	25	55	8		
1	21	19	18	16	15	13	12	10	8	6	4	1	2	1			
5	0	35	15	45	20	45	10	25	40	45	20	40	30	5			
1	21	20	19	17	16	14	13	11	9	7	4	1	4	1			
8	55	35	10	45	15	40	0	15	25	20	55	55	20	2			
2	23	21	20	18	17	15	14	12	10	8	5	2	5	5	9		
1	0	40	15	45	18	42	0	15	15	10	40	20					
2	24	22	21	19	18	16	15	13	11	9	5	6	2	Co	6		
4	10	50	25	55	20	45	5	15	17		35	55	n-				
2	25	24	22	21	19	17	16	14	12	10	7	3	ful-	3			
7	25	5	35	5	30	50	15	25	25	10	35	45					
⊗	26	25	23	22	20	19	17	15	13	11	8	4	to	0			
0																	⋄

Si														G
.														.
G	55	56	57	58	59	60	61	62	63	64	65	66	67	Si
.	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	Gr.'	.
	40	15	50	10	45	10	25	40	40	25	40	50		
3	28	26	25	23	22	20	18	17	15	12	10	6	va-	2
	0	40	10	40	10	35	50	0	0	45	0	20		7
6	29	28	26	25	23	22	20	18	16	14	11	8	cat.	2
	25	5	35	5	35	0	15	25	30	15	35	10		4
9	30	29	28	26	25	23	21	20	18	15	13	10	5 5	2
	50	30	0	35	5	25	45	0	5	55	25	5		1
1	32	30	29	28	26	25	23	21	19	17	15	12	6 0	1
2	15	55	30	0	35	0	20	40	45	40	20	20		8
1	33	32	31	29	28	26	25	23	21	19	17	14	10	1
5	50	30	5	35	10	40	0	20	30	30	15	30	20	5
1	35	34	32	31	29	28	26	25	23	21	19	16	13	1
8	20	0	35	10	45	15	40	5	15	25	15	45	25	2
2	36	35	34	32	31	29	28	26	25	23	21	19	16	9
1	55	35	10	50	25	55	20	45	5	15	15	0	5	
2	38	37	35	34	33	31	30	28	26	25	23	21	18	6
4	25	5	45	25	0	30	0	30	55	10	15	0	40	
2	40	38	37	36	34	33	31	30	28	27	25	23	21	3
7	0	40	5	0	40	15	50	20	45	5	15	20	5	
∂	41	40	38	37	36	34	33	32	30	29	27	25	23	0
0	30	15	50	40	20	55	30	5	35	0	20	30	30	↗
3	42	41	40	39	37	36	35	33	32	30	29	27	25	2
	55	40	30	10	50	30	5	50	20	50	15	50	45	7
6	44	43	41	40	39	38	36	35	34	32	31	29	27	2
	25	10	50	40	25	5	50	30	5	40	10	35	50	4
9	45	44	43	42	40	39	38	37	35	34	32	31	29	2
	50	35	25	10	55	40	25	5	45	20	55	25	50	1
1	47	46	44	43	42	41	39	38	37	36	34	33	31	1
2	10	0	50	35	25	0	55	40	20	0	35	15	40	8
1	48	47	46	44	43	42	41	40	38	37	36	34	32	1
5	25	20	10	55	45	35	25	10	50	35	15	55	25	5

[illegible]

TAB. 34 — Prosthaphaeresis of Declination [Prosthaphaeresis Declinationis]

Upper section. Heading: *Declinationi Signor. Bor. Adde; Australium Subtrahe.* — "To the declination of the northern signs add; for the southern signs subtract."
Sub-heading: *Latitudo Borealis* ("Northern latitude").

The leftmost column (G.) is the degree of the sign; the rightmost (G.) is its complement. The body columns are headed by the latitude argument 1, 3, 5, 7, 9 (degrees), each carrying degrees-and-minutes (Gr. ') of the prosthaphaeresis.

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
♈ 0	0 55	2 45	4 35	6 25	8 14	30
3	0 55	2 45	4 35	6 25	8 15	27
6	0 55	2 45	4 35	6 25	8 15	24
9	0 55	2 45	4 35	6 26	8 15	21
12	0 55	2 45	4 36	6 26	8 16	18
15	0 55	2 46	4 36	6 27	8 17	15
18	0 55	2 46	4 37	6 28	8 18	12
21	0 56	2 46	4 38	6 29	8 19	9
24	0 56	2 47	4 39	6 30	8 20	6
27	0 56	2 47	4 40	6 31	8 22	3
♉ 0	0 56	2 48	4 41	6 32	8 24	♏ 30
3	0 56	2 49	4 42	6 34	8 26	27
6	0 56	2 50	4 43	6 36	8 28	24
9	0 57	2 51	4 44	6 37	8 30	21
12	0 57	2 51	4 45	6 39	8 33	18
15	0 57	2 52	4 46	6 40	8 34	15
18	0 57	2 53	4 47	6 42	8 37	12
21	0 57	2 54	4 48	6 44	8 40	9
24	0 58	2 54	4 50	6 47	8 43	6
27	0 58	2 55	4 51	6 48	8 44	3
♊ 0	0 58	2 56	4 53	6 49	8 46	♐ 0
3	0 58	2 57	4 54	6 50	8 49	27
6	0 58	2 57	4 55	6 52	8 51	24

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
9	0 59	2 58	4 56	6 54	8 53	21
12	0 59	2 58	4 57	6 56	8 56	18
15	0 59	2 59	4 58	6 57	8 57	15
18	0 59	2 59	4 59	6 58	8 58	12
21	0 0	3 0	5 0	6 59	8 59	9
24	1 0	3 0	5 0	6 59	8 59	6
27	1 0	3 0	5 0	7 0	9 0	3
30	1 0	3 0	5 0	7 0	9 0	☾ 0

Lower section. Heading: *Declinat. Signor. Boreal. Subtrahe; Australium Adde.* — "For the declination of the northern signs subtract; for the southern signs add." Sub-heading: *Latitudo Australis* ("Southern latitude"). The tabulated values are identical to the upper section (declination prosthaphaeresis being symmetric in latitude); the add/subtract rule is reversed.

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
☿ 0	0 55	2 45	4 35	6 25	8 14	30
3	0 55	2 45	4 35	6 25	8 14	27
6	0 55	2 45	4 35	6 25	8 15	24
9	0 55	2 45	4 35	6 26	8 15	21
12	0 55	2 45	4 36	6 26	8 16	18
15	0 55	2 46	4 36	6 27	8 17	15
18	0 55	2 46	4 37	6 28	8 18	12
21	0 56	2 46	4 38	6 29	8 19	9
24	0 56	2 47	4 39	6 30	8 20	6
27	0 56	2 47	4 40	6 31	8 22	3
♊ 0	0 56	2 48	4 41	6 32	8 24	♏ 30
3	0 56	2 49	4 42	6 34	8 26	27
6	0 56	2 50	4 43	6 36	8 28	24
9	0 57	2 51	4 44	6 37	8 30	21
12	0 57	2 51	4 45	6 39	8 33	18
15	0 57	2 52	4 46	6 40	8 34	15

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
18	0 57	2 53	4 47	6 42	8 37	12
21	0 57	2 54	4 48	6 44	8 40	9
24	0 58	2 54	4 50	6 47	8 43	6
27	0 58	2 55	4 51	6 48	8 44	3
♐ 0	0 58	2 56	4 53	6 49	8 46	♌ ≈ 0
3	0 58	2 57	4 54	6 50	8 49	27
6	0 58	2 58	4 55	6 52	8 51	24
9	0 59	2 58	4 56	6 54	8 53	21
12	0 59	2 59	4 57	6 56	8 56	18
15	0 59	2 59	4 58	6 57	8 57	15
18	0 59	2 59	4 59	6 58	8 58	12
21	1 0	3 0	5 0	6 59	8 59	9
24	1 0	3 0	5 0	6 59	8 59	6
27	1 0	3 0	5 0	7 0	9 0	3
30	1 0	3 0	5 0	7 0	9 0	♍ 0

TAB. 35 — Prosthaphaeresis of Right Ascension
[Prosthaphaeresis Ascensionis Rectae]

Upper section. Heading: *Asc. Rectae Signor. Boreal. Subtrahe; Australium Adde.* — "From the right ascension of the northern signs subtract; for the southern signs add." Sub-heading: *Latitudo Borealis pro Signis Boreis* ("Northern latitude for the northern signs").

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
♍ 0	0 23	1 11	1 59	2 47	3 37	30
3	0 23	1 11	1 59	2 47	3 37	27
6	0 23	1 11	1 59	2 47	3 36	24
9	0 23	1 11	1 58	2 48	3 36	21
12	0 23	1 10	1 58	2 48	3 35	18
15	0 23	1 10	1 57	2 46	3 34	15
18	0 23	1 9	1 55	2 44	3 32	12
21	0 23	1 9	1 53	2 42	3 30	9

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
24	0 22	1 8	1 51	2 40	3 28	6
27	0 22	1 6	1 50	2 37	3 25	3
♊ 0	0 21	1 5	1 49	2 35	3 22	♋ 30
3	0 21	1 3	1 47	2 31	3 18	27
6	0 20	1 2	1 44	2 28	3 13	24
9	0 19	0 59	1 42	2 24	3 9	21
12	0 19	0 57	1 38	2 19	3 3	18
15	0 18	0 55	1 33	2 13	2 55	15
18	0 17	0 53	1 30	2 8	2 48	12
21	0 17	0 51	1 26	2 2	2 39	9
24	0 16	0 48	1 21	1 55	2 29	6
27	0 15	0 45	1 16	1 48	2 20	3
♌ 0	0 14	0 41	1 10	1 40	2 10	♍ 0
3	0 13	0 39	1 5	1 31	1 59	27
6	0 11	0 34	0 58	1 22	1 48	24
9	0 10	0 30	0 52	1 14	1 36	21
12	0 8	0 26	0 44	1 3	1 24	18
15	0 7	0 22	0 38	0 54	1 11	15
18	0 6	0 18	0 30	0 43	0 58	12
21	0 5	0 13	0 23	0 33	0 44	9
24	0 3	0 9	0 15	0 22	0 31	6
27	0 1	0 4	0 7	0 11	0 16	3
30	0 0	0 0	0 0	0 0	0 0	♎ 0

[Margin (foot of upper-right section): *Latitudo Australis pro Signis Australib.* — "Southern latitude for the southern signs."]

Lower section. Heading: *Asc. Rectae Signor. Boreal. Adde; Australium Subtrahe.* — "To the right ascension of the northern signs add; for the southern signs subtract." Sub-heading: *Latitudo Australis pro Signis Boreis* ("Southern latitude for the northern signs").

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
♐ 0	0 24	1 11	1 59	2 47	3 36	30

G.	1 Gr.'	3 Gr.'	5 Gr.'	7 Gr.'	9 Gr.'	G.
3	0 23	1 11	1 59	2 47	3 35	27
6	0 23	1 11	1 59	2 47	3 34	24
9	0 23	1 11	1 58	2 46	3 32	21
12	0 23	1 11	1 58	2 45	3 30	18
15	0 23	1 10	1 57	2 43	3 28	15
18	0 23	1 9	1 55	2 41	3 26	12
21	0 22	1 9	1 53	2 39	3 23	9
24	0 22	1 8	1 52	2 36	3 20	6
27	0 22	1 6	1 50	2 33	3 15	3
♄ ♀ 0	0 22	1 4	1 47	2 28	3 10	♄ ♀ 30
3	0 21	1 3	1 44	2 25	3 5	27
6	0 20	1 2	1 42	2 21	2 59	24
9	0 19	0 59	1 38	2 15	2 54	21
12	0 19	0 57	1 34	2 10	2 45	18
15	0 18	0 55	1 31	2 6	2 39	15
18	0 18	0 52	1 27	1 0	2 31	12
21	0 17	0 49	1 21	1 54	2 22	9
24	0 16	0 47	1 17	1 47	2 13	6
27	0 15	0 44	1 12	1 39	2 4	3
♂ ♀ 0	0 14	0 41	1 7	1 32	1 55	♂ ♀ 0
3	0 12	0 37	0 58	1 25	1 45	27
6	0 11	0 33	0 49	1 16	1 34	24
9	0 10	0 30	0 42	1 8	1 23	21
12	0 9	0 26	0 35	0 58	1 12	18
15	0 7	0 21	0 31	0 49	1 0	15
18	0 6	0 17	0 22	0 40	0 49	12
21	0 5	0 13	0 15	0 30	0 37	9
24	0 3	0 9	0 9	0 20	0 24	6
27	0 1	0 4	0 4	0 10	0 13	3
30	0 0	0 0	0 0	0 0	0 0	♂ ♀ 0

[Margin (foot of lower-right section): *Latitudo Borea pro Signis Australib.* — "Northern latitude for the southern signs."]

Third Part of the Tables, which concerns the Motions of the Sun and the Moon

TABULA 36. The Equal, or Mean, Motion of the Sun [*Solis Motus Aequalis, seu Medius*]

Epochs, or Radices [*Epochæ, seu Radices*] — Years before Christ [*Anni ante Christum*]

Two value-blocks, each in sexagesimal Sign · Degree · Minute · Second (Sig · Gr · ' · ") : the Longitude of the Sun from Aries [*Longit. ☉ ab ♈*] and the Longitude of the Sun's Apogee from Aries [*Longit. Apogei ☉ ab ♈*]. The left side-label for the lower group of years reads "Stylo veteri Iuliano" (Old Julian Style); below it "Stylo novo Gregoriano" (New Gregorian Style).

Years before Christ	Sun Sig	Sun Gr	Sun '	Sun "	Apogee Sig	Apogee e Gr	Apogee '	Apogee "
6000	7	21	40	14	10	26	35	53
5000	7	29	20	12	11	13	50	31
4000	8	7	0	10	0	1	5	10
3000	8	14	40	8	0	18	19	48
2000	8	22	20	6	1	5	34	28
1000	9	0	0	3	1	22	49	5
900	9	0	46	3	1	24	32	33
800	9	1	32	3	1	26	16	1
700	9	2	18	2	1	27	59	27
600	9	3	4	2	1	29	42	56
500	9	3	50	2	2	1	26	24
400	9	4	36	2	2	3	9	52
300	9	5	22	1	2	4	53	20
200	9	6	8	1	2	6	36	48
100	9	6	54	1	2	8	20	15

Years before Christ	Sun Sig	Sun Gr	Sun ' "	Sun ' "	Apogee Sig	Apogee e Gr	Apogee ' "	Apogee ' "
R Christi	9	7	40	1	2	10	3	43
100	9	8	26	1	2	11	47	11
200	9	9	12	1	2	13	30	39
300	9	9	58	1	2	15	14	6
400	9	10	44	0	2	16	57	34
500	9	11	30	0	2	18	41	2
600	9	12	16	0	2	20	24	30
700	9	13	2	0	2	22	7	58
800	9	13	48	0	2	23	51	26
900	9	14	34	0	2	25	34	54
1000	9	15	19	59	2	27	18	21
1100	9	16	5	59	2	29	1	49
1200	9	16	51	59	3	0	45	18
1300	9	17	37	59	3	2	28	44
1400	9	18	23	58	3	4	12	12
1500	9	19	9	58	3	5	55	40
1600	9	19	55	58	3	7	39	8
1700	9	20	41	58	3	9	22	35
1800	9	21	27	58	3	11	6	2
1900	9	22	13	58	3	12	49	29
2000	9	22	59	57	3	14	32	56
1581	9	19	32	27	3	7	19	29
1582	9	9	26	45	3	7	20	31
1584	9	9	57	14	3	7	22	35
B. 1600	9	10	4	35	3	7	39	8
1700	9	9	51	27	3	9	22	36
1800	9	9	38	19	3	11	6	4
1900	9	9	25	11	3	12	49	31
B. 2000	9	10	11	10	3	14	32	59
2100	9	9	58	2	3	16	16	27

Years before Christ	Sun Sig	Sun Gr	Sun ' "	Sun Sig	Apogee Sig	Apogee e Gr	Apogee ' "	Apogee "
2200	9	9	44	54	3	18	0	55
2300	9	9	31	46	3	19	44	23
B. 2400	9	10	17	45	3	21	27	51
2500	9	10	4	37	3	23	11	18
2600	9	9	51	29	3	24	54	46
2700	9	9	38	21	3	26	38	14
B. 2800	9	10	24	20	3	28	21	42
2900	9	10	11	12	4	0	5	10
3000	9	9	58	4	4	1	48	38
3100	9	9	44	56	4	3	32	6
B. 3200	9	10	30	55	4	5	15	34
3300	9	10	17	47	4	6	59	2

Expanded & Collected Years [Expansi, & Collecti] — Julian Expanded Years [Anni Iuliani Expansi]

Same two value-blocks: Longitude of the Sun from Aries (Sig · Gr · ' · ") and Longitude of the Sun's Apogee from Aries (Sig · Gr · ' · "). "B." prefixes the bissextile (leap) years. In the Apogee block, the Sign and Degree are 0 throughout; the motion appears in the ' and " columns.

Yea r	Sun Sig	Sun Gr	Sun ' "	Sun Sig	Apogee Sig	Apogee Gr	Apogee ' "	Apogee "
1	11	29	45	41	0	0	1	2
2	11	29	31	21	0	0	2	4
3	11	29	17	2	0	0	3	6
B. 4	0	0	1	50	0	0	4	8
5	11	29	47	31	0	0	5	10
6	11	29	33	11	0	0	6	12
7	11	29	18	52	0	0	7	15
B. 8	0	0	3	41	0	0	8	17
9	11	29	49	21	0	0	9	19
10	11	29	35	2	0	0	10	21

Yea r	Sun Sig	Sun Gr	Sun '	Sun ''	Apogee Sig	Apogee Gr	Apogee '	Apogee ''
11	11	29	20	42	0	0	11	23
B. 12	0	0	5	31	0	0	12	25
13	11	29	51	12	0	0	13	27
14	11	29	36	52	0	0	14	29
15	11	29	22	33	0	0	15	31
B. 16	0	0	7	22	0	0	16	33
17	11	29	53	2	0	0	17	35
18	11	29	38	43	0	0	18	37
19	11	29	29	23	0	0	19	39
B. 20	0	0	9	12	0	0	20	42
21	11	29	54	53	0	0	21	42
22	11	29	40	34	0	0	22	46
23	11	29	26	15	0	0	23	48
B. 24	0	0	11	2	0	0	24	50
25	11	29	56	43	0	0	25	52
26	11	29	42	24	0	0	26	54
27	11	29	28	5	0	0	27	56
B. 28	0	0	12	53	0	0	28	58
29	11	29	58	34	0	0	30	0
30	11	29	44	15	0	0	31	2
31	11	29	29	56	0	0	32	4
B. 32	0	0	14	43	0	0	33	7
33	0	0	0	24	0	0	34	9
34	11	29	46	5	0	0	35	11
35	11	29	31	46	0	0	36	13

Year	Sun Sig	Sun Gr	Sun '	Sun ''	Apogee Sig	Apogee Gr	Apogee '	Apogee ''
B. 36	0	0	16	33	0	0	37	15
37	0	0	2	14	0	0	38	17
38	11	29	47	55	0	0	39	19
39	11	29	33	36	0	0	40	21
B. 40	0	0	18	24	0	0	41	23
41	0	0	4	5	0	0	42	25
42	11	29	49	46	0	0	43	27
43	11	29	35	27	0	0	44	29
B. 44	0	0	20	14	0	0	45	31
45	0	0	5	55	0	0	46	33
46	11	29	51	36	0	0	47	35
47	11	29	37	17	0	0	48	37
B. 48	0	0	22	4	0	0	49	39
49	0	0	7	45	0	0	50	41
50	11	29	53	26	0	0	51	43
51	11	29	39	7	0	0	52	45
B. 52	0	0	23	55	0	0	53	48
53	0	0	9	36	0	0	54	50
54	11	29	55	17	0	0	55	52
55	11	29	40	58	0	0	56	54
B. 56	0	0	25	45	0	0	57	56

Expanded & Collected Years [Expansi, & Collecti] (continued)

Year	Sun Sig	Sun Gr	Sun '	Sun ''	Apogee Sig	Apogee Gr	Apogee '	Apogee ''
57	0	0	11	26	0	0	58	58

Year	Sun Sig	Sun Gr	Sun ' Sun ''	Apogee Sig	Apogee Gr	Apogee ' Apogee ''
58	11	29	57 7	0	1	0 0
59	11	29	42 48	0	1	1 2
B. 60	0	0	27 36	0	1	2 5
61	0	0	13 17	0	1	3 7
62	11	29	58 58	0	1	4 9
63	11	29	44 39	0	1	5 11
B. 64	0	0	29 26	0	1	6 13
65	0	0	15 7	0	1	7 15
66	0	0	0 48	0	1	8 17
67	11	29	46 29	0	1	9 19
B. 68	0	0	31 16	0	1	10 21
69	0	0	16 57	0	1	11 23
70	0	0	2 38	0	1	12 25
71	11	29	48 19	0	1	13 27
B. 72	0	0	33 7	0	1	14 30
73	0	0	18 48	0	1	15 32
74	0	0	4 29	0	1	16 34
75	11	29	50 10	0	1	17 36
B. 76	0	0	34 57	0	1	18 38
77	0	0	20 38	0	1	19 40
78	0	0	6 19	0	1	20 42
79	11	29	52 0	0	1	21 44
B. 80	0	0	36 48	0	1	22 46
81	0	0	21 29	0	1	23 48
82	0	0	7 10	0	1	24 50
83	11	29	52 51	0	1	25 52
B. 84	0	0	38 38	0	1	26 54
85	0	0	24 19	0	1	27 56
86	0	0	10 0	0	1	28 58
87	11	29	55 41	0	1	30 0

Year	Sun Sig	Sun Gr	Sun ' 	Sun '' 	Apogee Sig	Apogee Gr	Apogee ' 	Apogee ''
B. 88	0	0	40	2	0	1	31	3
89	0	0	26	10	0	1	32	5
90	0	0	11	51	0	1	33	7
91	11	29	57	32	0	1	34	9
B. 92	0	0	42	19	0	1	35	11
93	0	0	28	0	0	1	36	13
94	0	0	13	41	0	1	37	15
95	11	29	59	22	0	1	38	17
B. 96	0	0	44	10	0	1	39	19
97	0	0	29	51	0	1	40	21
98	0	0	15	32	0	1	41	23
99	0	0	1	13	0	1	42	25
B. 100	0	0	46	0	0	1	43	28
B. 200	0	1	32	0	0	3	26	56
B. 300	0	2	17	59	0	5	10	23
B. 400	0	3	3	59	0	6	53	51
B. 500	0	3	49	59	0	8	37	19
B. 600	0	4	35	59	0	10	20	46
B. 700	0	5	21	59	0	12	4	14
B. 800	0	6	7	58	0	13	47	42
B. 900	0	6	53	58	0	15	31	10
B. 1000	0	7	39	58	0	17	14	38

Year	Sun Sig	Sun Gr	Sun ' Sun "	Apogee Sig	Apogee Gr	Apogee ' Apogee "
B. 2000	0	15	19 56	1	4	29 16
B. 3000	0	22	59 53	1	21	43 54
B. 4000	1	0	39 51	2	8	58 32

The "Anni Collecti" (collected years) side-label marks the lower block (B. 200 through B. 4000).

Common and Bissextile Months [Menses Communes Bissextiles]

Completed months [Menses Completi], each with two value-blocks: Longitude of the Sun from the start of Aries [Lóg. ☉ ab init. ♈] and a second Longitude of the Sun from the start of Aries — the first for the common year, the second for the bissextile year. Sig · Gr · ' · ".

Month	Com mon Sig	Com mon Gr	Com mon '	Com mon "	Bissexti le Sig	Bissexti le Gr	Bissexti le '	Bissexti le "
Ianuarius (January)	1	0	33	18	1	0	33	18
Februar. (February)	1	28	9	11	1	29	8	20
Martius (March)	2	28	42	30	2	29	41	38
Aprilis (April)	3	28	16	40	3	29	15	48
Maius (May)	4	28	49	58	4	29	49	6
Iunius (June)	5	28	24	8	5	29	23	16
Iulius (July)	6	28	57	26	6	29	56	34
Augustus (August)	7	29	30	44	8	0	29	52
Septemb. (September)	8	29	4	54	9	0	4	2

Month	Com mon Sig	Com mon Gr	Com mon '	Com mon "	Bissexti le Sig	Bissext ile Gr	Bissexti le '	Bissexti le "
Octob. (October)	9	29	38	12	10	0	37	21
Nouemb. (November)	10	29	12	22	11	0	11	31
Decemb. (December)	11	29	45	41	0	0	44	49

[Note below the months table: "Pro Apog. singul. mensib. sume quina secunda scrupula." — "For the apogee in each of the individual months, take five seconds of arc."]

DIES (Days)

Mean motion of the Sun [Motus medius ☉] per completed day [Dies completi], in Sig · Gr · ' · " · ''' (with a third sexagesimal column, thirds).

Day	Sig	Gr	'	"	'''
1	0	0	59	8	20
2	0	1	58	16	40
3	0	2	57	24	59
4	0	3	56	33	19
5	0	4	55	41	39
6	0	5	54	49	59
7	0	6	53	58	19
8	0	7	53	6	38
9	0	8	52	14	58
10	0	9	51	23	18
11	0	10	50	31	38
12	0	11	49	39	57
13	0	12	48	48	17
14	0	13	47	56	37
15	0	14	47	4	57
16	0	15	46	13	17

Day	Sig	Gr	'	"	'''
17	0	16	45	21	36
18	0	17	44	29	56
19	0	18	43	38	16
20	0	19	42	46	36
21	0	20	41	54	56
22	0	21	41	3	15
23	0	22	40	11	35
24	0	23	39	19	55
25	0	24	38	28	15
26	0	25	37	36	35
27	0	26	36	44	54
28	0	27	35	53	14
29	0	28	35	1	34
30	0	29	34	9	54
31	1	0	33	18	14

HORÆ (Hours)

Mean motion of the Sun by the hour. Column heads: Gr · ' · " · ''' (with the unit-row gloss showing the place-values descend — the "Horæ / min. / sec." stub indicates hour, minute, second of time against degree·minute·second·third of arc).

Hour	Gr	'	"	'''
1	0	2	27	51
2	0	4	55	44
3	0	7	23	32
4	0	9	51	23
5	0	12	19	4
6	0	14	47	5
7	0	17	14	56
8	0	19	42	47
9	0	22	10	37
10	0	24	38	28

Hour	Gr	'	"	'''
11	0	27	6	19
12	0	29	34	10
13	0	32	2	1
14	0	34	29	52
15	0	36	57	42
16	0	39	25	33
17	0	41	53	24
18	0	44	21	15
19	0	46	49	6
20	0	49	16	57
21	0	51	44	47
22	0	54	12	38
23	0	56	40	29
24	0	59	8	20
25	1	1	36	11
26	1	4	4	1
27	1	6	31	52
28	1	8	59	43
29	1	11	27	34
30	1	13	55	25

HORÆ — In the Remaining Hours and Scruples [In Reliquis Horis, & Scrupulis]

A finer-scale continuation. Stub: Horæ / min. / sec.; columns Gr · ' · " · ''' shown shifted one sexagesimal place (the place-row reads I / II / III / IV across the value columns, with the seconds row II / III / IV / V).

Index	Gr (I/II)	' (II/III)	" (III/IV)	''' (IV/V)
31	1	16	23	16
32	1	18	51	6
33	1	21	18	57
34	1	23	46	48

Index	Gr (I/II)	' (II/III)	" (III/IV)	''' (IV/V)
35	1	26	14	39
36	1	28	42	30
37	1	31	10	21
38	1	33	38	11
39	1	36	6	2
40	1	38	33	53
41	1	41	1	44
42	1	43	29	36
43	1	45	57	26
44	1	48	25	16
45	1	50	53	7
46	1	53	20	58
47	1	55	48	49
48	1	55	16	40
49	2	0	44	30
50	2	3	12	21
51	2	5	40	12
52	2	8	8	3
53	2	10	35	54
54	2	13	3	45
55	2	15	31	35
56	2	17	59	26
57	2	20	27	17
58	2	22	55	8
59	2	25	22	59
60	2	27	50	50

TAB. 37. Parallaxes of the Sun [PARALLAXIVM SOLIS]

Parallax [Parallaxis] of the Sun by altitude [Altitudo], given in " · ''' for three distances: at Apogee [Apogeo], at Mean Distance [In med. dist.], and at Perigee [Perigeo].

Altitude (Gr)	Apogee "	Apogee '"	Mean "	Mean '"	Perigee "	Perigee '"
0	27	28	28	18	29	8
5	25	10	26	10	27	10
10	23	20	24	20	25	20
15	21	30	22	30	23	30
20	19	40	20	40	21	30
25	17	50	18	50	19	40
30	16	0	17	0	17	50
35	14	40	15	30	16	0
40	12	30	13	10	13	30
45	11	0	11	20	11	40
50	9	30	9	40	10	0
55	7	40	7	50	8	20
60	6	0	6	10	7	0
65	5	0	5	10	6	0
70	4	0	4	10	4	30
75	3	0	3	8	3	20
80	2	0	2	4	2	10
85	1	0	1	2	1	6
90	0	0	0	0	0	0

Footer (the anomaly-sign legend running across the foot of the parallax table):

| I. XI. | II. XII. | III. IX. | IV. X. | V. VII. | VI. VIII. |

[Signs of the Anomaly — Anomaliæ Signa.]

TAB. 38. Equations of the Sun [Aequationum Solis]

Caption: "Equations of the Sun, the whole eccentricity being 3480 parts, but bisected 1740, where the radius is 100000." [Aequationum Solis Excentricitate tota partium 3480. sed Bissectâ 1740. qualium Radius 100000.]

In Circular Form [In Forma Circulari]

The argument is the Anomaly in Signs and Degrees [Anom. Signa, Gradus]; the column-pairs are headed by the signs O through V, each "Subtrahe" (subtract), each giving G. · ' · " and a Difference column [Differentia / Diff.]. The foot of the table carries the complementary "Adde" (add) sign-labels (XI, X, IX, VIII, VII, VI) read with the anomaly-degree column [Anom. Sig. G.] on the right, which descends from 30. The leftmost degree column [Anom. Signa Gradus] ascends from 0.

O																		V					
Ano m. Gr (↓)	D			I			I			I			I			D			Ano m. Gr (↑)				
	O	O	i	I	I	i	I	I	I	D	I	II	I	I	I	V	V	V					
	ff			ff			I			i			V			i				ff			
	'	"	f	'	"	f	G	'	"	ff	G	I	'	"	ff	G	'	"		ff	'	"	f
0	0	0		5	5		1	4	4		1	5	4		1	4	4		5	5		30	
				9	5		3	5			9	1			3	5			9	5			
1	2	5	1	1	4	1	1	4	4	5	1	5	4	4	1	4	4	6	5	7	1	29	
		2			0	0	4	2	7		9	0			2	5	0		8	0			
		5			5															8			
2	4	1	1	3	2	1	1	4	3	5	1	5	3	4	1	4	4	6	5	1	1	28	
		0	2		4	0	5	8	6		9	9			1	1	4		6	7	1		
		5			4															0			
3	6	1	1	5	7	1	1	4	3	5	1	5	3	7	1	4	3	6	5	2	1	27	
		5	2			0	6	4	6		9	2			0	4	7		4	5	1		
		5			3															2			
4	8	2	1	6	4	1	1	4	2	5	1	5	2	1	1	3	2	7	5	3	1	26	
		0	2		9	0	7	9	5		9	2	0		9	4	0		2	2	1		
		5			2															3			
5	1	2	1	8	3	1	1	4	2	5	1	5	7	1	1	3	1	7	5	3	1	25	
		0	5	2		0	0	8	3	4		9		5		8	2	2	0	8	1		
		5			1															4			
6	1	3	1	1	1	1	1	4	1	5	1	5	4	2	1	3	5	7	4	4	1	24	
		2	0	2	0	0	0	9	9	3		8	7	0		6	8	4	8	3	1		
		5			0															5			
7	1	3	1	1	4	9	1	5	1	5	1	5	2	2	1	3	4	7	4	4	1	23	
		4	4	2	1	9	9	0	1	2		8	7	0		5	2	6	6	7	1		

Ano m. Gr (↓)	O															V						
				I			I			I			I									
	D			D			I			II			I			I			D			
	O	O	i	I	I	i	I	I	I	D	I	II	I	V	I	V	D	V	V	i	Ano	
	ff					ff	I	I	i	II	I	I	Di	V		i			ff	Gr		
'	"	f	'	"	f	G	'	"	ff	G	I	'	"	ff	G	'	"	ff	'	"	f	(↑)
	4															6						
8	1	3	1	1	2	9	1	5	1	5	1	5	8	1	1	3	2	7	4	5	1	22
	6	8	2	3	7	8		1		0		8		9		4	4	8	4	0	1	
	4															7						
9	1	4	1	1	4	9	1	5	4	4	1	5	4	1	1	3	4	8	4	5	1	21
	8	2	2	5		7		1	9	8		7	9	9		3		0	2	3	1	
	4															7						
10	2	4	1	1	4	9	1	5	3	4	1	5	3	1	1	3	4	8	4	5	1	20
	0	6	2	6	0	6		2	5	6		7	0	9		1	2	2	0	5	1	
	4															8						
11	2	4	1	1	1	9	1	5	1	4	1	5	1	2	1	3	1	8	3	5	1	19
	2	9	2	8	5	5		3	9	4		7	0	0		0	8	4	8	7	1	
	3															9						
12	2	5	1	1	4	9	1	5	5	4	1	5	4	2	1	3	5	8	3	5	1	18
	4	2	2	9	9	4		3	9	0		6	9	1		8	2	6	6	8	1	
	3															9						
13	2	5	1	2	2	9	1	5	3	3	1	5	2	2	1	2	2	8	3	5	1	17
	6	4	2	1	2	3		4	5	6		6	7	2		7	4	8	4	8	2	
	2															0						
14	2	5	1	2	5	9	1	5	7	3	1	5	3	2	1	2	2	8	3	5	1	16
	8	6	2	2	4	2		5		2		6		4		5	5	9	2	8	2	
	2															0						
15	3	5	1	2	2	9	1	5	3	3	1	5	3	2	1	2	2	9	3	5	1	15
	0	7	2	4	5	1		5	7	0		5	7	6		4	5	0	0	7	2	
	1															1						
16	3	5	1	2	5	9	1	5	3	2	1	5	7	3	1	2	5	9	2	5	1	14
	2	8	2	5	5	0		6		6		5		0		2	4	1	8	6	2	
	1															1						
17	3	5	1	2	2	8	1	5	2	2	1	5	3	3	1	2	2	9	2	5	1	13
	4	8	2	7	4	9		6	7	4		4	5	2		1	2	2	6	4	2	

Ano m. Gr (↓)	O																V					
					I				I				I									
	D			I			II			II			I			I			D			Ano m. Gr (↑)
	O	O	i	I	I	i	I	I	I	D	I	II	I	V	I	V	D	V	V	i		
	ff					ff	I	I	i	II	I	Di	V	i			ff			ff		
'	"	f	'	"	f	G'	"	ff	G	I'	"	ff	G	'	"	ff	'	"	f			
	0																2					
18	3	5	1	2	5	8	1	5	4	2	1	5	5	3	1	1	4	9	2	5	1	12
	6	8	2	8	2	8		6	9	2		3	9	6		9	9	3	4	2	2	
	0																2					
19	3	5	1	3	1	8	1	5	1	2	1	5	1	4	1	1	1	9	2	4	1	11
	8	7	1	0	8	6		7	0	1		3	9	0		8	5	4	2	9	2	
	9																3					
20	4	5	1	3	4	8	1	5	3	2	1	5	3	4	1	1	4	9	2	4	1	10
	0	5	1	1	2	4		7	0	0		2	5	4		6	0	5	0	6	2	
	9																3					
21	4	5	1	3	4	8	1	5	4	1	1	5	4	4	1	1	4	9	1	4	1	9
	2	3	1	3		2		7	9	9		1	9	6		5		6	8	2	2	
	8																4					
22	4	5	1	3	2	8	1	5	7	1	1	5	1	4	1	1	2	9	1	3	1	8
	4	0	1	4	4	0		8		9		1		8		3	7	7	6	8	2	
	8																4					
23	4	4	1	3	4	7	1	5	2	2	1	5	1	5	1	1	4	9	1	3	1	7
	6	7	1	5	2	8		8	7	0		0	1	0		1	9	8	4	4	2	
	7																4					
24	4	4	1	3	5	7	1	5	4	2	1	4	1	5	1	1	1	9	1	3	1	6
	8	3	1	6	8	6		8	7	0		9	9	2		0	0	9	2	0	2	
	6																4					
25	5	3	1	3	1	7	1	5	7	2	1	4	2	5	1	8	2	1	1	2	1	5
	0	8	1	8	2	4		9		0		8	3	3			0	0	0	5	2	
	5																0					
26	5	3	1	3	2	7	1	5	2	1	1	4	2	5	1	6	4	1	8	2	1	4
	2	2	1	9	4	2		9	2	5		7	9	4			9	0		0	2	
	4																1					
27	5	2	1	4	3	7	1	5	3	1	1	4	3	5	1	5	7	1	6	1	1	3
	4	5	1	0	4	0		9	2	0		6	4	5				0		5	2	

O																	V							
Ano m. Gr (↓)	D			I			I			II			I			I			D			Ano m. Gr (↑)		
	O	O	i	I	I	i	I	I	I	D	I	II	I	V	I	V	D	V	V	i	m.			
	ff			ff			I	I	i	II	I	Di	V	i	ff			ff			Gr			
	'	"	f	'	"	f	G	'	"	ff	G	I	'	"	ff	G	'	"	ff	'	"		f	
	3															2					5			
28	5	1	1	4	4	6	1	5	3	7	1	4	3	5	1	3	2	1	4	1	1	2		
	6	7	1	1	1	7		9	9			5	8	6			4	0		0	2			
	2															3					5			
29	5	7	1	4	4	6	1	5	4	4	1	4	4	5	1	1	4	1	2	5	1	1		
	8		1	2	5	4		9	0			4	2	6			0	0			2			
	0															4					5			
30	5	5	1	4	4	6	1	5	4	4	1	4	4	5	0	5	5	1	0	0	1	0		
	9	5	0	3	5	0		9	1			3	5	7		9	5	0			2			
	8															5					4			

Foot rubric (read with the right-hand ascending degree column): XI. Adde. | X. Adde. | IX. Adde. | VIII. Adde. | VII. Adde. | VI. Adde.

In Elliptical Form [In Forma Elliptica]

Same structure: argument is the Anomaly degree [Gr] (left, ascending from 0; right "An. Sig. Gr." descending from 30); column-pairs O through V "Subtr." (subtract), each G. · · ". (No separate Difference columns are printed in this lower half.)

Anom. Gr (↓)	O			I			I			II			I			V			V			Anom. Gr (↑)
	O	O		I	I		I	II	II	I	III	III	I	IV	IV	V	V	V	V	V		
	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	
	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	G	'	"	
0	0	0	0	0	5	5	1	4	2	1	59	38	1	4	1	1	0	2	30			
				8	0			2	6					4	4			6				
1	0	2	4	1	0	3	1	4	3	1	59	30	1	4	1	0	5	4	29			
					4			3	0					3	2		8	6				
2	0	4	6	1	2	2	1	4	5	1	59	20	1	4	8	0	5	5	28			
					0			4	4					2			6	4				
3	0	6	1	1	4	6	1	4	4	1	59	16	1	4	0	0	5	4	27			
		0						5	8					1			4	0				

Anom. Gr (↓)	O		I		I		II		I			V		V		Anom. Gr (↑)
	O		I		I	II	II	I	III	III		IV	IV	V	V	
	G'	"	G'	"	G'	'	"	G	'	"	G'	'	"	G'	"	
4	0 8	1	1 5	5	1 4	2	1	59	12	1	3	5	0 5	6	26	
		2		0		6	4					9	4	3		
5	0 1	1	1 7	3	1 4	2	1	58	56	1	3	4	0 5	1	25	
	0	4		0		7	2					8	4	1	4	
6	0 1	1	1 9	2	1 4	1	1	58	56	1	3	3	0 4	1	24	
	2	6		4		8	4					7	2	9	8	
7	0 1	1	1 1	5	1 4	6	1	58	40	1	3	2	0 4	2	23	
	4	8	0	2		9						6	0	7	4	
8	0 1	2	1 1	2	1 4	5	1	58	30	1	3	0	0 4	3	22	
	6	0	2	8		9	6					5		5	0	
9	0 1	2	1 1	6	1 5	0	1	58	12	1	3	4	0 4	2	21	
	8	2	4			0						3	8	3	6	
10	0 2	1	1 1	4	1 5	2	1	57	50	1	3	2	0 4	2	20	
	0	4	5	2		1	6					2	8	1	0	
11	0 2	2	1 1	2	1 5	1	1	57	34	1	3	4	0 3	3	19	
	2	4	7	0		2	6					1		9	0	
12	0 2	2	1 1	5	1 5	5	1	57	10	1	2	4	0 3	3	18	
	4	8	8	0		2	4					9	0	7	0	
13	0 2	3	1 2	1	1 5	3	1	56	46	1	2	2	0 3	2	17	
	6	2	0	0		3	0					8	2	5	6	
14	0 2	2	1 2	5	1 5	1	1	56	16	1	2	5	0 3	2	16	
	8	4	1	4		4	0					6	2	3	6	
15	0 3	2	1 2	2	1 5	5	1	55	46	1	2	3	0 3	2	15	
	0	2	3	2		4	2					5	0	1	6	
16	0 3	2	1 2	5	1 5	2	1	55	18	1	2	5	0 2	2	14	
	2	2	4	0		5	0					3	6	9	2	
17	0 3	2	1 2	1	1 5	5	1	54	40	1	2	2	0 2	1	13	
	4	0	6	4		5	2					2	5	7	6	
18	0 3	1	1 2	0	1 5	2	1	54	4	1	2	2	0 2	1	12	
	6	8	8			6	0					0	7	5	4	
19	0 3	1	1 2	4	1 5	5	1	53	30	1	1	2	0 2	1	11	

Anom. Gr (↓)	O		I		I		II		II		III		I V		V		Anom. Gr (↑)
	O	O	I	I	I	II	II	I	III	III			IV	IV	V	V	
	G'	"	G'	"	G'	"	"	G	'	"		G	'	"	G'	"	
	8	4	9			6	4						9	0	2	0	
20	0 4	1	1 3	2	1 5	1	1	52	54			1 1	4	0 2	4	10	
	0	0	0	4		7	0						7	8	1		
21	0 4	8	1 3	4	1 5	3	1	52	8			1 1	6	0 1	0	9	
	2		1	4		7	2						6		9		
22	0 4	0	1 3	4	1 5	4	1	52	24			1 1	2	0 1	5	8	
	4		3			8							4	6	6	4	
23	0 4	1	1 3	2	1 5	1	1	50	34			1 1	5	0 1	5	7	
	6	4	4	0		8	0						2	0	4	0	
24	0 4	4	1 3	4	1 5	2	1	49	48			1 1	1	0 1	4	6	
	7	8	5			8	8						1	0	2	4	
25	0 4	4	1 3	4	1 5	4	1	48	56			1 9	2	0 1	3	5	
	9	0	6	6		8	0						6	0	2		
26	0 5	3	1 3	0	1 5	5	1	48	4			1 7	4	0 8	3	4	
	1	6	8			8	6						4		0		
27	0 5	2	1 3	1	1 5	8	1	47	8			1 5	5	0 6	2	3	
	3	2	9	0		9							6		0		
28	0 5	1	1 4	1	1 5	2	1	46	8			1 4	6	0 4	2	2	
	5	2	0	6		9	0										
29	0 5	0	1 4	2	1 5	3	1	45	14			1 2	2	0 2	2	1	
	7		1	4		9	0						4				
30	0 5	5	1 4	2	1 5	3	1	44	14			1 0	2	0 0	0	0	
	8	0	2	6		9	8						6				

Foot rubric: XI. Adde. | X. Adde. | IX. Adde. | VIII. Adde. | VII. Adde. | VI. Adde.

TAB. 39. Lunar-Solar Distances, Horizontal Parallax, Hourly Motions, and Semidiameters at conjunction (♌) and opposition (♍)

Latin title: **TAB. 39. LuniSolaris Distantiarum, Parallax. Horiz. Horarij, & Semidiametrorum in ♌, & ♍.** ("Table 39. Of the lunar-solar distances, the

horizontal parallax, the hourly [motions], and the semidiameters at conjunction and opposition.")

The table is entered with the **Anomaly in degrees** (left column, ascending 0–180) and re-exited with the **Anomaly in degrees** complement (rightmost column, descending 360–180). The column groups are:

- **Distantia à centro Terræ** [distance from the Earth's centre]: *Ad Radium* (*part. 100000*) — given for the Sun (☉) and for the Moon (☾); and *In Semidiam. Terræ* [in Earth-semidiameters] under two hypotheses, *1.hyp.* and *2.hyp.*
- ♂ ♀ columns (whole part of Earth-semidiameters and minutes for the conjunction/opposition case), with sub-headings ' ''.
- **Parallaxis Horizontalis** [horizontal parallax]: ' '' ''.
- **Horarius mot. Verus** [true hourly motion]: ☉ (' '' ''') and ☾ (' '' ''').
- **Semidiam. apparentes** [apparent semidiameters]: ☉ (' '' ''') and ☾ (' '' ''').
- **Apo. Vmbrę in triâ.** ☾ [apogee shadow-cone, the Moon in the cone(?)]: ' ''.
- **Variat. demed. Vmbrę** [variation of the shadow's semi-diameter]: ''.
- **Axis Vmbræ Terræ in semid. terræ** [axis of the Earth's shadow, in Earth-semidiameters]: *1.hyp.* and *2.hyp.*

Because of the great width, the table below is transcribed in two stitched parts (left block and right block) sharing the **Anomal. Gr.** key. Sexagesimal sub-columns are labelled ' (minutes) and ' ' (seconds); the whole-degree/semidiameter figures stand to their left.

TAB. 39 — left block (distances)

Ano						
m.	Ad Rad. ☉	Ad Rad. ☌	In Sd.T.	In Sd.T.		
Gr.	(×100000)	(×100000)	1.hyp.	2.hyp.	♌♌'	♌♌''
0	101740	104343	7427	6666	63	40
5	101738	104318	7426	6665	63	38
10	101710	104287	7425	6663	63	37
15	101680	104208	7423	6661	63	35
20	101636	104112	7420	6658	63	31
25	101580	103970	7416	6655	63	26
30	101512	103828	7410	6651	63	20
35	101432	103635	7404	6646	63	14

Ano						
m.	Ad Rad. ☉	Ad Rad. ☽	In Sd.T.	In Sd.T.	♌°'	♌°''
Gr.	(×100000)	(×100000)	1.hyp.	2.hyp.		
40	101341	103439	7398	6640	63	6
45	101240	103195	7391	6634	62	58
50	101129	102951	7379	6627	62	48
55	101009	102672	7371	6619	62	39
60	100881	102377	7364	6610	62	27
65	100746	102056	7354	6601	62	15
70	100600	101729	7344	6592	62	3
75	100459	101384	7333	6582	61	51
80	100309	101025	7323	6572	61	38
85	100156	100655	7311	6562	61	25
90	100000	100275	7300	6552	61	10
95	99844	99905	7289	6543	60	57
100	99692	99522	7278	6533	60	43
105	99541	99140	7266	6524	60	29
110	99395	98769	7256	6514	60	15
115	99254	98407	7246	6504	60	2
120	99119	98046	7236	6494	59	49
125	98991	97715	7226	6487	59	37
130	98871	97382	7217	6480	59	25
135	98760	97090	7209	6473	59	15
140	98659	96795	7202	6466	59	5
145	98568	96553	7196	6459	58	55
150	98488	96313	7190	6453	58	45
155	98420	96144	7185	6449	58	37
160	98364	95955	7181	6446	58	32
165	98320	95843	7178	6442	58	28
170	98286	95734	7176	6440	58	24
175	98266	95690	7174	6439	58	22
180	98260	95657	7173	6438	58	21

TAB. 39 — right block (parallax, hourly motions, semidiameters, shadow)

The leading "27 / 28 / 29" figures in the parallax-minutes column and the "14 / 15 / 16" figures in the semidiameter-minutes columns are printed only on the rows where they change (they carry down until the next printed value); they are restored here on each row they govern.

A n o m . G r .	Par all. Hor iz.'	Par all. Hor iz."	Par all. Hor iz.'"'	H or. ar. ⊙ '	H or. ar. ⊙ "	H or. ar. ⋃ '	H or. ar. ⋃ "	Sd. ap p. ⊙ '	Sd. ap p. ⊙ "	Sd. ap p. ⋃ '	Sd. ap p. ⋃ "	A p o. V m b. '	A p o. V m b. "	V a r i a t. "	A x 1. h y .	A x 2. h y .	A n o m . G r .	
0	27	8	54	2	2	23	29	20	15	30	14	4 8	3 8	4 2	0	2 2 9	2 2 9	
																		½
5	27	10	54	3	2	23	29	22	15	30	14	4 8	3 8	4 3	0			
1 0	27	12	54	4	2	23	29	26	15	30	14	4 9	3 8	4 4	1			
1 5	27	14	54	6	2	23	29	32	15	31	14	5 0	3 8	5 0	2			
2 0	27	16	54	8	2	23	29	42	15	32	14	5 1	3 8	5 6	3			
2 5	27	17	54	10	2	23	29	51	15	33	14	5 2	3 9	8	4			
3 0	27	19	54	13	2	24	29	59	15	34	14	5 3	3 9	2 0	5	2 2 7	2 2 8	
3 5	27	22	54	20	2	24	30	9	15	35	14	5 5	3 9	3 3	6			

A n o m . G r .	Par all. Hor iz.'	Par all. Hor iz."	Par all. Hor iz.'''	H or ar. ⊙'	H or ar. ⊙"	H or ar. ⋃'	H or ar. ⋃"	Sd. ap p. ⊙'	Sd. ap p. ⊙"	Sd. ap p. ⋃'	Sd. ap p. ⋃"	A p o. V b.'	A p o. V b."	V a ri t. "	A x is 1. h y p .	A x is 2. h y p .	A n o m . G
4 0	27	25	54	39	2	24	30	18	15	36	14	5 7	3 9	4 5	7		
4 5	27	28	54	38	2	24	30	28	15	37	14	5 9	3 9	5 8	9		
5 0	27	32	54	46	2	24	30	38	15	38	15	1	4 0	1 4	1 1		
5 5	27	36	54	55	2	24	30	49	15	39	15	3	4 0	3 2	1 4	2 2 6	2 2 7
6 0	27	40	55	4	2	25	31	0	15	40	15	6	4 0	5 0	1 8		
6 5	27	44	55	14	2	25	31	14	15	41	15	9	4 1	1 0	2 2		
7 0	27	49	55	25	2	26	31	28	15	42	15	1 2	4 1	3 3	2 6		
7 5	27	54	55	36	2	26	31	44	15	43	15	1 5	4 1	5 5	3 0		
8 0	28	0	55	48	2	27	32	0	15	44	15	1 8	4 2	1 8	3 3		
8 5	28	8	56	1	2	27	32	18	15	45	15	2 1	4 2	4 5	3 6		
9 0	28	18	56	14	2	28	32	36	15	46	15	2 4	4 3	9	4 0	2 2 4 ⅔	2 2 6
9 5	28	26	56	26	2	29	32	54	15	47	15	2 7	4 3	3 6	4 3		
1	28	31	56	39	2	29	33	11	15	48	15	3	4	2	4		

A n o m . G r .	Par all. Hor iz.'	Par all. Hor iz."	Par all. Hor iz.""	H or ar. ⊙'	H or ar. ⊙"	H or ar. ⋃'	H or ar. ⋃"	Sd. ap p. ⊙'	Sd. ap p. ⊙"	Sd. ap p. ⋃'	Sd. ap p. ⋃"	A p o. V b. '	A p o. V b. "	V a ri t. "	A x is 1. h y p .	A x is 2. h y p .	A n o m . G
0 0												0	4		6		
1 0 5	28	35	56	52	2	30	33	28	15	49	15	3 3	4 4	2 8	4 8		
1 1 0	28	39	57	5	2	30	33	44	15	50	15	3 6	4 4	5 2	5 1		
1 1 5	28	42	57	17	2	30	33	58	15	51	15	4 1	4 5	1 8	5 4		
1 2 0	28	45	57	30	2	31	34	10	15	52	15	4 4	4 5	4 4	5 7	2 2 3	2 2 5
1 2 5	28	48	57	42	2	31	34	20	15	53	15	4 7	4 6	1 2	6 0		
1 3 0	28	51	57	54	2	31	34	30	15	54	15	5 0	4 6	3 6	6 2		
1 3 5	28	54	58	3	2	32	34	39	15	55	15	5 3	4 7	0	6 5		
1 4 0	28	56	58	15	2	32	34	47	15	56	15	5 6	4 7	2 0	6 8		
1 4 5	28	58	58	23	2	32	34	54	15	57	16	0	4 7	3 8	7 0		

A n o m . G r .	Par all. Hor iz.'	Par all. Hor iz."	Par all. Hor iz.'"'	H or ar. ⊙ '	H or ar. ⊙ "	H or ar. ⋃ '	H or ar. ⋃ "	Sd. ap p. ⊙ '	Sd. ap p. ⊙ "	Sd. ap p. ⋃ '	Sd. ap p. ⋃ "	A p o. V b. '	A p o. V b. "	V a t. "	A x 1. h y .	A x 2. h y .	A n o m . G r .
1 5 0	29	0	58	32	2	33	35	2	15	58	16	4	4 7	5 6	7 2	2 2 2 ½	2 2 4
1 5 5	29	2	58	39	2	33	35	10	15	58	16	6	4 8	1 3	7 3		
1 6 0	29	4	58	46	2	33	35	17	15	59	16	8	4 8	2 8	7 4		
1 6 5	29	5	58	50	2	33	35	23	16	0	16	9	4 8	3 8	7 5		
1 7 0	29	6	58	54	2	34	35	26	16	1	16	1 0	4 8	4 6	7 6		
1 7 5	29	7	58	56	2	34	35	28	16	2	16	1 1	4 8	5 2	7 7		
1 8 0	29	8	58	58	2	34	35	30	16	2	16	1 2	4 8	5 5	7 7	2 2 0 ⅔	2 2 3

TAB. 40. Of Refractions, corrected from the observations of Tycho, of others, and our own

Latin title: TAB. 40. *Refractionum ex Tychonis Observationibus, Aliorumque, & Nostris, emendatis.* ("Table 40. Of the refractions, corrected from the observations of Tycho [Brahe], of others, and our own.")

Al t. Gr	Æst. ☉'	Æst. ☽'	Æst. ★'	Æq. ☉'	Æq. ☽'	Æq. ★'	Hyb. ☉'	Hyb. ☽'	Hyb. ★'
24	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0

Below the table: De Emendatione Tychonicarum, vide dicta Lib. 1. Astronom. Reformatæ Cap. 14. & 15. ("On the correction of the Tychonic [refractions], see what is said in Book 1 of the *Astronomia Reformatæ*, chapters 14 and 15.")

TABULA 41. The Moon's Mean (Equable) Motion, and of the Node ☾

Latin title: TABULA 41. Lunæ Motus Aequalis, seu Medius, & Nodi ☾. ("Table 41. Of the Moon's equable, that is mean, motion, and of the Node.")

This opening carries the lunar **radices/epochs** and the **expanded and collected years**. Each of the three motions is given in zodiacal **Sign · Gr(degree) · ' · "** (heading Sig. G. ' "):

- **Longit. ab** ♈ — mean longitude reckoned from the first point of Aries (♈).
- **Anomalía** — the [mean] anomaly.
- **Nodi ☾ mot.** — the motion of the [ascending] Node.

Sub-table A — EPOCHÆ, SEV RADICES (Epochs, or radices), years *ante Christum* and *post*

Anni ante Christū	Long. ♈ Sig	Anom.			Nodi		
		G'	"	Sig	G'	"	Sig
6000	0	1 1	3 5		2 5	5 1	
		3 2	6		1 7	2	
5000	7	1 2	6 11		2 5	5 4	
		1			6 8	7	
4000	1	1 2	3 6		2 0	2 7	
		9 9	6				
3000	8	7 3	6 0		7 1	6 11	
		8					

Anni ante Christū	Long. ꝥ Sig	G ' "	Anom. Sig	G ' "	Nodi Sig	G ' "
2000	2	2 4 3 6 5 6 5		1 2 2 2 2		1 3 3 2 3 6
1000	9	1 5 5 0 3 5		1 3 1 5 7 9		2 4 2 0 2 9
900	7	2 4 5 7 1 3 6		5 3 2 1 3 5		6 3 2 1 2
800	5	2 3 4 1 9 2 7		2 3 3 8 4 2		2 2 1 2 0 6
700	4	7 2 3 8 1 8		1 3 3 4 2 3 9		8 9 9
600	2	1 1 2 3 5 0 9		1 3 4 11 6		2 5 2 3 8
500	0	2 5 2 9 2 9 0		1 3 5 7 9 3 3		9 4 5 6 6
400	11	0 4 1 4 8 1		8 4 0 2		2 3 4 5 5 9
300	9	8 3 2 10 7		2 3 7 10 6 4		1 2 4 1 4 2
200	7	1 2 5 5 6 5 3		1 4 1 5 5 4		2 1 3 7 3 6
100	5	2 1 4 0 4 4 4		3 3 2 1 4 1		1 2 2 3 9
Christi.	4	2 3 3 6 5		2 4 2 8 2 4		2 5 2 8 1 2
100	2	9 5 2 1 2 5		1 3 3 4 0 4 1		1 4 1 4 0 6
200	0	1 4 1 7 7 1 6		2 4 3 0 9 8		0 2 9 9
300	10	2 3 7 2 5 0		1 3 4 7 7 4 5		1 1 2 6 8
400	9	3 1 5 9 8 7		6 4 5 3 2		2 6 5 6
500	7	1 7 4 3		2 3 5 10		1 5 4

Anni ante Christū	Long. ʸ Sig	Anom.			Nodi				
		G ′	″	Sig	G ′	″	Sig	G ′	″
		1	8		4 4	9		7 5	9
600	5	1 5	3	10	1 5	6	6	3 4	4
		8 6	9		3			4	2
700	3	2 4	3	5	1 3	1	1	1 3	3
		6 5	0		5	2		9 3	5
800	2	4 3	2	11	2 5	1	9	5 2	2
		4	2		0	9		2	8
900	0	1 2	1	6	8 3	2	4	2 1	2
		2 3	3		5	4		1 1	1
1000	10	2 1	5	0	2 5	3	0	7 0	1
		0 2			7	0			5
1100	8	2 0	5	7	1 3	3	7	2 4	8
		8	5		5 5	7		2 9	
1200	7	5 4	4	2	4 5	4	3	8 3	1
		9	6			4		8	
1300	5	1 3	3	8	2 3	5	10	2 2	5
		3 8	7		2 5	0		4 6	5
1400	3	2 2	2	3	1 5	5	6	1 1	4
		1 7	8		1	6		0 5	8
1500	1	2 1	1	9	2 3	3	1	2 4	4
		9 6	9		9 6			6	1
1600	0	7 5	1	4	1 6	1	9	1 5	3
			0		8	0		1 4	5
1600 (Stylo Gregoriano)	7	2 1	2	0	7 2	9	9	1 2	5
		5 9	0		7			1 2	0
1700	5	2 5	3	6	1 5	2	4	2 1	5
		9 7	6		2 3	3		7 4	4
1800	3	2 3	5	0	1 1	3	0	1 6	5
		4 5	2		8 9	7		3	8
1900	1	1 1	8	6	2 4	5	8	2 5	2
		9 4			3 5	1		8 9	
2000	11	2 2	5	1	1 1	5	2	1 4	5
		7	9		2 5	8		4 7	5

Anni ante Christū	Long. ♃ Sig	G ' "	Anom. Sig	G ' "	Nodi Sig	G ' "
2100	9	2 4 1 7 1 1 5		2 4 1 10 7 2 2		0 4 0 0
2200	7	1 1 3 2 6 9 1		3 8 2 5 6		1 3 4 6 2
2300	5	1 5 4 8 0 7 7		8 3 4 1 4 0		2 2 8 4

Sub-table B — ANNI EXPANSI, ET COLLECTI (single/expanded and collected years)

The right portion of the opening tabulates **single years (Anni Expansi)** 1–60 and then **collected years (Anni Collecti)** 64, 68, 72, 76, 80, ..., 6000. The "B." prefix marks the bissextile (leap) years; the note "**Omnes hi sunt Bissextiles**" ("all these are bissextile") runs vertically beside the 64–92 block. Same three motions, Sig. G. ' ".

Anni Exp.	Long. ♃ Sig	G ' "	Anom. Sig	G ' "	Nodi Sig	G ' "
1	4	9 2 3 2 3		2 4 8 0 8 3		1 1 4 9 9 3
2	8	1 4 5 5 8 6		2 2 1 1 7 6 5		8 3 2 9 6
3	0	2 9 8 8 8		2 9 2 1 6 3		2 5 9 7 9
B. 4	5	2 4 4 0 0 2 5		7 5 2 2 6 3		1 2 3 7 2
5	10	0 5 4 3 8		6 3 3 3 9 1		6 4 4 1 6
6	2	9 2 5 6 8 0		5 2 3 3 2 9		2 1 2 6 9
7	6	1 5 5 9 8 1 3		4 5 4 4 6		1 2 1 5 1 2
B. 8	11	1 2 3 0 1 5 0		1 5 4 5 5 2 7		4 4 4 4
9	3	2 4 3 3		1 3 5 5		2 3 4

Anni Exp.	Long. ʸ Sig	Anom.			G ' "	Sig	G ' "	Nodi Sig	G ' "
		0 8 3					4 5 5		4 8
10	8	0 1 3 6					1 1 3 6		1 2 3
		1 5					3 9		3 3 2
11	0	9 3 3 9					1 2 1 7		2 4 1
		4 8					2 1		3 5
B. 12	5	2 8 1 0					2 4 1 7		2 6 8
		6					3 9 2		2
13	9	1 3 1 3					2 3 2 8		1 2 5
		1 1 8					2 2 0		1 5 1
14	1	2 5 2 6					2 1 2 9		0 4 3
		0 4 1					1 5 7		5 4
15	6	0 1 2 9					1 5 3 9		2 5 1
		7 3					9 8 5		0 7
B. 16	10	2 5 1 1					1 4 3 10		9 2 1
		2 1					5 6		8 1
17	3	2 1 4 4					0 2 4 10		2 4 5
		4					8 4		8 7 4
18	7	1 3 6 6					2 1 5 11		1 7 3
		1 7					9 1 2		8 7
19	11	2 0 9 9					2 5 0 0		7 2 2
		1					7 5		7 0
20	4	1 3 4 1					9 4 1 0		2 5 1
		3 3 6					2		6 0 3
21	8	2 5 4 4					8 2 9 1		1 9 5
		2 6 9					5		6 7
22	1	2 1 5 7					7 8 1 2		5 2 4
		9 1					7		9 0
23	5	1 4 5 10					5 5 2 2		2 4 2
		1 2 4					1 5		4 9 3
B. 24	10	4 1 3 1					1 3 2 3		1 1 1
		6 1					7 8 4		4 2 6
25	2	1 3 3 4					1 2 3 4		3 3 0
		3 9 4					6 1 2		2

Anni Exp.	Long. ʸ Sig	Anom.			G ' "	Sig	G ' "	Nodi Sig	G ' "	"
		G ' "	Sig	G ' "						
26	6	2 2 3	7			1 4 4	4		2 5 4	
		3 6				5 0			2 1 3	
27	11	2 2 3	10			1 4 4	5		1 1 2	
		5 9				3 7 8			2 1 6	
B. 28	3	2 5 1	1			2 3 4	6		1 3 1	
		4 9 7				5 4 7			4 9	
29	8	4 2 1	4			2 1 5	6		2 5 2	
		2 9				4 7 5			0 4	
30	0	1 4 2	7			2 1 3	7		1 1 4	
		3 5 2				3			0 3 5	
31	4	2 8 2	10			2 4 1	7		2 3 2	
		3 4				1 4 1			9 3 8	
B. 32	9	1 4 2	2			3 3 1	8		1 5 2	
		5 2				1 0			8 6 1	
33	1	2 5 4	5			2 1 1	9		8 1 5	
		5				4 8			6	
34	6	4 2 7	8			0 5 2	9		2 3 4	
		8				7 6			7 5 8	
35	10	1 5 1	10			2 4 3	10		1 5 3	
		3 1 0				9 0 4			6 5 1	
B. 36	3	6 2 4	2			1 2 3	11		6 1 2	
		4 7				1 7 3			8 4	
37	7	1 4 5	5			1 1 4	11		2 3 7	
		5 7 0				0 0 1			5 8	
38	11	2 1 5	8			8 5 4	0		1 5 5	
		5 0 2				3 9			4 7 0	
39	4	4 3 5	11			7 3 5	1		4 1 3	
		3 5				6 7			7 3	
B. 40	8	2 7 3	2			1 2 2	1		2 4 2	
		7 2				9 4			3 0 7	
41	1	6 3 3	5			1 7 1	2		1 0 1	
		0 5				8 0			3 0	
42	5	1 5 3	8			1 5 1	3		2 1 5	

Anni Exp.	Long. ʸ Sig	Anom.			G ' "	Sig	G ' "	Nodi Sig	G ' "
		5 3 7					6 0 8		9 3
43	9	2 1 4	11				1 3 2 3		2 3 3
		5 6 0					5 3 6		1 9 6
B. 44	2	1 5 1	2				2 2 2 4		1 2 2
		7 0 8					7 0 5		1 9
45	6	2 1 2	5				2 3 3 5		0 2 1
		7 3 0					6 3		2 3
46	11	6 3 2	8				2 4 4 5		1 4 5
		6 3					4 6 1		9 1 6
47	3	1 5 2	11				2 2 4 6		9 1 3
		5 9 5					3 9 9		9
B. 48	8	8 3 3	3				5 1 4 6		2 2 3
		3					6 8		8 4 2
49	0	1 5 5	6				3 5 6 7		1 4 1
		7 6					9		7 4 6
50	4	2 1 8	9				2 4 4 8		7 3 5
		7 9					3		9
51	9	6 4 1	0				1 2 1 8		2 2 4
		2 0					6 2		6 3 2
B. 52	1	2 1 4	3				1 1 1 9		1 4 3
		9 5 8					3 3 1		5 6 5
53	6	8 3 5	6				1 5 1 10		5 6 1
		8 1					1 6 9		8
54	10	1 1 5	9				1 3 2 10		2 2 2
		8 3					0 9 7		4 6
55	2	2 2 5	0				9 2 3 11		1 4 4
		7 4 6					2 5		3 5 5
B. 56	7	1 5 3	3				2 9 3 0		3 8 3
		9 8 3					1 4		8
57	11	2 2 3	6				1 5 4 0		2 2 2
		9 1 6					9 2 2		2 8 1
58	4	8 4 3	9				1 3 5 1		1 4 4
		4 8					8 5 0		1 8

Anni Exp.	Long. ʸ Sig	Anom.			Nodi Sig			G ' "		
		G ' "	Sig	G ' "	Sig	G ' "	Sig	G ' "	Sig	
59	8	1 7 4	0	1 1 5	2	1 7 4		1 7 4		
		8 1		7 8 8					7	
B. 60	1	1 4 1	3	2 6 4	2	2 3 4		2 3 4		
		0 1 9		9		0 0 0		0 0 0		
64	7	1 2 4	4	7 2 2	5	7 5 4		7 5 4		
		4		7		2 3				
68	0	2 6 4	4	1 5 2	7	2 1 4		2 1 4		
		2 9		4 8 0		5 4 6		5 4 6		
72	6	1 4 3	4	2 5 1	10	1 3 4		1 3 4		
		2 9 4		2 5 4		2 6 8		2 6 8		
76	0	3 3 2	5	0 5 3	0	2 5 5		2 5 5		
		2 0		1 6		9 8 1		9 8 1		
80	5	2 1 5	5	8 4 5	3	1 2 5		1 2 5		
		4 5		8		7 0 4		7 0 4		
84	11	1 5 5	5	1 4 2	6	4 4 5		4 4 5		
		4 7 0		6 4 8		2 6		2 6		
88	5	5 4 3	5	2 4 5	8	2 4 5		2 4 5		
		0 5		4 0 1		2 9		2 9		
92	10	2 2 2	6	2 3 1	11	9 2 2		9 2 2		
		6 3 1		7 4		7		7		
96	4	1 6 6	6	1 3 3	1	2 4 4		2 4 4		
		7		0 3 9		6 9		6 9		
100	10	7 4 5	6	1 3 7	4	1 1 7		1 1 7		
		8 1		8 0		4 1		4 1		
200	8	1 3 4	1	7 0 1	8	2 2 1		2 2 1		
		5 7 2		3		8 2 3		8 2 3		
300	6	2 2 3	7	2 3 2	1	1 3 2		1 3 2		
		3 6 3		5 0 0		2 3 0		2 3 0		
400	5	1 1 2	2	1 0 2	5	2 4 2		2 4 2		
		5 4		4 6		6 4 7		6 4 7		
500	3	9 4 1	9	2 3 3	10	1 5 3		1 5 3		
		5		0 3		0 5 3		0 5 3		
600	1	1 5 6	3	2 0 3	2	2 6 4		2 6 4		

Anni Exp.	Long. Υ Sig	Anom.			Nodi Sig			
		G ' "	Sig	G ' "		G ' "		
		6 3		1 9		5 0		
700	11	2 4 5 10		9 3 4 7		9 1 4		
		4 1 7		0 5		7 7		
800	10	2 3 4 4		2 0 5 11		2 2 5		
		0 8		8 2		3 8 3		
900	8	1 1 3 11		1 3 5 4		7 4 0		
		0 9 9		6 0 9		0		
1000	6	1 8 3 6		5 1 5 8		2 5 7		
		8 0				1 1		
2000	1	6 1 0 0		1 2 1 5		1 4 1		
		7		0 1		3 2 4		
3000	7	2 2 3 6		1 3 1 2		5 3 2		
		4 5 0		5 6		3 0		
4000	2	1 3 0 0		2 4 2 10		2 2 2		
		2 4		0 1		7 4 7		
5000	9	0 4 2 6		2 5 2 7		1 1 3		
		2 9		5 7		9 5 4		
6000	3	1 5 5 1		0 6 3 4		1 6 4		
		8 0 9		3		1 1		

TABULA 41 (continued). MENSES ANNI COMMUNIS / BISSEXTILIS / DIES; HORÆ ET SCRUPULA

This opening continues Table 41 with the **completed months** of the common year and of the bissextile year, the **days**, and finally the **hours and scruples** (sexagesimal fractions of the day). Each block gives the same three motions in sig. G. ' " (the Node block is headed G. ' ", the leading sign omitted as it stays at 0 within a month/day).

MENSES ANNI COMMUNIS (months of the common year, completed)

Menses (compl.)	Long. Υ Sig	Anom.			Nodi			
		G ' "	Sig	G ' "		G ' "		
Ianuar.	1	1 2 6 1		1 0 5 1		3 3		
		8 8		5 2		8 0		

Menses (compl.)	Long. ♀ Sig	G	'	"	Anom. Sig	G	'	"	Nodi G	'	"
Febr.	1	2	2	2	1	2	5	2	3	7	2
		7	4	6		0	0				8
Martius	3	1	5	3	3	5	5	5	4	4	5
		5	2	2		0	5			5	7
Aprilis	4	2	1	2	4	7	4	5	6	2	1
		1	0			7	3			1	6
Maius	6	9	3	8	5	2	4	4	7	5	4
		8				2	8	5		9	6
Iunius	7	1	5	3	6	2	4	4	9	3	6
		4	5	9		4	5	3		5	
Iulius	9	3	2	4	8	9	4	3	11	1	3
		3	4			6	5			3	5
August.	10	2	5	5	9	2	4	2	12	5	5
		1	1	0		4	7	6		2	
Septēb.	11	2	9	2	10	2	4	2	14	2	2
		7		1		6	4	5		7	4
Octob.	1	1	3	2	0	1	4	1	16	5	5
		5	7	6		1	5	7			4
Nouēb.	2	2	5	5	1	1	4	1	17	4	1
		0	4	7		3	2	5		1	3
Decēb.	4	9	2	3	2	2	4	8	19	1	4
		3				8	3			9	3

MENSES ANNI BISSEXTILIS (months of the bissextile year, completed)

Menses (compl.)	Long. ♀ Sig	G	'	"	Anom. Sig	G	'	"	Nodi G	'	"
Ianuar.	1	1	2	6	1	1	0	5	1	3	3
		8	8			5		2		8	0
Febr.	2	1	3	1	2	3	5	5	3	1	3
		0	5			3	6			0	9
Martius	3	2	3	7	3	1	5	4	4	4	8
		9				8	4	9		9	
Aprilis	5	4	2	3	4	2	5	4	6	2	2

Menses (compl.)	Long. ♀ Sig	G	'	"	Anom. Sig	G	'	"	Nodi G	'	"
		0		7		0	1	7		4	6
Maius	6	2	4	4	6	5	5	3	8	6	5
		2	8	3			2	9			6
Iunius	7	2	6	1	7	7	4	3	9	4	2
		8		4			9	7		2	5
Iulius	9	1	3	1	8	2	5	2	11	2	5
		6	4	9		0	0	9		0	5
August.	11	5	2	2	10	7	5	2	12	5	2
				5			1	0		9	5
Sept.	0	1	1	5	11	9	4	1	14	3	3
		0	9	6			8	9		0	5
Octob.	1	2	4	1	0	2	4	1	16	9	5
		8	8			4	9	1			
Nou.	3	4	5	3	1	2	4	9	17	4	2
				2		6	6			4	4
Dec.	4	2	3	3	3	1	4	2	19	2	5
		2	3	8		1	7			2	4

DIES (days, completed)

Dies (compl.)	Long. ♀ Sig	G	'	"	Anom. Sig	G	'	"	Nodi G	'	"
1	0	1	1	3	0	1	3	5	0	3	1
		3	0	5		3		4			1
2	0	2	2	1	0	2	7	4	0	6	2
		6	1	0		6		8			1
3	1	9	3	4	1	9	1	4	0	9	3
			1	5			1	2			2
4	1	2	4	2	1	2	1	3	0	1	4
		2	2	0		2	5	6		2	3
5	2	5	5	5	2	5	1	3	0	1	5
			2	5			9	0		5	3
6	2	1	3	2	2	1	2	2	0	1	4
		9		0		8	3	4		9	

Dies (compl.)	Long. ʹ Sig	Anom.			Nodi					
		G ʹ	ʹ	Sig	G ʹ	ʹ	G	ʹ	ʹ	
7	3	2 1	5	3	1 2	1	0	2	1	
		4			7 8			2	4	
8	3	1 2	4	3	1 3	1	0	2	2	
		5 4	0		4 1	2		5	5	
9	3	2 3	1	3	2 3	5	0	2	3	
		8 5	5		7 5			8	6	
10	4	1 4	5	4	1 3	5	0	3	4	
		1 5	0		0 8	9		1	6	
11	4	2 5	2	4	2 4	5	0	3	5	
		4 6	5		3 2	3		4	7	
12	5	8 7	0	5	6 4	4	0	3	8	
					6 7			8		
13	5	2 1	3	5	1 5	4	0	4	1	
		1 7	5		9 0	1		1	8	
14	6	4 2	1	6	2 5	3	0	4	2	
		8 0			4 5			4	9	
15	6	1 3	4	6	1 5	2	0	4	4	
		7 8	5		5 8	9		7	0	
16	7	0 4	2	6	2 2	2	0	5	5	
		9 0			9 3			0	0	
17	7	1 5	5	7	1 6	1	0	5	1	
		3 9	5		2 7			4		
18	7	2 1	3	7	2 1	1	0	5	1	
		7 0	0		5 0	1		7	1	
19	8	1 2	5	8	8 1	5	1	0	2	
		0 1			4				2	
20	8	2 3	4	8	2 1	5	1	3	3	
		3 1	0		1 7	9			3	
21	9	6 4	1	9	4 2	5	1	6	4	
		2 5			1 3				3	
22	9	1 5	5	9	1 2	4	1	9	5	
		9 2	0		7 5	7			4	
23	10	3 3	2	10	0 2	4	1	1	5	

Dies (compl.)	Long. ♀ Sig	G	'	"	Anom. Sig	G	'	"	Nodi G	'	"
				5			9	1		3	
24	10	1	1	0	10	1	3	2	1	1	1
		6	4			3	3	5		6	5
25	10	2	2	3	10	2	3	2	1	1	2
		9	4	6		6	7	8		9	6
26	11	1	3	1	11	9	4	2	1	2	3
		2	5	1			1	2		2	7
27	11	2	4	4	11	2	4	1	1	2	4
		5	5	6		2	5	6		5	7
28	0	8	5	2	0	5	4	1	1	2	5
			6	1			9	0		8	8
29	0	2	6	5	0	1	5	4	1	3	9
		2		6		8	3			2	
30	1	5	1	3	1	1	5	8	1	3	1
			7	1			6			5	9
31	1	1	2	6	1	1	0	5	1	3	3
		8	8			5		2		8	0

HORÆ, ET SCRUPULA (hours and scruples)

Latin heading: **HORÆ, ET SCRUPULA**. Sub-headings give the three motions — **Longit.** ☽ **ab** ♀ [the Moon's longitude from Aries], **Anomalia**, **No.** ☾ **mot.** [motion of the Node] — each tabulated against successively finer time units: the row-key Horæ/Min./Sec. (hours, minutes, seconds), with the resulting motion in degree-and-sexagesimal sub-orders (the column heads run Gr. ' " for hours, then ' " " for minutes, then " " " " for seconds). The body below is keyed by the integer 1–60 (serving as hours, then minutes, then seconds at the three scales); the printed sub-order labels are I, II, III, IV.

For the longitude and anomaly the printed sub-columns at the hour scale are (Gr. ' · ") but only two figures are printed per cell in the body (the degree/minute pair shown); the Node column gives (' · "). Transcribing the body exactly as printed:

n	Long. ♀ Gr/I	Long. II	Anom. Gr/I	Anom. II	No. ☾ I	No. ☾ II
1	0	32	56	0	32	40
					0	8

n	Long. γ Gr/I	Long. II	Anom. Gr/I	Anom. II	No. $\mathfrak{U}$ I	No. $\mathfrak{U}$ II
2	1	5	53	1	5	20
					0	16
3	1	38	49	1	37	59
					0	24
4	2	11	46	2	10	39
					0	32

key	Long. a	Long. b	Anom. a	Anom. b	Node a	Node b
1	0	32	0	32	0	8
2	1	5	1	5	0	16
3	1	38	1	37	0	24
4	2	11	2	10	0	32
5	2	44	2	43	0	40
6	3	17	3	15	0	48
7	3	50	3	48	0	56
8	4	23	4	21	1	4
9	4	56	4	53	1	12
10	5	29	5	26	1	19
11	6	2	5	59	1	27
12	6	35	6	31	1	35
13	7	8	7	4	1	43
14	7	41	7	37	1	51
15	8	14	8	9	1	59
16	8	47	8	42	2	7
17	9	20	9	15	2	15
18	9	52	9	47	2	23
19	10	25	10	20	2	31
20	10	58	10	53	2	39
21	11	31	11	25	2	47
22	12	4	11	58	2	55
23	12	37	12	31	3	3

key	Long. a	Long. b	Anom. a	Anom. b	Node a	Node b
24	13	10	13	3	3	11
25	13	43	13	36	3	19
26	14	16	14	9	3	27
27	14	49	14	41	3	35
28	15	22	15	14	3	45
29	15	55	15	47	3	51
30	16	28	16	19	3	58
31	17	1	16	52	4	6
32	17	34	17	25	4	14
33	18	7	17	57	4	22
34	18	40	18	30	4	30
35	19	12	19	3	4	38
36	19	45	19	35	4	46
37	20	18	20	8	4	54
38	20	51	20	41	5	2
39	21	24	21	13	5	10
40	21	57	21	46	5	18
41	22	30	22	19	5	26
42	23	3	22	51	5	34
43	23	36	23	24	5	42
44	24	9	23	57	5	50
45	24	42	24	29	5	58
46	25	15	25	2	6	6
47	25	48	25	35	6	14
48	26	21	26	7	6	22
49	26	54	26	40	6	29
50	27	27	27	13	6	37
51	27	59	27	45	6	45
52	28	32	28	18	6	53
53	29	5	28	51	7	1
54	29	38	29	23	7	9

key	Long. a	Long. b	Anom. a	Anom. b	Node a	Node b
55	30	11	29	56	7	17
56	30	44	30	29	7	25
57	31	17	31	1	7	33
58	31	50	31	34	7	41
59	32	23	32	7	7	49
60	32	56	32	39	7	57

TABLE 42. The Equations of the Moon at the Syzygies, that is, at Conjunction (♌) and Opposition (♍)

The argument (Anom., the lunar anomaly) runs 0–30 degrees down the left margin and 30–0 up the right margin. Six entry-columns are headed by sign-numbers 0, I, II, III, IV, V, each labelled *Subtr.* (subtract); each gives the equation in degrees (G.), minutes ('), and seconds ("). The sign-numbers continuing the cycle (XI, X, IX, VIII, VII, VI), each labelled *Adde* (add), are printed across the foot.

An																			An
om	0	I		II		IV		I		V								om.	
.	Sub	0	0	Sub	I	I	Sub	I	I	III	II	Sub	I	V	Sub	V	V	(Gr.	
(G.	tr.			tr.			tr.	I	I	Subt	II	I	tr.	V	tr.			)	
)	G.	'	"	G.	'	"	G.	'	"	r. G.	I'	"	G.	'	"	G.	'	"	
0	0	0	0	2	2	4	4	1	5	4	5	2	4	2	2	2	3	1	30
					5	7		4	1		8	0		2	0		3	8	
1	0	5	4	2	3	1	4	1	2	4	5	2	4	1	4	2	2	4	29
					0	2		7	9		8	6		9	6		8	1	
2	0	1	8	2	3	3	4	2	2	4	5	2	4	1	7	2	2	1	28
		0			4	4		0			8	7		7			4		
3	0	1	1	2	3	5	4	2	3	4	5	2	4	1	2	2	1	1	27
		5	2		8	4		2	1		8	2		4	4		9	8	
4	0	2	1	2	4	1	4	2	5	4	5	1	4	1	3	2	1	3	26
		0	6		3	1		4	5		8	4		1	6		4	3	
5	0	2	2	2	4	2	4	2	1	4	5	5	4	8	4	2	9	4	25
		5	0		7	5		7	4		7	9		3			5		

An om . (G.)	0 Sub tr. G.	I 0 0 Sub ' " G.			II I I Sub ' " G.			III I I Subt ' " r. G.			IV II Sub I I tr. ' " G.			I V I V Sub ' " tr. G.			An V V om. ' ")		
6	0	3	2	2	5	3	4	2	2	4	5	3	4	5	4	2	4	5	24
		0	3		1	7		9	9		7	7			5			5	
7	0	3	2	2	5	4	4	3	3	4	5	1	4	2	4	2	0	2	23
		5	6		5	6		1	9		7	0			2				
8	0	4	2	2	5	5	4	3	4	4	5	3	3	5	3	1	5	7	22
		0	8		9	2		3	4		6	8		9	5			5	
9	0	4	2	3	3	5	4	3	4	4	5	1	3	5	2	1	5	9	21
		5	9			4		5	4		6			6	3			0	
10	0	5	3	3	7	5	4	3	3	4	5	1	3	5	6	1	4	8	20
		0	0			3		7	9		5	8		3				5	
11	0	5	3	3	1	4	4	3	3	4	5	3	3	4	4	1	4	5	19
		5	0		1	9		9	0		4	0		9	5			0	
12	1	0	2	3	1	4	4	4	1	4	5	3	3	4	2	1	3	1	18
			8		5	2		1	7		3	6		6	0			5	
13	1	5	2	3	1	3	4	4	5	4	5	3	3	4	5	1	2	5	17
			5		9	1		2	9		2	7		2	0			9	
14	1	1	2	3	2	1	4	4	3	4	5	3	3	3	1	1	2	4	16
		0	1		3	7		4	5		1	3		9	6			4	
15	1	1	1	3	2	5	4	4	5	4	5	2	3	3	3	1	1	3	15
		5	6		6	9		6			0	3		5	8			9	
16	1	2	1	3	3	3	4	4	3	4	4	7	3	3	5	1	1	2	14
		0	0		0	8		7	0		9			1	5			4	
17	1	2	3	3	3	1	4	4	5	4	4	4	3	2	8	1	9	1	13
		5			4	3		8	0		7	6		8				4	
18	1	2	5	3	3	4	4	5	6	4	4	2	3	2	1	1	3	5	12
		9	5		7	4		0			6	1		4	8			9	
19	1	3	4	3	4	1	4	5	1	4	4	5	3	2	2	0	5	4	11
		4	4		1	2		1	6		4	0		0	4			8	
20	1	3	3	3	4	3	4	5	2	4	4	1	3	1	2	0	5	2	10
		9	2		4	6		2	1		3	3		6	5			3	
21	1	4	1	3	4	5	4	5	2	4	4	3	3	1	2	0	4	1	9

An om	0	I			II			III			IV			V			An om.
(G.)	Sub	0	0	Sub	I	I	Sub	I	I	Subt	II	I	Sub	I	V	Sub	(Gr.)
)	G.	'	"	G.	'	"	G.	'	"	r. G.	I'	"	G.	'	"	G.	)
		4	8		7	6		3	1		1	1		2	2		8 0
22	1	4	3	3	5	1	4	5	1	4	3	4	3	8	1	0	4 5 8
		9			1	2		4	6		9	3		5			2 2
23	1	5	4	3	5	2	4	5	5	4	3	5	3	4	5	0	3 3 7
		3	7		4	4		5			7	1					7 3
24	1	5	2	3	5	3	4	5	4	4	3	5	2	5	5	0	3 1 6
		8	9		7	2		5	9		5	4		9	2		2 3
25	2	3	8	4	0	3	4	5	2	4	3	5	2	5	3	0	2 5 5
					6			6	8		3	1		5	5		6 2
26	2	7	4	4	3	3	4	5	1	4	3	4	2	5	1	0	2 3 4
		4			5			7			1	2		1	4		1 0
27	2	1	1	4	6	3	4	5	2	4	2	2	2	4	4	0	1 8 3
		8	8		0			7	9		9	9		6	9		6
28	2	1	5	4	9	2	4	5	5	4	2	1	2	4	2	0	1 4 2
		6	0		1			7	1		7	1		2	1		0 6
29	2	2	2	4	1	8	4	5	8	4	2	4	2	3	5	0	5 2 1
		1	0		2			8			4	8		7	1		3
30	2	2	4	4	1	5	4	5	2	4	2	2	2	3	1	0	0 0 0
		5	7		4	1		8	0		2	0		3	8		

Foot labels (add): XI. Adde. | X. Adde. | IX. Adde. | VIII. Adde. | VII. Adde. | VI. Adde.

TABLE 43. The Equation of the Node, and the Maximum Latitude of the Moon

SUBTRACT

Three sign-pairs head the table: Sign 0 or 6; Sign I or 7; Sign 2 or 8. Under each, two paired columns: *Æquat. ∅* (equation of the node) and *Lat. Max.* (maximum latitude), each in degrees (G.), minutes ('), seconds ("). The left and right margins

carry "*Distantia vera* $\supset a \odot$ " (the true distance of the Moon from the Sun) and the argument in degrees (Gr.). The foot carries the complementary signs (11 *or* 5; 10 *or* 4; 9 *or* 3) under the rubric **ADDE** (add).

[illegible]

0/6 Æquat. ⌘ G.	0/6 Lat.Ma x. G.	I/7 Æquat. ⌘ G.	I/7 Lat.Ma x. G.	2/8 Æquat. ⌘ G.	2/8 Lat.Ma x. G.
1	5	1	5	0	5
1	5	1	5	0	5
1	5	1	5	0	5
1	5	1	5	0	5
1	5	1	5	0	5

Foot labels (add): Sign 11 *vel* 5 | Sign 10 *vel* 4 | Sign 9 *vel* 3 — **ADDE.**

TABLE 44. LATITUDE OF THE MOON

This table is laid out in four panels across two openings; each panel takes a sign-argument (*Signa Argumenti* / *Signa Argum.*) and is keyed to the argument of latitude (*Arg. Latit.*) running 0–30 down and 30–0 up. The column-heads give the degree of the sign (e.g. 4·58, 5·0, 5·5, 5·10, 5·15, 5·18) marking the *Latitudinis Maximæ Termini* (the limits of maximum latitude). Each entry is in degrees (G.), minutes ('), seconds (").

Panel 1 — sign-headers across the top: 0. Latit. Bor. (north latitude); VI. Latit. Austr. (south latitude)

Column groups: 4·58 | 5·0 | 5·5 | 5·10 | 5·15 | 5·18.

G r	4·58	5·0	5·5	5·10	5·15	5·18	G r
. G.	' "	G. ' "	G. ' "	G. ' "	G. ' "	G. ' "	.
0	0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	3 0
1	0	5 1 0 3	5 1 0 4	5 1 0 9	5 2 0 4	5 2 0 9	2 3 9
2	0	1 2 0 0 5	1 2 0 0 7	1 3 0 0 8	1 4 0 0 8	1 5 0 0 9	2 1 5 8
3	0	1 3 0 5 6	1 4 0 5 1	1 5 0 5 7	1 1 0 6 2	1 2 0 6 8	2 1 3 2 6 5 7
4	0	2 4 0	2 5 0	2 1 0	2 3 0	2 5 0	2 2 6 2

G													G						
r	4·58			5·0			5·5			5·10			5·15			5·18			r
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.
		0	7		0	4		1	6		1	6		1	7		2		6
5	0	2	5	0	2	7	0	2	3	0	2	5	0	2	2	0	2	3	2
		5	8		6			6	3		6	9		7	5		7	7	5
6	0	3	9	0	3	1	0	3	5	0	3	2	0	3	5	0	3	8	2
		1			1	9		1	0		2	2		2	3		3		4
7	0	3	1	0	3	3	0	3	8	0	3	4	0	3	2	0	3	5	2
		6	9		6	1		7			7	4		8	1		8	5	3
8	0	4	2	0	4	4	0	4	2	0	4	6	0	4	4	0	4	7	2
		1	9		1	2		2	4		3			3	8		4		2
9	0	4	3	0	4	5	0	4	3	0	4	2	0	4	1	0	4	3	2
		6	8		6	2		7	9		8	6		9	3		9	5	1
1	0	5	4	0	5	2	0	5	5	0	5	4	0	5	3	0	5	3	2
0		1	6		2			2	4		3	6		4	8		5		0
1	0	5	5	0	5	1	0	5	7	0	5	4	1	0	1	1	0	2	1
1		6	3		7	0		8			9							9	9
1	1	1	5	1	2	1	1	3	2	1	4	2	1	5	2	1	5	5	1
2			9			8			0			2			4			4	8
1	1	7	4	1	7	2	1	8	3	1	9	3	1	1	4	1	1	1	1
3						4			1			8		0	5		1	9	7
1	1	1	8	1	1	2	1	1	4	1	1	5	1	1	5	1	1	4	1
4		2			2	9		3	1		4	3		6			6	2	6
1	1	1	1	1	1	3	1	1	5	1	2	7	1	2	2	1	2	3	1
5		7	0		7	3		8	0		0			1	4		2		5
1	1	2	1	1	2	3	1	2	5	1	2	2	1	2	4	1	2	2	1
6		2	1		2	6		3	8		5	1		6	3		7	4	4
1	1	2	1	1	2	3	1	2	4	1	3	3	1	3	0	1	3	4	1
7		7	0		7	7		9			0	2		2			2	2	3
1	1	3	8	1	3	3	1	3	9	1	3	4	1	3	1	1	3	5	1
8		2			2	6		4			5	1		7	3		7	9	2
1	1	3	4	1	3	3	1	3	1	1	4	4	1	4	2	1	4	1	1
9		7			7	4		9	1		0	8		2	6		3	4	1
2	1	4	5	1	4	3	1	4	1	1	4	5	1	4	3	1	4	2	1

G																G			
r	4·58			5·0			5·5			5·10			5·15			5·18			r
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.
0		1	8		2	0		4	2		5	4		7	6		8	7	0
2	1	4	5	1	4	2	1	4	1	1	5	5	1	5	4	1	5	3	9
1		6	1		7	3		9	0		0	7		2	4		3	8	
2	1	5	4	1	5	1	1	5	8	1	5	0	1	5	5	1	5	4	8
2		1	1		2	6		4			6			7	1		8	7	
2	1	5	3	1	5	6	1	5	3	2	0	5	2	2	5	2	3	5	7
3		6	0		7			9			9			6			3		
2	2	1	1	2	1	5	2	3	5	2	5	5	2	7	5	2	8	5	6
4			7			4			6			7			9			9	
2	2	6	1	2	6	3	2	8	4	2	1	5	2	1	5	2	1	1	5
5						9			5		0	1		2	8		4		
2	2	1	4	2	1	2	2	1	3	2	1	4	2	1	5	2	1	1	4
6		0	3		1	2		3	3		5	5		7	6		9		
2	2	1	2	2	1	4	2	1	2	2	2	3	2	2	5	2	2	5	3
7		5	3		6			8	0		0	5		2	1		3	8	
2	2	2	0	2	1	4	2	2	2	2	2	2	2	2	4	2	2	5	2
8		0			0	2		3			5	3		7	4		8	3	
2	2	2	3	2	2	1	2	2	4	2	3	8	2	3	3	2	3	4	1
9		4	4		5	8		7	3		0			2	3		3	5	
3	2	2	6	2	2	5	2	3	2	2	3	5	2	3	2	2	3	3	0
0		9			9	2		2	2		4	1		7	0		8	4	

Foot labels: Signa Argum. — XI. Latit. Austr. | V. Latit. Bor.

Panel 2 — sign-headers: XI. Latit. Austr.; I. Latitudo Bor.; V. Latit. Bor.; VII. Latit. Austr.

Column groups: 4·58 | 5·0 | 5·5 | 5·10 | 5·15 | 5·18.

G																G												
r	4·58				5·0				5·5				5·10				5·15				5·18				r			
.	G.		'	"	G.		'	"	G.		'	"	G.		'	"	G.		'	"	G.		'	"	.			
0	2				2	6	2		2	5	2		3	2	2		3	5	2		3	2	2		3	3	3	
						9				9	2			2	2			4	1			7	0			8	4	0

G																G			
r	4·58			5·0			5·5			5·10			5·15			5·18			r
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.
1	2	3	3	2	3	2	2	3	5	2	3	3	2	4	5	2	4	2	2
		3	6		4	3		6	7		9	1		2			3	1	9
2	2	3	3	2	3	5	2	4	1	2	4	7	2	4	4	2	4	5	2
		8			8	0		1	9		4			6	6		8		8
3	2	4	2	2	4	1	2	4	5	2	4	4	2	5	2	2	5	4	2
		2	6		3	5		5	8		8	1		1	4		2	4	7
4	2	4	4	2	4	3	2	5	2	2	5	1	2	5	0	2	5	2	2
		6	6		7	7		0	5		3	2		6			7	1	6
5	2	5	4	2	5	5	2	5	4	2	5	3	3	0	3	3	1	5	2
		1			1	6		4	7		7	9		0			5	5	
6	2	5	1	2	5	1	2	5	8	3	2	4	3	6	2	3	6	2	2
		5	9		6	2		9						6			6	4	
7	2	5	3	3	0	2	3	3	2	3	6	2	3	1	5	3	1	1	2
		9	0		4			4			4			0	3		2	7	3
8	3	3	3	3	4	3	3	7	3	3	1	4	3	1	4	3	1	1	2
		8			3			7			0	1		3	5		5	7	2
9	3	7	4	3	8	3	3	1	4	3	1	5	3	1	4	3	1	3	2
		3			9			1	7		4	6		8			9	8	1
1	3	1	4	3	1	4	3	1	5	3	1	7	3	2	2	3	2	5	2
0		1	4		2	2		5	4		9			2	0		3	5	0
1	3	1	4	3	1	4	3	1	5	3	2	1	3	2	2	3	2	8	1
1		5	2		6	1		9	7		3	3		6	9		8		9
1	3	1	3	3	2	3	3	2	5	3	2	1	3	3	3	3	3	1	1
2		9	6		0	6		3	6		7	6		0	6		2	7	8
1	3	2	2	3	2	2	3	2	5	3	3	1	3	3	4	3	3	2	1
3		3	6		4	8		7	2		1	6		4	0		6	2	7
1	3	2	1	3	2	1	3	3	4	3	3	1	3	3	4	3	4	2	1
4		7	3		8	6		1	4		5	2		8	0		0	3	6
1	3	3	5	3	3	0	3	3	3	3	3	3	3	4	3	3	4	2	1
5		0	6		2			5	1		9			2	4		4	0	5
1	3	3	3	3	3	4	3	3	1	3	4	5	3	4	2	3	4	1	1
6		4	5		5	0		9	6		2	1		6	7		8	3	4

G																G									
r	4·58			5·0			5·5			5·10			5·15			5·18			r						
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.						
1	3		3	1	3		3	1	3		4	5	3		4	3	3		5	1	3		5	2	1
7			8	0			9	7			2	6			6	5			0	4			2		3
1	3		4	4	3		4	4	3		4	3	3		5	1	3		5	5	3		5	4	1
8			1	2			2	9			6	2			0	4			3	6			5	7	2
1	3		4	7	3		4	1	3		5	4	3		5	5	3		5	3	3		5	2	1
9			5				6	8			0				3	0			7	6			9	5	1
2	3		4	3	3		4	4	3		5	3	3		5	2	4		0	4	4		3	1	1
0			8	0			9	3			3	3			7	2				7					0
2	3		5	5	3		5	2	3		5	5	4		0	4	4		4	4	4		6	3	9
1			1	2			3				6	5				7				0				6	
2	3		5	9	3		5	1	4		0	1	4		4	1	4		8	6	4		1	6	8
2			5				6	8				4				0							0		
2	3		5	1	3		5	2	4		3	2	4		7	2	4		1	2	4		1	2	7
3			8	9			9	9				8				7			1	6			3	8	
2	4		1	2	4		2	3	4		6	3	4		1	4	4		1	4	4		1	4	6
4				3				6				8			0	0			4	2			6	4	
2	4		4	2	4		5	3	4		9	4	4		1	5	4		1	5	4		1	5	5
5				4				9				4			3	0			7	6			9	6	
2	4		7	2	4		8	3	4		1	4	4		1	5	4		2	1	4		2	4	4
6				1				7			2	5			6	3			1				3		
2	4		1	1	4		1	3	4		1	4	4		1	5	4		2	3	4		2	9	3
7			0	5			1	0			5	1			9	2			4				6		
2	4		1	5	4		1	1	4		1	3	4		2	4	4		2	1	4		2	1	2
8			3				4	9			8	3			2	7			7				9	0	
2	4		1	4	4		1	3	4		2	1	4		2	3	4		2	5	4		3	4	1
9			5	9			7				1	9			5	6			9	2			2		
3	4		1	2	4		1	4	4		2	3	4		2	2	4		3	4	4		3	5	0
0			8	6			9	3			4				8	2			2	2			4	1	

Foot labels: Signa Argum. — X. Latit. Austr. | IV. Latit. Bor.

TABLE 44. *Residuum* (continued)

Panel 3 — sign-headers: II. Latitudo Bor.; VIII. Latit. Austr.

Column groups: 5·58 | 5·0 | 5·5 | 5·10 | 5·15 | 5·18.

G	5·58			5·0			5·5			5·10			5·15			5·18			G
r	5·58			5·0			5·5			5·10			5·15			5·18			r
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.
0	4	1	2	4	1	4	4	2	3	4	2	2	4	3	4	4	3	5	3
		8	6		9	3		4			8	2		2	2		4	1	0
1	4	2	5	4	2	1	4	2	4	4	3	3	4	3	2	4	3	3	2
		0	9		2	8		6	0		1			5	5		7	4	9
2	4	2	2	4	2	4	4	2	1	4	3	3	4	3	3	4	4	1	2
		3	8		4	9		9	4		3	8		8			0	3	8
3	4	2	5	4	2	1	4	3	4	4	3	8	4	4	3	4	4	4	2
		5	3		7	4		1	1		6			0	5		2	8	7
4	4	2	1	4	2	3	4	3	3	4	3	3	4	4	3	4	4	1	2
		8	3		9	4		4			8	3		3			5	7	6
5	4	3	2	4	3	4	4	3	2	4	4	5	4	4	2	4	4	4	2
		0	8		1	9		6	0		0	2		5	4		7	0	5
6	4	3	3	4	3	0	4	3	3	4	4	8	4	4	4	4	4	5	2
		2	8		4			8	4		3			7	2		9	8	4
7	4	3	4	4	3	6	4	4	4	4	4	1	4	4	5	4	5	1	2
		4	3		6			0	2		5	8		9	4		2	1	3
8	4	3	4	4	3	6	4	4	4	4	4	2	4	5	0	4	5	1	2
		6	3		8			2	4		7	2		2			4	9	2
9	4	3	3	4	4	2	4	4	4	4	4	2	4	5	2	4	5	2	2
		8	8		0			4	2		9	2		4			6	1	1
1	4	4	2	4	4	5	4	4	3	4	5	1	4	5	5	4	5	1	2
0		0	7		1	2		6	3		1	5		5	7		8	8	0
1	4	4	1	4	4	3	4	4	2	4	5	4	4	5	4	5	0	9	1
1		2	1		3	7		8	0		3			7	7				9
1	4	4	5	4	4	1	4	5	2	4	5	4	4	5	3	5	1	5	1
2		3	0		5	7		0			4	7		9	2				8
1	4	4	2	4	4	5	4	5	3	4	5	2	5	1	1	5	3	3	1

G													G
r	5·58		5·0		5·5		5·10		5·15		5·18		r
.	G.	'	"	G.	'	"	G.	'	"	G.	'	"	.
3		5	3		6	2		1	9		6	5	
1 4		4	5	4	4	2	4	5	1	4	5	5	5
4		6	2		8	1		3	0		7	8	
1 4		4	1	4	4	4	4	5	3	4	5	2	5
5		8	8		9	5		4	5		9	4	
1 4		4	3	4	5	4	4	5	5	5	0	4	5
6		9	5		1			5	5		6		
1 4		5	4	4	5	1	4	5	1	5	2	2	5
7		0	9		2	8		7	0				
1 4		5	5	4	5	2	4	5	1	5	3	1	5
8		1	8		3	5		8	8		2		
1 4		5	0	4	5	2	4	5	2	5	4	1	5
9		3			4	9		9	3		8		
2 4		5	5	4	5	2	5	0	2	5	5	1	5
0		3	7		5	6		1			7		
2 4		5	4	4	5	1	5	1	1	5	6	1	5
1		4	9		6	8		4			0		
2 4		5	3	4	5	4	5	2	1	5	6	5	5
2		5	6		7						8		
2 4		5	1	4	5	4	5	2	4	5	7	4	5
3		6	7		7	5		2			0		
2 4		5	5	4	5	2	5	3	2	5	8	1	5
4		6	2		8	1		0			8		
2 4		5	2	4	5	5	5	3	5	5	8	4	5
5		7	2		8	1		0			9		
2 4		5	4	4	5	1	5	4	1	5	9	1	5
6		7	6		9	6		5			4		
2 4		5	5	4	5	3	5	4	3	5	9	3	5
7		8			9	5		4			4		
2 4		5	1	4	5	4	5	4	4	5	9	4	5
8		8	8		9	9		9			9		
2 4		5	2	4	5	5	5	4	5	5	9	5	5

G r .	5·58 G.	'	"	5·0 G.	'	"	5·5 G.	'	"	5·10 G.	'	"	5·15 G.	'	"	5·18 G.	'	"	G r .		
9		8	6		9	7		7		7		4	7		7	5					
3	4		5	3	5		0	0	5		5	0	5		1	0	5		1	3	0
0			8	0								0			5				7	0	

Foot labels: Signa Argum. — IX. Latit. Austr. | III. Latit. Bor.

TABLE 45. The Reduction of the True Place [of the Moon] to the Ecliptic

Sign-pairs head three column-groups: Sig. 0 *or* 6; 1 *or* 7; 2 *or* 8 — all under the rubric **Subtrahe** (subtract). The complementary signs (11; 10; 9) head the foot under **Adde** (add). Entries are in minutes (') and seconds ("); the argument (*Argum.*) runs 0–30 down and 30–0 up.

Argum. (G.)	0/6 '	"	1/7 '	"	2/8 '	"	Argum. (G.)
0	0	0	6	6	6	5	30
1	0	15	6	12	5	54	29
2	0	30	6	18	5	48	28
3	0	45	6	24	5	39	27
4	0	59	6	29	5	30	26
5	1	13	6	35	5	21	25
6	1	27	6	40	5	12	24
7	1	42	6	44	5	1	23
8	1	56	6	47	4	51	22
9	2	10	6	51	4	40	21
10	2	24	6	54	4	29	20
11	2	38	6	56	4	18	19
12	2	52	6	57	4	7	18
13	3	6	6	58	3	55	17
14	3	19	6	59	3	42	16
15	3	32	7	0	3	31	15

Argum. (G.)	0/6 ' "	1/7 ' "	2/8 ' "	Argum. (G.)
16	3	43 6	59 3	18 14
17	3	56 6	58 3	5 13
18	4	8 6	57 2	51 12
19	4	19 6	56 2	38 11
20	4	30 6	54 2	23 10
21	4	41 6	51 2	9 9
22	4	52 6	47 1	55 8
23	5	2 6	44 1	41 7
24	5	12 6	40 1	26 6
25	5	22 6	35 1	12 5
26	5	31 6	28 0	58 4
27	5	40 6	23 0	45 3
28	5	49 6	17 0	30 2
29	5	58 6	11 0	15 1
30	6	6 6	5 0	0 0

Foot labels (add): 11 / 5 | 10 / 4 | 9 / 3 — **Adde.**

TABLE 46. The Critical [Points] of Eclipses

Argument of latitude (*Argum. Latitud.*) by sign (*Sig.*) and degree (G.). Columns: *Latitudo Vera* ∩ (the true latitude of the Moon); *Arcus verus inter cætera* (the true arc between the rest); *Arcus inter momenta* (the arc between the moments); *Tempus addendum* (the time to be added) — each in degrees/minutes/seconds as headed. The left margin reads "o *Latit. Bor. Descend.* / 6 *Latit. Austr. Ascend.*" (0: north latitude, descending; 6: south latitude, ascending); the right margin reads "*Sign. 5 Latit. Austr. Descend.* / *Sign. 11 Latit. Bor. Ascend.*" The right *Argum. Latitud.* runs 29–12 up.

S
i

g .	Latit. Vera ∩ G.	Arc. verus ' " inter cæt. G.	Arc. inter ' " mom. '	Tempus " add. '	Argum. " Latit. (G.)
0	0	5 1 0	5 1 0	1 0	2 29
		4	3	5	8

S						
i						
g	Latit. Vera	Arc. verus	Arc. inter	Tempus	Argum.	
.	» G.	' " inter cæt. G.	' " mom. '	" add. '	" Latit. (G.)	
0	0	1 2 0	1 2 0	3 0	5 28	
		0 7	0 5	0	6	
0	0	1 4 0	1 3 0	4 1	2 27	
		5 1	5 9	5	4	
0	0	2 5 0	2 5 0	5 1	5 26	
		0 4	0 2	9	1	
0	0	2 7 0	2 5 1	1 2	1 25	
		6	6	3	6	
0	0	3 1 0	3 1 1	2 2	4 24	
		1 9	1 6	7	2	
0	0	3 3 0	3 2 1	4 3	9 23	
		6 1	6 8	2		
0	0	4 4 0	4 3 1	5 3	3 22	
		1 2	1 9	6	4	
0	0	4 5 0	4 4 2	1 3	5 21	
		6 2	6 9	0	9	
0	0	5 2 0	5 5 2	2 4	2 20	
		2	1 9	4	4	
0	0	5 1 0	5 6 2	3 4	4 19	
		7 0	7	8	9	
0	1	2 1 1	2 1 2	5 5	1 18	
		8	3	2	4	
1	1	7 2 1	7 1 3	6 5	3 17	
		4	8		9	
1	1	1 2 1	1 2 3	1 6	3 16	
		2 9	2 2	9		
1	1	1 3 1	1 2 3	3 6	2 15	
		7 3	7 5	2	7	
1	1	2 3 1	2 2 3	4 6	4 14	
		2 6	2 7	4	9	
1	1	2 3 1	2 2 3	5 7	1 13	

S						
i						
g	Latit. Vera	Arc. verus	Arc. inter	Tempus	Argum.	
.	ᵀ G.	' " inter cæt. G.	' " mom. '	" add. '	" Latit. (G.)	
		7 7	7 7	6	1	
1	1	3 3 1	3 2 4	8 7	3 12	
		2 6	2 6		3	

TAB. 47 — The Final (Composite) Equation of the Moon

This is a double-entry table. Each half-page panel is read in two directions: top-to-bottom for the sign named in the panel header (with the distance arguments running 3 → 30 along the top), and bottom-to-top for the complementary sign named in the panel footer (with the distance arguments running 27 → 0 along the bottom). The argument across the columns is the Moon's distance from the Sun [*Distantia* ᵀ *a* ☉] — that is, its elongation toward quadrature (☐), conjunction (♌), or opposition (♍). The argument down the left/right is the **first-equated anomaly** [*Anomalia primò Aequata*], given in signs (*Sig.*) and degrees (*G.*). Each cell gives the equation in degrees (*G.*) and minutes (*'*). The marginal letters **A.** and **S.** mark, respectively, where a column's values turn (the small inline rubrics in the body; transcribed verbatim as printed). The instruction band beneath each panel reads, for the *Subt.* (subtract) panels: *Supra Scalam Subtrahitur Ascendendo, infra verò Descendendo* — "Above the scale it is subtracted when ascending, below it when descending"; and for the *Adde* (add) panels the corresponding *Additur / Subtrahitur* rubric as printed.

Page 53 (p. 53) — SIGNUM 0 / SIGNA 5

Panel 1 (upper): SIGNUM 0 — *Distantiae* ᵀ *a* ☉, *vel eius* ♌ *ad* ☐

Column heads: distance = 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Subt.**).
Read top-down for **Signum 0**; read bottom-up for **Signa 5** (footer distances 27, 24, 21, 18, 15, 12, 9, 6, 3, 0).

S i g	3 (°)	6 (°)	9 (°)	12 (°)	15 (°)	18 (°)	21 (°)	24 (°)	27 (°)	30 (°)	S i G g
0	0·3	0·7	0· 10	0·13	0·16	0·19	0·21	0·23	0·25	0·27	3 0
	0·3	7	10	13	17	20	23	26	28	31	2 4
	0·3	7	10	14	17	21	24	28	31	34	1 8
	0·3	6	10	14	17	21	25	29	32	36	1 2
	0·3	6	9	13	17	21	25	29	33	37	6
	0·3	0·5	0·9	0·12	0·16	0·20	0·25	0·29	0·33	0·38	0 1 1
1	0·2	0·5	0·8	0·11	0·15	0·19	0·24	0·28	0·33	0·38	2 4
	0·2	4	7	10	13	18	22	27	32	37	1 8
	0·1	3	5	8	12	16	20	25	30	35	1 2
	0·1	2	4	6	9	13	17	22	27	33	6
	0·A. 0	0·1	0·2	0·4	0·7	0·10	0·14	0·19	0·24	0·29	0 1 0
2	0·1	0·A. 1	0·A. 0	0·2	0·4	0·7	0·11	0·15	0·20	0·25	2 4
	0·1	0·2	2	0·A. 1	1	3	7	11	15	21	1 8
	0·2	3	4	4	0·A. 2	0·A. 1	3	7	10	15	1 2
	0·3	5	6	7	6	5	0·A. 3	1	5	10	6
	0·4	0·7	0·9	0·10	0·10	0·9	0·8	0·A. 5	0·A. 1	0·3	0 9
3	0·5	0·8	0· 11	0·13	0·14	0·14	0·13	0·11	0·8	0·A. 4	2 4

S i g	3 (°)	6 (°)	9 (°)	12 (°)	15 (°)	18 (°)	21 (°)	24 (°)	27 (°)	30 (°)	S i g
	0·5	10	14	16	18	19	18	17	15	11	1 8
	0·6	12	16	20	22	24	24	24	22	19	1 2
	0·7	13	19	23	26	29	30	30	29	27	6
	0·8	0· 15	0· 21	0·26	0·30	0·34	0·36	0·37	0·36	0·35	0 8
4	0·9	0· 16	0· 23	0·29	0·34	0·38	0·41	0·43	0·44	0·43	2 4
	0·9	18	25	32	38	43	47	50	51	51	1 8
	0· 10	19	27	35	42	48	52	56	58	59	1 2
	0· 10	20	29	38	45	52	57	1·2	1·1	1·7	6
	0· 11	0· 21	0· 31	0·40	0·48	0·56	1·2	1·7	1·11	1·14	0 7
5	0· 11	0· 22	0· 33	0·42	0·51	0·59	1·6	1·12	1·17	1·21	2 4
	0· 12	23	34	44	54	1·2	1·10	1·17	1·23	1·27	1 8
	0· 12	24	35	46	56	1·5	1·14	1·21	1·28	1·33	1 2
	0· 12	24	36	47	57	1·7	1·17	1·25	1·32	1·38	6
	0· 12	0· 24	0· 36	0·48	0·59	1·9	1·19	1·28	1·36	1·42	0 6
G r .	27	24	21	18	15	12	9	6	3	0	G r .

Footer band: **SIGNA 5. Distantiae** $\gg a \odot a \square ad \phi, vel \phi^\circ$ — *Supra Scalam Additur Ascendendo, infra verò Descendendo* ("Above the scale it is added when ascending, below it when descending").

Panel 2 (lower): **SIGNUM 0** — *Distantiae* $\gg a \odot a \square ad \phi, vel \phi^\circ$ (additive)

Column heads: distance = 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Adde**).
Read top-down for **Signum 0** (signs 6–11); read bottom-up for **Signa 5** (footer distances 27, 24, 21, 18, 15, 12, 9, 6, 3, 0).

S i g	3 (°)	6 (°)	9 (°)	12 (°)	15 (°)	18 (°)	21 (°)	24 (°)	27 (°)	30 (°)	S i g
6	0 · 12	0 · 24	0 · 36	0 · 48	0 · 59	1 · 9	1 · 19	1 · 28	1 · 36	1 · 42	3 0
	12	24	36	48	1 · 0	1 · 10	1 · 20	1 · 30	1 · 38	1 · 46	2 4
	12	24	36	48	1 · 0	1 · 11	1 · 22	1 · 32	1 · 40	1 · 49	1 8
	12	24	36	48	1 · 0	1 · 11	1 · 22	1 · 32	1 · 42	1 · 51	1 2
	12	24	36	48	59	1 · 11	1 · 22	1 · 33	1 · 42	1 · 52	6
	0 · 11	0 · 23	0 · 35	0 · 47	58	1 · 10	1 · 21	1 · 32	1 · 42	1 · 52	0 5
7	0 · 11	0 · 22	0 · 34	0 · 45	0 · 57	1 · 9	1 · 20	1 · 31	1 · 41	1 · 51	2 4
	10	21	32	44	55	7	18	29	39	49	1 8
	10	20	31	42	53	4	15	26	37	47	1 2
	9	0 · 19	29	40	50	1 · 1	1 · 12	23	34	44	6
	0 · 8	0 · 18	0 · 27	0 · 37	0 · 48	0 · 58	9	1 · 19	1 · 30	1 · 40	0 4
8	0 · 8	0 · 16	0 · 25	0 · 35	0 · 44	0 · 55	1 · 5	1 · 15	1 · 25	1 · 35	2 4

S i g	3 (°)	6 (°)	9 (°)	12 (°)	15 (°)	18 (°)	21 (°)	24 (°)	27 (°)	30 (°)	S i G g
	7	15	23	32	41	51	1 · 1	1 · 11	20	30	1 8
	6	13	21	28	37	47	56	6	16	25	1 2
	5	12	18	26	34	42	51	1 · 0	9	18	6
	0 · 4	0 · 10	0 · 16	0 · 23	0 · 30	0 · 38	0 · 46	0 · 54	1 · 1	1 · 12	0 3
9	0 · 4	0 · 8	0 · 14	0 · 20	0 · 26	0 · 33	0 · 41	0 · 48	0 · 57	1 · 5	2 4
	3	7	11	16	22	29	35	42	50	58	1 8
	2	5	9	13	18	24	30	36	43	50	1 2
	1	4	6	10	14	19	24	30	36	43	6
	0 · 1	0 · 2	0 · 4	0 · 7	0 · 10	0 · 14	0 · 19	0 · 24	0 · 29	0 · 35	0 2
1 0	0 · 1	0 · 1	0 · 2	0 · 4	0 · 7	0 · 10	0 · 14	0 · 18	0 · 23	0 · 28	2 4
	0 · S. 0	0 · S. 0	0 · S. 0	0 · 1	0 · 3	0 · 6	0 · 9	0 · 12	0 · 16	0 · 20	1 8
	0 · 1	1	2	0 · S. 1	0 · S. 0	0 · 1	0 · 4	0 · 6	0 · 9	0 · 13	1 2
	0 · 2	2	3	3	0 · 3	0 · S. 2	0 · S. 1	0 · 0	0 · 3	0 · 6	6
	0 · 2	0 · 4	0 · 5	0 · 6	0 · 6	0 · 6	0 · 5	0 · S. 4	0 · S. 3	0 · S. 1	0 1
1 1	0 · 2	0 · 5	0 · 6	0 · 9	0 · 9	0 · 9	0 · 9	0 · 9	0 · 8	0 · 7	2 4
	3	5	8	11	12	13	13	13	13	18	1 8
	3	6	9	13	13	15	16	17	18	18	1 2
	3	6	9	12	15	17	19	21	23	25	6

S											S
i											i
g	3 (°)	6 (°)	9 (°)	12 (°)	15 (°)	18 (°)	21 (°)	24 (°)	27 (°)	30 (°)	G g
	0 · 3	0 · 7	0 · 10	0 · 13	0 · 16	0 · 19	0 · 21	0 · 23	0 · 25	0 · 26	0 0
G	27	24	21	18	15	12	9	6	3	0	G
r											r
.											.

Footer band: **SIGNA 5. Dist.** › **a** ☉ **a** □ **ad** ♂, **vel** ♀ — *Supra Scalam Subtrahitur Ascendendo, infra autem Descendendo.*

Page 54 (p. 54) — SIGNUM I / SIGNA IV

**** **[Table title: Residuum TABULA 47. Aequationis** › *Ultima* — "Continuation of Table 47, of the Final Equation of the Moon."]

Panel 3 (upper): SIGNUM I — *Distantiae* › **a** ☉, *vel eius* ♀ **ad** □

Column heads: distance = 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Subt.**).
Read top-down for **Signum I**; read bottom-up for **Signa IV** (footer distances 30, 27, 24, 21, 18, 15, 12, 9, 6, 3, 0).

Sig G 0 (°) 3 (°) 6 (°) 9 (°) 12 (°) 15 (°) 18 (°) 21 (°) 24 (°) 27 (°) 30 (°) G Sig	--- --- --- --- --- --- --- --- --- --- --- --- ---	0 0 0
· 27 0 · 29 0 · 30 0 · 30 0 · 31 0 · 31 0 · 30 0 · 30 0 · 29 0 · 27 0 · 26		
30 6 31 33 35 36 37 38 38 38 38 37 37 24 12 34		
36 39 41 43 44 46 46 47 47 47 18 18 36 39 42 45		
48 50 52 54 55 56 56 12 24 37 41 45 48 52 55 57 1 ·		
0 1 · 2 1 · 4 1 · 5 6 30 38 0 · 42 0 · 47 0 · 52 0 · 55 0 · 58 1 · 2		
1 · 5 1 · 8 1 · 10 1 · 12 0 11 1 6 0 · 38 0 · 42 0 · 47 0 · 50 0 · 57		
1 · 1 1 · 5 1 · 9 1 · 13 1 · 16 1 · 19 24 12 37 42 47 52 58 3		
7 12 16 20 24 18 18 35 40 46 52 57 3 9 14 19 24		
28 12 24 33 38 44 50 56 3 9 14 20 26 31 6 30		
29 0 · 35 0 · 41 0 · 48 0 · 54 1 · 1 1 · 7 1 · 14 1 · 20 1 · 26 1 · 32 0		
10 2 6 0 · 25 0 · 31 0 · 38 0 · 44 0 · 51 0 · 58 1 · 5 1 · 12 1 · 19 1 ·		
26 1 · 32 24 12 21 27 33 40 47 54 1 · 1 1 · 9 1 · 17 1 · 24		
1 · 31 18 18 15 21 27 34 41 49 57 1 · 5 1 · 13 1 · 21 1 · 29		
12 24 10 15 21 28 35 43 51 1 · 0 1 · 7 1 · 16 1 · 24 6		
30 0 · A. 3 0 · 8 0 · 14 0 · 21 0 · 28 0 · 36 0 · 44 0 · 52 1 · 1 1 · 10		
1 · 19 0 9 3 6 0 · 4 0 · 1 0 · A. 6 0 · 13 0 · 20 0 · 28 0 · 36 0 · 44		

0 · 54 | 1 · 3 | 1 · 12 | 24 | | | 12 | 11 | 0 · A. 7 | 0 · A. 2 | 4 | 11 | 19 | 27 | 36 | 45
 | 55 | 1 · 4 | 18 | | | 18 | 19 | 15 | 10 | 0 · A. 5 | 2 | 10 | 17 | 26 | 35 | 45 | 55 |
 12 | | | 24 | 27 | 24 | 20 | 14 | 0 · A. 8 | 0 · A. 1 | 7 | 15 | 25 | 34 | 44 | 6 | | |
 30 | 35 | 0 · 33 | 0 · 29 | 0 · 24 | 0 · 19 | 0 · 12 | 0 · A. 4 | 0 · 4 | 0 · 13 | 0 · 23 | 0 · 33
 | 0 | 8 | | 4 | 6 | 0 · 43 | 0 · 41 | 0 · 38 | 0 · 34 | 0 · 29 | 0 · 23 | 0 · 16 | 0 · A. 8 | 0 ·
 A. 0 | 0 · 11 | 0 · 20 | 24 | | | 12 | 51 | 50 | 48 | 45 | 40 | 35 | 28 | 21 | 0 · A. 12 |
 0 · A. 3 | 0 · 7 | 18 | | | 18 | 59 | 59 | 58 | 55 | 51 | 46 | 40 | 33 | 25 | 17 | 0 · A.
 7 | 12 | | | 24 | 1 · 7 | 1 · 8 | 1 · 7 | 1 · 5 | 1 · 1 | 58 | 53 | 46 | 38 | 30 | 21 | 6 | |
 | | 30 | 1 · 14 | 1 · 16 | 1 · 16 | 1 · 15 | 1 · 13 | 1 · 9 | 1 · 2 | 59 | 52 | 44 | 35 | 0 | 7
 | | 5 | 6 | 1 · 21 | 1 · 24 | 1 · 24 | 1 · 24 | 1 · 21 | 1 · 17 | 1 · 11 | 1 · 4 | 58 | 50 | 50 |
 24 | | | 12 | 27 | 31 | 32 | 34 | 33 | 31 | 28 | 24 | 18 | 12 | 4 | 18 | | | 18 | 33
 | 37 | 39 | 43 | 42 | 41 | 39 | 36 | 31 | 25 | 18 | 12 | | | 24 | 38 | 43 | 45 | 49 |
 49 | 50 | 51 | 49 | 47 | 43 | 31 | 6 | | | 30 | 1 · 42 | 1 · 48 | 1 · 51 | 1 · 56 | 1 · 58
 | 1 · 59 | 1 · 59 | 1 · 59 | 1 · 57 | 1 · 54 | 1 · 44 | 0 | 6 | | **Gr.** | | **30** | **27** | **24** | **21** |
18 | **15** | **12** | **9** | **6** | **3** | **0** | **Gr.** | |

Footer band: **SIGNA IV. Distantiae** $\mathfrak{D}$ **a** $\odot$ **a** $\square$ **ad** ϕ , **vel** ϕ — *Supra Scalam*
Additur in Ascensu, infra autem Additur in Descensu.

Panel 4 (lower): SIGNUM I — Distantiae $\mathfrak{D}$ **a** $\odot$ **a** $\square$ **ad** ϕ , **vel eius** ϕ
 (additive)

Column heads: distance = 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Adde**).
 Read top-down for **Signum I**; read bottom-up for **Signa IV** (footer distances 30,
 27, 24, 21, 18, 15, 12, 9, 6, 3, 0).

| Sig | G | 0 (°) | 3 (°) | 6 (°) | 9 (°) | 12 (°) | 15 (°) | 18 (°) | 21 (°) | 24 (°) | 27 (°)
 ') | 30 (°) | G | Sig | |---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---| | 6 | 0 | 1
 · 42 | 1 · 48 | 1 · 53 | 1 · 56 | 1 · 58 | 1 · 59 | 1 · 59 | 1 · 57 | 1 · 54 | 1 · 50 | 1 · 44 |
 30 | | | 6 | 46 | 53 | 58 | 2 · 2 | 2 · 5 | 2 · 7 | 2 · 7 | 2 · 6 | 2 · 2 | 1 · 56 | 1 · 56 | 24
 | | | 12 | 49 | 56 | 2 · 2 | 7 | 11 | 13 | 15 | 14 | 11 | 7 | 2 · 7 | 18 | | | 18 | 51 |
 58 | 2 · 5 | 11 | 15 | 19 | 21 | 22 | 21 | 17 | 2 · 11 | 12 | | | 24 | 52 | 2 · 0 | 7 | 14
 | 19 | 23 | 26 | 28 | 27 | 25 | 2 · 17 | 6 | | | 30 | 1 · 52 | 2 · 0 | 8 | 15 | 21 | 26 |
 30 | 32 | 34 | 33 | 2 · 21 | 0 | 5 | | 7 | 6 | 1 · 51 | 2 · 0 | 8 | 16 | 22 | 28 | 32 | 35 |
 38 | 38 | 2 · 38 | 24 | | | 12 | 49 | 1 · 59 | 7 | 15 | 22 | 28 | 33 | 37 | 40 | 41 | 42
 | 18 | | | 18 | 47 | 57 | 6 | 14 | 21 | 28 | 33 | 38 | 41 | 44 | 45 | 12 | | | 24 | 1
 · 44 | 54 | 3 | 11 | 19 | 26 | 32 | 37 | 41 | 44 | 46 | 6 | | | 30 | 1 · 40 | 1 · 50 | 1 ·
 59 | 8 | 16 | 23 | 30 | 35 | 40 | 44 | 2 · 46 | 0 | 4 | | 8 | 6 | 1 · 35 | 1 · 45 | 1 · 54 |
 2 · 3 | 2 · 12 | 2 · 19 | 2 · 26 | 2 · 32 | 2 · 37 | 2 · 42 | 2 · 45 | 24 | | | 12 | 30 | 40 |
 49 | 58 | 6 | 14 | 21 | 28 | 33 | 38 | 42 | 18 | | | 18 | 24 | 34 | 43 | 52 | 2 · 0 | 8
 | 15 | 22 | 28 | 33 | 37 | 12 | | | 24 | 18 | 27 | 36 | 45 | 1 · 53 | 2 · 1 | 9 | 16 | 22

	27		32		6				30		1·12		1·20		1·29		1·38		1·46		1·54		2·2		8		14
	20		2·25		0		3		9		6		1·5		1·13		1·21		1·29		1·37		1·45		1·53		2
·	0		2·7		2·12		2·17		24				12		0·58		1·5		13		21		29		36		43
	1·57		3		8		18				18		0·50		0·57		1·5		12		20		27		34		41
	58		1·58		12				24		0·43		49		56		1·3		11		18		25		32		38
	6				30		0·35		0·41		0·47		0·54		1·0		1·7		1·13		1·19		1·24		1·		
28		1·33		0		2			10		6		0·28		0·33		0·38		0·44		0·50		0·56		1·2		1·
8		1·14		1·19		1·24		24				12		20		25		30		35		40		46		51	
·	0		1·5		1·11		18				18		13		17		21		26		30		35		40		45
58		12				24		6		9		13		16		21		25		29		34		38		43	
	0·S.1		0·2		0·4		0·8		0·11		0·15		0·18		0·22		0·27		0·31		0·35		0				
	1			11		6		0·7		0·S.5		0·S.3		0·S.1		0·2		0·5		0·8		0·11		0·14		0	
·	18		0·22		24				12		13		12		11		9		0·S.8		0·S.5		0·S.2		0·0		4
	1·14		18				18		18		18		18		17		16		14		12		10		0·S.8		13
			24		23		24		24		24		23		23		22		20		19		26		26		6
	0·29		0·30		0·31		0·31		0·31		0·30		0·30		0·30		0·28		0·27		0·26		0		0		
			Gr.				30		27		24		21		18		15		12		9		6		3		0
			Gr.																								

Footer band: **SIGNA IV. Dist.** $\gg$ **a** $\odot$ **a** $\square$ **ad** ϕ , **vel** ϕ — *Supra Scalam Subtrahitur in Ascensu, infra vero Descendendo.*

Page 55 (p. 55) — SIGNA II / SIGNA III

**** **[Table title: Residuum TABULAE 47. Aequationis** $\gg$ *Ultima* — "Continuation of Table 47, of the Final Equation of the Moon."]

Panel 5 (upper): SIGNA II — *Distantiae* $\gg$ **a** $\odot$, *vel eius* ϕ *ad* $\square$

Column heads: distance = 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Subt.**).
Read top-down for **Signa II**; read bottom-up for **Signa III** (footer distances 30, 27, 24, 21, 18, 15, 12, 9, 6, 3, 0).

	Sig		G		0 (°)		3 (°)		6 (°)		9 (°)		12 (°)		15 (°)		18 (°)		21 (°)		24 (°)		27 (°)					
·	26		0·24		0·22		0·20		0·17		0·15		0·12		0·9		0·6		0·3		0·0		30					
			6		37		36		34		32		30		28		26		23		20		18		15		12	
46		44		43		41		39		37		34		32		29		18				18		56		56		55
	52		50		48		46		43		12				24		1·5		1·6		1·6		1·6		1·5		1·4	
	1·3		1·1		0·59		0·57		6				30		1·12		1·14		1·15		1·16		1·17		1·			
16		1·16		1·15		1·14		1·12		1·10		0		11			1		6		1·19		1·21		1·23		1	
·	24		1·26		1·27		1·27		1·26		1·25		1·23		1·23		24				12		24		27			

30 | 32 | 34 | 36 | 36 | 37 | 36 | 35 | 32 | 18 | | | 18 | 28 | 32 | 36 | 38 | 41 | 43
 | 45 | 46 | 46 | 46 | 43 | 12 | | | 24 | 31 | 36 | 40 | 44 | 47 | 50 | 53 | 54 | 55 |
 56 | 56 | 6 | | | 30 | 32 | 38 | 43 | 48 | 52 | 56 | 59 | 2 · 1 | 2 · 3 | 2 · 4 | 2 · 5 | 0
 | 10 | | 2 | 6 | 1 · 32 | 1 · 39 | 1 · 45 | 1 · 50 | 1 · 55 | 1 · 59 | 2 · 3 | 2 · 7 | 2 · 9 | 2 ·
 11 | 2 · 12 | 24 | | | 12 | 31 | 38 | 45 | 51 | 57 | 2 · 2 | 7 | 11 | 14 | 17 | 19 | 18 |
 | | 18 | 29 | 36 | 43 | 51 | 57 | 3 | 9 | 13 | 18 | 21 | 24 | 12 | | | 24 | 24 | 33 |
 41 | 49 | 56 | 3 | 9 | 15 | 20 | 24 | 27 | 6 | | | 30 | 19 | 28 | 36 | 45 | 53 | 1 · 0 |
 2 · 8 | 14 | 20 | 25 | 29 | 0 | 9 | | 3 | 6 | 0 · 12 | 1 · 21 | 1 · 31 | 1 · 40 | 1 · 48 | 1 ·
 57 | 2 · 5 | 2 · 14 | 2 · 18 | 2 · 24 | 2 · 30 | 24 | | | 12 | 4 | 14 | 24 | 33 | 42 | 51 |
 1 · 0 | 9 | 15 | 22 | 28 | 18 | | | 18 | 0 · 55 | 5 | 15 | 25 | 35 | 45 | 54 | 3 | 11 |
 18 | 25 | 12 | | | 24 | 44 | 0 · 55 | 5 | 16 | 26 | 36 | 46 | 56 | 5 | 13 | 20 | 6 | | |
 | 30 | 33 | 0 · 43 | 0 · 54 | 1 · 6 | 1 · 16 | 1 · 26 | 1 · 37 | 1 · 47 | 1 · 57 | 2 · 6 | 2 · 14
 | 0 | 8 | | 4 | 6 | 0 · 20 | 0 · 31 | 0 · 42 | 0 · 54 | 1 · 4 | 1 · 15 | 1 · 26 | 1 · 37 | 1 · 47
 | 1 · 57 | 2 · 6 | 24 | | | 12 | 7 | 18 | 29 | 40 | 51 | 1 · 2 | 14 | 25 | 36 | 47 | 57 |
 18 | | | 18 | 0 · A. 7 | 4 | 15 | 26 | 37 | 49 | 1 · 1 | 13 | 24 | 35 | 46 | 12 | | | 24
 | 21 | 0 · A. 11 | 0 · A. 0 | 12 | 23 | 35 | 47 | 59 | 1 · 11 | 22 | 33 | 6 | | | 30 | 35
 | 0 · 25 | 0 · 15 | 0 · A. 4 | 0 · 8 | 0 · 20 | 0 · 32 | 0 · 44 | 0 · 56 | 1 · 8 | 1 · 20 | 0 | 7 |
 | 5 | 6 | 0 · 50 | 0 · 40 | 0 · 30 | 0 · 19 | 0 · A. 8 | 0 · 4 | 0 · 16 | 0 · 28 | 0 · 41 | 0 · 53
 | 1 · 5 | 24 | | | 12 | 1 · 4 | 55 | 45 | 35 | 24 | 0 · A. 12 | 0 · A. 0 | 12 | 25 | 37 |
 50 | 18 | | | 18 | 18 | 1 · 10 | 1 · 1 | 51 | 40 | 28 | 16 | 0 · A. 4 | 8 | 21 | 33 | 12 |
 | | 24 | 31 | 24 | 15 | 1 · 6 | 56 | 45 | 33 | 21 | 0 · A. 8 | 4 | 17 | 6 | | | 30 | 1 ·
 44 | 1 · 37 | 1 · 29 | 1 · 21 | 1 · 11 | 1 · 0 | 0 · 49 | 0 · 37 | 0 · A. 13 | 0 · 0 | 0 · 0 | 0 |
 6 | | **Gr.** | | **30** | **27** | **24** | **21** | **18** | **15** | **12** | **9** | **6** | **3** | **0** | **Gr.** | |

Footer band: **SIGNA III. Distantiae** › **a** ⊙ **a** □ **ad** ♂, **vel** ♀ — *Supra Scalam*
Additur in Ascendendo, infra autem Descendendo.

Panel 6 (lower): SIGNA II — Distantiae › *a* ⊙ *a* □ *ad* ♂, *vel eius* ♀
 (additive)

Column heads: distance = 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 (each marked **Adde**).
 Read top-down for **Signa II**; read bottom-up for **Signa III** (footer distances 30, 27,
 24, 21, 18, 15, 12, 9, 6, 3, 0).

| Sig | G | 0 (°) | 3 (°) | 6 (°) | 9 (°) | 12 (°) | 15 (°) | 18 (°) | 21 (°) | 24 (°) | 27 (°
 ') | 30 (°) | G | Sig | |---|---|---|---|---|---|---|---|---|---|---|---|---|---| | 6 | 0 | 1
 · 44 | 1 · 37 | 1 · 29 | 1 · 21 | 1 · 11 | 1 · 0 | 0 · 49 | 0 · 37 | 0 · 25 | 0 · 13 | 0 · 0 | 30 |
 | | 6 | 56 | 50 | 43 | 35 | 26 | 16 | 5 | 0 · 54 | 0 · 42 | 0 · 29 | 0 · 17 | 24 | | | 12
 | 2 · 7 | 2 · 2 | 1 · 56 | 48 | 40 | 30 | 20 | 9 | 0 · 58 | 0 · 46 | 0 · 33 | 18 | | | 18 |
 17 | 12 | 7 | 2 · 0 | 1 · 53 | 1 · 44 | 1 · 35 | 24 | 1 · 13 | 1 · 2 | 0 · 50 | 12 | | | 24 |
 25 | 21 | 17 | 11 | 5 | 57 | 48 | 38 | 28 | 17 | 1 · 5 | 6 | | | 30 | 2 · 32 | 2 · 30 | 2 ·

26 | 21 | 15 | 9 | 2 · 1 | 1 · 51 | 1 · 41 | 1 · 31 | 1 · 20 | 0 | 5 | | 7 | 6 | 2 · 38 | 2 · 36
 | 2 · 34 | 2 · 30 | 2 · 24 | 2 · 18 | 2 · 11 | 2 · 3 | 1 · 54 | 1 · 44 | 1 · 33 | 24 | | | 12 |
 42 | 42 | 40 | 36 | 32 | 27 | 20 | 13 | 5 | 56 | 1 · 46 | 18 | | | 18 | 45 | 45 | 44 |
 41 | 38 | 33 | 28 | 22 | 14 | 6 | 1 · 56 | 12 | | | 24 | 46 | 47 | 47 | 45 | 43 | 39 |
 34 | 29 | 22 | 14 | 2 · 6 | 6 | | | 30 | 2 · 46 | 2 · 48 | 2 · 48 | 2 · 47 | 2 · 45 | 2 · 41 |
 2 · 37 | 2 · 32 | 2 · 25 | 2 · 17 | 2 · 8 | 0 | 4 | | 8 | 6 | 2 · 45 | 2 · 47 | 2 · 48 | 2 · 48 |
 2 · 47 | 2 · 45 | 2 · 42 | 2 · 38 | 2 · 33 | 2 · 27 | 2 · 20 | 24 | | | 12 | 42 | 44 | 46 |
 47 | 47 | 46 | 44 | 40 | 37 | 31 | 25 | 18 | | | 18 | 37 | 41 | 43 | 45 | 45 | 45 | 43
 | 41 | 38 | 33 | 28 | 12 | | | 24 | 32 | 36 | 39 | 41 | 42 | 42 | 41 | 40 | 37 | 34 |
 30 | 6 | | | 30 | 2 · 25 | 2 · 29 | 2 · 33 | 2 · 35 | 2 · 37 | 2 · 38 | 2 · 38 | 2 · 37 | 2 ·
 35 | 2 · 33 | 2 · 29 | 0 | 3 | | 9 | 6 | 2 · 17 | 2 · 22 | 2 · 25 | 2 · 29 | 2 · 31 | 2 · 32 | 2 ·
 33 | 2 · 23 | 2 · 32 | 2 · 30 | 2 · 27 | 24 | | | 12 | 8 | 13 | 17 | 21 | 24 | 27 | 27 |
 27 | 27 | 26 | 24 | 18 | | | 18 | 1 · 58 | 3 | 8 | 13 | 17 | 20 | 21 | 22 | 21 | 20 | 19
 | 12 | | | 24 | 48 | 1 · 53 | 1 · 58 | 2 · 3 | 8 | 11 | 13 | 13 | 13 | 13 | 12 | 6 | | |
 30 | 1 · 37 | 1 · 42 | 1 · 47 | 1 · 51 | 1 · 55 | 1 · 58 | 2 · 0 | 2 · 3 | 2 · 4 | 2 · 5 | 2 · 5 | 0
 | 2 | | 10 | 6 | 1 · 25 | 1 · 30 | 1 · 35 | 1 · 39 | 1 · 43 | 1 · 47 | 1 · 50 | 1 · 52 | 1 · 54 |
 1 · 55 | 1 · 56 | 24 | | | 12 | 13 | 18 | 23 | 27 | 31 | 35 | 38 | 41 | 43 | 45 | 46 |
 18 | | | 18 | 0 · 0 | 5 | 10 | 14 | 18 | 22 | 25 | 28 | 31 | 33 | 35 | 12 | | | 24 | 0
 · 12 | 0 · 6 | 0 · 5 | 9 | 13 | 16 | 18 | 21 | 23 | 6 | 23 | 6 | | | 30 | 0 · S. 3 | 0 · S. 0
 | 0 · 4 | 0 · 7 | 0 · 10 | 0 · 13 | 0 · 16 | 0 · S. 9 | 0 · S. 6 | 0 · S. 3 | 0 · 0 | 0 | 1 | | 11 |
 6 | 0 · 14 | 0 · 12 | 0 · S. 4 | 0 · S. 7 | 0 · S. 4 | 0 · S. 1 | 0 · 2 | 0 · 5 | 0 · 8 | 0 · 12 | 0 ·
 15 | 24 | | | 12 | 24 | 21 | 18 | 17 | 15 | 14 | 12 | 9 | 6 | 3 | 0 | 18 | | | 18 | 30
 | 28 | 27 | 26 | 24 | 23 | 23 | 20 | 19 | 13 | 12 | 12 | | | 24 | 33 | 33 | 31 | 30 |
 28 | 26 | 24 | 19 | 13 | 13 | 6 | 6 | | | 30 | 0 · 29 | 0 · 27 | 0 · 26 | 0 · 24 | 0 · 23 |
 0 · 20 | 0 · 19 | 0 · 13 | 0 · 12 | 0 · 12 | 0 · 0 | 0 | 0 | | **Gr.** | | **30** | **27** | **24** | **21** | **18** |
15 | **12** | **9** | **6** | **3** | **0** | **Gr.** | |

Footer band: **SIGNA III. Dist.** ☉ **a** ⊙ **a** □ **ad** ☿, **vel** ♀ — *Supra Scalam Subtrahitur Ascendendo, infra Descendendo.*

TABLE 48. The Moon's hourly motion away from the Sun at conjunction (☿) and opposition (♀), and likewise the hourly motions within the 12 hours before, or after.

[Signs of the equated anomaly of the Moon at the top: 0, 1, 2, 3, 4, 5]

For each sign-group the two columns are:

- **Horar.** ☿ & ♀ — the hourly [motion] at conjunction and opposition (minutes ', seconds ");

- **Horar. ultra** — the hourly [motion] beyond [it] (minutes ', seconds ").

The argument column **Anomal. Gr.** (degrees of anomaly) runs down at left for the top signs (0–5) and up at right for the bottom signs (11–6).

A																					A				
n	0				1				2				3				4				5				n
o	0				1				2				3				4				5				o
m	u				u				u				u				u				u				m
a	l				l				l				l				l				l				a
l.	0	0	l	t	1	1	l	t	2	2	l	t	3	3	l	t	4	4	l	t	5	5	l	t	l.
(	♌	♌	t	r	♌	♌	t	r	♌	♌	t	r	♌	♌	t	r	♌	♌	t	r	♌	♌	t	r	(
G	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	G
r	♌	♌	a		♌	♌	a		♌	♌	a		♌	♌	a		♌	♌	a		♌	♌	a		r
.)	,	"	,	"	,	"	,	"	,	"	,	"	,	"	,	"	,	"	,	"	,	"	,	"	.)
0	2	5	2	3	2	3	2	0	2	3	2	1	3	8	3	2	3	4	3	4	3	3	3	2	3
	6	7	6	7	7	5	7		8	2	8	7	0		0	4	1	2	2	4	2	4	4	1	0
3	2	5	2	3	2	3	2	7	2	4	2	2	3	1	3	4	3	4	3	5	3	3	3	2	2
	6	9	6	8	7	7	7		8	1	8	9	0	9	0	1	1	8	2	5	2	9	4	9	7
6	2	0	2	3	2	4	2	1	2	4	2	4	3	3	3	4	3	5	3	6	3	4	3	3	2
	7		6	9	7	3	7	5	8	9	8	0	0	0	1		1	4	3		2	3	4	6	4
9	2	3	2	4	2	4	2	2	2	5	2	5	3	4	3	1	3	0	3	1	3	4	3	4	2
	7		6	0	7	9	7	2	8	9	8	3	0	0	1	0	2		3	6	2	6	4	3	1
1	2	6	2	4	2	5	2	3	2	6	2	2	3	5	3	2	3	6	3	2	3	5	3	5	1
2	7		6	1	7	6	7	1	9		9		0	0	1	5	2		3	6	2	0	4	0	8
1	2	9	2	4	2	0	2	3	2	1	2	1	3	0	3	3	3	1	3	3	3	5	3	5	1
5	7		6	3	8		7	6	9	6	9	6	1		1	9	2	1	3	7	2	5	4	6	5
1	2	1	2	4	2	6	2	4	2	2	2	2	3	1	3	5	3	1	3	4	3	5	3	1	1
8	7	5	6	5	8		7	3	9	5	9	8	1	0	1	3	2	6	3	6	2	7	5		2
2	2	2	2	4	2	1	2	5	2	3	2	4	3	1	3	8	3	2	3	5	3	5	3	4	9
1	7	0	6	8	8	2	7	1	9	5	9	1	1	9	2		2	1	3	7	2	9	5		
2	2	2	2	5	2	1	2	0	2	4	2	5	3	2	3	2	3	2	3	5	3	0	3	9	6
4	7	6	6	2	8	8	8		9	6	9	6	1	7	2	1	2	6	4		3		5		
2	2	3	2	5	2	2	2	9	2	5	3	9	3	3	3	3	3	3	3	1	3	1	3	1	3
7	7	1	6	6	8	4	8		9	5	0		1	5	2	3	2	0	4	3	3		5	1	
3	2	3	2	0	2	3	2	1	3	8	3	2	3	4	3	4	3	3	3	2	3	2	3	1	0
0	7	5	7		8	2	8	7	0		0	4	1	2	2	4	2	4	4	1	3		5	5	

A																									A
n	0				1				2				3				4				5				n
o	0				1				2				3				4				5				o
m	u				u				u				u				u				u				m
a	u				u				u				u				u				u				a
l.	0	0	l	t	1	1	l	t	2	2	l	t	3	3	l	t	4	4	l	t	5	5	l	t	l.
(	♂	♂	t	r	♂	♂	t	r	♂	♂	t	r	♂	♂	t	r	♂	♂	t	r	♂	♂	t	r	(
G	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	&	&	r	a	G
r	♂	♂	a		♂	♂	a		♂	♂	a		♂	♂	a		♂	♂	a		♂	♂	a		r
.)	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	.)
(	\	1	\	\	\	1	\	\	\	9	\	\	\	8	\	\	\	7	\	\	\	6	\	\	(
G		1				0																		G	
r																								r	
.)																								.)	

[Signs of the equated anomaly of the Moon at the foot: 11, 10, 9, 8, 7, 6]

TABLE 49. The verification of the Moon's [motion] at conjunction (♌) and opposition (♌) of the luminaries.

Minutes of the hourly [motion] of the Moon away from the Sun at conjunction (♌) and opposition (♌).

Column-groups are headed by **M.** (the integer minutes of motion) 27 through 35. Within each group the sub-columns are **Grad. · H.** ', then **Minut. H.** ' ", then **Second.** ' " ". The left argument runs **1–60** (single steps to 30, then by fives to 60).

a																		
r																		
g	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
1	2	13	2	9	2	4	2	0	1	56	1	52	1	49	1	46	1	43
2	4	27	4	17	4	8	4	0	3	52	3	45	3	38	3	32	3	26
3	6	40	6	26	6	12	6	0	5	48	5	37	5	27	5	18	5	9
4	8	53	8	34	8	17	8	0	7	45	7	30	7	16	7	4	6	51
5	11	7	10	43	10	21	10	0	9	41	9	22	9	5	8	49	8	34
6	13	20	12	51	12	25	12	0	11	37	11	15	10	55	10	35	10	17
7	15	33	15	0	14	29	14	0	13	33	13	7	12	44	12	21	12	0

a																		
r																		
g	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
8	17	47	17	9	16	33	16	0	15	29	15	0	14	33	14	7	13	43
9	20	0	19	17	18	37	18	0	17	25	16	52	16	22	15	53	15	26
1	22	13	21	26	20	41	20	0	19	21	18	45	18	11	17	39	17	9
0																		
1	24	17	23	34	22	46	22	0	21	17	20	37	20	0	19	25	18	51
1																		
1	26	40	25	43	24	50	24	0	23	14	22	30	21	49	21	11	20	34
2																		
1	28	53	27	51	26	54	26	0	25	10	24	22	23	38	22	56	22	17
3																		
1	31	7	30	0	28	58	28	0	27	6	26	15	25	27	24	42	24	0
4																		
1	33	20	32	9	31	2	30	0	29	2	28	7	27	16	26	26	25	43
5																		
1	35	33	34	17	33	6	32	0	30	58	30	0	29	5	28	14	27	26
6																		
1	37	47	36	26	35	10	34	0	32	54	31	52	30	55	30	0	29	9
7																		
1	40	0	38	34	37	14	36	0	34	50	33	45	32	44	31	47	30	51
8																		
1	42	13	40	43	39	19	38	0	36	46	35	37	34	33	33	32	32	34
9																		
2	44	27	42	51	41	23	40	0	38	43	37	30	36	22	35	18	34	17
0																		
2	46	40	45	0	43	27	42	0	40	39	39	22	38	11	37	4	35	59
1																		
2	48	53	47	9	45	31	44	0	42	35	41	15	40	0	38	49	37	43
2																		
2	51	7	49	17	47	35	46	0	44	31	43	7	41	49	40	35	39	26
3																		
2	53	20	51	26	49	39	48	0	46	27	45	0	43	38	42	21	41	8

a																		
r																		
g	27	27	28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
4																		
2	55	33	53	34	51	43	50	0	48	24	46	52	45	27	44	7	42	51
5																		
2	57	47	55	43	53	48	52	0	50	20	48	45	47	16	45	53	44	34
6																		
2	1·	0	57	51	55	52	54	0	52	16	50	37	49	5	47	39	46	17
7	0																	
2	2	13	1·	0	57	56	56	0	54	12	52	30	50	55	49	25	48	0
8			0															
2	4	27	2	9	1·	0	58	0	56	8	54	22	52	44	51	10	49	43
9					0													
3	6	40	4	17	2	4	1·	0	58	4	56	15	54	33	52	56	51	25
0							0											
3	1·	47	1·	0	1·	24	1·	0	1·	45	1·	37	1·	38	1·	45	59	59
5	17		15		12		10		7		5		3		1			
4	1·	53	1·	43	1·	45	1·	0	1·	25	1·	0	1·	44	1·	35	1·	33
0	28		25		22		20		17		15		12		10		8	
4	1·	0	1·	26	1·	6	1·	0	1·	6	1·	22	1·	49	1·	24	1·	8
5	40		36		33		30		27		24		21		19		17	
5	1·	7	1·	8	1·	26	1·	0	1·	47	1·	45	1·	54	1·	14	1·	42
0	51		47		43		40		36		33		30		28		25	
5	2·	13	1·	51	1·	47	1·	0	1·	28	1·	7	1·	0	1·	3	1·	16
5	2		57		53		50		46		43		40		37		34	
6	2·	20	2·	34	2·	8	2·	0	1·	8	1·	30	1·	5	1·	53	1·	51
0	13		8		4		0		56		52		49		45		42	

TABLE 50. Of the intervals of the Moon and the Earth outside conjunction (ϕ) and opposition (ϕ°).

Argument: **Anomalia Excentrici, seu duplicata elongatio** $\bowtie$ à $\odot$ (the anomaly of the eccentric, or the doubled elongation of the Moon from the Sun) — two coupled degree columns. Then **Excentricitas Lunaris orbitæ** (the eccentricity of

the Moon's orbit): "Qualium Radius est 100000" and "in semidiamet. Terrę Semid. '". Then **Distantia** › **Apogeæ seu Maxima à centro Terræ** (the Moon's distance at apogee, or maximum, from the Earth's centre): "Qualium Radius est 100000" and "In semid. Terræ Semid. '". Then **Distantia** › **Perigeæ, seu Minima à centro Terræ** (the Moon's distance at perigee, or minimum): the same two sub-columns.

G G							
r	r	Eccentr.	Eccentr.	Apogee /	Apogee	Perigee	Perigee
.	.	/100000	semid. '	100000	semid. '	/100000	semid. '
0	3	4343	2 21	104343	63 21	95657	58 39
	6						
	0						
1	3	4517	2 27	104517	63 27	95483	58 33
0	5						
	0						
2	3	4821	2 36	104821	63 36	95179	58 24
0	4						
	0						
3	3	5342	2 53	105342	63 54	94658	58 7
0	3						
	0						
4	3	5993	3 14	105993	64 14	94007	57 46
0	2						
	0						
5	3	6688	3 37	106688	64 37	93312	57 23
0	1						
	0						
6	3	7470	4 2	107470	65 2	92530	56 58
0	0						
	0						
7	2	8252	4 28	108252	65 28	91748	56 32
0	9						
	0						
8	2	8990	4 52	108990	65 52	91010	56 8
0	8						
	0						
9	2	9685	5 15	109685	66 15	90315	55 45

G G							
r r	Eccentr.	Eccentr.	Apogee /	Apogee	Perigee	Perigee	
. .	/100000	semid. '	100000	semid. '	/100000	semid. '	
0 7							
0							
1 2	9936	5 36	109936	66 36	90064	55 24	
0 6							
0 0							
1 2	10944	5 55	110944	66 55	89056	55 5	
1 5							
0 0							
1 2	11509	6 14	110509	67 14	88491	54 44	
2 4							
0 0							
1 2	12243	6 28	112243	67 28	87757	54 32	
3 3							
0 0							
1 2	12378	6 42	112378	67 42	87622	54 18	
4 2							
0 0							
1 2	12634	6 50	112634	67 50	87396	54 10	
5 1							
0 0							
1 2	12855	6 57	112855	67 57	87145	54 3	
6 0							
0 0							
1 1	12986	7 1	112986	68 1	87014	53 59	
7 9							
0 0							
1 1	13029	7 3	113029	68 3	86970	53 57	
8 8							
0 0							

TABLE 51. The Moon's distance from the Earth's centre outside conjunction ($\odot$) and opposition ($\oslash$).

Anomalia Excentricitatis, seu duplicata Elongatio ☽ à ☉ (the anomaly of the eccentricity, or the doubled elongation of the Moon from the Sun), tabulated in steps of 20 across the top: 0, 20, 40, 60, 80, 100, 120, 140, 160, 180; with the complementary row 360, 340, 320, 300, 280, 260, 240, 220, 200, 180. Body values are **Semidiametri Terræ** (semidiameters of the Earth), each cell "Sem. '". Argument **Anomalia Orbis æquata** (the equated anomaly of the orb) runs down at left (Gr./Gr.).

G	Gr											
r.	.	0	20	40	60	80	100	120	140	160	180	
0	36	63 21	63 48	64 17	64 48	65 23	66 1	66 36	67 7	67 36	68 3	0
10	35	63 19	63 44	64 11	64 44	65 18	65 56	66 29	67 0	67 29	67 55	0
20	34	63 15	63 37	64 2	64 37	65 8	65 47	66 16	66 47	67 15	67 38	0
30	33	63 8	63 27	63 50	64 26	64 53	65 32	65 57	66 28	66 54	67 13	0
40	32	62 58	63 14	63 34	64 10	64 31	65 10	65 31	66 0	66 24	66 39	0
50	31	62 44	62 57	63 13	63 48	64 3	64 40	64 57	65 24	65 44	65 55	0
60	30	62 26	62 36	62 48	63 19	63 28	64 1	64 14	64 38	64 53	65 0	0
70	29	62 3	62 10	62 18	62 42	62 49	63 12	63 21	63 40	63 50	63 53	0
80	28	61 36	61 39	61 42	61 56	61 59	62 12	62 17	62 28	62 33	62 32	0
90	27	61 2	61 0	60 59	61 0	61 0	61 0	61 1	61 0	61 0	60 55	0
100	26	60 30	60 21	60 16	60 4	60 1	59 48	59 45	59 32	59 27	59 18	0

G r.	Gr .	0	20	40	60	80	100	120	140	160	180
11 0	25 0	60 2	59 51	59 40	59 18	59 12	58 48	58 41	58 20	58 10	57 57
12 0	24 0	59 40	59 25	59 10	58 41	58 31	57 59	57 48	57 22	57 7	56 50
13 0	23 0	59 22	59 4	58 45	58 12	57 57	57 20	57 5	56 36	56 16	55 55
14 0	22 0	59 8	58 47	58 24	57 52	57 29	56 50	56 30	56 0	55 36	55 11
15 0	21 0	58 58	58 34	58 3	57 36	57 7	56 28	56 4	55 32	55 6	54 37
16 0	20 0	58 50	58 24	57 56	57 25	56 52	56 13	55 45	55 13	54 45	54 12
17 0	19 0	58 44	58 17	57 47	57 17	56 42	56 3	55 32	55 0	54 31	53 55
18 0	18 0	58 39	58 12	57 42	57 12	56 37	55 59	55 25	54 53	54 24	53 47

TABLE 52. The Moon's apparent semidiameter and horizontal parallax outside conjunction ($\oslash$) and opposition ($\ominus$).

Distance $\oslash$ from Earth's centre (Semid. $'$)	Apparent semidiam. $\oslash$ outside $\oslash$ & $\ominus$ ($'$ $''$)	Horizontal parallax $\oslash$ outside $\oslash$ & $\ominus$ ($'$ $''$)
52 0	18 8	66 6
52 30	17 58	65 30
53 0	17 48	64 51
53 30	17 38	64 15
54 0	17 29	63 39
54 30	17 19	63 4
55 0	17 10	62 30
55 30	17 0	61 57
56 0	16 49	61 23
56 30	16 41	60 51

Distance ☽ from Earth's centre (Semid. ')	Apparent semidiam. ☽ outside ☿ & ♀ (' ")	Horizontal parallax ☽ outside ☿ & ♀ (' ")
57 0	16 34	60 20
57 30	16 25	59 49
58 0	16 16	59 17
58 30	16 8	58 46
59 0	16 0	58 16
59 30	15 52	57 47
60 0	15 45	57 18
60 30	15 37	56 50
61 0	15 26	56 21
61 30	15 20	55 55
62 0	15 14	55 30
62 30	15 6	54 57
63 0	14 58	54 35
63 30	14 51	54 3
64 0	14 44	53 42
64 30	14 36	53 19
65 0	14 29	52 57
65 30	14 24	52 28
66 0	14 19	52 2
66 30	14 14	51 37
67 0	14 8	51 13
67 30	14 0	50 52
68 0	13 52	50 32

TABLE 53. The parallax of the Moon in the circle of true altitude.

Parallaxis Horizontalis Minuta (minutes of horizontal parallax) — the column-groups across the top, headed 50 through 64, give the parallax in minutes (') and seconds (") corresponding to each value of the horizontal parallax. Argument **Altitudo vera** (true altitude, G. = degrees) runs down at left, 1–60.

5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6
0 0 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 0 0 1 1 2 2 3 3 4 4

, " , " , " , " , " , " , " , " , " , " , " , " , " , " , " , " , " , "

4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5 6 5 6 5 6 5
9 9 0 9 1 9 2 9 3 9 4 9 5 9 6 9 7 9 8 9 9 9 9 0 9 1 9 2 9 3 9
4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5 6 5 6 5 6 5
9 9 0 9 1 9 2 9 3 9 4 9 5 9 6 9 7 9 8 9 9 9 9 0 9 1 9 2 9 3 9
4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5 6 5 6 5 6 5
9 7 0 7 1 7 2 7 3 7 4 7 5 7 6 7 7 8 8 9 9 7 0 7 1 7 2 7 3 7
4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5 6 5 6 5 6 5
9 5 0 5 1 4 2 4 3 4 4 4 5 4 6 4 7 1 8 9 9 4 0 4 1 4 2 4 3 4
4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 5 6 5 6 5 6 5
9 3 0 2 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 0 9 0 0 0 1 0 2 0 3 0
4 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 6 4 6 4 6 4 6 4
9 9 0 8 1 7 2 7 3 7 4 7 5 7 6 7 7 7 8 6 9 6 0 5 1 5 2 5 3 5
4 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 6 3 6 3 6 3 6 3
9 3 0 2 1 2 2 2 3 2 4 2 5 2 6 2 7 2 8 1 9 0 0 9 1 9 2 9 3 9
4 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 6 3 6 3 6 3 6 3
9 7 0 6 1 6 2 6 3 6 4 5 5 5 6 5 7 5 8 5 9 3 0 2 1 2 2 2 3 2
4 3 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2 6 2 6 2 6 2 6 2
9 0 0 9 1 8 2 8 3 8 4 7 5 7 6 7 7 7 8 5 9 4 0 4 1 4 2 4 3 4
4 2 5 2 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 6 1 6 1 6 1 6 1 6 1
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9 0 1 2 9 2 8 3 8 4 8 5 8 6 8 7 5 8 3 9 2 0 1 1 1 2 1
4 5 4 5 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 3 6 3 6 3 6 3
8 3 9 1 0 9 1 8 2 7 3 7 4 7 5 6 6 6 7 3 8 1 9 9 0 8 1 8 2 8
4 4 4 4 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 2 5 2 6 2 6 2 6 2
8 2 9 0 0 8 1 6 2 5 3 5 4 4 5 3 6 2 7 0 8 8 9 6 0 4 1 4 2 4
4 3 4 2 5 2 5 2 5 2 5 2 5 2 5 1 5 1 5 1 5 1 5 1 6 1 6 9 6 8
8 1 9 8 0 5 1 3 2 2 3 1 4 0 5 8 6 7 7 5 8 4 9 2 0 0 1 2
4 1 4 1 5 1 5 9 5 7 5 6 5 5 5 3 5 1 5 5 5 5 5 5 5 5 6 5 6 5

5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6
0 0 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 0 0 1 1 2 2 3 3 4 4

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7	3	8	2	9	1	0	8	1	6	2	5	3	2	4	0	5	8	6	5	7	3	8	0	9	8	0	6	1	4	
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6	7	7	3	8	9	9	5	0	1	1	9	2	7	3	2	4	8	5	5	6	2	7	9	8	7	9	3	0		
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6	9	7	4	8	9	9	5	0	1	1	8	2	6	3	1	4		5		6		6	7	7	4	8	9	9	1	
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6	8	7	4	8		9		0		0	7	1	5	2	0	3	5	4	0	5	6	6	2	7	9	8	5	9	1	
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5	8	6	3	7	8	8	2	9	8	0	5	1	3	2	6	3	0	4	5	5	1	6		7		7	8	8	8	
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5	6	6	1	7	5	8	0	9	5	0	2	1	0	1		2	5	3	0	4	6	5	1	6	7	7	2	8	8	
4	1	4	8	4	2	4	5	4	5	4	4	5	4	5	3	5	3	5	3	5	2	5	2	5	2	5	1	5	1	
5	4	6		7		7	6	8	1	9	9	0	1	1	9	2	7	3	2	4	8	5	5	6	2	7	9	8	7	
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4	2	5	5	6	8	7	2	8	6	9	2	0	8	1	1	2		2	8	3	3	4	9	5	1	6	6	7	1	
4	2	4	2	4	1	4	7	4	1	4	5	4	5	5	4	5	3	5	3	5	5	5	4	5	1	5	6	5	1	
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4		4	6	5	9	6	2	7	5	8	9	9	3	0	6	1		2		2	1	3	5	4	2	5	0	6	0	
4	3	4	3	4	2	4	1	4	8	4	5	4	5	4	4	5	4	5	3	5	2	5	1	5	1	5	4	5	5	
3	9	4	1	5	3	6	5	7		7	3	8	5	9	7	0	0	1	2	2	5	3	8	4	1	5		5	8	
4	1	4	4	4	5	4	4	4	3	4	3	4	2	4	1	5	1	5	1	5	5	5	4	5	3	5	3	5	2	
3	4	4		4	5	5	6	6	8	7	1	8	5	9	7	0	0	1		1	3	2	6	3	9	4	2	5	5	

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0 0 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 0 0 1 1 2 2 3 3 4 4

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2	5	3	6	4	7	5	8	6		7		7	4	8	6	9	8	0	0	1	1	2	3	3		3	8	4	0
4	1	4	7	4	5	4	4	4	3	4	3	4	2	4	1	4	5	4	5	5	4	5	4	5	3	5	2	5	1
2	7	3		3	7	4	8	5	9	6	0	7	2	8	3	9		9	6	0	8	1	0	2	2	3	4	4	4
4	4	4	3	4	2	4	1	4	9	4	0	4	5	4	4	4	3	4	2	5	1	5	5	5	5	5	4	5	3
1	8	2	8	3	7	4	8	5		6		6	0	7	1	8	2	9	3	0	4	1		1	7	2	7	3	8
4	2	4	9	4	5	4	4	4	3	4	2	4	1	4	7	4	5	4	4	4	4	5	3	5	2	5	1	5	0
1		2		2	6	3	6	4	7	5	7	6	7	7		7	8	8	9	9	0	0	1	1	3	2	3	3	
4	5	4	3	4	2	4	1	4	4	4	5	4	4	4	3	4	2	4	1	4	4	4	5	5	4	5	3	5	2
0	0	1	8	2	6	3	5	4		4	3	5	3	6	2	7	3	8	3	9		9	2	0	1	1	1	2	1
4	3	4	6	4	5	4	4	4	3	4	1	4	9	4	5	4	4	4	3	4	2	4	1	5	2	5	5	5	4
0		1		1	3	2	3	3	1	4	9	5		5	8	6	8	7	7	8	7	9	4	0		0	1	1	1
3	4	4	3	4	2	4	8	4	5	4	4	4	3	4	2	4	1	4	0	4	4	4	3	4	2	5	1	5	1
9	6	0	3	1	0	2		2	7	3	4	4	4	5	2	6	2	7		7	9	8	6	9	3	0	2	1	
3	0	4	0	4	4	4	3	4	2	4	9	4	5	4	4	4	3	4	2	4	1	4	5	4	4	4	3	5	2
9		0		0	7	1	4	2	2	3		3	6	4	5	5	4	6	3	7	0	7	6	8	3	9	1	0	0
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8		8	2	9	8	0	4	1	0	1	6	2	3	3	0	4	7	5		5	1	6	5	7	0	8		8	5
3	3	3	1	3	2	3	4	4	3	4	1	4	5	4	5	4	3	4	2	4	8	4	5	4	3	4	2	4	7
7	2	8	7	9		9	7	0	3	1	9	2		2	0	3	6	4	2	5		5	3	6	8	7	3	8	
3	5	3	4	3	2	3	1	3	5	4	4	4	2	4	1	4	5	4	4	4	2	4	9	4	5	4	3	4	2
6	6	7	1	8	6	9	1	9	6	0	1	1	6	2	2	2	7	3	2	4	5	5		5	3	6	8	7	4
3	2	3	4	3	4	3	3	3	1	4	2	4	4	4	3	4	1	4	5	4	4	4	2	4	8	4	5	4	3
6	1	7		7	9	8	3	9	7	0		0	7	1	0	2	4	2	7	3	2	4	5	5		5	3	6	8
3	4	3	2	3	1	3	5	3	3	3	2	4	7	4	4	4	3	4	1	4	5	4	3	4	2	4	6	4	5
5	4	6	7	7	0	7	4	8	9	9	3	0		0	8	1	0	2	4	2	8	3	9	4	3	5		5	1
3	1	3	5	3	3	3	1	3	5	3	3	3	3	4	5	4	4	4	3	4	1	4	5	4	3	4	2	4	3
5	0	5	0	6	0	7	3	7	6	8	9	9	5	0		0	8	1	0	2	3	2	5	3	7	4	0	5	

5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6
0 0 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 0 0 1 1 2 2 3 3 4 4

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3	3	3	1	3	5	3	3	3	1	3	5	3	3	3	1	3	5	4	3	4	1	4	4	4	4	4	2	4	1
4	2	5	1	5	0	6	2	7	3	7	7	8	9	9	9	9	7	0	7	1	9	2		2	5	3	7	4	4
3	5	3	3	3	1	3	5	3	3	3	1	3	5	3	3	3	1	3	5	4	3	4	1	4	5	4	3	4	2
4		4	2	5	9	5	3	6	2	7	7	7	3	8	3	9	9	9	7	0	7	1	3	1	3	2	5	3	5
3	1	3	5	3	2	3	9	3	5	3	2	3	0	3	3	3	1	3	4	3	2	3	5	4	3	4	1	4	3
3	3	3	1	4	9	5		5	0	6	6	7		7	6	8	2	8	5	9	2	9	4	0	3	1	3	2	5
3	3	3	1	3	4	3	2	3	8	3	3	3	1	3	4	3	2	3	2	3	3	3	7	3	5	4	3	4	4
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1	2	2	9	3		3	5	4	5	5		5	2	6	2	7		7	0	8	8	8	6	9	5	0	3	0	3
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1	1	1	7	2	3	3		3	1	4	8	4	6	5	5	6	4	6	1	7	8	8		8	4	9	2	0	
3	2	3	4	3	4	3	1	3	5	3	3	3	1	3	4	3	2	3	0	3	3	3	1	3	5	3	3	3	7
0	8	1		1	0	2	8	2	6	3		4	0	4	7	5	5	6		6	7	7	4	7	2	8	0	9	
2	4	3	2	3	5	3	3	3	1	3	4	3	2	3	5	3	3	3	1	3	4	3	2	3	0	3	3	3	1
9	6	0	1	0	6	1	3	2	0	2	6	3	3	3	8	4	5	5	0	5	6	6	3	7		7	6	8	2
2	2	2	3	3	1	3	4	3	2	3	5	3	3	3	9	3	4	3	1	3	5	3	3	3	7	3	4	3	1
9		9	7	0	2	0	7	1	3	1	8	2	5	3		3	5	4	9	4	5	5	1	6		6	1	7	6
2	2	2	5	2	2	3	0	3	3	3	1	3	4	3	2	3	5	3	2	3	3	3	3	3	1	3	4	3	2
8	3	8	3	9	7	0		0	5	1	0	1	6	2	0	2	5	3	9	4		4	7	5	3	5	6	6	0
2	3	2	8	2	4	2	1	2	4	3	2	3	5	3	3	3	5	3	3	3	1	3	4	3	1	3	4	3	2
7	5	8		8	1	9	3	9	7	0	1	0	6	1	0	2		2	7	3	0	3	4	4	9	4	7	5	4
2	4	2	2	2	5	2	2	2	5	2	3	3	6	3	3	3	1	3	4	3	1	3	5	3	2	3	5	3	2
6	6	7	2	7	5	8	6	8	9	9	2	0		0	9	1	3	1	4	2	6	2	0	3	4	3	3	4	7
2	4	2	3	2	8	2	3	2	1	2	4	2	1	2	4	3	2	3	5	3	2	3	5	3	2	3	5	3	2
6		6	6	7		7	9	8	1	8	3	9	6	9	7	0	6	0	4	1	2	1	3	2	8	2	7	3	9
2	1	2	5	2	2	2	5	2	2	2	5	2	2	2	5	2	2	2	5	3	2	3	5	3	3	3	0	3	3
5	9	5	0	6	1	6	1	7	2	7	3	8	5	8	5	9	7	9	7	0	8	0	9	1	1	2		2	1

Tomus II — Tabulae Novalmagesticae (continued)

Part III — Lunar parallax tables (conclusion of TAB. 53)

Remainder of TABLE 53. Parallaxes of the Moon [♀] in the circle of true altitude.

Minutes of horizontal parallax [Minuta Parallaxis Horizontalis].

This page concludes TAB. 53. The upper table gives, for each value of the horizontal parallax (the column heads 50–64, in seconds — read together with the table's leading minutes), the lunar parallax at each degree of true altitude from 61° to 90°. Each column carries a pair of sub-columns ' (minutes) and " (seconds).

Altitud vera (G.)	5 0	5 0	5 1	5 1	5 2	5 2	5 3	5 3	5 4	5 4	5 5	5 5	5 6	5 6	5 7	5 7	5 8	5 8	5 9	5 9	5 0	6 0	6 1	6 1	6 2	6 2	6 3	6 3	6 4	6 4
	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
61	2 4	3 3	2 5	3 	2 5	3 3	2 6	3 	2 6	3 7	2 	3 7	2 8	3 	2 8	3 4	2 9	3 	2 9	3 0	3 	3 0	3 	3 0	3 1	3 	3 1	3 	3 1	3
62	2 3	4 6	2 4	1 6	2 4	2 5	1 5	2 3	1 5	2 6	1 1	2 6	0 0	2 7	1 0	2 7	0 8	2 	2 8	3 7	2 9	3 	2 9	6 	2 9	3 5	3 0	3 	4 0	3
63	2 3	0 	2 3	2 8	2 3	5 6	2 4	2 3	2 4	1 1	2 5	1 9	2 5	2 7	1 6	2 6	2 6	1 5	2 7	2 3	4 7	2 1	2 8	9 	2 8	3 7	2 9	4 	2 9	3
64	2 2	1 3	2 2	4 0	2 3	7 	2 3	2 4	0 	2 4	2 	2 4	5 4	2 5	2 1	2 5	2 4	2 1	2 2	2 4	2 1	2 6	2 6	1 4	2 7	3 1	2 8	2 8	5 	2 8
65	2 1	2 7	2 1	5 2	2 2	1 7	2 2	2 2	4 3	2 	8 3	2 4	1 4	2 2	1 4	2 4	2 5	2 0	2 5	2 5	2 7	2 6	2 3	2 6	1 9	2 7	3 	5 7	2 	3
66	2 0	4 1	2 1	3 	2 1	2 7	2 1	2 1	5 2	2 6	1 2	2 1	2 3	2 7	1 3	2 3	2 8	2 4	2 3	2 4	2 5	2 3	2 4	1 9	2 5	3 3	2 8	2 6	4 	2 6
67	1 9	5 0	2 0	1 3	2 0	3 6	2 1	0 	2 1	2 4	2 8	2 2	2 2	1 7	2 3	2 7	2 3	1 	2 3	2 5	2 3	2 0	2 4	2 3	1 4	2 7	2 5	2 	2 5	2 8
68	1 9	1 	1 9	2 3	1 9	4 5	2 0	7 	2 0	3 1	2 0	2 4	1 1	2 7	1 0	2 2	2 4	2 	2 2	2 7	2 2	5 1	2 3	2 3	1 3	2 3	2 6	2 4	0 	2 4
69	1 8	1 3	1 8	3 3	1 8	5 4	1 9	1 6	1 9	3 8	2 0	2 	2 0	2 2	2 4	2 1	2 7	2 	2 2	2 9	2 1	2 2	5 3	2 2	1 3	2 3	2 5	2 8	2 3	2

Altitud vera (G.)	5 0	5 0	5 1	5 1	5 2	5 2	5 3	5 3	5 4	5 4	5 5	5 5	5 6	5 6	5 7	5 7	5 8	5 8	5 9	5 9	5 0	5 0	6 0	6 0	6 1	6 1	6 2	6 2	6 3	6 3	6 4	6 4
	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
70	1 7	2 2	1 7	4 2	1 8	2 8	1 8	2 2	1 8	4 4	1 9	5 9	1 6	2 9	1 8	4 0	2 0	1 0	4 0	2 1	3 0	2 0	5 1	2 2	1 3	2 1	3 4	2 1	5 6	2 2	1 8	
71	1 6	3 2	1 6	5 1	1 7	1 0	1 7	3 0	1 7	5 0	1 8	1 8	1 8	3 0	1 8	5 1	1 9	1 2	1 9	3 1	5 9	2 1	1 9	2 1	1 0	2 1	3 0	2 0	5 3	2 1	1 4	
72	1 5	4 2	1 6	0 6	1 8	1 6	1 7	3 6	1 7	5 6	1 6	1 7	1 5	3 4	1 7	5 4	1 8	1 4	1 8	3 2	1 8	5 0	1 9	1 0	1 9	1 0	1 9	1 0	3 9	1 9	2 0	
73	1 4	4 0	1 5	8 5	1 6	2 5	1 4	4 6	1 6	2 6	1 6	1 6	1 6	3 7	1 6	5 6	1 7	1 5	1 7	3 2	1 7	4 9	1 8	4 8	1 8	8 7	1 8	2 7	1 8	4 5	1 9	
74	1 4	0 4	1 4	1 6	1 4	3 3	1 4	5 0	1 5	7 5	1 5	2 3	1 5	4 0	1 5	5 8	1 6	1 6	1 6	3 2	1 6	4 7	1 7	4 7	1 7	6 7	1 7	2 7	1 4	1 7	0 8	
75	1 3	8 3	1 3	2 4	1 3	4 0	1 3	5 6	1 4	1 2	1 4	1 7	2 4	1 3	4 4	5 9	1 5	1 6	1 5	1 3	1 5	4 7	1 6	4 6	1 4	4 6	1 6	2 1	1 6	3 8	1 5	
76	1 2	1 6	1 2	3 1	1 2	4 6	1 3	1 6	1 3	1 6	1 3	1 3	3 6	1 4	1 6	4 4	1 6	1 4	1 3	1 4	1 4	1 5	1 4	1 1	1 1	1 1	1 1	1 5	1 3	1 5	4 9	
77	1 1	2 6	1 1	3 9	1 1	5 2	1 2	6 2	1 2	6 0	1 2	1 4	1 2	3 8	1 3	4 3	1 2	1 3	1 3	2 3	1 9	4 3	1 3	4 3	1 4	8 4	1 3	1 4	1 7	1 4	2 2	
78	1 0	3 4	1 0	4 6	1 0	5 8	1 1	1 1	1 4	2 1	1 7	3 1	5 1	1 0	3 2	1 2	1 6	1 2	1 6	2 8	1 2	4 0	1 2	5 4	1 3	8 3	1 5	1 3	2 1	1 3	5 5	
79	9 0	4 8	9 2	5 0	1 4	4 0	1 5	1 0	1 7	2 0	1 9	3 0	1 1	5 0	1 1	3 1	1 6	1 1	1 6	2 1	1 7	3 1	1 7	5 1	1 0	3 2	1 5	1 2	3 5	1 8	2 8	
80	8 8	4 8	8 9	5 9	9 0	1 0	9 0	2 0	9 1	3 1	9 1	4 1	9 2	5 0	1 2	3 0	1 0	1 4	1 0	1 4	2 0	3 4	1 0	4 4	1 6	3 0	1 4	1 6	5 8	1 1	2 0	
81	7 6	5 8	8 6	6 8	8 1	8 6	2 5	8 5	8 5	3 4	8 4	4 8	5 3	9 9	3 3	9 1	1 3	9 2	1 2	9 3	9 3	4 9	9 4	5 9	1 5	2 3	1 5	1 2	1 0	1 2	1 1	
82	7 8	5 8	7 3	1 3	7 1	2 9	7 9	2 7	7 7	3 6	7 6	4 4	7 5	8 4	3 8	8 1	1 2	8 0	2 8	8 8	2 8	8 8	3 8	8 8	4 8	8 8	5 8	9 6	4 8	9 6	4 8	
83	6 9	6 9	6 9	1 9	6 6	2 6	6 3	3 6	6 1	4 8	6 5	4 8	6 5	7 5	2 5	7 0	1 7	1 7	7 5	2 7	7 5	3 4	7 4	2 4	7 4	3 2	7 6	4 2	7 9	4 6	5 6	
84	5 9	1 9	5 5	2 5	5 1	3 7	5 7	3 4	5 4	4 0	5 5	5 6	5 6	2 6	6 8	8 6	1 5	6 5	2 2	6 9	2 9	6 6	2 9	6 6	3 6	6 6	4 2	6 2	4 8	4 8		
85	4 4	2 2	4 4	3 3	4 4	3 4	4 4	4 4	4 4	4 5	4 5	5 5	5 5	2 5	5 7	7 5	1 5	5 1	1 5	5 2	5 5	3 5	5 3	5 3	5 3	5 3	5 3	4 5	4 5	4 5	4 4	

Altitud vera (G.)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	
	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	0	0	1	1	2	2	3	3	4	4	4	
	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
		6		1		6		1		6		1		7						3		9		4		0		5		0		
86	3	3	3	3	3	4	3	4	3	4	3	5	3	5	4	7	4	6	4	1	4	1	4	2	4	2	4	2	4	3		
		1		6		1		4		9		3		8					1		6		0		4		8		2			
87	2	4	2	4	2	4	2	4	2	5	2	5	2	5	3	1	3	4	3	8	3	1	3	1	3	1	3	2	3	2		
		0		3		6		9		2		5		9							2		5		8		1		4			
88	1	4	1	4	1	5	1	5	1	5	1	5	2	0	2	1	2	2	2	3	2	5	2	8	2	1	2	1	2	1		
		7		9		1		3		5		7													0		2		4			
89	0	5	0	5	0	5	0	5	0	5	0	5	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	7	1	8		
		4		5		6		7		8		9																				
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Lower panel — Mean horizontal parallax (M. Parallax Horizontalis), columns 65–67

Three side-by-side blocks of the mean horizontal parallax for horizontal-parallax values 65, 66, 67, tabulated against true altitude (G.) from 1° to 90°. Each value carries a ' and " pair.

Altitudo vera (G.)	65 '	65 "	66 '	66 "	67 '	67 "
1	64	59	65	59	66	59
2	64	59	65	59	66	59
3	64	57	65	57	66	57
4	64	54	65	54	66	54
5	64	50	65	50	66	50
6	64	45	65	45	66	45
7	64	39	65	39	66	39
8	64	32	65	32	66	32
9	64	23	65	23	66	23
10	64	13	65	13	66	13
11	64	2	65	2	66	2
12	63	50	64	50	65	50
13	63	37	64	37	65	37

Altitude vera (G.)	65 '	65 "	66 '	66 "	67 '	67 "
14	63	22	64	21	65	21
15	63	6	64	5	65	5
16	62	49	63	48	64	47
17	62	31	63	30	64	31
18	62	12	63	10	64	8
19	61	51	62	49	63	47
20	61	29	62	27	63	25
21	61	6	62	3	63	2
22	60	42	61	39	62	37
23	60	17	61	14	62	11
24	59	51	60	47	61	44
25	59	23	60	19	61	15
26	58	55	59	50	60	46
27	58	25	59	20	60	16
28	57	55	58	49	59	44
29	57	23	58	17	59	10
30	56	49	57	43	58	36
31	56	16	57	8	57	31
32	55	41	56	33	57	25
33	55	5	55	57	56	49
34	54	29	55	20	55	11
35	53	50	54	41	55	32
36	53	10	54	0	54	56
37	52	30	53	19	54	51
38	51	49	52	37	54	9
39	51	7	51	55	52	44
40	50	25	51	12	52	0
41	49	41	50	27	51	15
42	48	55	49	41	50	28
43	48	9	48	54	49	41
44	47	22	48	7	48	53

Altitude vera (G.)	65 '	65 ''	66 '	66 ''	67 '	67 ''
45	46	35	47	19	48	4
46	45	46	46	30	47	14
47	44	57	45	40	46	23
48	44	7	44	49	45	31
49	43	16	43	57	44	38
50	42	24	43	4	43	44
51	41	23	42	10	42	39
52	40	38	41	16	41	54
53	39	44	40	21	40	58
54	38	48	39	25	40	1
55	37	52	38	28	39	3
56	36	55	37	30	38	5
57	35	58	36	32	37	6
58	35	0	35	33	36	6
59	34	1	34	34	35	6
60	33	2	33	34	34	6
61	32	33	32	33	33	3
62	31	2	31	31	32	1
63	30	0	30	28	30	58
64	28	59	29	26	29	54
65	27	57	28	23	28	50
66	26	54	27	19	27	45
67	25	51	26	15	26	40
68	24	47	25	10	25	34
69	23	43	24	5	24	28
70	22	39	23	0	23	21
71	21	34	21	54	22	14
72	20	28	20	47	21	6
73	19	21	19	39	19	58
74	18	15	18	31	18	49
75	17	8	17	22	17	40

Altitudo vera (G.)	65 ′	65 ″	66 ′	66 ″	67 ′	67 ″
76	16	1	16	14	16	31
77	14	54	15	6	15	21
78	13	47	13	58	14	12
79	12	39	12	50	13	2
80	11	31	11	42	11	52
81	10	22	10	33	10	41
82	9	13	9	23	9	30
83	8	4	8	13	8	19
84	6	55	7	3	7	8
85	5	46	5	52	5	57
86	4	37	4	42	4	45
87	3	28	3	32	3	34
88	2	18	2	21	2	23
89	1	9	1	10	1	11
90	0	0	0	0	0	0

Quarta Pars — Part Four of the Remaining Tables, for Eclipses

Quarta Pars Tabularum Reliquarum pro Eclipsibus.

Fourth Part of the Remaining Tables, for Eclipses.

TABLE 54 — Epacts for mean new and full moons

TABULA 54. Epactarum pro Noviluniis, ac Pleniluniis Mediis. (Table of Epacts for mean new moons and mean full moons.)

Epochs of the Epacts (Epochae Epactarum)

Left column heading: *Ante Christum* (before Christ); years counted upward in completed years, but entering into the calculation in descending order — *Anni completi ascendendo; sed ineuntes in calculo descendenti*. The lower block, headed

Radix Christi and then *Anni completi*, runs forward from the Christian era.
Columns: Anni (years) | D. (days) | H. (hours) | ' | ''.

Anni	D.	H.	'	''
6000	11	12	54	15
5000	27	4	6	37
4000	13	6	34	50
3000	29	9	3	7
2000	16	0	15	27
1000	1	2	43	35
900	26	7	14	14
800	21	23	0	39
700	17	14	47	5
600	13	6	33	30
500	8	22	19	56
400	4	14	6	21
300	0	5	52	47
200	25	10	23	16
100	21	2	9	41
Radix Christi	16	17	56	7
100	12	9	42	32
200	8	1	28	58
300	3	17	15	23
400	29	9	1	49
500	24	13	32	18
600	20	5	18	43
700	15	21	5	9
800	11	12	51	34
900	7	4	38	0
1000	2	20	24	24
1100	28	0	54	52
1200	23	16	41	17
1300	19	8	27	43

Anni	D.	H.	'	"
1400	15	0	14	8
1500	10	16	0	34
1600	6	7	46	54
1700	1	23	33	25
1800	27	4	4	4
1900	22	19	50	19
2000	18	11	36	44

Epacts for single years 1–100, then by hundreds and thousands

Columns: Anni | D. | H. | ' | ". (Years marked **B.** are bissextile/leap years.)

Anni	D.	H.	'	"
1	10	15	11	22
2	21	6	22	44
3	2	8	50	2
B. 4	14	0	1	24
5	24	15	12	46
6	5	17	40	5
7	16	8	51	26
B. 8	28	0	2	48
9	9	2	30	7
10	19	17	41	29
11	0	20	8	47
B. 12	12	11	20	9
13	23	2	31	31
14	4	4	58	50
15	14	20	10	12
B. 16	26	11	21	33
17	7	13	48	52
18	18	5	0	14
19	28	20	11	36
B. 20	10	22	38	54

Anni	D.	H.	'	"
21	21	13	50	16
22	2	16	17	35
23	13	7	28	57
B. 24	24	22	40	19
25	6	1	7	37
26	16	16	18	59
27	27	7	30	21
B. 28	9	9	57	39
29	20	1	9	1
30	1	3	36	20
31	11	18	47	42
B. 32	23	9	59	4
33	4	12	26	22
34	15	3	37	44
35	25	18	49	6
B. 36	7	21	16	25
37	18	12	27	46
38	29	3	39	8
39	10	6	6	27
B. 40	21	21	17	49
41	2	23	45	7
42	13	14	56	29
43	24	6	7	51
B. 44	6	8	35	10
45	16	23	46	32
46	27	14	57	53
47	8	17	25	12
B. 48	20	8	36	34
49	1	11	3	52
50	12	2	15	14
51	22	17	26	36

Anni	D.	H.	'	"
B. 52	4	19	53	55
53	15	11	5	17
54	26	2	16	38
55	7	4	43	57
B. 56	18	19	53	19
57	29	11	6	41
58	10	13	33	59
59	21	4	45	21
B. 60	3	7	10	40
61	13	22	24	2
62	24	13	35	24
63	5	16	2	42
B. 64	17	7	14	4
65	27	22	25	26
66	9	0	52	45
67	19	16	4	6
B. 68	1	18	31	25
69	12	9	42	47
70	23	0	54	9
71	4	3	21	27
B. 72	15	18	32	49
73	26	9	44	11
74	7	12	11	30
75	18	3	22	51
B. 76	0	5	50	10
77	10	21	1	32
78	21	12	12	54
79	2	14	40	12
B. 80	14	5	51	34
81	24	21	2	56
82	5	23	30	15

Anni	D.	H.	'	"
83	16	14	41	37
B. 84	28	5	52	58
85	9	8	20	17
86	19	23	31	39
87	1	1	58	58
B. 88	12	17	10	19
89	23	8	21	42
90	4	10	49	0
91	15	2	0	22
B. 92	26	17	11	44
93	7	19	39	2
94	18	10	50	24
95	29	2	1	46
B. 96	11	4	29	5
97	21	19	40	26
98	2	22	7	45
99	13	13	19	7
B. 100	25	4	30	29
200	20	20	19	54
300	16	12	3	20
400	12	3	49	45
500	7	19	36	10
600	3	11	22	36
700	28	15	53	5
800	24	7	39	30
900	19	23	25	56
1000	15	15	12	22
2000	1	17	40	40
3000	17	8	53	1
4000	3	11	21	19
5000	19	2	33	40

Anni	D.	H.	'	"
6000	5	5	1	59
7000	20	20	14	20
8000	6	22	42	38
9000	22	14	0	0
10000	8	16	23	17
11000	24	7	35	39
12000	10	10	3	58

Epacts by month — common year (Anni Communis) and bissextile year (Anni Bissextil.)

Columns: Menses (months) | D. | H. | ' | " for each of the two year-types.

	Com mon D.	Com mon H.	Com mon '	Com mon "	Bissextil e D.	Bissextil e H.	Bissextile '	Bissextile "
Ianu ar.	1	11	15	57	1	11	15	57
Febr .	29	11	15	57	0	22	31	54
Mar tius	1	9	47	50	2	9	47	50
Apri lis	1	21	3	47	2	21	3	47
Mai us	3	8	19	44	4	8	19	44
Iuni us	3	19	35	41	4	19	35	41
Iuli us	5	6	51	38	6	6	51	38
Aug ust.	6	18	7	35	7	18	7	35
Sept éb.	7	5	23	31	8	5	23	31
Octo b.	8	16	39	28	9	16	39	28

Men ses	Com mon D.	Com mon H.	Com mon '	Com mon "	Bissextil e D.	Bissextil e H.	Bissextile '	Bissextile "
Nou éb.	9	3	55	25	10	3	55	25
Dec éb.	10	15	11	22	11	15	11	22

Revolutions of new moons (Revoluciones & Noviluniorum) and full moons (♌ Pleniluniorum)

Columns: Ordo (order) | D. | H. | ' | " for new moons; D. | H. | ' | " for full moons.

O r d o	Novil. D.	Novil. H.	Novil. '	Novil. "	Plenil. D.	Plenil. H.	Plenil. '	Plenil. "
I	29	12	44	3	14	18	22	2
II	59	1	28	6	44	7	6	5
II	88	14	12	10	73	19	50	8
I								
I	118	2	56	13	103	8	34	11
V								
V	147	15	40	16	132	21	18	14
V	177	4	24	19	162	10	2	17
I								
V	206	17	8	22	191	22	46	21
II								
V	236	5	52	25	221	11	30	24
II								
I								
I	265	18	36	29	251	0	14	27
X								
X	295	7	20	32	280	12	58	30
X	324	20	4	35	310	1	42	33
I								
X	354	8	48	38	339	14	26	37

O								
r								
d	Novil.	Novil.			Plenil.	Plenil.		
o	D.	H.	Novil. '	Novil. "	D.	H.	Plenil. '	Plenil. "
II								
X	383	21	32	41	369	3	10	40
II								
I								

TABLE 55 — Eclipse limits; distance from the node

TAB. 55. *Termini Eclipsium. Distantia à Nodo* ☾. (Eclipse limits; distance from the [ascending] node ☾.) Subdivided into Lunarium (for lunar eclipses) and Solarium (for solar eclipses), each giving the limit at apogee (☽ Apog.) and at perigee (Perigea), in G. (degrees) and ' (minutes). The row labels read "Sole (Apog. / Perig.)" — the Sun at apogee / at perigee.

(S								
u								
n	Lunar		Lunar	Lunar	Solar ☉		Solar	Solar
at	☽ Apog.	Lunar ☽	Perige	Perigea	Apog.	Solar ☉	Perige	Perigea
)	G.	Apog. '	a G.	'	G.	Apog. '	a G.	'
A	10	48	12	2	15	58	17	14
po								
g.								
Pe	10	40	11	53	16	5	17	20
ri								
g.								

Part V — Parallaxes of longitude and latitude

PARALLAXES OF LONGITUDE, AND OF LATITUDE.

TABLE 56 — Mesoplastic parallax

TABULA 56. *Parallaxeon Mecoplatica*. (Table of mesoplastic parallaxes. [The source prints "Mecoplatica" with a c; the established corpus form is "mesoplastic."])

Minutes of horizontal parallax [Minuta Parallaxeos Horizontalis].

The argument runs down the left margin as *Latitud. latus. G.* (the degree of latitude-distance, 0 to 90, by twos) and is repeated down the right margin as *Longit. latus. G.* (the complementary longitude-distance, 90 down to 0). The right-margin label printed vertically reads *Nonagesimi Altitudo* (the altitude of the nonagesimal). The body columns are headed 1 through 13, each carrying a ' and " pair, giving the mesoplastic parallax for that argument.

	1																			1	1	1	1	Longi			
Latit.	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	1	0	1	1	1	2	1	3	t.
latus																			0		1		2		3		latus
G.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	G.
0	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0	1	0	1	0	1	0	1	0	90
																			0		1		2		3		
2	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0	1	0	1	0	2	0	1	0	88
																			0		1		2		3		
4	1	0	2	0	3	5	4	5	5	5	6	5	7	5	8	5	9	5	1	5	1	5	1	5	1	5	86
						9	9	9	9	9	9	9	9	9	9	9	8	0	8	1	8	2	8	3	8		
6	1	0	1	5	3	5	4	5	5	5	6	5	7	5	8	5	9	5	1	5	1	5	1	5	1	5	84
				9	9	8	8	8	7	7	6	6	6	6	6	6	6	0	6	1	5	2	5	3	5		
8	0	5	1	5	3	5	3	5	4	5	5	5	6	5	7	5	8	5	9	5	1	5	1	5	1	5	82
	9	9	8	8	8	7	6	6	5	5	4	0	4	1	3	2	2			4	0	4	1	3	2	2	
10	0	5	1	5	2	5	3	5	4	5	5	5	6	5	7	5	8	5	9	5	1	5	1	4	1	4	80
	9	8	7	6	5	4	4	3	2										1	0	0	1	5	2	8		
12	0	5	1	5	2	5	3	5	4	5	5	5	6	5	7	4	8	4	8	4	1	4	1	4	1	4	78
	9	7	6	5	3	2	1	9	8	7	0	6	1	4	2	3			7	0	6	1	4	2	3		
14	0	5	1	5	2	5	3	5	4	5	5	4	6	4	7	4	8	4	9	4	1	4	1	3	1	3	76
	8	6	5	3	1	9	8	6	4										2	0	1	1	9	2	7		
16	0	5	1	5	2	5	3	5	4	5	5	4	6	4	7	4	8	3	9	3	1	3	1	3	1	3	74
	8	5	3	1	8	6	4	1	9	7	0	5	1	2	2	0											
18	0	5	1	5	2	5	3	4	4	4	5	4	6	3	7	3	8	3	9	3	1	2	1	2	1	2	72
	7	4	1	8	5	2	9	7	4											1	0	8	1	5	2	2	
20	0	5	1	5	2	4	3	4	4	4	5	3	6	3	7	3	8	2	9	2	1	2	1	1	1	1	70
	6	3	9	6	2	8	5	1	7	4	0	0	1	7	2	3											
22	0	5	1	5	2	4	3	4	4	3	5	3	6	2	7	2	8	2	9	1	1	1	1	8	1	3	68
	6	1	7	3	8	4	9	5	1	6	0	2	1	2													
24	0	5	1	5	2	4	3	3	4	3	5	2	6	2	7	1	8	1	9	8	1	3	1	5	1	5	66

Latit. latus G.	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	1	0	1	1	1	2	1	3	Longi t. latus G.
	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	
		5		0		4		9		4		9		4		9		3		0		0		8		1	3
26	0	5	1	4	2	4	3	3	4	3	5	2	6	1	7	1	8	5	8	5	9	5	1	4	1	4	64
		4		8		2		6		0		4		8		1				9		3		0		7	1
28	0	5	1	4	2	3	3	3	4	2	5	1	6	1	7	4	7	5	8	5	9	4	1	3	1	2	62
		3		6		9		2		5		8		1				7		0		3		0		6	1
30	0	5	1	4	2	3	3	2	4	2	5	1	6	4	6	5	7	4	8	4	9	3	1	2	1	1	60
		2		4		6		8		0		2				6		8		0		2		0		4	1
32	0	5	1	4	2	3	3	2	4	1	5	5	5	5	6	4	7	3	8	2	9	2	1	1	1	1	58
		1		2		3		4		4				6		7		8		9		0		0		1	1
34	0	5	1	3	2	2	3	1	4	9	4	5	5	4	6	3	7	2	8	1	9	7	9	5	1	4	56
		0		9		9		9				8		8		8		8		7				7		0	7
36	0	4	1	3	2	2	3	1	4	3	4	5	5	4	6	2	7	1	8	5	8	5	9	4	1	3	54
		9		7		6		4				1		0		8		7				4		2		0	1
38	0	4	1	3	2	2	3	9	3	5	4	4	5	3	6	1	7	6	7	5	8	4	9	2	1	1	52
		7		5		2				6		4		1		8				3		0		7		0	5
40	0	4	1	3	2	1	3	4	3	5	4	3	5	2	6	8	6	5	7	4	8	2	9	1	9	5	50
		6		2		8				0		6		2				4		0		6		2		8	
42	0	4	1	2	2	1	2	5	3	4	4	2	5	1	5	5	6	4	7	2	8	1	8	5	9	4	48
		5		9		3		8		3		7		2		7		1		6		1		5		0	
44	0	4	1	2	2	9	2	5	3	3	4	1	5	2	5	4	6	2	7	1	7	5	8	3	9	2	46
		3		6				3		6		9				5		8		2		5		8		1	
46	0	4	1	2	2	5	2	4	3	2	4	1	4	5	5	3	6	1	6	5	7	3	8	2	9	2	44
		2		3				7		8		0		2		3		5		7		9		0			
48	0	4	1	2	2	0	2	4	3	2	4	1	4	4	5	2	6	1	6	4	7	2	8	2	8	4	42
		0		0				1		1				1		1				1		2				2	
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		9		7		6		4		3		1		0				7		6				3		1	
52	0	3	1	1	1	5	2	2	3	5	3	4	4	1	4	5	5	3	6	9	6	4	7	2	8	0	38
		7		4		1		8				2		9		5		1				6		3			
54	0	3	1	1	1	4	2	2	2	5	3	3	4	7	4	4	5	1	5	5	6	2	7	3	7	3	36
		5		1		6		1		6		2				2		7		3		8				8	

Latit. latus G.	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	1	0	1	1	1	2	1	3	Longi t. latus G.
56	0	3	1	7	1	4	2	1	2	4	3	2	3	5	4	2	5	2	5	3	6	9	6	4	7	1	34
58	0	3	1	4	1	3	2	7	2	3	3	1	3	4	4	1	4	4	5	1	5	5	6	2	6	5	32
59	0	3	1	2	1	3	2	4	2	3	3	5	3	3	4	7	4	3	5	9	5	4	6	1	6	4	31
60	0	3	1	0	1	3	2	0	2	3	3	0	3	3	4	0	4	3	5	0	5	3	6	0	6	3	30
61	0	2	0	5	1	2	1	5	2	2	2	5	3	2	3	5	4	2	4	5	5	2	5	4	6	1	29
62	0	2	0	5	1	2	1	5	2	2	2	4	3	1	3	4	4	1	4	4	5	1	5	3	6	6	28
63	0	2	0	5	1	2	1	4	2	1	2	4	3	1	3	3	4	5	4	3	5	0	5	2	5	5	27
64	0	2	0	5	1	1	1	4	2	1	2	3	3	4	3	3	3	5	4	2	4	4	5	1	5	4	26
65	0	2	0	5	1	1	1	4	2	7	2	3	2	5	3	2	3	4	4	1	4	3	5	5	5	3	25
66	0	2	0	4	1	1	1	3	2	2	2	2	2	5	3	1	3	4	4	4	4	2	4	5	5	1	24
67	0	2	0	4	1	1	1	3	1	5	2	2	2	4	3	7	3	3	3	5	4	1	4	4	5	5	23
68	0	2	0	4	1	7	1	3	1	5	2	1	2	3	3	0	3	2	3	4	4	7	4	3	4	5	22
69	0	2	0	4	1	4	1	2	1	4	2	9	2	3	2	5	3	1	3	3	3	5	4	1	4	3	21
70	0	2	0	4	1	2	1	2	1	4	2	3	2	2	2	4	3	5	3	2	3	4	4	6	4	2	20
71	0	2	0	3	0	5	1	1	1	3	1	5	2	1	2	3	2	5	3	1	3	3	3	5	4	1	19
72	0	1	0	3	0	5	1	1	1	3	1	5	2	1	2	2	2	4	3	5	3	2	3	4	4	1	18

Latit.	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	1	1	1	1	Longi				
latus																			0	1	2	3	t.				
G.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	G.				
		9		7		6		4		3		1		0		8		7			4		2				
73	0	1	0	3	0	5	1	1	1	2	1	4	2	3	2	2	2	3	2	5	3	1	3	3	4	17	
		8		5		3		0		8		5				0		8		5		3		0		8	
74	0	1	0	3	0	5	1	6	1	2	1	3	1	5	2	1	2	2	2	4	3	2	3	1	3	3	16
		7		3		0				3		9		6		2		9		5				8		5	
75	0	1	0	3	0	4	1	2	1	1	1	3	1	4	2	4	2	2	2	3	2	5	3	6	3	2	15
		6		1		7				8		3		9				0		5		1				2	
76	0	1	0	2	0	4	0	5	1	1	1	2	1	4	1	5	2	1	2	2	2	4	2	5	3	9	14
		5		9		4		8		3		7		2		6		1		5		0		4			
77	0	1	0	2	0	3	0	5	1	6	1	2	1	3	1	4	2	1	2	1	2	2	2	4	2	5	13
		4		7		9		4				1		4		8				5		8		2		5	
78	0	1	0	2	0	3	0	5	1	2	1	1	1	2	1	4	1	5	2	5	2	1	2	3	2	4	12
		2		5		7		0				5		7		0		2				7		0		2	
79	0	1	0	2	0	3	0	4	0	5	1	9	1	2	1	3	1	4	1	5	2	6	2	1	2	2	11
		1		3		4		6		7				0		2		3		4				7		9	
80	0	1	0	2	0	3	0	4	0	5	1	2	1	1	1	2	1	3	1	4	1	5	2	5	2	1	10
		0		1		1		2		2				3		3		4		4		5				6	
81	0	9	0	1	0	2	0	3	0	4	0	5	1	6	1	1	1	2	1	3	1	4	1	5	2	5	9
				9		8		8		7		6				5		4		3		3		2			
82	0	8	0	1	0	2	0	3	0	4	0	5	0	5	1	7	1	1	1	2	1	3	1	4	1	4	8
				7		5		3		2		0		8				5		3		2		0		9	
83	0	7	0	1	0	2	0	2	0	3	0	4	0	5	0	5	1	6	1	1	1	2	1	2	1	3	7
				5		2		9		7		4		1		9				3		0		8		5	
84	0	6	0	1	0	1	0	2	0	3	0	3	0	4	0	5	0	5	1	3	1	9	1	1	1	2	6
				3		9		5		1		8		3		0		6						5		1	
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86	0	4	0	8	0	1	0	1	0	2	0	2	0	2	0	3	0	3	0	4	0	4	0	5	0	5	4
						3		7		1		5		9		3		8		2		6		0		4	
87	0	3	0	6	0	9	0	1	0	1	0	1	0	2	0	2	0	2	0	3	0	3	0	3	0	4	3
								3		6		9		2		5		8		1		4		8		1	

L a t. G .	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	L o n g. G .
G .	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	G .
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	.
0	1	0	1	0	1	5	1	5	1	5	1	5	1	5	2	5	2	5	2	5	2	5	2	5	9
	4		5		5	9	6	9	7	9	8	9	9	9	0	9	1	9	2	9	3	9	4	9	0
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	4		5		5	9	6	9	7	9	8	9	9	9	0	9	1	9	2	9	3	9	4	9	8
4	1	5	1	5	1	5	1	5	1	5	1	5	1	5	2	5	2	5	2	5	2	5	2	5	8

L a t. G .	1 4 4 .	1 5 5 "	1 6 6 "	1 7 7 "	1 8 8 "	1 9 9 "	2 0 0 "	2 1 2 "	2 2 2 "	2 3 3 "	2 4 4 "	2 5 5 "	2 6 6 "	L o n g. G .														
	3	8	4	8	5	8	6	7	7	7	8	7	9	7	0	7	1	7	2	7	3	6	4	6	5	6	6	
6	1	5	1	5	1	5	1	5	1	5	1	5	1	5	2	5	2	5	2	5	2	5	2	5	2	5	8	
	3	5	4	5	5	5	6	4	7	4	8	4	9	3	0	3	1	3	2	2	3	2	4	2	5	1	4	
8	1	5	1	5	1	5	1	5	1	4	1	4	1	4	2	4	2	4	2	4	2	4	2	4	2	4	8	
	3	2	4	1	5	1	6	0	7	9	8	9	9	8	0	8	1	6	2	7	3	6	4	5	5	5	2	
1	1	4	1	4	1	4	1	4	1	4	1	4	1	4	2	4	2	4	2	3	2	3	2	3	2	3	8	
0	3	7	4	6	5	5	6	4	7	3	8	3	9	2	0	1	1	0	2	9	3	8	4	7	5	6	0	
1	1	4	1	4	1	3	1	3	1	3	1	3	1	3	2	3	2	3	2	3	2	2	2	2	2	2	7	
2	3	3	4	9	5	9	6	8	7	6	8	5	9	4	0	2	1	1	2	9	3	8	4	7	5	6	8	
1	1	3	1	3	1	3	1	3	1	3	1	2	1	2	2	2	2	2	2	1	2	1	2	1	2	1	7	
4	3	5	4	3	5	2	6	0	7	0	8	6	9	5	0	3	1	1	2	9	3	8	4	6	5	4	6	
1	1	2	1	2	1	2	1	2	1	1	1	1	1	1	2	1	2	9	2	7	2	4	2	2	2	0	7	
6	3	8	4	5	5	3	6	1	7	8	8	6	9	4	0	1	1		2		3		4		5		4	
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8	3	9	4	6	5	3	6	0	7		8		9		9	8	0	3	1	3	2	0	3	7	4	4	2	
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0	3		4		5		5	9	6	5	7	1	8	8	9	4	0	0	1	7	2	3	3	0	4	6	0	
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2	2	9	3	4	4	0	5	6	6	1	7	7	8	3	9	8	0	4	1	0	2	5	3	1	4		8	
2	1	4	1	4	1	3	1	3	1	2	1	2	1	1	1	1	2	6	2	1	2	5	2	5	2	4	6	
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0	2		2	9	3	1	4	3	5	5	6	7	8	1	9		9	5	0	7	1	9	2	2	2		0	
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3	1	3	1	2	1	1	1	5	1	5	1	3	1	2	1	1	1	4	1	5	2	4	2	3	2	2	5	

L a t. G .	1 4 4 .	1 5 5 "	1 6 6 "	1 7 7 "	1 8 8 "	1 9 9 "	2 0 0 "	2 1 2 "	2 2 2 "	2 3 3 "	2 4 4 "	2 5 5 "	2 6 6 "	L o n g. G .													
4	1	6	2	6	3	6	4	4	5	6	5	7	4	8	4	9	9	4	0	3	1	3	1	1	6		
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6	1	9	2		2	7	3	5	4	4	6	1	6	9	7	8	8	6	9	5	0	3	1		1	9	4
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8		2	0		0	2	1	3	2		2	3	3	3	4		4	3	5	3	6		6	4	7	4	2
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0				8	0	7	0	6	1	4	2	3	2	1	3	0	4		4	7	5	6	6		6	3	0
5	8	3	9	1	9	5	1	2	1	5	1	4	1	1	1	5	1	3	1	9	1	4	1	2	1	0	3
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5	8	1	8	4	9	2	1	0	1	3	1	1	1	4	1	2	1	5	1	3	1	6	1	4	1	1	3
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5	7	5	8	2	8	5	9	3	1	4	1	3	1	1	1	4	1	1	1	5	1	2	1	5	1	3	3
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0				0				0				0	0		0	0	1		1	0	2		2	0	3		0
6	6	4	7	1	7	4	8	1	8	4	9	1	9	4	1	1	1	4	1	1	1	3	1	7	1	3	2

L a t. G .	1 4 4 .	1 4 5 "	1 5 6 "	1 6 7 "	1 7 8 "	1 8 9 "	1 9 0 "	2 0 1 "	2 1 2 "	2 2 3 "	2 3 4 "	2 4 5 "	2 5 6 "	2 6 7 "	2 7 8 "	2 8 9 "	2 9 0 "	2 0 1 "	2 1 2 "	2 2 3 "	2 3 4 "	2 4 5 "	2 5 6 "	2 6 7 "	L o n g. G .		
1	7	6	5	4	3	2	2	0	1	0	0	1	1	1	8	2	2	6	9								
6	6	3	7	2	7	3	7	5	8	2	8	5	9	2	9	5	1	2	1	4	1	1	1	4	1	1	2
2	4			1	9	7	5	3	1	0	0	0	8	1	6	1	4	2	2	8							
6	6	2	6	4	7	1	7	4	8	1	8	3	9	5	9	3	9	5	1	2	1	5	1	2	1	4	2
3	1	8	6	3	0	7			2	9	0	6	0	4	1	1	1	8	7								
6	6	8	6	3	7	1	7	2	7	5	8	2	8	4	9	1	9	3	1	5	1	3	1	5	1	2	2
4			4		7	3	0	6	2	9	0		0	1	0	7	1	4	6								
6	5	5	6	2	6	4	7	1	7	3	8	2	8	2	8	5	9	1	9	4	1	9	1	3	1	0	2
5	5	0	6	1	8			8	3	8	3	0	4	1	5												
6	5	4	6	6	6	3	6	5	7	1	7	4	8	8	8	3	8	5	9	2	9	4	1	1	1	3	2
6	2			0	5	9	4		2	7	1	6	0	0	0	4	4										
6	5	2	5	5	6	1	6	3	7	2	7	2	7	4	8	1	8	3	8	5	9	2	9	4	1	9	2
7	8	1	5	8				5	9	2	6	9	3	6	9	3	6	0	3								
6	5	1	5	3	5	5	6	2	6	4	7	7	7	2	7	5	8	1	8	3	8	5	9	2	9	4	2
8	5	7	9	2	4				9	1	4	6	8	1	3	2											
6	5	1	5	2	5	4	6	5	6	2	6	4	7	1	7	3	7	5	8	1	8	3	8	5	9	2	2
9			2	4				7	8	0	2	3	4	6	7	1	1										
7	4	4	5	8	5	2	5	4	6	9	6	3	6	5	7	1	7	3	7	5	8	1	8	3	8	5	2
0	7			8	9				0	0	1	1	3	2	3	3	0										
7	4	3	4	5	5	1	5	3	5	5	6	1	6	3	6	5	7	1	7	3	7	5	8	1	8	3	1
1	3	3	3	3	2	2	2	2	2	2	2	1	1	1	0	9											
7	4	1	4	3	4	5	5	1	5	3	5	5	6	1	6	3	6	5	7	9	7	2	7	4	8	5	1
2	9	8	7	5	4	3	2	1	0																		
7	4	5	4	2	4	4	4	5	5	1	5	3	5	5	6	1	6	2	6	4	7	4	7	2	7	4	1
3			3	1	8	6	4	2	0	8	6																
7	3	5	4	8	4	2	4	4	4	5	5	1	5	3	5	4	6	4	6	2	6	3	6	5	7	1	1
4	1			5	1	8	4	1	7																		
7	3	3	3	5	4	8	4	2	4	3	4	5	5	1	5	2	5	4	5	5	6	1	6	2	6	4	1
5	7	3			4	9	5	0	6	1	7	2	8	3	5												
7	3	2	3	3	3	5	4	7	4	2	4	3	4	5	5	5	5	1	5	3	5	4	6	3	6	1	1

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L a t. G .	2 7 7 ,	2 8 8 "	2 9 9 "	3 0 0 "	3 1 1 "	3 2 2 "	3 3 3 "	3 4 4 "	3 5 5 "	3 6 6 "	3 7 7 "	3 8 8 "	3 9 9 "	3 0 0 "	3 1 1 "	3 2 2 "	3 3 3 "	3 4 4 "	3 5 5 "	3 6 6 "	3 7 7 "	3 8 8 "	3 9 9 "	3 0 0 "	L o n g. G .	
0	2 6	5 9	2 7	5 9	2 8	5 9	2 9	5 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	3 7	3 8	3 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	9 0
2	2 6	5 9	2 7	5 9	2 8	5 9	2 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	3 7	3 8	3 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	3 7	8 8
4	2 6	5 6	2 7	5 6	2 8	5 6	2 9	3 0	3 5	3 1	3 5	3 2	3 5	3 3	3 5	3 4	3 7	3 4	3 5	3 5	3 6	3 4	3 7	3 4	3 8	8 6
6	2 6	5 1	2 7	5 1	2 8	5 0	2 9	3 0	3 0	3 1	3 9	3 2	3 9	3 4	3 8	3 5	3 8	3 6	3 8	3 5	3 6	3 7	3 7	3 8	3 7	4 4
8	2 6	4 4	2 7	4 4	2 8	4 3	2 9	3 0	3 2	3 1	3 4	3 2	3 0	3 4	3 5	3 9	3 6	3 8	3 5	3 9	3 6	3 8	3 7	3 8	3 8	8 2
10	2 6	3 5	2 7	3 4	2 8	3 3	2 9	3 0	3 2	3 1	3 0	3 2	3 0	3 3	2 8	2 7	2 6	2 6	2 3	2 7	2 6	2 5	2 8	2 4	2 0	8 0
12	2 6	2 4	2 7	2 3	2 8	2 9	2 1	2 0	3 9	3 1	3 8	3 2	3 7	3 5	3 4	3 4	3 6	3 1	3 3	3 6	3 1	3 7	3 0	3 8	3 8	7 8
14	2 6	1 2	2 7	1 1	2 8	9 9	2 7	3 0	3 5	3 1	3 2	3 3	3 0	3 3	5 8	3 4	3 5	3 6	3 5	3 5	3 6	3 5	3 7	3 1	3 6	7 6
16	2 5	5 7	2 6	5 5	2 7	5 3	2 8	2 9	2 4	2 8	2 0	2 4	2 1	2 3	3 9	3 4	3 7	3 5	3 4	3 7	3 5	3 4	3 6	3 2	3 0	7 4
18	2 5	4 1	2 6	3 8	2 7	3 5	2 8	2 9	2 2	2 3	2 9	2 3	2 0	2 3	1 7	1 4	1 5	1 3	1 3	1 4	1 3	1 6	1 7	1 9	1 7	6 2
20	2 5	2 2	2 6	2 9	2 1	2 5	2 8	2 9	2 4	2 8	2 0	2 4	2 1	2 3	5 7	5 2	5 3	5 0	5 3	5 4	5 6	5 3	5 4	5 3	5 6	9 0
22	2 5	2 5	2 5	2 8	2 6	2 3	2 7	2 9	2 4	2 5	2 9	2 3	2 0	2 3	3 2	3 2	3 7	3 3	3 2	3 3	3 4	3 8	3 5	3 4	3 6	8 8
24	2 4	4 0	2 5	3 5	2 6	3 0	2 7	2 5	2 8	2 3	2 9	2 4	2 0	2 3	1 9	1 1	1 8	1 2	1 3	1 3	1 8	1 4	1 3	1 5	1 8	6 6
26	2 4	1 6	2 5	1 0	2 6	4 6	2 5	2 8	2 7	2 2	2 8	2 4	2 0	2 3	3 4	3 1	3 8	3 2	3 2	3 3	3 6	3 4	3 5	3 4	3 5	6 4

[illegible]

[illegible]

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L																					L
a	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	o
t.	2	7	2	8	2	9	3	0	3	1	3	2	3	3	3	4	3	5	3	6	g.
G	7	8	9	0	1	2	3	4	5	6	7	8	9								G
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	.
8	0	5	0	5	1	0	1	3	1	6	1	9	1	1	1	1	1	1	1	1	2
8		6		9									1	3	5	7	9	1	4		2
8	0	2	0	2	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0	4	1
9		8		9		0		2		3		5		6		7		8		9	0
9																					0
0																					

horizontal parallax 40'–52'

L																					L
a	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	n
t.	4	0	4	1	4	2	4	3	4	4	4	5	4	6	4	7	4	8	4	9	g.
G	0	1	2	3	4	5	6	7	8	9	0	1	2								G
.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	.
0	3	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	9
	9	9	0	9	1	9	2	9	3	9	4	8	5	8	6	8	7	8	8	9	0
2	3	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	8
	9	9	0	9	1	9	2	9	3	9	4	8	5	8	6	8	7	8	8	9	8
4	3	5	4	5	4	5	4	4	4	5	4	5	4	5	4	5	4	5	4	5	8
	9	4	0	4	1	4	2	4	3	3	4	3	5	3	6	3	7	3	8	3	6
6	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	8
	9	7	0	6	1	6	2	6	3	3	4	5	5	5	6	4	7	4	8	4	4
8	3	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	8
	9	7	0	6	1	5	2	5	3	4	4	4	5	3	6	3	7	2	8	1	2
1	3	2	4	2	4	2	4	2	4	2	4	1	4	1	4	1	4	1	4	1	8
0	9	3	0	2	1	1	2	1	3	0	4	9	5	8	6	7	7	6	8	5	0
1	3	7	4	6	4	5	4	3	4	2	4	1	4	5	4	5	4	5	4	5	7
2	9		0		1		2		3		4		4	9	5	8	6	7	7	5	8
1	3	4	3	4	4	4	4	4	4	4	4	4	4	3	4	3	4	3	4	3	7
4	8	9	9	8	0	6	1	4	2	2	3	0	4	9	5	7	6	5	7	3	6

[illegible]

L a t. G .	4 0 ,	4 0 "	4 1 ,	4 1 "	4 2 ,	4 2 "	4 3 ,	4 3 "	4 4 ,	4 4 "	4 5 ,	4 5 "	4 6 ,	4 6 "	4 7 ,	4 7 "	4 8 ,	4 8 "	4 9 ,	4 9 "	5 0 ,	5 0 "	5 1 ,	5 1 "	5 2 ,	5 2 "	L o n g. G .
4 6 4 8 5 0 5 2 5 4 5 6 8 9 6 1 2 3 4 6 5 0																											

L a t. G .	4 0 ,	4 0 "	4 1 ,	4 1 "	4 2 ,	4 2 "	4 3 ,	4 3 "	4 4 ,	4 4 "	4 5 ,	4 5 "	4 6 ,	4 6 "	4 7 ,	4 7 "	4 8 ,	4 8 "	4 9 ,	4 9 "	5 0 ,	5 0 "	5 1 ,	5 1 "	5 2 ,	5 2 "	L o n g. G .
6 7 6 8 6 9 7 0 7 1 7 2 3 7 4 5 6 8 7 8 9 1 0 1 2 3 4 5 6 7 8 9	1 5 1 4 1 4 3 0 1 3 1 2 8 1 9 6 5 4 0 7 8 6 3 5 2 1 0 9 4 1 8 0 5 3 2 1 6 7 0 4 1 5 9 3 0 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4																										

L a t. G .	4 0 0 ,	4 1 1 "	4 2 2 "	4 3 3 "	4 4 4 "	4 5 5 "	4 6 6 "	4 7 7 "	4 8 8 "	4 9 9 "	5 0 0 "	5 1 1 "	5 2 2 "	L o n g. G .	
8 2 8 3 8 4 8 5 8 6 8 7 8 8 8 9 9 0	5 0 4 5 3 2 2 4 1 3 0 2 0	3 4 5 3 1 7 9 5 4 2 0 3 2 3 0	5 2 0 7 8 2 4 5 0 4 4 0 3 4 2 5 4	5 1 7 5 2 9 3 6 4 5 1 8 0 7 5 6 4	5 9 2 6 0 8 1 4 2 5 3 6 4	5 6 3 8 5 1 2 4 0 7 1 8 2	6 4 7 3 8 2 9 1 0 4 1 5 2	7 2 4 1 6 3 4 2 5 1 6 4 7	8 3 5 4 6 7 7 8 8 9 9	9 4 5 3 6 2 7 1 8 0 0	0 5 1 4 2 3 3 2 4 1 5 0 6	1 6 7 5 8 4 9 3 0 2 1 1 2	2 7 8 6 9 5 0 4 1 3 2 2 3	2 8 9 7 0 6 1 5 2 4 3 3 4	L o n g. G .

Parallaxes of Longitude and Latitude (continued)

Remainder of TAB. 56. Of the Mesoplastic Parallax [Parallaxeos Mecoplasticæ]

This is the concluding portion (the *residuum*) of Table 56, giving the mesoplastic parallax. The body of the table tabulates **Minutes of Horizontal Parallax** [**Minuta Parallaxeos Horizontalis**] from 53' through 66' across the top. Each horizontal-parallax value heads a paired column giving the resulting parallax in minutes (') and seconds ("). The leftmost column is the **Latitude argument** [**Latitud. latus.**], labelled G. (degrees), running 0 → 90; the rightmost column is

the corresponding **Longitude argument [Lōgitud. latus.]** (the *Nonagesimi Altitudo* — the altitude of the nonagesimal), running $90 \rightarrow 0$.

The argument increment is 2° down to row 56, then 1° from 56 to 90 (left) / 0 (right).

L																															L
a	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	o	
t.	3	3	4	4	5	5	6	6	7	7	8	8	9	9	0	0	1	1	2	2	3	3	4	4	5	5	6	6	6	n	
G	.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	g	
0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	9	
	2	8	3	8	4	8	5	8	6	8	7	8	8	8	9	8	0	8	1	8	2	8	3	8	4	8	5	8	0		
2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	8	
	2	8	3	8	4	8	5	8	6	8	7	8	8	8	9	8	0	8	1	8	2	8	3	8	4	8	5	8	8		
4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5	8	
	2	2	3	2	4	2	5	2	6	0	7	0	8	0	9	0	0	0	1	0	2	0	3	0	4	0	5	0	6		
6	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	6	4	6	4	6	3	6	3	6	3	6	3	6	3	8
	2	2	3	2	4	2	5	1	6	1	7	1	8	0	9	0	0	0	1	0	2	9	3	9	4	8	5	8	4		
8	5	2	5	2	5	2	5	2	5	2	5	2	5	2	5	2	6	2	6	2	6	2	6	2	6	2	6	2	6	2	8
	2	9	3	8	4	8	5	7	6	7	7	6	8	6	9	5	0	4	1	4	2	3	3	3	4	2	5	1	2		
1	5	1	5	1	5	1	5	9	5	8	5	7	5	6	5	5	6	4	6	2	6	2	6	1	6	0	6	5	8		
0	2	1	3	0	4	0	5		6		7		8		9		0		1		2		3		4		4	9	0		
1	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	6	3	6	3	6	3	6	3	6	3	6	3	7
2	1	0	2	9	3	8	4	6	5	5	6	4	7	2	8	1	9	0	0	8	1	7	2	6	3	4	4	3	8		
1	5	2	5	2	5	2	5	2	5	1	5	1	5	1	5	1	5	1	6	1	6	1	6	7	6	5	6	3	7		
4	1	6	2	5	3	3	4	1	5	9	6	8	7	6	8	4	9	2	0	0	1	0	2		3		4		6		
1	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5	4	5	3	5	3	6	3	6	3	6	2	6	2	7		
6	0	7	1	5	2	3	3		4	8	5	6	6	3	6	1	8	9	9	6	0	4	1	2	2	9	3	7	4		
1	5	2	5	2	5	1	5	1	5	1	5	1	5	7	5	4	5	1	5	5	5	5	6	5	6	4	6	4	7		
8	0	5	1	2	2	9	3	6	4	3	5	0	6		7		8		8	8	9	5	0	2	1	9	2	6	2		
2	4	4	5	4	5	4	5	3	5	3	5	3	5	2	5	2	5	2	5	1	5	1	6	1	6	6	6	2	7		
0	9	8	0	5	1	1	2	7	3	4	4	0	5	7	6	4	7	0	8	9	9	4	0	1	1		2		0		
2	4	9	5	4	5	0	5	5	5	5	5	4	5	4	5	3	5	3	5	2	5	2	5	2	6	1	6	1	6		
2	9		0		1		1	5	2	1	3	7	4	2	5	8	6	4	7	8	8	5	9	1	0	6	1	2	8		
2	4	2	4	2	5	1	5	1	5	5	5	5	5	5	5	4	5	4	5	4	5	4	5	3	5	2	5	2	6	1	6
4	8	5	9	0	0	5	1	0	2		3	9	4	4	4	9	5	4	6	6	7	3	8	8	9	3	0	8	6		

L																													L	
a	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	o	
t	3	3	4	4	5	5	6	6	7	7	8	8	9	9	0	0	1	1	2	2	3	3	4	4	5	5	6	6	n	
G	.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	g
.	.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"	.
2	4	3	4	3	4	2	5	2	5	1	5	8	5	2	5	5	5	5	5	4	5	3	5	3	5	2	5	2	6	
6	7	8	8	2	9	6	0	0	1	4	2		3		3	6	4	0	5	4	6	8	7	2	8	6	9	0	4	
2	4	4	4	4	4	3	4	2	5	2	5	1	5	6	5	5	5	5	5	4	5	3	5	3	5	2	5	1	6	
8	6	8	7	1	8	4	9	7	0	0	1	3	2		2	9	3	2	4	5	5	8	6	1	7	4	8	7	2	
3	4	5	4	4	4	3	4	3	4	2	5	1	5	6	5	5	5	5	5	4	5	3	5	2	5	1	5	1	6	
0	5	4	6	6	7	8	8	0	9	2	0	4	1		1	8	2	0	3	2	4	4	5	6	6	8	7	0	0	
3	4	5	4	4	4	3	4	2	4	2	4	1	5	2	5	5	5	4	5	3	5	2	5	3	5	7	5	5	5	
2	4	7	5	8	6	9	7	9	8	0	9	1	0		0	3	1	4	2	4	3	6	4	4	5		5	8	8	
3	4	5	4	4	4	2	4	2	4	1	4	5	4	5	4	4	5	3	5	2	5	1	5	3	5	5	5	4	5	
4	3	6	4	6	5	5	6	5	7	5	8		8	4	9	4	0	4	1	2	2	3	3		3	3	4	2	6	
3	4	5	4	4	4	2	4	1	4	6	4	5	4	4	4	3	4	2	5	8	5	5	5	4	5	3	5	2	5	
6	2	2	3	1	4	9	5	8	6		6	5	7	3	8	2	9	0	0		0	8	1	6	2	3	3	3	4	
3	4	4	4	3	4	2	4	8	4	5	4	4	4	3	4	1	4	4	4	5	4	3	5	2	5	1	5	1	5	
8	1	6	2	3	3	1	4		4	6	5	3	6	0	7	7	8		8	0	9	9	0	6	1	3	2		2	
4	4	3	4	2	4	8	4	5	4	4	4	2	4	1	4	5	4	4	4	3	4	1	4	2	4	4	5	3	5	
0	0	6	1	2	2		2	4	3	0	4	6	5	2	5	8	6	4	7	0	8	6	9		9	8	0	4	0	
4	3	2	4	7	4	4	4	3	4	1	4	1	4	5	4	3	4	2	4	4	4	4	4	3	4	1	4	2	4	
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	3			3			3			3			3			3		
Sc	3	3	0	3	3	1	3	3	2	3	3	3	3	3	4	3	3	5
ru	0	0	½	1	1	½	3	2	2	½	3	3	½	3	4	4	½	5
p.	3			1			3			3			3			5		
De	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(
fic.	D'	D	½	D'	D	(	D'	D	½	D'	D	(	D'	D	½	D'	D	(
	)	)	)	(	)	)	)	)	)	(	)	)	)	)	)	(	)	)
	1	6	1	5	0	4	0	4	0	5	9	7	9	9	9	1	9	8
56	2	2	2	4	2	4	2	2	2	0	2	4	2	2	2	5	1	4
	2		1	9	1	1	1	0	1		0	1	0	3	0		9	6
58	2	1	2	4	2	2	2	6	2	4	2	2	2	6	2	4	2	2
	3	2	2	9	2	7	2		1	5	1	6	1		0	7	0	8
60	2	0	2	3	2	1	2	5	2	3	2	9	2	4	2	3	2	1
	4		3	6	3	4	2	1	2	0	2		1	9	1	0	1	1
62	2	4	2	2	2	0	2	3	2	1	2	5	2	3	2	1	2	5
	4	8	4	4	4		3	7	3	4	2	3	2	2	2	4	1	4
64	2	3	2	1	2	4	2	2	2	0	2	3	2	1	2	5	2	3
	5	6	5	1	4	7	4	3	4		3	8	3	6	2	6	2	6
66	2	2	2	3	2	3	2	9	2	4	2	2	2	0	2	3	2	1
	6	4	5	5	5	3	5		4	5	4	2	4		3	9	3	8

Scrupula Incidentiæ, &c. [Scruples of Incidence, etc.]

TAB. 58. Scrupula Incidentiæ in Eclipsi ☾, a... Semimora in Eclipsi ☉. [Table 58. Scruples of Incidence in a Lunar Eclipse; and the Half-Duration in a Solar Eclipse]

Subheading: **Difference of the Semidiameters of the Moon [☾] and the Shadow [Umbra], or the sum of the Semidiameters of the Sun [☉] and Moon [☾] [Differentia Semidiametrorum ☾, & Vmbræ, vel summa Semidiametror. ☉, & ☾].**

The columns are headed 21' through 28' (the difference/sum semidiameter argument), each split into ' and ". The leftmost column is the **Latitude [Latit.]** argument; the vertical left-margin label reads **Scruples of the true or apparent**

latitude of the Moon [Scrupula latitudinis ☾ veræ, aut apparentis]. Rows run 0–27 in this upper half-table.

Upper table (semidiameter argument 21'–28')

La tit.	21 '	21 "	22 '	22 "	23 '	23 "	24 '	24 "	25 '	25 "	26 '	26 "	27 '	27 "	28 '	28 "
0	21	0	22	0	23	0	24	0	25	0	26	0	27	0	28	0
1	20	59	21	59	22	59	23	59	24	59	25	59	26	59	27	59
2	20	54	21	55	22	55	23	55	24	55	25	55	26	56	27	56
3	20	47	21	48	22	48	23	49	24	49	25	50	26	50	27	50
4	20	37	21	38	22	39	23	40	24	41	25	41	26	42	27	43
5	20	24	21	25	22	27	23	28	24	30	25	31	26	32	27	33
6	20	7	21	10	22	12	23	14	24	16	25	18	26	20	27	21
7	19	48	20	51	21	55	22	57	24	0	25	2	26	5	27	7
8	19	25	20	30	21	34	22	38	23	41	24	44	25	47	26	50
9	18	58	20	4	21	10	22	15	23	19	24	24	25	28	26	31
10	18	28	19	36	20	43	21	49	22	55	24	0	25	5	26	9
11	17	53	19	3	20	12	21	20	22	27	23	34	24	39	25	45
12	17	14	18	26	19	37	20	47	21	56	23	4	24	11	25	18
13	16	30	17	45	18	58	20	10	21	21	22	31	23	40	24	48
14	15	39	16	58	18	15	19	30	20	43	21	55	23	6	24	15
15	14	42	16	6	17	26	18	44	20	0	21	14	22	27	23	39
16	13	36	15	6	16	31	17	53	19	13	20	30	21	45	22	59
17	12	20	13	58	15	30	16	56	18	20	19	40	20	59	22	15
18	10	49	12	39	14	19	15	52	17	21	18	46	20	7	21	27
19	8	57	11	5	12	58	14	40	16	15	17	45	19	11	20	34
20	6	24	9	10	11	21	13	16	15	0	16	37	18	8	19	36
21	0	0	6	33	9	23	11	37	13	34	15	20	16	59	18	32
22			0	0	6	43	9	36	11	52	13	51	15	39	17	19
23					0	0	6	51	9	48	12	7	14	9	15	59
24							0	0	7	0	10	0	12	22	14	25
25									0	0	7	9	10	12	12	37
26											0	0	7	17	10	24

La	21	21	22	22	23	23	24	24	25	25	26	26	27	27	28	28
tit.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
27													0	0	7	26

Remainder of TAB. 58. *Scrupula Incidentiæ in Eclipsi ☉, aut Semimora in Eclipsi ☉.* [Remainder of Table 58. *Scruples of Incidence in a Solar Eclipse; or the Half-Duration in a Solar Eclipse*]

Subheading: **Difference of the Semidiameters of the Moon [☾] and the Shadow [Umbra]; or the sum of the Semidiameters of the Sun [☉] and Moon [☾] [Differentia Semidiametror. ☾, & Vmbræ; vel summa Semidiametror. ☉, & ☾].** Columns 29'–36', each split into ' and ". Same left **Latit.** argument, running 0–36.

Lower table (semidiameter argument 29'–36')

La	29	29	30	30	31	31	32	32	33	33	34	34	35	35	36	36
tit.	'	"	'	"	'	"	'	"	'	"	'	"	'	"	'	"
0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0
1	28	59	29	59	30	59	31	59	32	59	33	59	34	59	35	59
2	28	56	29	56	30	56	31	56	32	56	33	56	34	56	35	57
3	28	51	29	51	30	51	31	51	32	51	33	52	34	52	35	53
4	28	44	29	44	30	44	31	45	32	45	33	46	34	46	35	47
5	28	34	29	35	30	35	31	36	32	37	33	38	34	38	35	39
6	28	22	29	24	30	25	31	26	32	27	33	28	34	29	35	30
7	28	8	29	11	30	12	31	14	32	15	33	16	34	17	35	19
8	27	52	28	55	29	57	30	59	32	1	33	3	34	4	35	6
9	27	34	28	37	29	40	30	42	31	45	32	48	33	49	34	51
10	27	13	28	17	29	21	30	24	31	27	32	30	33	33	34	35
11	26	50	27	55	28	59	30	3	31	7	32	10	33	14	34	17
12	26	24	27	30	28	35	29	40	30	44	31	49	32	53	33	57
13	25	55	27	2	28	9	29	14	30	20	31	25	32	30	33	34
14	25	24	26	32	27	40	28	46	29	53	30	59	32	5	33	10
15	24	50	25	59	27	8	28	16	29	23	30	31	31	37	32	44

La tit.	29 '	29 "	30 '	30 "	31 '	31 "	32 '	32 "	33 '	33 "	34 '	34 "	35 '	35 "	36 '	36 "
16	24	11	25	23	26	33	27	43	28	52	30	0	31	8	32	15
17	23	30	24	43	25	56	27	7	28	17	29	27	30	36	31	44
18	22	44	24	0	25	15	26	27	27	40	28	51	30	2	31	11
19	21	55	23	13	24	30	25	45	26	59	28	12	29	24	30	35
20	21	0	22	22	23	41	24	59	26	15	27	30	28	43	29	53
21	20	0	21	25	22	48	24	9	25	27	26	44	28	0	29	14
22	18	54	20	23	21	51	23	14	24	36	25	55	27	13	28	30
23	17	40	19	16	20	47	22	15	23	40	25	2	26	23	27	42
24	16	17	18	0	19	37	21	10	22	39	24	5	25	29	26	50
25	14	42	16	35	18	20	19	59	21	33	23	3	24	30	25	54
26	12	51	14	58	16	53	18	39	20	19	21	55	23	26	24	54
27	10	35	13	4	15	14	17	11	18	59	20	41	22	16	23	59
28	7	34	10	46	13	18	15	30	17	28	19	17	21	0	22	38
29	0	0	7	41	10	57	13	32	15	45	17	46	19	36	21	20
30			0	0	7	49	11	8	13	45	16	0	18	2	19	54
32					0	0	7	56	11	19	13	58	16	15	18	18
34							0	0	8	4	11	30	14	11	16	30
36									0	0	8	11	11	41	14	23
											0	0	8	19	11	50
													0	0	8	26
															0	0

TABLE 59. The Scruples of Incidence, and Semimora, in a Lunar Eclipse.

Sum of the Semidiameters of the Moon ☾ and of the Shadow ☾. [*Summa Semidiametrorum ☾, & Vmbræ.*]

The argument down the left margin is the **True Latitude** [*Latitudo Vera*] of the Moon (☾), 0 to 60. Each block heads with the relevant value of the sum of semidiameters (52', 54', 55', ... 60'); under each, the paired sub-columns are I (minutes ') and II (seconds ").

[The first argument column, 53', is omitted from the printed sequence; the 52' column carries values only for the first four rows (0–3) and is blank thereafter.]

Lat.																
Ver	52	52'	54	54'	55	55'	56	56'	57	57'	58	58'	59	59'	60	60'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
0	54	0	54	0	55	0	56	0	57	0	58	0	59	0	60	0
1			53	59	54	59	55	59	56	59	57	59	58	59	59	59
2			53	58	54	58	55	58	56	57	57	57	58	57	59	58
3			53	55	54	55	55	55	56	55	57	55	58	55	59	56
4			53	51	54	51	55	51	56	52	57	52	58	52	58	52
5			53	46	54	46	55	46	56	47	57	47	58	48	59	48
6			53	40	54	40	55	40	56	41	57	41	58	42	59	42
7			53	33	54	33	55	33	56	34	57	34	58	35	59	35
8			53	25	54	25	55	25	56	26	57	26	58	27	59	27
9			53	15	54	16	55	16	56	17	57	18	58	19	59	19
10			53	4	54	6	55	6	56	7	57	8	58	9	59	10
11			52	52	53	54	54	55	55	56	56	57	57	58	59	0
12			52	39	53	41	54	42	55	44	56	45	57	46	58	48
13			52	25	53	27	54	28	55	30	56	32	57	33	58	35
14			52	9	53	12	54	13	55	15	56	18	57	19	58	21
15			51	52	52	55	53	57	54	59	56	2	57	4	58	6
16			51	34	52	37	53	40	54	42	55	45	56	46	57	50
17			51	15	52	18	53	22	54	24	55	27	56	30	57	33
18			50	55	51	58	53	2	54	5	55	8	56	11	57	14
19			50	33	51	37	52	41	53	44	54	48	55	51	56	54
20			50	10	51	14	52	19	53	22	54	27	55	30	56	33
21			49	45	50	50	51	55	52	19	54	4	55	8	56	12
22			49	19	50	24	51	30	52	35	53	40	54	45	55	49
23			48	51	49	57	51	4	52	9	53	15	54	20	55	25
24			48	22	49	29	50	36	51	42	52	48	53	54	54	59
25			47	52	48	59	50	7	51	14	52	20	53	27	54	32
26			47	20	48	28	49	36	50	44	51	51	52	58	54	4

Lat.																
Ver	52	52'	54	54'	55	55'	56	56'	57	57'	58	58'	59	59'	60	60'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
27			46	46	47	55	49	4	50	12	51	20	52	28	53	35
28			46	10	47	20	48	30	49	39	50	48	51	56	53	4
29			45	33	46	44	47	55	49	5	50	14	51	23	52	32
30			44	54	46	6	47	18	48	29	49	39	50	48	51	58
31			44	13	45	26	46	39	47	51	49	2	50	12	51	23
32			43	30	44	44	45	58	47	11	48	23	49	34	50	46
33			42	45	44	0	45	15	46	29	47	43	48	55	50	7
34			41	57	43	14	44	30	45	45	47	1	48	14	49	26
35			41	7	42	26	43	43	44	59	46	16	47	31	48	44
36			40	15	41	35	42	54	44	12	45	29	46	45	48	0
37			39	20	40	42	42	2	43	22	44	40	45	58	47	14
38			38	22	39	46	41	8	42	29	43	49	45	9	46	26
39			37	21	38	47	40	11	41	34	42	56	44	17	45	36
40			36	17	37	45	39	11	40	37	42	0	43	23	44	44
41			35	9	36	40	38	8	39	36	41	1	42	26	43	49
42			33	57	35	31	37	2	38	32	40	0	41	26	42	51
43			32	40	34	18	35	52	37	24	38	55	40	24	41	52
44			31	18	33	0	34	38	36	14	37	48	39	18	40	48
45			29	51	31	37	33	19	34	59	36	36	38	9	39	42
46			28	17	30	9	31	56	33	40	35	20	36	57	38	31
47			26	35	28	34	30	27	32	15	33	59	35	40	37	18
48			24	44	26	51	28	51	30	45	32	34	34	18	36	0
49			22	42	24	59	27	7	29	7	31	2	32	52	34	38
50			20	24	22	55	25	13	27	22	29	24	31	19	33	10
51			17	46	20	35	23	8	25	27	27	37	29	40	31	37
52			14	34	17	57	20	47	23	21	25	41	27	53	29	56
53			10	21	14	22	18	5	21	20	24	11	26	56	28	7
54			0	0	10	27	15	33	18	25	21	19	23	46	26	9
55					0	0	10	33	14	58	18	25	21	21	23	59

Lat.																
Ver	52	52'	54	54'	55	55'	56	56'	57	57'	58	58'	59	59'	60	60'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
56							0	0	10	38	15	6	18	34	21	32
57									0	0	10	43	15	14	18	44
58											0	0	10	49	15	22
59													0	0	10	55
60															0	0

TABLE 59 (continued). The remaining Scruples of Incidence, and Semimora, in a Lunar Eclipse.

The remaining Sum of the Semidiameters of the Moon ☾ and of the Shadow ☾. [*Reliqua Scrupula Incidentiæ, & Semimora in Eclipsi Lunæ. — Reliqua Summa Semidiametrorum ☾, & Vmbræ.*]

This continues TABLE 59 with the sum-of-semidiameters arguments 61' through 68'; the **True Latitude** index now runs 0 to 67.

Lat.																
Ver	61	61'	62	62'	63	63'	64	64'	65	65'	66	66'	67	67'	68	68'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
0	61	0	62	0	63	0	64	0	65	0	66	0	67	0	68	0
1	60	59	61	59	62	59	63	59	64	59	65	59	66	59	67	59
2	60	58	61	58	62	58	63	58	64	58	65	58	66	58	67	58
3	60	56	61	56	62	56	63	56	64	56	65	56	66	56	67	56
4	60	53	61	53	62	53	63	53	64	53	65	53	66	53	67	53
5	60	48	61	48	62	49	63	49	64	49	65	49	66	49	67	49
6	60	42	61	42	62	43	63	43	64	43	65	44	66	44	67	44
7	60	35	61	35	62	36	63	36	64	37	65	38	66	38	67	38
8	60	28	61	28	62	29	63	29	64	30	65	31	66	31	67	31
9	60	20	61	20	62	21	63	21	64	22	65	23	66	24	67	24
10	60	11	61	11	62	12	63	12	64	13	65	14	66	15	67	16
11	60	1	61	6	62	2	63	2	64	3	65	4	66	5	67	6
12	59	49	60	50	61	51	62	52	63	53	64	54	65	55	66	56
13	59	36	60	37	61	38	62	40	63	41	64	43	65	44	66	45

Lat.																
Ver	61	61'	62	62'	63	63'	64	64'	65	65'	66	66'	67	67'	68	68'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
14	59	22	60	23	61	25	62	27	63	28	64	30	65	32	66	33
15	59	2	60	9	61	11	62	13	63	14	64	16	65	18	66	20
16	58	52	59	54	60	56	61	58	62	59	64	1	65	3	66	5
17	58	35	59	38	60	40	61	42	62	44	63	46	64	48	65	50
18	58	17	59	20	60	23	61	25	62	28	63	30	64	32	65	34
19	57	57	59	1	60	5	61	7	62	10	63	13	64	15	65	18
20	57	37	58	41	59	45	60	48	61	51	62	54	63	57	65	0
21	57	16	58	20	59	24	60	28	61	31	62	34	63	37	64	41
22	56	54	57	58	59	2	60	7	61	10	62	13	63	16	64	21
23	56	30	57	35	58	39	59	44	60	48	61	51	62	55	64	0
24	56	5	57	10	58	15	59	20	60	25	61	29	62	33	63	38
25	55	39	56	44	57	50	58	55	60	1	61	5	62	10	63	15
26	55	11	56	17	57	24	58	29	59	35	60	40	61	45	62	51
27	54	42	55	49	56	56	58	2	59	8	60	14	61	19	62	25
28	54	12	55	19	56	27	57	33	58	40	59	47	60	52	61	58
29	53	40	54	48	55	56	57	3	58	11	59	18	60	24	61	30
30	53	7	54	16	55	24	56	32	57	40	58	48	59	55	61	1
31	52	32	53	42	54	51	56	0	57	8	58	17	59	24	60	31
32	51	56	53	6	54	16	55	25	56	35	57	44	58	52	60	0
33	51	18	52	29	53	40	54	50	56	0	57	10	58	19	59	27
34	50	39	51	51	53	2	54	13	55	24	56	34	57	44	58	53
35	49	58	51	11	52	23	53	35	54	46	55	57	57	8	58	18
36	49	15	50	29	51	42	52	55	54	7	55	19	56	30	57	42
37	48	30	49	45	50	59	52	13	53	26	54	39	55	51	57	4
38	47	43	48	59	50	15	51	30	52	44	53	58	55	11	56	24
39	46	55	48	12	49	29	50	45	52	0	53	15	54	29	55	43
40	46	4	47	23	48	41	49	58	51	14	52	30	53	45	55	0
41	45	10	46	31	47	51	49	9	50	26	51	43	52	59	54	15
42	44	14	45	36	46	58	48	18	49	37	50	55	52	12	53	29

Lat.																
Ver	61	61'	62	62'	63	63'	64	64'	65	65'	66	66'	67	67'	68	68'
a	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II	'I	II
43	43	16	44	39	46	3	47	25	48	46	50	5	51	23	52	41
44	42	15	43	40	45	6	46	29	47	52	49	12	50	32	51	51
45	41	11	42	39	44	6	45	31	46	55	48	17	49	38	50	59
46	40	4	41	34	43	4	44	31	45	56	47	20	48	42	50	5
47	38	52	40	26	41	57	43	27	44	54	46	20	47	44	49	9
48	37	39	39	15	40	48	42	20	43	50	45	18	46	44	48	10
49	36	20	37	59	39	36	41	10	42	43	44	12	45	41	47	9
50	34	57	36	39	38	20	39	57	41	32	43	4	44	35	46	5
51	33	28	35	15	36	59	38	40	40	18	41	53	43	27	44	59
52	31	53	33	46	35	34	37	19	39	1	40	39	42	15	43	50
53	30	11	32	11	34	4	35	53	37	39	39	21	41	0	42	37
54	28	22	30	28	32	27	34	21	36	11	37	57	39	40	41	20
55	26	23	28	37	30	43	32	44	34	38	36	29	38	16	39	59
56	24	11	26	37	28	51	30	59	33	0	34	56	36	47	38	35
57	21	44	24	24	26	50	29	6	31	15	33	16	35	13	37	5
58	18	54	21	55	24	36	27	3	29	11	31	30	33	32	35	30
59	15	30	19	3	22	6	24	48	27	17	29	35	31	45	33	49
60	11	0	15	37	19	13	22	16	25	0	27	30	29	49	32	0
61	0	0	11	11	16	45	19	22	22	27	25	12	27	43	30	3
62			0	0	11	11	15	53	19	40	22	38	25	24	27	56
63					0	0	11	16	16	0	19	40	22	48	25	35
64							0	0	11	22	16	8	19	49	22	59
65									0	0	11	27	16	15	19	59
66											0	0	11	32	16	22
67													0	0	11	37

TABLE 60. The Distance of the Centres of both Luminaries [in conjunction].

[*Distantia Centrorum utriusq; Luminaris.*] The running header reads "The Distance of the Centres of the Sun ☉ and the Moon ☾ in conjunction [♌]."

The argument down the left margin is **Scrup.** (scruples). Each argument heading (0', 10', 20', ... 60') carries three sub-columns: **G.** (degrees), **I** (minutes '), **II** (seconds ").

[The argument index runs 0, 1, 2, 4, then by twos (6, 8, 10, ... 92, 94, 96, 98, 99); rows 3 and 5 are not printed, and the final two entries are 98 and 99.]

S																					
c																					
r																					
u	0	0		1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6
p	'	'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'
.	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	3	0	0	4
1	0	0	4	0	0	6	0	0	8	0	0	1	0	0	1	0	0	1	0	0	1
												0			2			4			7
2	0	0	1	0	0	2	0	0	2	0	0	2	0	0	3	0	0	3	0	0	3
			7			0			3			6			0			4			8
4	0	1	8	0	1	1	0	1	1	0	1	2	0	1	3	0	1	3	0	1	4
						3			9			6			2			9			6
6	0	2	3	0	2	4	0	2	5	0	2	5	0	3	8	0	3	1	0	3	2
			2			1			0			9						8			7
8	0	4	3	0	4	4	0	4	5	0	5	6	0	5	1	0	5	3	0	5	4
			1			2			4						8			0			3
1	0	7	3	0	7	1	0	7	3	0	7	4	0	8	1	0	8	1	0	8	3
0						7			2			6						7			2
1	0	1	9	0	1	2	0	1	4	0	1	1	0	1	1	0	1	3	0	1	5
2		0			0	6		0	4		1			1	9		1	3		1	5
1	0	1	4	0	1	9	0	1	2	0	1	4	0	1	1	0	1	3	0	1	5
4		3	9		4			4	9		4	9		5	0		5	1		5	2
1	0	1	3	0	1	2	0	1	4	0	1	1	0	1	3	0	1	5	0	2	2
6		8			8	6		8	9		9	2		9	5		9	9		0	3
1	0	2	5	0	2	1	0	2	4	0	2	8	0	2	3	0	2	1	0	2	2
8		2	1		3	6		3	2		4			4	4		5			5	7
2	0	2	1	0	2	4	0	2	9	0	2	3	0	3	7	0	3	3	0	3	6
0		8	2		8	1		9			9	8		0			0	6		1	
2	0	3	8	0	3	3	0	3	1	0	3	4	0	3	1	0	3	4	0	3	1

S																					
c																					
r																					
u	0	0		1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6
p	'	'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'
.	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II
2		4			4	9		5	0		5	2		6	4		6	6		7	8
2	0	4	3	0	4	1	0	4	4	0	4	2	0	4	5	0	4	2	0	4	4
4		0	7		1	1		1	5		2	0		2	4		3	9		4	
2	0	4	4	0	4	1	0	4	5	0	4	3	0	5	9	0	5	4	0	5	2
6		7	0		8	7		8	4		9	1		0			0	6		1	4
2	0	5	1	0	5	5	0	5	3	0	5	1	0	5	5	0	5	3	0	5	1
8		5	7		5	7		6	6		7	6		7	7		8	7		9	8
3	1	3	2	1	4	1	1	4	5	1	5	3	1	6	1	1	7	2	1	7	4
0			7			0			3			6			9					6	
3	1	1	1	1	1	5	1	1	4	1	1	2	1	1	1	1	1	1	1	1	4
2		2	2		2	8		3	3		4	9		5	5		6			6	7
3	1	2	3	1	2	1	1	2	7	1	2	5	1	2	4	1	2	3	1	2	2
4		1	1		2	9		3			3	6		4	4		5	3		6	3
3	1	3	2	1	3	1	1	3	5	1	3	5	1	3	4	1	3	4	1	3	3
6		1	3		2	4		3			3	6		4	8		5	0		6	2
3	1	4	4	1	4	4	1	4	3	1	4	3	1	4	2	1	4	2	1	4	1
8		1	9		2	3		3	7		4	1		5	5		6	0		7	5
4	1	5	4	1	5	4	1	5	4	1	5	3	1	5	3	1	5	3	1	5	3
0		2	9		3	6		4	2		5	9		6	7		7	4		8	2
4	2	4	2	2	5	2	2	6	2	2	7	2	2	8	2	2	9	2	2	1	2
2			3			2			2			2			2			2		0	3
4	2	1	3	2	1	3	2	1	3	2	1	3	2	2	4	2	2	4	2	2	4
4		6	1		7	3		8	5		9	8		0	1		1	4		2	7
4	2	1	2	2	3	1	2	3	2	2	3	2	2	3	3	2	3	4	2	3	4
6		9			0	7		1	2		2	8		3	4		4	0		3	6
4	2	4	2	2	4	3	2	4	4	2	4	5	2	4	1	2	4	9	2	4	1
8		2	8		3	6		4	4		5	2		7			8			9	9
5	2	5	1	2	5	2	2	5	3	2	5	5	3	1	1	3	2	1	3	3	2
0		6	8		7	8		8	9		9	0					3			5	
5	3	1	4	3	1	5	3	1	9	3	1	2	3	1	3	3	1	5	3	1	5

S																					
c																					
r																					
u	0	0		1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6
p	'	'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'
.	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II
2		0	1		1	5		3			4	3		5	7		6	1		8	
5	3	2	3	3	2	5	3	2	1	3	2	2	3	3	4	3	3	2	3	3	1
4		5	9		6	5		8	1		9	8		0	5		2			3	9
5	3	4	8	3	4	2	3	4	4	3	4	6	3	4	2	3	4	4	3	4	7
6		1			2	7		3	6		5			6	6		7	6		9	
5	3	5	1	3	5	3	3	5	5	4	1	1	4	2	4	4	4	5	4	5	2
8		7	3		8	5		9	7			9			2						8
6	4	1	5	4	1	1	4	1	4	4	1	7	4	1	3	4	2	5	4	2	2
0		3	2		5	7		6	2		8			9	2		0	8		2	4
6	4	3	4	4	3	3	4	3	0	4	3	2	4	3	5	4	3	2	4	3	5
2		1			2	2		4			5	8		6	6		8	4		9	3
6	4	4	5	4	5	2	4	5	5	4	5	2	4	5	5	4	5	2	4	5	5
4		8	0		0	0		1	1		3	2		4	3		6	4		7	6
6	5	7	1	5	8	4	5	1	1	5	1	5	5	1	2	5	1	5	5	1	3
6			1			4		0	7		1	1		3	5		4	9		6	3
6	5	2	4	5	2	4	5	2	1	5	3	5	5	3	3	5	3	7	5	3	4
8		6			7	0		9	6		0	3		2	0		4			5	4
7	5	4	3	5	4	1	5	4	5	5	5	2	5	5	9	5	5	4	5	5	2
0		5	2		7	1		8	0		0	9		2			3	9		5	9
7	6	5	3	6	7	1	6	8	5	6	1	4	6	1	2	6	1	5	6	1	4
2			4			6			8		0	0		2	2		4			5	8
7	6	2	1	6	2	5	6	2	3	6	3	2	6	3	9	6	3	5	6	3	4
4		6	0		7	4		9	9		1	4		3			4	4		6	0
7	6	4	1	6	4	6	6	5	5	6	5	4	6	5	3	6	5	1	6	5	7
6		7	9		9			0	4		2	2		4	0		6	8		8	
7	7	9	3	7	1	5	7	1	4	7	1	3	7	1	2	7	1	1	7	2	7
8					0	3		2	3		4	4		6	5		8	6		0	
8	7	3	2	7	3	1	7	3	6	7	3	0	7	3	5	7	4	4	7	4	4
0		1	0		3	3		5			7			8	4		0	8		2	3
8	7	5	1	7	5	7	7	5	3	7	5	5	8	1	5	8	3	5	8	5	4

S																					
c																					
r																					
u	0	0		1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6
p	'	'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'
.	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II	G	I	II
2		4	2		6			8			9	9			5			2			9
8	8	1	3	8	1	3	8	2	3	8	2	3	8	2	3	8	2	3	8	2	3
4		7	5		9	3		1	2		3	1		5	0		7	0		9	0
8	8	4	3	8	4	3	8	4	3	8	4	4	8	4	4	8	5	4	8	5	4
6		1	4		3	6		5	8		7	0		9	2		1	4		3	7
8	9	6	8	9	8	1	9	1	1	9	1	2	9	1	2	9	1	3	9	1	3
8						2		0	7		2	2		4	7		6	2		8	7
9	9	3	1	9	3	2	9	3	2	9	3	3	9	3	4	9	4	5	9	4	5
0		1	4		3	1		5	8		7	5		9	3		1	1		3	9
9	9	5	5	9	5	4	1	1	1	1	3	2	1	5	3	1	7	4	1	9	5
2		6	4		9		0		4	0		4	0		5	0		6	0		7
9	1	2	8	1	2	2	1	2	3	1	2	4	1	3	0	1	3	1	1	3	2
4	0	3		0	5	1	0	7	4	0	9	7	0	2		0	4	4	0	6	8
9	1	4	5	1	5	1	1	5	2	1	5	4	1	5	0	1	1	1	1	3	3
6	0	9	6	0	2	1	0	4	7	0	6	3	0	9		1		6	1		3
9	1	1	1	1	1	3	1	2	5	1	2	1	1	2	3	1	2	5	1	3	1
8	1	7	9	1	9	7	1	1	6	1	4	4	1	6	3	1	8	2	1	1	2
9	1	3	1	1	3	3	1	3	5	1	3	1	1	4	3	1	4	5	1	4	1
9	1	1	2	1	3	2	1	5	2	1	8	3	1	0	3	1	2	4	1	5	5

Tomus II — Tabulae Novalmagesticae

Part IV (continued): Lunar Parallaxes

TAB. 61. Parallaxes of the Moon in the Circle of True Altitude, given the distance from the centre of the Earth [*Parallaxes Lunæ in Circulo Altitudinis Veræ, sub data distantia à centro Terræ*]

The table gives the Moon's parallax in altitude, in minutes (') and seconds ("), as a function of apparent altitude (Alt., in degrees [Gr.]) and of the Moon's distance from the centre of the Earth expressed in Earth-semidiameters [*Distantia* » à

centro Terræ in semidiametris Terræ]. Distance columns 52 through 61 are tabulated. The left panel covers altitudes 0°–60°; the right panel (same distance columns) continues with altitudes 60°–89°.

Left panel — Altitudes 0°–60° (Distances 52–61)

Each distance heading spans two sub-columns: minutes (') and seconds (").

Alt. (Gr.)	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	6 '	6 "	6 '	6 "
0	6 6	6 4	6 1	5 3	6 9	3 2	6 0	3 1	6 3	2 0	6 0	2 9	5 7	1 8	5 6	1 7	5 8	1 6	5 1	2 1
1	6 6	6 4	6 1	5 3	6 9	3 2	6 9	2 1	6 3	2 0	6 9	1 9	5 7	1 8	5 6	1 7	5 8	1 6	5 1	2 1
2	6 6	5 4	6 0	5 3	6 8	3 2	6 8	2 1	6 2	2 0	6 8	1 9	5 6	1 8	5 5	1 7	5 7	1 6	5 1	1 9
3	6 6	4 4	6 9	4 3	6 7	3 2	6 7	2 1	6 1	2 0	6 7	1 9	5 5	1 8	5 4	1 7	5 6	1 5	5 1	1 8
4	6 6	1 4	6 7	4 3	6 5	3 2	6 5	2 1	6 8	1 0	6 5	1 9	5 2	1 8	5 1	1 7	5 3	1 6	5 1	1 6
5	6 5	5 7	6 4	4 3	6 3	3 1	6 2	2 1	6 1	1 4	6 0	1 1	5 9	8 8	5 7	8 7	5 9	5 6	5 1	3 3
6	6 5	5 2	6 8	3 3	6 6	2 2	6 6	1 2	6 1	1 0	6 0	7 9	5 8	3 8	5 3	7 7	5 5	5 6	5 1	9 6
7	6 5	4 6	6 4	3 2	6 3	2 0	6 2	1 0	6 1	4 0	6 0	1 8	5 7	5 7	5 8	5 7	5 0	5 6	5 1	4 6
8	6 5	3 8	6 4	2 4	6 3	1 2	6 2	3 2	6 0	5 7	5 9	5 4	5 8	5 0	5 7	5 1	5 6	5 3	5 5	5 7
9	6 5	2 9	6 4	1 5	6 3	3 1	6 4	5 0	6 8	4 9	5 6	4 8	5 2	4 7	5 3	4 6	5 4	4 5	5 1	4 8
10	6 5	1 9	6 4	5 2	6 3	5 1	6 5	4 0	6 9	3 9	5 7	3 8	5 3	3 7	5 4	3 6	5 5	3 4	5 1	3 9
11	6 5	8 3	6 4	5 2	6 2	4 1	6 4	3 0	6 8	2 9	5 7	2 8	5 3	2 7	5 4	2 6	5 5	2 4	5 1	2 9
12	6 4	5 5	6 3	4 1	6 2	3 0	6 1	2 2	6 0	1 6	5 9	1 6	5 8	1 2	5 7	1 3	5 6	1 4	5 1	1 8

Alt. (Gr.)	5 2 '	5 2 "	5 3 '	5 3 "	5 4 '	5 4 "	5 5 '	5 5 "	5 6 '	5 6 "	5 7 '	5 7 "	5 8 '	5 8 "	5 9 '	5 9 "	6 0 '	6 0 "	6 1 '	6 1 "
13	6 4	4 1	6 3	2 8	6 2	1 7	6 1	9 1	6 0	3 0	5 9	3 0	5 7	5 9	5 7	1 0	5 6	2 0	5 0	6 1
14	6 4	2 6	6 3	1 4	6 2	3 0	6 5	5 0	5 9	4 9	5 8	4 8	5 7	4 5	5 6	4 7	5 5	4 9	5 4	5 2
15	6 4	1 0	6 2	5 7	6 1	4 7	6 0	3 9	5 9	3 4	5 8	3 2	5 7	3 0	5 6	3 2	5 5	3 5	5 4	3 7
16	6 3	5 3	6 2	4 0	6 1	3 1	6 0	2 2	5 9	1 8	5 8	1 6	5 7	1 4	5 6	1 6	5 5	2 0	5 4	2 2
17	6 3	3 5	6 2	2 2	6 1	1 3	6 0	4 0	5 9	1 0	5 7	5 9	5 6	5 7	5 6	0 0	5 5	4 0	5 0	6 4
18	6 3	1 5	6 2	3 0	6 4	5 9	5 6	4 8	5 2	4 7	5 0	4 6	5 9	3 5	5 3	4 4	5 7	4 3	5 0	4 9
19	6 2	5 4	6 1	4 3	6 0	3 4	5 9	2 7	5 8	2 2	5 7	2 1	5 6	2 1	5 5	2 4	5 4	2 9	5 3	3 2
20	6 2	3 1	6 1	2 1	6 0	1 3	5 9	6 0	5 8	1 0	5 7	1 0	5 6	1 5	5 0	4 4	5 0	1 0	5 3	1 4
21	6 2	8 0	6 0	5 8	5 9	5 1	5 8	4 4	5 7	4 0	5 6	4 0	5 5	4 0	5 4	4 4	5 3	5 0	5 0	5 5
22	6 1	4 4	6 0	3 4	5 9	2 7	5 8	2 1	5 7	1 8	5 6	1 8	5 5	1 8	5 4	2 2	5 3	2 8	5 2	3 5
23	6 1	1 9	6 0	9 0	5 9	2 7	5 7	5 7	5 6	5 4	5 5	5 4	5 4	5 4	5 3	5 9	5 3	4 0	5 2	1 3
24	6 0	5 2	5 9	4 2	5 8	3 6	5 7	3 1	5 6	2 9	5 5	2 9	5 4	2 9	5 3	3 4	5 2	4 0	5 1	5 0
25	6 0	2 4	5 9	1 5	5 8	9 7	5 0	5 6	5 5	3 0	5 5	4 0	5 4	5 3	5 0	9 2	5 5	1 0	5 5	2 7
26	5 9	5 5	5 8	4 7	5 7	4 1	5 6	3 8	5 5	3 6	5 4	3 8	5 3	3 9	5 2	4 4	5 1	5 0	5 1	3 0
27	5 9	2 5	5 8	7 0	5 7	1 2	5 6	1 0	5 5	8 0	5 4	1 1	5 3	1 3	5 2	1 8	5 1	2 5	5 0	3 8
28	5 8	5 4	5 7	4 6	5 6	4 2	5 5	4 0	5 4	3 9	5 3	4 2	5 2	4 5	5 1	5 1	5 0	5 9	5 0	1 1

Alt. (Gr.)	5 2 '	5 2 "	5 3 '	5 3 "	5 4 '	5 4 "	5 5 '	5 5 "	5 5 '	5 6 "	5 6 '	5 7 "	5 7 '	5 8 "	5 8 '	5 9 "	5 9 '	6 0 '	6 0 "	6 1 '	6 1 "
29	5 8	2 2	5 7	1 4	5 6	1 1	5 5	9 4	5 4	9 3	5 2	1 2	5 2	1 6	5 1	2 3	5 0	3 2	4 9	4 3	
30	5 7	4 8	5 6	4 2	5 5	3 9	5 4	3 7	5 3	3 8	5 2	4 2	5 1	4 7	5 0	5 4	5 0	5 9	4 9	1 3	
31	5 7	1 3	5 6	9 5	5 5	6 4	5 4	4 3	5 6	6 2	5 0	1 1	5 6	1 0	5 4	2 9	4 7	3 8	4 8	4 3	
32	5 6	3 8	5 5	3 4	5 4	3 2	5 3	3 0	5 2	3 3	5 1	3 7	5 0	4 4	4 9	5 2	4 9	7 9	4 8	1 5	
33	5 6	2 4	5 4	5 8	5 3	5 7	5 2	5 5	5 1	5 9	5 1	4 0	5 0	1 0	4 9	1 9	4 8	3 4	4 7	4 7	
34	5 5	2 5	5 4	2 1	5 3	2 1	5 2	2 0	5 1	2 4	5 0	3 0	4 9	3 5	4 8	4 6	4 8	0 7	4 7	1 6	
35	5 4	4 6	5 3	4 3	5 2	4 3	5 1	4 4	5 0	4 8	4 9	5 5	4 8	5 9	4 8	1 2	4 7	2 5	4 6	3 7	
36	5 4	5 3	5 4	4 2	5 5	4 1	5 4	7 1	5 0	1 1	4 9	1 8	4 8	2 2	4 7	3 7	4 6	5 0	4 6	2 6	
37	5 3	2 4	5 2	2 4	5 1	2 4	5 0	2 9	4 9	3 3	4 8	4 1	4 7	4 6	4 6	4 4	4 6	1 4	4 5	2 7	
38	5 2	4 2	5 1	4 3	5 0	4 4	4 9	4 9	4 8	5 4	4 8	3 7	4 7	9 6	4 4	2 5	4 8	3 8	4 4	5 1	
39	5 2	0 1	5 4	1 0	5 5	3 9	4 4	8 8	4 5	1 7	4 4	2 6	4 1	3 5	4 6	4 5	4 5	0 4	4 5	1 5	
40	5 1	1 7	5 0	1 8	4 9	2 1	4 8	2 7	4 7	3 5	4 6	4 4	4 5	4 3	5 5	4 4	8 4	2 2	4 3	3 8	
41	5 0	3 2	4 9	3 4	4 8	3 8	4 7	4 5	4 6	5 3	4 6	4 5	4 4	1 5	4 4	2 8	4 3	4 3	4 3	0 3	
42	4 9	4 6	4 8	4 9	4 7	5 4	4 7	2 7	4 6	1 0	4 5	2 1	4 4	3 4	4 3	4 7	4 3	3 2	4 2	2 1	
43	4 8	5 9	4 8	3 7	4 7	9 6	4 8	1 5	4 7	2 4	4 8	3 3	4 2	5 3	4 2	6 3	4 2	2 4	4 1	4 1	
44	4 8	1 1	4 7	1 6	4 6	2 3	4 5	3 3	4 4	4 3	4 3	5 5	4 3	9 3	4 2	4 4	4 1	4 3	4 1	0 1	

Alt. (Gr.)	5 2 '	5 2 "	5 3 '	5 3 "	5 4 '	5 4 "	5 5 '	5 5 "	5 5 '	5 6 "	5 6 '	5 7 "	5 7 '	5 8 "	5 8 '	5 9 "	5 9 '	6 0 '	6 0 "	6 1 '	6 1 "
45	4 7	2 3	4 6	2 9	4 5	3 6	4 4	4 6	4 3	5 8	4 3	1 2	4 2	2 5	4 1	4 1	4 1	4 1	1 0	4 9	1
46	4 6	3 4	4 5	4 1	4 4	4 8	4 3	5 9	4 3	1 2	4 2	2 5	4 1	4 1	4 0	5 8	4 0	1 8	3 9	3 7	3
47	4 5	4 4	4 4	5 2	4 4	0 3	4 1	1 2	4 3	2 1	4 8	3 0	4 6	5 0	4 4	1 9	3 5	3 8	3 4	5	5
48	4 4	5 3	4 4	1 3	4 1	1 2	4 3	2 1	4 8	3 0	4 0	5 0	4 0	4 9	1 9	3 8	2 0	3 8	5 0	3 8	1 0
49	4 4	1 3	4 0	1 2	4 1	2 1	4 1	3 4	4 0	5 0	4 0	9 9	3 4	2 8	3 4	4 8	3 8	5 7	3 6	2	2
50	4 3	8 2	4 8	1 1	4 0	3 0	4 4	4 0	4 0	1 9	3 0	2 8	3 7	3 7	3 8	5 7	3 7	1 9	3 6	4 1	4
51	4 2	1 4	4 1	2 6	4 0	3 9	3 9	5 4	3 9	1 1	3 8	3 0	3 7	4 9	3 7	1 1	3 6	3 2	3 5	5	5
52	4 1	2 0	4 0	3 3	3 9	4 7	3 9	3 8	3 0	2 7	3 0	4 7	3 0	1 7	3 6	2 3	3 5	4 5	3 5	9	9
53	4 0	2 1	3 9	3 9	3 8	5 4	3 8	1 1	3 7	2 8	3 6	4 9	3 6	1 0	3 5	3 4	3 4	5 7	3 4	2	2
54	3 9	2 9	3 8	4 3	3 8	0 7	3 8	1 6	3 7	3 5	3 8	5 5	3 5	2 0	3 4	2 4	4 4	3 4	9 3	3 4	3
55	3 8	3 2	3 7	4 7	3 7	5 6	3 4	2 5	3 5	4 5	3 5	7 5	3 4	2 9	3 3	5 4	3 3	2 0	3 2	4 6	4
56	3 7	3 4	3 6	5 0	3 6	1 0	3 5	3 0	3 4	5 2	3 4	1 5	3 3	3 8	3 3	4 2	3 0	3 1	3 7	5	5
57	3 6	3 6	3 5	5 2	3 5	1 4	3 4	3 5	3 3	5 7	3 3	2 3	3 2	4 7	3 2	1 3	3 1	4 0	3 1	8	8
58	3 5	3 7	3 4	5 4	3 4	1 7	3 3	3 9	3 3	2 2	3 9	2 1	3 4	5 1	3 1	2 1	3 0	4 9	3 0	1 8	1
59	3 4	3 7	3 3	5 6	3 3	1 9	3 2	4 3	3 2	7 1	3 4	3 1	3 1	1 0	3 8	2 9	2 7	5 9	2 9	2 7	2
60	3 3	3 7	3 2	5 8	3 2	2 1	3 1	4 6	3 1	1 1	3 0	3 8	3 0	6 0	2 9	3 5	2 9	5 8	2 8	3 5	3

Right panel — Altitudes 60°–89° (Distances 52–61)

The right panel repeats the distance columns 52–61 for the higher altitudes. The source prints it in two stacked blocks: distances 52–56 over altitudes 60°–89°, then (with its own Alt./G. sub-header) distances 57–61 over altitudes 60°–89°.

Alt. (Gr.)	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	5 '	5 "	6 '	6 "	6 '	6 "
60	3 3	3 7	3 2	5 8	3 2	2 1	3 1	4 6	3 1	1 1	3 0	3 8	3 0	6 9	2 5	3 9	2 9	5 8	2 8	3 5
61	3 2	3 6	3 1	5 8	3 1	2 2	3 0	4 8	3 0	1 4	2 9	4 2	2 9	1 1	2 8	4 1	2 8	1 2	2 7	4 3
62	3 1	3 4	3 0	5 8	3 0	2 3	2 9	4 9	2 9	1 7	2 8	4 6	2 8	1 6	2 7	4 7	2 7	1 9	2 6	5 1
63	3 0	3 1	2 9	5 7	2 9	2 3	2 8	5 0	2 8	1 9	2 7	4 9	2 8	2 0	2 6	5 2	2 6	2 5	2 6	5 1
64	2 9	2 9	2 8	5 6	2 8	2 3	2 7	5 0	2 7	2 1	2 6	5 2	2 6	2 4	2 5	5 7	2 5	3 1	2 5	5 5
65	2 8	2 6	2 7	5 4	2 7	2 2	2 6	5 0	2 6	2 2	2 5	5 4	2 5	2 7	2 5	1 5	2 4	3 6	2 4	1 1
66	2 7	2 2	2 6	5 1	2 6	2 1	2 5	5 0	2 5	2 3	2 4	5 6	2 4	2 9	2 4	4 3	2 0	4 3	2 3	1 7
67	2 6	1 8	2 5	4 8	2 5	1 9	2 4	5 0	2 4	2 3	2 3	5 7	2 3	3 2	2 3	7 2	2 2	4 4	2 2	2 2
68	2 5	1 3	2 4	4 4	2 4	1 6	2 3	4 9	2 3	2 3	2 2	5 8	2 2	3 4	2 2	1 0	2 1	4 8	2 1	2 7
69	2 4	8 3	2 0	4 3	2 3	1 3	2 2	4 8	2 2	2 1	2 9	5 1	2 1	3 6	2 1	1 3	2 0	5 2	2 0	3 1
70	2 3	2 2	2 5	3 2	2 0	1 1	2 6	4 1	2 1	2 1	2 0	5 9	2 0	3 7	2 0	1 5	1 9	5 5	1 9	3 5
71	2 1	5 6	2 1	3 0	2 1	6 0	2 3	4 0	2 0	2 0	1 9	5 9	1 9	3 8	1 9	1 7	1 8	5 8	1 8	3 9
72	2 0	4 9	2 0	2 5	2 0	2 9	1 0	4 0	1 9	1 9	1 8	5 8	1 8	3 9	1 8	1 8	1 8	0 7	1 7	4 2
73	1 9	4 1	1 9	1 9	1 8	5 8	1 8	3 6	1 8	1 8	1 7	5 7	1 7	3 8	1 7	1 9	1 7	2 6	1 6	4 5

Alt. (Gr.)	5 2 '	5 2 "	5 3 '	5 3 "	5 4 '	5 4 "	5 5 '	5 5 "	5 5 '	5 6 "	5 6 '	5 7 "	5 7 '	5 8 "	5 8 '	5 9 "	5 9 '	6 0 '	6 0 "	6 1 '	6 1 "
74	1 8	3 2	1 8	1 3	1 7	5 4	1 7	3 2	1 7	1 6	1 6	5 7	1 6	3 7	1 6	2 0	1 6	4 6	1 5	4 7	
75	1 7	2 4	1 7	6 6	1 5	4 9	1 6	2 8	1 6	1 3	1 5	5 3	1 5	3 5	1 6	2 5	1 0	5 5	1 4	4 9	
76	1 6	1 6	1 5	5 9	1 5	4 3	1 5	2 4	1 5	1 0	1 4	5 0	1 4	3 5	1 4	2 0	1 4	7 3	1 1	5 1	
77	1 5	8 6	1 4	5 2	1 4	3 6	1 4	1 9	1 4	6 3	1 7	4 3	1 4	3 3	1 4	2 0	1 3	8 2	1 3	5 3	
78	1 4	0 6	1 3	4 5	1 3	2 9	1 3	1 4	1 3	2 4	1 2	4 4	1 2	3 3	1 2	2 0	1 2	9 1	1 5	5 5	
79	1 2	5 1	1 2	3 7	1 2	2 3	1 2	9 6	1 1	5 7	1 1	4 2	1 1	3 1	1 1	1 9	1 1	9 0	1 6	5 6	
80	1 1	4 2	1 1	2 9	1 1	1 6	1 1	4 0	1 2	5 0	1 9	3 0	1 9	2 0	1 9	1 8	1 0	8 0	9 7	5 7	
81	1 0	3 3	1 0	2 1	1 0	9 6	9 6	5 8	9 7	4 6	9 6	3 6	9 6	2 6	9 7	1 7	9 7	8 8	8 8	5 5	
82	9 3	2 3	9 3	1 3	9 3	2 8	8 3	5 3	8 2	4 2	8 3	3 3	8 3	2 4	8 5	1 5	8 5	7 7	7 7	5 9	
83	8 3	1 3	8 3	5 7	7 5	5 8	7 8	4 8	7 7	3 7	7 9	2 9	7 9	2 1	7 3	1 3	7 3	7 7	7 7	0 0	
84	7 7	3 7	6 7	5 7	6 8	4 8	6 8	4 2	6 2	3 2	6 2	2 5	6 5	1 8	6 8	1 1	6 5	6 5	6 5	0 0	
85	5 2	5 2	5 2	4 7	5 0	4 6	5 6	3 6	5 7	2 7	5 7	2 1	5 1	1 6	5 6	9 6	5 6	5 5	5 5	0 0	
86	4 2	4 2	4 2	3 7	4 2	3 2	4 2	2 9	4 2	2 2	4 2	1 7	4 7	1 3	4 3	7 3	4 3	4 3	4 3	0 0	
87	3 2	3 2	3 2	2 8	3 4	2 4	3 4	2 2	3 2	1 7	3 7	1 3	3 3	1 0	3 0	5 0	3 0	3 3	3 3	0 0	
88	2 1	2 1	2 1	1 8	2 6	1 6	2 7	1 7	2 1	1 1	2 1	8 1	2 1	6 1	2 1	3 1	2 1	2 1	2 1	0 0	
89	1 0	1 0	1 0	9 0	1 0	8 0	1 0	7 0	1 0	5 0	1 0	4 0	1 0	3 0	1 0	1 0	1 0	1 0	1 0	0 0	

Part V: Tables for the Five Planets — Saturn

TABULA 62. Mean Motions of Saturn ♄ [*Mediorum Motuum Saturni ♄*]

All quantities are given as Sign · Degree (G.) · minute (') · second ("). The three motions tabulated are: mean longitude reckoned from Aries [*Longit. ab ♈*], the apogee [*Apogaei*], and the northern node [*Nodi Bor.* — node of the ascending (boreal) limit].

Epochae, seu Radices Motuum (Epochs, or Radices of the Motions)

Years completed before Christ [*Anni Completi ante Christum*], then after Christ.

Anni ante Christum	Long. ab ♈ Sig.	G · ' "	Apogaei Sig.	G · ' "	Nodi Bor. Sig.	G · ' "
6000	3	1 4 1 0 5 1 3		2 5 5 1 4 8 5		2 4 6 5 6
5000	3	1 1 1 1 0 5 8		2 4 4 2 6 1 0		2 5 1 8 8
4000	3	4 4 2 2 9 3		2 2 2 2 8 4 5		1 1 3 0 0 0
3000	2	2 2 2 4 9 3 8		0 7 1 2 0		1 2 4 7 2 2
2000	2	2 5 3 5 3 7 3		1 4 5 2 9 5		2 3 5 4 4 4
1000	2	1 3 3 6 8 1 8		3 3 4 3 2 0		1 4 6 7
900	7	1 5 2 6 1 9		6 4 5 3 2 6		2 3 1 0 9
800	0	5 2 2 6 6 6		9 5 1 3 3 2		3 1 3 3 2
700	4	2 5 5 6 8 3 0		1 3 2 3 3 8		3 5 4 6 5
600	9	2 2 1 6 2 1 4		1 1 4 3 6 3 4		4 3 5 9 8
500	2	1 4 3 6 5 8 8		1 2 0 3 9 4		5 2 1 3 1
400	7	9 1 2 6		2 3 1 3		6 6 2

Anni ante Christum	Long. ab Υ Sig.	G . ' "	Apogaei Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
		6		2 4 6		4
300	0	2 4 2 6		2 4 3 3		6 4 3
		3 6		5 4 2		9 7
200	4	2 1 5 6		2 5 4 3		7 3 5
		6 0 0		8 4 8		2 0
100	9	1 3 1 7		2 5 0 3		8 1 3
		9 8 8				6
A. Chr.	2	1 5 4 7		5 1 2 3		8 5 1
		3 5		5 5		9 8
100	7	6 3 8 7		8 2 3 3		9 4 3
		3		5 0		2 0
200	0	0 0 3 7		1 3 5 3		1 2 4
		3		1 5 7		0 5 3
300	4	2 2 5 7		1 4 1 3		1 8 5
		3 7 8		4 6 3		1 7
400	9	1 5 2 7		1 5 3 3		1 5 1
		6 5 2		7 6 0		1 2 0
500	2	1 2 4 7		2 6 4 3		1 3 2
		0 2 7		1 6		2 5 4
600	7	3 5 1 7		2 1 2 3		1 1 3
		0 1		4 7		3 8 7
700	11	2 1 3 7		2 2 2 3		1 1 5
		7 7 6		7 7 0		4 0
800	4	2 4 0 8		0 3 3 3		1 4 4
		0 5		7 7		4 5
900	9	1 1 2 8		3 4 5 3		1 2 1
		4 2 5		7 3		5 8 7
1000	2	7 3 5 8		6 5 1 3		1 1 3
		9 0		8 0		6 1 0
1100	7	1 7 1 8		1 8 2 3		1 5 4
		4		0 6		6 4 3
1200	11	2 3 3 8		1 1 4 3		1 3 5
		4 4 8		3 8 2		7 7 6

Anni ante Christum	Long. ab √ Sig.	G . ' "	Apogaei Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
1300	4	1 2 2 8 8		1 2 5 3 6 8 8		1 2 9 8 1
1400	9	1 2 2 8 1 9 6		1 3 1 3 9 9 4		1 4 2 9 2
1500	2	4 5 5 8 6 0		2 4 3 3 2 9 0		1 4 3 9 7 5
1600	6	2 2 1 8 8 4 4		2 5 4 3 5 9 6		2 3 4 0 0 8
1600 (Greg.)	6	2 4 1 8 8 0		2 5 4 3 5 9 3		2 3 4 0 0 7
1700	11	2 2 3 8 1 9 4		2 1 0 3 9 0		2 1 2 1 4
1800	4	1 5 5 9 4 4 8		2 2 1 3 0 7		2 5 1 1 7 5
1900	9	8 2 2 9 0 2		5 3 3 3 0 2		2 4 3 2 0 2
2000	2	1 4 4 9 7 6		8 4 4 3 0 9		2 2 4 3 3 5
2100	6	2 1 1 9 5 5 0		1 5 5 3 1 1		2 6 5 4 8
2200	11	1 4 3 9 8 2 4		1 1 2 3 5 1		2 5 1 4 0 1
2300	4	1 8 5 9 2 6		1 1 3 3 8 1 6		2 3 2 5 3 4

Anni Collecti (Collected Years)

Motus Anni	Long. ab √ Sig.	G . ' "	Apogei Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
40	4	9 2 5 0 2 8		1 1 7 0 6		0 1 1 7 7
60	0	1 4 2 0 4 7		1 5 1 0 4 0		0 2 5 5 6
80	8	1 4 5 0		2 3 1 0		0 3 3

Motus Anni	Long. ab ♀ Sig.	G . ' "	Apogei Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
		8 5 5		2 3		4 4
100	4	2 2 2 0		3 1 1 0		0 4 1
		3 7 4		0 6		3 3
200	9	1 5 4 0		6 2 3 0		1 2 2
		6 4 9		0 3		6 6
300	2	1 2 1 0		9 3 4 0		2 9 4
		0 2 4		0 9		0
400	7	3 4 3 0		1 4 6 0		2 5 5
		9 8		2 1		2 3
500	11	2 1 3 0		1 5 2 0		3 3 6
		7 7		5 1 2		6
600	4	2 4 2 0		1 1 3 0		4 1 1
		0 4 7		9 9		9 9
700	9	1 1 5 0		2 1 5 0		5 2 3
		4 1 2		2 1 5		2
800	2	7 3 1 0		2 2 1 0		5 4 4
		9 6		5 2 2		5 6
900	7	1 6 4 0		2 3 2 0		6 2 5
		1		8 2 8		8 9
1000	11	2 3 5 1		1 4 4 0		7 1 1
		4 4		2 5		2 2
2000	11	1 8 1 2		3 2 3 0		1 2 2
		9 1		5 0		4 4 4
3000	11	1 4 1 3		5 8 1 0		2 3 3
		3 2 6		5		1 6 6
4000	11	8 1 2 4		6 5 0 0		2 4 4
		6 2		1		8 8 8
5000	11	2 5 2 5		8 3 4 1		6 1 0
		0 7		3 5		
6000	10	2 2 3 6		1 1 3 1		1 1 1
		7 4 2		0 6 0		3 3 2

Anni Expansi, & Collecti (Expanded and Collected Years 1–20)

[B. marks bissextile (leap) years.]

Motus Anni	Long. ab ♀ Sig.	G . ' "	Apogaei Sig.	G . ' "	Nodi Bor. Gr.	' "
1	0	1 1 3	0	0 1 5	0	0 2
		2 3 4		4		6
2	0	2 2 9	0	0 3 4	0	0 5
		4 7		8		2
3	1	6 4 4	0	0 5 4	0	1 1
		0 3		3		8
B. 4	1	1 5 1	0	0 7 3	0	1 4
		8 6 8		7		4
5	2	1 9 5	0	0 9 3	0	2 1
		2		1		0
6	2	1 2 2	0	0 1 2	0	2 3
		3 3 6		1 5		5
7	2	2 3 1	0	0 1 1	0	3 1
		5 7		3 9		
B. 8	3	7 5 3	0	0 1 1	0	3 2
		2 6		5 3		7
9	3	2 6 1	0	0 1 7	0	3 5
		0 0		7		3
10	4	2 1 4	0	0 1 1	0	4 1
		9 4		9		9
11	4	1 3 1	0	0 2 5	0	4 4
		4 3 8		0 6		5
B. 12	4	2 4 5	0	0 2 5	0	5 1
		6 8 3		2 0		1
13	5	9 2 2	0	0 2 4	0	5 3
		8		4 4		7
14	5	2 1 2	0	0 2 3	0	6 3
		1 6		6 8		
15	6	3 2 3	0	0 2 3	0	6 2
		9 6		8 2		9

Motus Anni	Long. ab ♀ Sig.	G . ' "	Apogaei Sig.	G . ' "	Nodi Bor. Gr.	' "
B. 16	6	1 4 1 5 5 1	0	0 3 2 0 6	0	6 5 5
17	6	2 5 4 7 8 5	0	0 3 2 2 1	0	7 2 1
18	7	1 1 2 0 2 0	0	0 3 1 4 5	0	7 4 6
19	7	2 2 5 2 5 4	0	0 3 9 6	0	8 1 2
B. 20	8	4 4 2 1 9	0	0 3 3 8	0	8 3 8

Radices affixæ sunt Meridiano Bononiensi, in meridie ultimo Decembris præcedentis. Anni præter 1. Christi, qui est iniens, sunt completi, tam sursum numerando ante Christum, quam deorsum post Christum.

[The radices are fixed to the Meridian of Bologna [*Meridiano Bononiensi*], at noon of the last day of December preceding. The years — except year 1 of Christ, which is the beginning year — are completed years, counted both upward before Christ and downward after Christ.]

Menses (Months)

Mean motion accumulated to the end of each month, in the common year [*Communis*] and the bissextile year [*Bissextilis*], for longitude from Aries [*Long. ab ♀*] and for the apogee [*Apogei*]. (Values in degrees [Gr.], ', ".)

Men sis	Communis Long. ab ♀ Gr.	' "	Bissextilis Long. ab ♀ Gr.	' "	Apogei ' "
Ianu ar.	1	2 1 8	1	2 1 8	0 1 0
Febr.	1	5 3 8 5	2	0 3 6	0 1 9
Mart ij	3	0 5 3	3	2 5 4	0 2 8
April is	4	1 1 0	4	3 1 1	0 3 7
Maij	5	3 2	5	5 3	0 4

Men sis	Communis Gr.	Long. ab ♀		Bissextilis Long. ab ♀		Gr.		Apogei	
		'	"			'	"	'	"
			9				0		8
Iunij	6	3	4	6		5	4	0	5
			6				7		6
Iulij	7	6	4	7		8	5	1	6
Aug	8	8	2	8		1	2	1	1
usti			3			0	4		7
Sept	9	8	4	9		1	4	1	2
eb.			0			0	1		5
Octo	10	1	5	10		1	5	1	3
b.		0	8			2	9		5
Nou	11	1	6	11		1	7	1	4
eb.		1				3			5
Dece	12	1	3	12		1	3	1	5
b.		3	4			5	5		4

Dies (Days)

Mean motion accumulated by day, for longitude from Aries [*Long. ab ♀*] and the apogee [*Apog.*]. (Long.: degrees [G.], ' , " — degrees are 0 throughout. Apog.: " only.)

Dies	Long. ab ♀ G.	'	"	Apog. "
1	0	2	1	0
2	0	4	1	0
3	0	6	2	1
4	0	8	2	1
5	0	10	3	2
6	0	12	4	2
7	0	14	4	2
8	0	16	5	3
9	0	18	5	3
10	0	20	6	3
11	0	22	7	4
12	0	24	7	4

Dies	Long. ab Υ G.	'	"	Apog. "
13	0	26	8	4
14	0	28	8	5
15	0	30	9	5
16	0	32	9	5
17	0	34	10	6
18	0	36	11	6
19	0	38	11	6
20	0	40	12	7
21	0	42	12	7
22	0	44	13	7
23	0	46	14	8
24	0	48	14	8
25	0	50	15	8
26	0	52	15	9
27	0	54	16	9
28	0	56	17	9
29	0	58	17	10
30	1	0	18	10
31	1	2	18	10
32	1	4	19	11

Horae (Hours)

Mean motion in longitude from Aries [*Long. ab Υ*] by hour. (Values in ', ".)

Horae	Long. ab Υ '	"
1	0	5
2	0	10
3	0	15
4	0	20
5	0	25
6	0	30
7	0	35

Horae	Long. ab Υ '	"
8	0	40
9	0	45
10	0	50
11	0	55
12	1	0
13	1	5
14	1	10
15	1	15
16	1	20
17	1	25
18	1	30
19	1	35
20	1	40
21	1	45
22	1	50
23	1	55
24	2	0
25	2	5
26	2	10
27	2	15
28	2	20
29	2	25
30	2	30
40	3	20
60	5	0

Aequationes Saturni (Equations of Saturn)

TABULA 63. First Equation of the Inequality of Saturn [*Aequatio Prima Inaequalitatis Saturni*]

The table is entered by the simple anomaly in degrees [*Anomalia simplex, Gr.*], read top-to-bottom on the left for signs 0–V and bottom-to-top on the right for the

complementary signs XI–VI. Each sign column gives degrees [G.], ', ". The upper rubric **SVBTRAHE** (subtract) applies to signs 0–V; the lower rubric **ADDE** (add) applies to signs XI–VI. Values are the equation argument; for signs 0, the leading degree-figure is 0.

	0			I			II			III			IV			V			Anom
	G			G						G			G			G			Gr.
Anom. Gr.	.	'	"	.	'	"	G.	'	"	G.	'	"	G.	'	"	.	'	"	.
0	0	0	0	3	6	1	5	3	1	6	3	1	5	5	4	3	3	3	30
						7		1	2		6	3		5	8		1		
1	0	6	3	3	1	1	5	3	4	6	3	4	5	5	3	3	2	4	29
			3		2			4	7		6	0		2	6		4	2	
2	0	1	5	3	1	4	5	3	1	6	3	0	5	4	1	3	1	1	28
		2	6		7	3		8	9		7			9	7		8	9	
3	0	1	2	3	2	2	5	4	4	6	3	1	5	4	5	3	1	5	27
		9	8		3	3		1	8		7	0		5	1		1	5	
4	0	2	4	3	2	5	5	4	1	6	3	9	5	4	1	3	5	2	26
		5	8		8	8		5	2		7			2	8			3	
5	0	3	1	3	3	2	5	4	2	6	3	7	5	3	3	2	5	4	25
		2	1		4	9		8	9		7			8	7		8	6	
6	0	3	4	3	3	5	5	5	3	6	3	5	5	3	4	2	5	4	24
		8	7		9	6		1	9		7			4	8		2		
7	0	4	3	3	4	2	5	5	4	6	3	4	5	3	5	2	4	2	23
		5	2		5	1		4	3		6	0		0	2		5	1	
8	0	5	3	3	5	4	5	5	4	6	3	1	5	2	4	2	3	3	22
		1	7		0	3		7	1		6	0		6	9		8	5	
9	0	5	5	3	5	2	6	0	3	6	3	3	5	2	4	2	3	4	21
		7	0		6				2		5	4		2	1		1	7	
10	1	4	8	4	1	1	6	3	1	6	3	5	5	1	2	2	2	5	20
					6				8		4	6		8	5		4	7	
11	1	1	2	4	6	2	6	5	5	6	3	1	5	1	1	2	1	6	19
		0	7			6			8		4	3		4			8		
12	1	1	4	4	1	3	6	8	3	6	3	2	5	9	2	2	1	1	18
		6	6		1	2			2		3	5			9		1	6	
13	1	2	5	4	1	3	6	1	1	6	3	2	5	4	5	2	4	1	17
		3			6	4		1			2	9			1			8	

Anom. Gr.	0			I			II			III			IV			V			Anom . Gr.
	G	.	'	"	.	'	"	G.	.	"	G.	.	"	G.	.	"	.	'	"
14	1	2	2	4	2	3	6	1	2	6	3	2	5	0	8	1	5	1	16
		9	5		1	3		3	3		1	2					7	7	
15	1	3	4	4	2	2	6	1	3	6	3	4	4	5	1	1	5	1	15
		5	4		6	9		5	7		0			5	9		6	0	
16	1	4	1	4	3	1	6	1	4	6	2	3	4	5	2	1	5	0	14
		2			1	9		7	6		8	8		0	3		3		
17	1	4	1	4	3	4	6	1	5	6	2	4	4	4	1	1	4	4	13
		8	8		6			9	0		7			5	9		5	7	
18	1	5	3	4	4	4	6	2	4	6	2	2	4	4	9	1	3	3	12
		4	4		0	5		1	8		5	2		0			8	2	
19	2	0	4	4	4	2	6	2	4	6	2	3	4	3	5	1	3	1	11
		4			5	2		3	0		3	4		4	4		1	6	
20	2	6	5	4	5	5	6	2	2	6	2	4	4	2	3	1	2	5	10
		4			0	6		5	4		1	0		9	4		3	9	
21	2	1	2	4	5	2	6	2	5	6	1	3	4	2	7	1	1	4	9
		3			4	5		6	9		9	9		4			6	0	
22	2	1	8	4	5	4	6	2	2	6	1	3	4	1	3	0	5	2	8
		9			8	9		8	8		7	0		8	3		9	0	
23	2	2	7	5	3	8	6	2	5	6	1	1	4	1	5	0	5	5	7
		5						9	0		5	2		2	2		1	9	
24	2	3	2	5	7	2	6	3	6	6	1	4	4	7	5	0	4	3	6
		1			3			1			2	6					4	7	
25	2	3	5	5	1	3	6	3	1	6	1	1	4	1	1	0	3	1	5
		6	9		1	4		2	5		0	3		6			7	5	
26	2	4	5	5	1	3	6	3	1	6	7	3	3	5	2	0	2	5	4
		2	5		5	9		3	5		3			5	5		9	2	
27	2	4	5	5	1	3	6	3	1	6	4	4	3	4	3	0	2	2	3
		8	1		9	9		4	0		7			9	2		2	7	
28	2	5	4	5	2	3	6	3	5	6	1	5	3	4	3	0	1	0	2
		4	3		3	4		4	8		3			3	1		5		
29	3	0	3	5	2	2	6	3	3	5	5	5	3	3	2	0	7	3	1
		2			7	4		5	9		8	3		7	2		1		

	0			I			II			III			IV			V			Anom		
	G			G			G			G			G			G					
Anom. Gr.	.	'	"	.	'	"	G.	'	"	G.	'	"	G.	'	"	.	'	"	.	Gr.	
30	3	6	1	5	3	1	6	3	1	5	5	4	3	3	3	0	0	0	0		
			7		1	2		6	3		5	8		1							
(sign, read up)	X			X			IX			VII			VI			V			Anom		
	I									I			I			I			.	Gr.	

TABULA 64. Equated Anomaly of Saturn, corresponding to the Simple Anomaly [*Anomalia Aequata Saturni, respondens Anomaliae simplici*]

Entered by the simple anomaly in degrees [*Anom. simpl. Gr.*], signs 0–V read downward (left/top), complementary signs XI–VI read upward (bottom rubric). Each sign column gives Sign · degree (G.) · ' · " — i.e. the equated anomaly in zodiacal coordinates.

	0	I			II			III			IV			V			Ano		
Anom.	Si	Si			Sig			III			Sig			Si			m.		
Gr.	g.	'	"	g.	'	"	.	'	"	Sig.	'	"	.	'	"	g.	'	"	Gr.
0	0	0	0	0	2	4	1	1	0	2	4	2	3	8	0	4	2	4	30
					0	4		8			1	2					0	4	
1	0	5	3	0	1	4	1	6	1	2	4	2	3	9	4	4	2	4	29
		6	2		7	5		7			1	5					3	5	
2	0	5	5	1	1	4	1	4	3	2	4	3	3	1	3	5	2	4	28
		3			4	8		8			1	1		1	3		6	9	
3	0	4	3	1	1	5	2	3	2	2	4	3	4	1	2	5	2	5	27
		9	8		1	2					1	9		3	5		9	4	
4	0	4	1	1	8	5	2	1	2	3	4	5	4	1	1	5	3	1	26
		6	0			9		9			1	3		5	9		3		
5	0	4	4	1	6	8	2	0	0	3	4	1	4	1	1	5	3	9	25
		2	3								2	0		7	8		6		
6	0	3	1	1	3	1	2	5	3	3	4	3	4	1	2	5	3	1	24
		9	5			9		8	4		2	2		9	0		9	9	
7	0	3	4	1	0	3	2	5	1	3	4	5	4	2	2	5	4	2	23
		5	7			2		7	2		2	6		1	5		2	9	
8	0	3	2	1	5	4	2	5	5	3	4	2	4	2	3	5	4	4	22
		2	1		7	7		5	3		3	3		3	3		5	1	

Anom. Gr.	0 Si g.	I Si ' " g.	II Sig ' " .	III Sig. ' " Sig.	IV Sig ' " .	V Si ' " g.	Ano m. Gr.
9	0	2 5 1 8 6	5 4 2 5	5 3 3 4 7	4 5 4 3 3	2 4 5 5 3	4 5 21 9 3
10	0	2 3 1 5 1	5 2 2 2 2	5 2 3 3 3	4 2 4 4 8	2 5 5 7 5	5 8 20 2
11	0	2 7 1 2	4 4 2 9 4	5 1 3 2 3	4 5 4 5	3 9 5 0	5 2 19 5 3
12	0	1 4 1 8 3	4 8 2 7	5 7 3 1	4 4 4 5 6	3 2 5 2 7	5 4 18 8 1
13	0	1 2 1 5 1	4 3 2 4 5	5 5 3 0	4 3 4 6 0	3 4 5 4 8	1 5 17 9
14	0	1 5 1 1 9	4 5 2 2	4 6 3 9	4 1 4 7 0	3 1 5 7 0	5 1 16 8
15	0	8 3 1 7	3 3 2 9 6	4 1 3 8 0	4 1 4 8 0	3 3 5 9 6	8 3 15 7
16	0	5 1 1 8	3 1 2 7 0	4 1 3 7 8	4 6 4 9	4 5 5 2	1 5 14 1 9
17	0	1 5 1 9	3 4 2 4 8	4 2 3 6 8	5 5 4 0	4 3 5 4 5	1 2 13 5 1
18	0	5 4 1 8 1	3 2 2 2 7	4 4 3 5 6	5 7 4 1	4 8 5 7	1 4 12 8 3
19	0	5 2 1 5 3	3 9 2 0	4 6 3 5	5 1 4 2 3	4 4 5 9 4	2 7 11 2
20	0	5 8 1 2	2 5 2 7 5	4 2 3 4 8	5 2 4 3 3	5 2 5 2 2	2 3 10 5 1
21	0	4 5 1 8 3	2 4 2 5 3	4 5 3 3 3	5 3 4 4 7	5 4 5 5	2 5 9 8 6
22	0	4 4 1 5 1	2 3 2 3 3	4 2 3 3 3	5 5 4 5 3	5 4 5 7 7	3 2 8 2 1
23	0	4 2 1 2 9	2 2 2 1 5	4 5 3 2 6	5 1 4 7 2	0 3 5 2	3 4 7 5 7
24	0	3 1 1 9 9	1 2 2 9 0	4 3 3 2 1	5 3 4 8 4	3 1 5 9	3 1 6 9 5

Anom. Gr.	0 Si g.	I Si g.	II Sig	III Sig.	IV Sig	V Si g.	Ano m. Gr.
25	0	3 9 1 6	1 1 2 7 8	4 1 3 2 0	0 0 4	6 8 5	4 4 5 2 3
26	0	3 1 1 3	1 1 2 5 9	4 5 3 1 3	1 2 4 9	8 5 5 9	4 1 4 6 0
27	0	2 5 1 9 4	1 2 2 3 5	4 3 3 1 9	3 2 4	1 5 5 1 2	4 3 3 9 8
28	0	2 4 1 6 4	1 3 2 1 3	4 3 3 1 1	4 3 4 8	1 4 5 4 8	5 5 2 3
29	0	2 4 1 3 5	9 4 2 5	4 2 3 1 5	6 1 4 7	1 4 5 7 5	5 3 1 6 2
30	0	2 4 1 0 4	8 0 2	4 2 3 1 2	8 0 4	2 4 5 0 4	0 0 0
(sign, read up)	XI	X	IX	VIII	VII	VI	Ano m. Gr.

EQUATIONS OF SATURN.

TABULA 65. Of the Maximum Equations, or of the Parallaxes of the Annual Orbit, for Saturn.

Signs, and every fifteenth Degree of the equated Solar Anomaly (*Signa, & quindenī Gradus Anomalīæ Solis Æquatæ*).

Left-margin index: An. h — Sig. G. (Sign, Degree of the equated anomaly of Saturn), ascending. Right-margin index: An. h — G. Sig. (Degree, Sign), descending (complement). Each numeric column gives G. (degrees) and ' (minutes) of the maximum equation. Column sub-headings under each sign are the argument in degrees (0, 15, 30).

	0	0 /	0 /	I /	I /							V /	V /	
An. h	/	15	30	15	30	II /	II /	III /	III /	IV /	IV /	15	30	An. h
Sig·G	0°	°	°	°	°	15°	30°	15°	30°	15°	30°	°	°	G·Sig
0 · 0	5	5	5	5	5	5	5	5 40	5 38	5	5	5	5	0 · 12

An. h Sig·G	0 / 0°	0 / 15 °	0 / 30 °	I / 15 °	I / 30 °	II / 15°	II / 30°	III / 15°	III / 30°	IV / 15°	IV / 30°	V / 15 °	V / 30 °	An. h G·Sig
	4 7	47	46	46	44	43	41			37	36	35	35	
3	4 7	47	46	46	44	43	41	40	38	37	36	35	35	27
6	4 7	47	47	46	44	43	41	40	38	37	36	35	35	24
9	4 7	47	47	46	44	43	41	40	38	37	36	35	35	21
12	4 8	47	47	46	45	43	42	40	38	37	36	36	35	18
15	5 4 8 8	5 48	5 47	5 46	5 45	5 44	5 42	5 41	5 39	5 37	5 36	5 36	5 35	15 · 11
0 · 18	5 4 8	5 48	5 47	5 47	5 45	5 45	5 42	5 41	5 39	5 38	5 37	5 36	5 35	12
21	4 9	48	48	47	45	45	43	42	39	38	37	36	36	9
24	4 9	49	48	47	46	45	43	42	40	39	37	36	36	6
27	4 9	49	48	48	46	45	43	42	40	39	38	37	37	3
30	5 5 0	5 50	5 49	5 48	5 47	5 47	5 44	5 41	5 41	5 40	5 38	5 38	5 37	0 · 11
I · 3	5 5 0	5 50	5 49	5 47	5 47	5 47	5 44	5 43	5 41	5 40	5 39	5 38	5 38	27
6	5 1	51	50	49	48	47	45	43	42	41	39	39	38	24
9	5 2	52	51	50	48	47	45	44	42	41	41	39	39	21
12	5	52	51	50	49	48	46	44	43	42	41	40	40	18

An. ħ Sig·G	0 / 0°	0 / 15 °	0 / 30 °	I / 15 °	I / 30 °	II / 15°	II / 30°	III / 15°	III / 30°	IV / 15°	IV / 30°	V / 15 °	V / 30 °	An. ħ G·Sig
	2													
15	5	5	5	5	5	5	5	5 45	5 44	5	5	5	5	15 ·
	5	53	52	51	50	49	47			43	41	41	40	10
	3													
I · 18	5	5	5	5	5	5	5	5 46	5 44	5	5	5	5	12
	5	53	53	52	50	50	47			43	42	42	41	
	4													
21	5	54	54	53	51	50	48	47	45	44	43	43	42	9
	5													
24	5	55	54	53	52	51	49	48	46	45	44	43	42	6
	5													
27	5	56	55	54	53	52	50	49	47	46	44	44	43	3
	6													
30	5	5	5	5	5	5	5	5 49	5 48	5	5	5	5	0 · 10
	5	57	56	55	54	53	51			47	45	45	44	
	7													
2 · 3	5	5	5	5	5	5	5	5 50	5 48	5	5	5	5	27
	5	58	57	56	55	54	52			47	46	46	45	
	8													
6	5	59	58	57	56	55	53	51	49	48	47	47	46	24
	9													
9	6	6 0	59	58	57	56	54	52	50	49	48	48	47	21
	0													
12	6	6 1	6	59	58	57	55	53	51	50	49	49	48	18
	1		0											
15	6	6 2	6	6 0	59	58	56	54	52	51	50	50	49	15 · 9
	2		1											
2 · 18	6	6 3	6	6 1	6 0	59	57	55	53	52	51	51	50	12
	3		2											
21	4	4	3	2	1	6 0	58	56	54	53	52	52	51	9
24	5	5	4	3	2	1	59	57	55	54	53	53	52	6
27	6	6	5	4	3	2	6 0	58	57	55	54	54	53	3

An.ħ Sig·G	0 / 0°	0 / 15 °	0 / 30 °	I / 15 °	I / 30 °	II / 15°	II / 30°	III / 15°	III / 30°	IV / 15°	IV / 30°	V / 15 °	V / 30 °	An.ħ G·Sig
30	6 7	6 7	6 6	6 5	6 4	6 3	6 1	59	58	57	55	55	54	0·9
3·3	6 8	6 8	6 8	6 7	6 5	6 4	6 2	6 1	59	58	57	56	56	27
6	1 0	10	9	8	6	5	3	6 2	6 0	59	58	57	56	24
9	1 1	11	10	9	7	6	4	3	6 1	6 0	59	58	57	21
12	1 2	12	11	10	9	7	5	4	2	6 1	6 0	59	58	18
15	6 1 3	6 13	6 12	6 11	6 10	6 8	6 6	6 5	6 3	6 2	6 1	6 0	6 0	15·8
3·18	6 1 4	6 14	6 13	6 12	6 11	6 10	6 8	6 6	6 4	6 3	6 2	6 1	6 1	12
21	1 5	15	14	13	12	11	9	7	5	4	3	2	2	9
24	1 6	16	15	14	13	12	10	8	6	5	4	3	3	6
27	1 7	17	16	16	14	13	11	9	7	6	5	4	3	3
30	6 1 9	6 18	6 18	6 17	6 15	6 14	6 12	6 10	6 8	6 7	6 6	6 5	6 4	0·8
4·3	6 2 0	6 19	6 19	6 18	6 16	6 15	6 13	6 11	6 9	6 8	6 6	6 5	6 5	27
6	2 1	20	20	19	17	16	14	11	10	9	7	6	6	24
9	2 2	21	21	20	18	17	15	13	11	10	8	7	7	21
12	2	22	21	21	19	18	16	14	12	11	10	8	7	18

An. h Sig·G	0 / 0°	0 / 15 °	0 / 30 °	I / 15 °	I / 30 °	II / 15°	II / 30°	III / 15°	III / 30°	IV / 15°	IV / 30°	V / 15 °	V / 30 °	An. h G·Sig
	2													
15	6	6	6	6	6	6	6	6 15	6 13	6	6	6	6	15 · 7
	2	23	22	22	20	19	17			11	10	10	9	
	3													
4 · 18	6	6	6	6	6	6	6	6 16	6 14	6	6	6	6	12
	2	24	24	23	21	20	17			13	11	11	10	
	4													
21	2	25	25	24	22	20	18	17	15	14	13	12	11	9
	5													
24	2	26	26	25	23	21	18	18	16	15	14	13	13	6
	6													
27	2	26	26	26	24	22	19	19	16	16	15	13	13	3
	6													
30	6	6	6	6	6	6	6	6 20	6 17	6	6	6	6	0 · 7
	2	27	27	26	24	23	20			16	15	14	13	
	7													
5 · 6	6	6	6	6	6	6	6	6 20	6 18	6	6	6	6	24
	2	28	28	27	25	24	21			16	16	15	14	
	8													
12	2	29	29	28	26	24	22	21	19	17	17	16	15	18
	9													
18	2	29	29	28	27	24	23	21	19	18	17	16	15	12
	9													
24	3	30	30	29	27	25	23	22	20	18	18	17	16	6
	0													
6 · 0	6	6	6	6	6	6	6	6 22	6 20	6	6	6	6	0 · 6
	3	30	30	29	27	25	23			19	17	17	16	
	0													

Bottom-header signs (read right→left for the complementary entry): XI · 30 / 15 | X · 30 / 15 | IX · 30 / 15 | VIII · 30 / 15 | VII · 30 / 15 | VI · 30 / 15.

Signs, and every sixth Degree of the equated Solar Anomaly (*Signa, & seni Gradus Anomalix Solis Æquatæ*).

[Margin (left, vertical): Anomalia Æquata Saturni — the equated anomaly of Saturn.] [Margin (right, vertical): Anomalia Æquata Saturni.]

LATITUDES OF SATURN.

TABULA 66. The Proportional Minutes of the Latitude of Saturn.

The equated anomaly of the eccentric of Saturn (*Anomalia Æquata Excentrici Saturni*).

[Margin (left, vertical): Anomalia Orbis Saturni — the anomaly of Saturn's orb.]
[Margin (right, vertical): Anomalia Orbis Saturni.]

Signs 0–I

Column groups: each sign-argument (Sign / Gr.) gives **Scrupula proportionalia** (G., ') and **Decr. in $\circ$** ('). The final three columns give **Incr. in σ** ('), **Scrup. Proport. Incrementi & Decrementi** (G., '), and the right index **Anom. orbis** $\mathfrak{h}$ (G., Sig.).

Anom· orbis $\mathfrak{h}$ Sig·G	0/0° Scr.pro p. (G ')	D e c r $\circ$	0/15° Scr.p rop.	0/30° Scr.p rop.	I/15° Scr.p rop.	I/30° Scr.p rop.	I n c r σ	Scr.Prop .Incr.&D ecr. (G ')	Anom· orbis $\mathfrak{h}$ G·Sig
0 · 0	48 20	0	48 20	48 19	48 17	48 15	0	60 0 A.	0 · 12
6	48 20	0	48 20	48 20	48 19	48 17	0	59 25	24
12	48 23	0	48 23	48 23	48 22	48 20	0	58 26	18
18	48 38	0	48 38	48 38	48 37	48 35	0	55 40	12
24	48 54	0	48 54	48 54	48 53	48 51	1	52 20	6
30	49 11	0	49 11	49 11	49 10	49 8	1	48 47	0 · 11
I · 6	49 31	0	49	49	49	49	2	44 39	24

Anom· orbis ħ Sig·G	0/0° Scr.pro p. (G ')	D e c r σ	0/15° Scr.p rop.	0/30° Scr.p rop.	I/15° Scr.p rop.	I/30° Scr.p rop.	I n c r σ	Scr.Prop .Incr.&D ecr. (G ')	Anom· orbis ħ G·Sig
			31	31	31	30			
12	49 51	0	49 51	49 51	49 51	49 50	2	40 41	18
18	50 13	0	50 13	50 13	50 13	50 12	2	36 12	12
24	50 35	0	50 35	50 35	50 35	50 34	3	31 52	6
30	50 59	0	50 59	50 59	50 59	50 58	3	26 57	0 · 10
2 · 6	51 23	0	51 23	51 23	51 23	51 22	4	22 16	24
12	51 48	0	51 48	51 48	51 48	51 48	5	17 7	18
18	52 14	0	52 14	52 14	52 14	52 14	5	11 48	12
24	52 40	0	52 40	52 40	52 40	52 40	6	6 41	6
30	53 6	0	53 6	53 6	53 6	53 6	7	1 34	0 · 9
3 · 6	53 33	0	53 33	53 33	53 33	53 33	7	3 9 B.	24
12	54 0	0	54 0	54 0	54 1	54 1	8	7 43	18
18	54 30	0	54 30	54 30	54 31	54 31	8	12 45	12
24	55 0	0	55 0	55 1	55 2	55 3	9	17 48	6
30	55 31	0	55 31	55 32	55 33	55 35	1 0	23 0	0 · 8
4 · 6	56 3	0	56 3	56 6	56 6	56 8	1 0	28 25	24
12	56 36	0	56 38	56 40	56 42	56 51	1 1	33 51	18

Anom· orbis ħ Sig·G	0/0° Scr.pro p. (G ')	D e c r ♂	0/15° Scr.p rop.	0/30° Scr.p rop.	I/15° Scr.p rop.	I/30° Scr.p rop.	I n c r ♂	Scr.Prop .Incr.&D ecr. (G ')	Anom· orbis ħ G·Sig
18	57 10	0	57 11	57 12	57 14	57 17	1 2	37 45	12
24	57 38	0	57 39	57 41	57 44	57 47	1 2	44 25	6
30	58 0	0	58 3	58 3	58 6	58 10	1 3	48 1	0 · 7
5 · 6	58 19	0	58 20	58 22	58 25	58 29	1 3	51 20	24
12	58 37	0	58 38	58 40	58 43	58 48	1 3	54 19	18
18	58 51	0	58 52	58 54	58 58	59 2	1 3	56 42	12
24	59 3	0	59 4	59 7	59 10	59 14	1 4	58 44	6
30	59 10	0	59 11	59 14	59 18	59 23	1 4	60 0	0 · 6

Bottom-header sub-arguments under signs (read right→left): G. 30 / 15 — XI; G. 15 — X; G. 0 — X.

Signs II–III (Residuum TAB. 66)

[Body heading: Residuum TAB. 66. Scrupula Proportionalia Latitudinis Saturni. — Continuation of TAB. 66.] Anomalia Æquata Excentrici Saturni.

Anom.orbis ħ	II/0° Scr.prop. (G ')	D e c r ♂	II/15° Scr.pr op.	D e c r ♂	II/30° Scr.pr op.	D e c r ♂	III/15° Scr.pr op.	I n c r ♂	Scr.Prop. Incr.&De cr. (G ')	Anom.orbis ħ G·Sig
0 · 0	48 15	4	48 12	5 48 8	7 48 3	9 0	6 0 A.			0 · 12
6	48 17	4	48 14	5 48 11	7 48 5	9 0	59 25			24
12	48 20	4	48 18	5 48 14	7 48 8	9 0	58 26			18

Anom·o rbis ħ Sig·G	II/0° Scr.prop. (G ')	D e c r σ°	II/15° Scr.pr op.	D e c r op.	II/30° Scr.pr op.	D e c r op.	III/15° Scr.pr op.	I D _n e c r σ	Scr.Prop. Incr.&De cr. (G ')	Anom·o rbis ħ G·Sig
18	48 35	4	48 34	5	48 30	7	48 24	9 0	55 40	12
24	48 51	4	48 48	5	48 47	7	48 41	9 1	52 20	6
30	49 8	4	49 6	5	49 5	7	49 0	9 1	48 47	0 · 11
I · 6	49 30	4	49 28	5	49 26	7	49 22	9 2	44 39	24
12	49 50	4	49 48	6	49 46	8	49 42	1 2 0	40 41	18
18	50 12	4	50 10	6	50 9	8	50 5	1 3 0	36 12	12
24	50 34	4	50 32	6	50 31	8	50 27	1 3 0	31 52	6
30	50 58	4	50 56	6	50 56	9	50 53	1 4 1	26 57	0 · 10
2 · 6	51 22	4	51 21	6	51 20	9	51 17	1 4 1	22 16	24
12	51 48	5	51 46	6	51 46	9	51 44	1 5 1	17 7	18
18	52 14	5	52 14	7	52 13	9	52 11	1 5 1	11 48	12
24	52 40	5	52 39	8	52 39	1	52 38 0	1 6 2	6 41	6
30	53 6	5	53 5	8	53 5	1	53 5 0	1 7 2	1 34	0 · 9
3 · 6	53 33	5	53 33	8	53 33	1	53 33 0	1 7 3	3 9 B.	24
12	54 1	5	54 2	8	54 2	1	54 2 1	1 8 4	7 43	18
18	54 32	6	54 34	8	54 34	1	54 35 1	1 8 4	12 45	12
24	55 3	6	55 6	8	55 6	1	55 8 1	1 9 5	17 48	6

Anom·o rbis ħ Sig·G	II/0° Scr.prop. (G ')	D e c r σ°	II/15° Scr.pr op.	D e c r op.	II/30° Scr.pr op.	D e c r op.	III/15° Scr.pr op.	I D _n e c r σ	Scr.Prop. Incr.&De cr. (G ')	Anom·o rbis ħ G·Sig
30	55 35	6	55 37	9	55 39	1	55 41 2	1 1 5 0	23 0	0 · 8
4 · 6	56 8	6	56 13	9	56 16	1	56 16 2	1 1 5 0	28 25	24
12	56 42	6	56 45	9	56 48	1	56 51 2	1 1 5 1	33 51	18
18	57 17	6	57 20	9	57 24	1	57 28 2	1 1 5 2	37 45	12
24	57 47	6	57 51	9	57 55	1	57 59 2	1 1 5 2	44 25	6
30	58 10	6	58 14	9	58 18	1	58 23 3	1 1 6 3	48 1	0 · 7
5 · 6	58 29	6	58 34	9	58 39	1	58 45 3	1 1 6 3	51 20	24
12	58 48	6	58 53	9	58 59	1	59 5 3	1 1 6 3	54 19	18
18	59 2	6	59 7	9	59 13	1	59 19 3	1 1 6 3	56 43	12
24	59 14	7	59 20	1	59 26 0	1	59 32 3	1 1 6 4	58 44	6
30	59 23	7	59 28	1	59 34 0	1	59 40 3	1 1 6 4	60 0	0 · 6

Bottom-header sub-arguments (read right→left): G. 30 / 15 — IX; G. 30 — VIII; G. 15 / 0 — VIII.

LATITUDES OF SATURN (continued).

Residuum TAB. 66. The Proportional Minutes of the Latitude of Saturn (signs IV–V).

Anomalia Æquata Excentrici Saturni.

[Margin (left, vertical): Anomalia Orbis Saturni.] [Margin (right, vertical):
Anomalia Orbis Saturni.]

Anom·or bis h Sig·G	IV/0° Scr.prop. (G ')	D ec r o	IV/15° Scr.pr op.	D e c r	IV/30° Scr.pr op.	D e c r	V/15° Scr.pr op.	D e c r	V/30° Scr.pr op.	Anom·or bis h G·Sig
0 · 0	47 58	10	47 54	1	47 51	1	47 49	1	47 48	0 · 12
				2		3		4		
6	47 59	10	47 55	1	47 52	1	47 50	1	47 49	24
				2		3		4		
12	48 2	10	47 58	1	47 55	1	47 53	1	47 52	18
				2		3		4		
18	48 19	10	48 15	1	48 12	1	48 10	1	48 9	12
				2		3		4		
24	48 36	11	48 32	1	48 29	1	48 28	1	48 27	6
				3		4		5		
30	48 56	11	48 52	1	48 49	1	48 47	1	48 46	0 · 11
				3		4		5		
I · 6	49 18	11	49 14	1	49 11	1	49 9	1	49 8	24
				3		4		5		
12	49 38	12	49 35	1	49 33	1	49 30	1	49 30	18
				4		6		6		
18	50 2	12	50 0	1	49 56	1	49 56	1	49 15	12
				4		6		6		
24	50 24	12	50 22	1	50 19	1	50 18	1	50 18	6
				4		7		7		
30	50 50	13	50 48	1	50 47	1	50 45	1	50 45	0 · 10
				5		7		7		
2 · 6	51 15	13	51 13	1	51 11	1	51 11	1	51 10	24
				5		6		8		
12	51 42	14	51 41	1	51 40	1	51 39	1	51 38	18
				6		7		8		
18	52 10	14	52 9	1	52 7	1	52 7	1	52 7	12
				6		7		9		
24	52 37	15	52 36	1	52 35	1	52 35	1	52 35	6

Anom·or bis h Sig·G	IV/0° Scr.prop. (G ')	D ec r o	IV/15° Scr.pr op.	D e c r	IV/30° Scr.pr op.	D e c r	V/15° Scr.pr op.	D e c r	V/30° Scr.pr op.	Anom·or bis h G·Sig
				7		8		9		
30	53 5	15	53 5	1	53 5	1	53 5	2	53 5	0 · 9
				7		8		0		
3 · 6	53 33	16	53 33	1	53 33	1	53 33	2	53 33	24
				8		9		0		
12	54 3	17	54 3	1	54 4	1	54 4	2	54 4	18
				9		9		1		
18	54 36	17	54 37	1	54 37	2	54 38	2	54 38	12
				9		0		1		
24	55 9	18	55 10	1	55 11	2	55 12	2	55 12	6
				9		0		2		
30	55 43	18	55 44	2	55 45	2	55 46	2	55 47	0 · 8
				0		1		2		
4 · 6	56 19	18	56 21	2	56 22	2	56 23	2	56 24	24
				0		1		3		
12	56 54	18	56 57	2	56 59	2	57 0	2	57 1	18
				1		1		3		
18	57 32	18	57 35	2	57 37	2	57 38	2	57 39	12
				2		2		3		
24	58 3	18	58 6	2	58 8	2	58 10	2	58 12	6
				2		2		4		
30	58 27	19	58 31	2	58 34	2	58 36	2	58 37	0 · 7
				3		3		4		
5 · 6	58 50	19	58 54	2	58 57	2	58 59	2	59 0	24
				3		3		4		
12	59 10	19	59 14	2	59 17	2	59 20	2	59 22	18
				3		3		4		
18	59 25	19	59 29	2	59 32	2	59 35	2	59 37	12
				3		3		5		
24	59 37	19	59 42	2	59 46	2	59 49	2	59 51	6
				4		4		5		

Anom.or bis h Sig·G	IV/0° Scr.prop. (G ')	D ec r σ°	IV/15° Scr.pr op.	D e IV/30° c Scr.pr r op.	D e V/15° c Scr.pr r op.	D e V/30° c Scr.pr r op.	Anom.or bis h G·Sig
30	59 46	19	59 51	2 59 55 2	2 59 50 4	2 60 0 5	0 · 6

TABULA 67. Of the Latitude, Reduction, and Curtation of Saturn.

Gr.Dist àΩ 0 Bor / 6 Austr — Lat (G´) Red (´´) Curt (´´) 1 Bor / 7 Austr — Lat (G´) Red (´´) Curt (´´) 2 Bor / 8 Austr — Lat (G´) Red (´´) Curt (´´) Gr.Dist àΩ																													
2 33		1 27		[blank]		30		1		0 3		0 4		0		1 32		1 29		10		2 35		1 25		29			
	2		0 6		0 8		1		1 34		1 30		11		2 36		1 23		28		3		0 9		0 11		1		1 37
1 32		11		2 38		1 21		27		4		0 12		0 15		1		1 39		1 34		11		2 39		1 19		26	
	26		5		0 16		0 18		2		1 42		1 35		12		2 41		1 17		25		6		0 19		0 22		2
2		1 44		1 36		12		2 42		1 15		24		7		0 22		0 25		2		1 47		1 37		12		2	
43		1 13		23		8		0 25		0 28		3		1 49		1 38		12		2 44		1 11		22		9		0	
28		0 32		3		1 52		1 38		13		2 46		1 8		21		10		0 31		0 35		3		1 54		1	
39		13		2 47		1 5		20		11		0 34		0 38		4		1 56		1 39		13		2 48		1 3		19	
	12		0 37		0 42		4		1 58		1 40		13		2 49		1 0		18		13		0 40		0 45		4		2 1
4		2 1		1 40		14		2 49		0 57		17		14		0 43		0 48		5		2 3		1 41		14		2 50	
	0 54		16		15		0 46		0 51		5		2 5		1 41		14		2 51		0 51		15		16		0		
49		0 54		6		2 7		1 41		14		2 51		0 48		14		17		0 52		0 58		6		2 9		1 40	
	15		2 52		0 45		13		18		0 55		1 0		6		2 11		1 40		15		2 53		0 42		12		
	19		0 58		1 3		7		2 14		1 39		15		2 53		0 38		11		20		1 0		1 5		7		2
16		1 39		15		2 54		0 35		10		21		1 3		1 8		7		2 18		1 38		16		2 54		0	
32		9		22		1 6		1 11		7		2 20		1 38		16		2 55		0 28		8		23		1 9		1 13	
	8		2 22		1 37		16		2 55		0 25		7		24		1 12		1 15		8		2 23		1 36		16		2
56		0 22		6		25		1 15		1 18		8		2 25		1 35		16		2 56		0 18		5		26		1	
18		1 19		9		2 26		1 34		16		2 57		0 15		4		27		1 21		1 21		9		2 28		1	
32		17		2 57		0 11		3		28		1 23		1 23		9		2 30		1 30		17		2 57		0 8		2	

| | 29 | 1 26 | 1 25 | 10 | 2 32 | 1 29 | 17 | 2 57 | 0 4 | | 1 | | 30 | 1 29 | 1 28 | 10
 | 2 33 | 1 27 | 17 | 2 57 | 0 0 | | 0 |

Bottom-header sign-pairs (read right→left for the descending index): 5 Bor. & 11 Austr. | 4 Bor. & 10 Austr. | 3 Bor. & 9 Austr.

TABLE 68. Of the Mean Motions of Jupiter ♃
EPOCHS, or RADICES OF THE MOTIONS

Completed years before Christ	Long. from ♈ Sig.	Apogee		N. Node	
		' "	Sig.	' "	Sig.
6000	5	2 3	11	5 3	1
		9 0		5 3	
5000	9	3 5	0	4 3	1
		2 2		0 2	
4000	1	3 1	1	2 3	2
		6 4		5 1	
3000	5	3 3	2	1 3	2
		9 6		0 0	
2000	9	4 5	3	5 2	2
		2 8		5 9	
1000	1	4 2	4	4 2	2
		6 0		0 8	
900	7	4 4	4	8 5	2
		0		8	
800	0	2 0	4	3 2	2
		3		7 8	
700	5	4 2	4	5 5	2
		1 0		8	
600	10	5 4	4	3 2	2
		9 0		4 8	
500	3	1 0	4	2 5	2
		8		8	
400	9	3 2	4	3 2	2
		6 1		1 8	
300	2	5 4	4	5 5	2

Completed years before Christ	Long. from ♀ Sig.	' "	Apogee Sig.	' "	N. Node Sig.	' "
		4 2		9 7		7 8
200	7	1 3 4		2 2 2		1 2
		3		8 6		8 0
100	0	3 2 4		5 5 2		5 2
		1 4		6 5		9 2
Christ	5	4 4 4		2 2 2		4 2
		9 5		5 4		0 5
100	11	8 8 5		5 5 2		2 2
				3 6		1 9
200	4	2 2 5		2 2 2		2 3
		6 8		2 6		2
300	9	4 4 5		5 5 2		4 3
		4 9		0 6		3 4
400	2	3 9 5		1 2 3		2 3
				9 5		4 7
500	8	2 2 5		4 5 3		5 4
		1 9		7 5		0
600	1	3 4 5		1 2 3		4 4
		9 9		6 5		6 3
700	6	5 1 5		4 5 3		2 4
		8 0		4 5		7 5
800	11	1 3 5		1 2 3		8 4
		6 0		3 5		8
900	4	4 5 5		4 5 3		4 5
		0		1 5		9 1
1000	10	5 1 5		1 2 3		3 5
		3 0		0 5		0 4
1100	3	1 3 5		3 5 3		1 5
		1 0		8 5		1 7
1200	8	2 5 5		7 5 3		5 0
		9 0				3
[Sty. veteri / Old Style] 1300	1	4 1 5		3 5 3		3 3
		8 0		5 5		4

Completed years before Christ	Long. from ♀ Sig.	Apogee Sig.			N. Node Sig.				
1400	6	6	3	6	4	2	3	1	6
			0			5		5	
1500	0	2	5	6	3	5	3	5	9
		4	0		2	5		6	
1600	5	4	1	6	5	2	3	3	1
		3	0		1	5		7	2
[Sty. Gregoriano / Gregorian Style] 1600	5	5	1	6	1	2	3	3	1
		3	8			2		7	1
1700	10	6	3	6	2	5	3	1	1
			9		9	2		8	6
1800	3	1	5	6	5	2	3	5	2
		9	9		8	2		9	1
1900	8	3	2	6	2	5	3	4	2
		3	2		6	1		0	6
2000	2	5	4	6	5	2	3	2	3
		1	2		5	1		1	0
2100	7	5	2	6	2	5	3	2	2
					3	1			1
2200	0	1	2	6	5	2	3	4	1
		8	2		2	1		3	2
2300	5	3	4	6	2	5	3	2	3
		1	2		0	1		4	

SINGLE (EXPANDED) AND COLLECTED YEARS

[The leading "B." marks bissextile (leap) years. The argument is the count of *Anni* (years).]

Yea rs	Long. from ♀ Sig.	G . ' "			Apogee G. ' "			N. Node G. ' "		
1	1	0	2	3	0	1	2	0	0	2
			0	2			9			5
2	2	0	4	4	0	2	5	0	0	4
			1				8			9

Yea rs	Long. from ♀ Sig.	G . ' "			Apogee G. ' "			N. Node	G. ' "
3	3	1	1	3	0	4	2	0	1 1
				6			7		4
B. 4	4	1	2	8	0	5	5	0	1 3
			7				6		8
5	5	1	4	4	0	7	2	0	2 3
			7	0			5		
6	6	2	8	1	0	8	5	0	2 2
				2			4		8
7	7	2	2	4	0	1	2	0	2 5
			8	4		0	4		2
B. 8	8	2	5	1	0	1	5	0	3 1
			4	6		1	3		7
9	9	3	1	4	0	1	2	0	3 4
			4	8		3	2		2
10	10	3	3	2	0	1	5	0	4 6
			5	0		4	1		
11	11	3	5	5	0	1	2	0	4 3
			5	3		6	0		1
B.	0	4	2	2	0	1	4	0	4 5
12			1	4		7	9		5
13	1	4	4	5	0	1	1	0	5 2
			1	6		9	8		0
14	2	5	2	2	0	2	4	0	5 4
				8		0	7		5
15	3	5	2	1	0	2	1	0	6 9
			3			2	6		
B.	4	5	4	3	0	2	4	0	6 3
16			8	2		3	6		4
17	5	6	9	4	0	2	1	0	6 5
						5	5		9
18	6	6	2	3	0	2	4	0	7 2
			9	7		6	4		3
19	7	6	5	9	0	2	1	0	7 4

Yea				G		Apogee							
rs	Long. from ♀	Sig.		.	'	"	G.	'	"	N. Node	G.	'	"
						0		8	3				8
B.	8			7	1	4	0	2	4	0		8	1
20				5	0			9	2				3

[Margin (foot of left block): *Radices affixae sunt Meridiano Bononiensi, in meridie ultimo Decembris praecedentis. Anni praeter 1. Christi, qui est iniens, sunt Completi, tam numerando sursum ante Christum, quàm deorsum post Christum.* — "The radices are fixed to the meridian of Bologna, at noon on the last day of the preceding December. The years — apart from the 1st of Christ, which is the entering (incipient) year — are completed years, whether one counts upward before Christ or downward after Christ."]

COLLECTED JULIAN YEARS

Yea				G		Apogee		G		N. Node	Sig.	G		
rs	Long. from ♀	Sig.		.	'	"	Sig.	.	'	"		.	'	"
40	4			1	3	2	0	0	5	2	0	0	1	2
				4	1	0			9	4			6	5
60	0			2	4	0	0	1	2	6	0	0	2	3
				1	7				9				4	8
80	8			2	2	4	0	1	5	4	0	0	3	5
				9	1	0			8	8			2	0
100	5			6	1	2	0	2	2	3	0	0	4	3
					8	0			8	0			1	
200	10			1	3	4	0	4	5	0	0	1	2	6
				2	6	0			7				2	
300	3			1	5	1	0	7	2	3	0	2	3	8
				8	5				5	0				
400	8			2	1	2	0	9	5	5	0	2	4	1
				5	3	1			3	9			4	1
500	2			1	3	4	0	1	2	2	0	3	2	1
					1	1			2	2	9		5	4
600	7			7	5	1	0	1	5	5	0	4	6	1
					0				4	0	9			7
700	0			1	8	2	0	1	1	2	0	4	4	1

Yea rs	Long. from γ Sig.	G . ' "	Apogee Sig.	G . ' "	N. Node Sig.	G . ' "
		4 2		7 9 9		7 9
800	5	2 2 4 0		1 4 5 0		5 2 2
		0 6 2		9 7 9		8 2
900	10	2 4 2 0		2 1 2 0		6 9 2
		6 5		2 6 9		5
100	4	3 3 2 0		2 4 5 0		6 5 2
0		2		4 4 9		0 8
200	8	6 6 4 1		1 2 5 0		1 4 5
0		5		9 9 7		3 0 6
300	0	9 1 7 2		1 1 5 0		2 3 2
0		0		4 4 6		0 1 3
400	4	1 1 3 3		8 5 5 0		2 2 5
0		2 3 0		9 4		7 1 1
500	8	1 1 5 4		3 4 5 1		4 1 1
0		5 6 2		4 3		2 8
600	0	1 2 1 4		2 2 5 1		1 2 4
0		8 0 5		8 9 1		1 1 6

MONTHS OF THE YEAR (Common / Bissextile)

[Two longitude blocks: in the **common year** only minutes and seconds are tabulated; in the **bissextile (leap) year** the full Degrees, minutes, seconds are given, together with the Apogee (Apog.) and Node (Nodi.) increments.]

Mont h	Common: Long. from γ ' "	Bissextile: Long. from γ G. ' "	Apog. ' "	Nodi. " "
Janua ry	2	3 37 4	2 3 36 9	0 0
Febru ary	4	5 17 4	4 5 16 9	0 7
March	7	2 54 8	7 1 53 3	0 15
April	9	5 32 8	1 3 31 0	0 22
May	12	3 9	1 3 8	0 29

Mont h	Common: Long. from Υ ' "	Bissextile: Long. from Υ G. ' "	Apog. ' "	Nodi. " "
		3	2 8	
June	15	2 47	1 7 46 5	0 37
July	17	3 24 7	1 4 23 7 2	0 44
August	20	1 2 2	2 1 1 0 7	0 52
September	22	4 40 1	2 4 39 2 6	1 0
October	25	1 17 6	2 2 16 5 1	1 7
November	27	4 55 5	2 5 54 7 0	1 15
December	30	2 32 0	3 2 31 0 5	1 22

DAYS and HOURS

[Left sub-block: motion per Day (Dies) — Longitude from Υ in G., ' , " and Apogee in ". Right sub-block: motion per Hour (Horae) — Longitude from Υ in ' , ".]

D a y	Long. from Υ G.	'	"	Apog. "	Ho ur	Long. from Υ ' "	"
1	0	4	5	0	1	0	1
			9				2
2	0	9	5	0	2	0	2
			9				5
3	0	1	5	0	3	0	3
		4	8				7
4	0	1	5	1	4	0	5
		9	7				0
5	0	2	5	1	5	1	2
		4	6				
6	0	2	5	1	6	1	1

D a y	Long. from Υ G.	'	"	Apog. "	Ho ur	Long. from Υ '	"
		9	6				5
7	0	3	5	1	7	1	2
		4	5				7
8	0	3	5	1	8	1	3
		9	4				8
9	0	4	5	2	9	1	5
		4	3				2
1	0	4	5	2	10	2	5
0		9	3				
1	0	5	5	2	11	2	1
1		4	2				7
1	0	5	5	2	12	2	3
2		9	1				0
1	1	4	5	3	13	2	4
3			0				2
1	1	9	5	3	14	2	5
4			0				5
1	1	1	4	3	15	3	7
5		4	9				
1	1	1	4	3	16	3	2
6		9	8				0
1	1	2	4	4	17	3	3
7		4	8				2
1	1	2	4	4	18	3	4
8		9	7				4
1	1	3	4	4	19	3	5
9		4	6				7
2	1	3	4	4	20	4	9
0		9	5				
2	1	4	4	5	21	4	2
1		4	5				2
2	1	4	4	5	22	4	3

D a y	Long. from Υ G.	'	"	Apog. "	Ho ur	Long. from Υ '	"
2		9	4				4
2	1	5	4	5	23	4	4
3		4	3				7
2	1	5	4	5	24	4	5
4		9	2				9
2	2	4	4	6	25	5	1
5			2				2
2	2	9	4	6	26	5	2
6			1				4
2	2	1	4	6	27	5	3
7		4	0				7
2	2	1	3	6	28	5	4
8		9	9				9
2	2	2	3	7	29	6	2
9		4	9				
3	2	2	3	7	30	6	1
0		9	8				4
3	2	3	3	7	40	8	1
1		4	7				9
3	2	3	3	7	60	12	2
2		9	6				8

TABLE 69. The First Equation of Jupiter's Inequality

[The argument runs down each side as the *simple anomaly* (Anom. simpl., in degrees, Gr.); the top band carries the *Signs of the simple anomaly* (Signa Anomaliae simplicis) 0–V with the instruction **SUBTRACT** (SVBTRAHE); the bottom band carries signs XI–VI with the instruction **ADD** (ADDE). Each sign-column gives Degrees (G.), minutes ('), seconds (").]

Anom. (Gr.)	0: G.	'	"	I: G.	'	"	II: G.	'	"	III: G.	'	"	IV: G.	'	"	V: G.	'	"	Anom. (Gr.)
0	0	0	0	2	3	2	4	4	2	5	3	2	4	5	5	2	5	0	30
					8	0		0	3		3	8		7	0		6		
1	0	5	3	2	4	1	4	4	2	5	3	4	4	5	4	2	5	4	29
			0		3	5		3	3		3	6		5			0	5	
2	0	1	0	2	4	4	4	4	1	5	3	5	4	5	1	2	4	2	28
		1			8			6	7		3	7		2	3		5	4	
3	0	1	3	2	5	4	4	4	6	5	3	0	4	4	1	2	4	0	27
		6	1		2	9		9			4			9	6		0		
4	0	2	0	2	5	3	4	5	4	5	3	5	4	4	1	2	3	3	26
		2			7	2		1	8		3	9		6	2		4	3	
5	0	2	2	3	2	9	4	5	2	5	3	1	4	4	2	2	2	3	25
		7	9					4	7		3	9		3			9		
6	0	3	5	3	6	4	4	5	1	5	3	4	4	3	4	2	2	3	24
		2	7			5		7			3	0		9	5		3	0	
7	0	3	2	3	1	2	4	5	3	5	3	2	4	3	2	2	1	5	23
		8	4		1	2		9	4		3	2		6	2		7	6	
8	0	4	5	3	1	5	5	2	4	5	3	5	4	3	5	2	1	1	22
		3	2		5	4					2	9		2	4		2	7	
9	0	4	1	3	2	2	5	4	3	5	3	3	4	2	2	2	6	3	21
		9	8		0	2		0			2	1		9	0		4		
10	0	5	4	3	2	4	5	6	5	5	3	5	4	2	4	2	0	4	20
		4	2		4	7		0			1	8		5	1		9		
11	1	0	5	3	2	6	5	9	5	5	3	2	4	2	5	1	5	2	19
					9						1	1		1	5		5		
12	1	5	2	3	3	2	5	1	1	5	3	2	4	1	5	1	4	1	18
			8		3	3		1	4		0	4		8			9	1	
13	1	1	5	3	3	3	5	1	1	5	2	2	4	1	1	1	4	2	17
		0	0		7	8		3	8		9	2		4	1		3	0	
14	1	1	1	3	4	5	5	1	1	5	2	1	4	1	1	1	3	2	16
		6	1		1	0		5	5		8	5		0	3		7	7	
15	1	2	3	3	4	5	5	1	6	5	2	8	4	6	1	1	3	3	15
		1	1		5	9		7			7			1			1	2	
16	1	2	4	3	5	6	5	1	4	5	2	5	4	2	5	1	2	3	14

Anom. (Gr.)	0: G.	'	"	I: G.	'	"	II: G.	'	"	III: G.	'	"	IV: G.	'	"	V: G.	'	"	Anom. (Gr.)
			6 9			0			8 9			5 4						5 4	
17	1		3 6 3			5 7 5			2 2 5			2 3 3			5 5 1			1 3 13	
			2			4			0 7			4 2			7 4			9 5	
18	1		3 2 3			5 3 5			2 2 5			2 2 3			5 3 1			1 3 12	
			7 1			8			2			3			3 7			3 4	
19	1		4 3 4			1 5 5			2 3 5			2 2 3			4 1 1			7 3 11	
			2 4			4			3 4			1 9			9 4			2	
20	1		4 4 4			5 4 5			2 5 5			1 4 3			4 4 1			1 2 10	
			7 6			1			4 8			9 9			4 4			8	
21	1		5 5 4			9 2 5			2 2 5			1 3 3			4 1 0			5 2 9	
			2 5			4			6 0			8			0 0			5 5	
22	1		5 4 4			1 3 5			2 3 5			1 1 3			3 3 0			4 2 8	
			8			3			7 3			6 3			5 1			9 0	
23	2		3 1 4			1 5 5			2 3 5			1 1 3			3 4 0			4 1 7	
			3			6 0			8 8			4 6			0 8			3 2	
24	2		8 2 4			2 2 5			2 3 5			1 1 3			2 1 0			3 2 6	
			1			0 5			9 6			2 3			6			7	
25	2		1 2 4			2 5 5			3 2 5			1 4 3			2 1 0			3 5 5	
			3 6			3 6			0 8			0			1 0			0 2	
26	2		1 2 4			2 2 5			3 1 5			7 5 3			1 1 0			2 4 4	
			8 9			7 3			1 5			0			6 6			4 2	
27	2		2 2 4			3 4 5			3 5 5			5 3 3			1 1 0			1 3 3	
			3 8			0 5			1 6			0			1 8			8 3	
28	2		2 2 4			3 2 5			3 3 5			4 3 3			6 1 0			1 2 2	
			8 6			4			2 2						5			2 2	
29	2		3 2 4			3 1 5			3 2 5			0 3 3			1 8 0			6 1 1	
			3 3			7 6			3			2						1	
30	2		3 2 4			4 2 5			3 2 4			5 5 2			5 0 0			0 0 0	
			8 0			0 3			3 8			7 0			6				
(Gr.)	XI			X			IX			VIII			VII			VI			(Gr.)

TABLE 70. The Equated Anomaly of Jupiter, corresponding to the Simple Anomaly

[Same folded layout: top band signs 0–V with **ADD** (ADDE); bottom band signs XI–VI. Each entry gives Sign (Sig.), G., ', ". The result is the equated anomaly *Anomalía Aequata*.]

Ano m. (Gr.)	0: Sig .	I: Sig ' " .	II: Sig. ' " Sig.	III: Sig. ' " Sig.	IV: Sig. ' " Sig.	V: Sig ' " .	Ano m. (Gr.)
0	0	0 0 0	3 3 1 6 1	3 2 2 5 1	1 0 3 3	3 2 4 5 1	3 3 30 6 1
1	0	5 5 0 7	3 0 1 4	3 5 2 3 6	1 1 3 3	3 4 4 6 9	3 2 29 9
2	0	5 1 1 4 0	3 3 1 1 1	3 3 2 2 3	1 6 3 3	3 2 5 8 1	4 3 28 1 8
3	0	5 1 1 1 6	2 3 2 9	3 1 3 1 2	1 1 4 3 3	3 5 5 9 5	4 1 27 4 3
4	0	4 2 1 8 1	2 3 2 6 7	2 5 3 9 4	1 2 4 3 4	4 3 5 1 2	4 5 26 6 0
5	0	4 2 1 5 7	2 1 2 4 3	2 3 3 8 9	1 3 4 3 8	4 1 5 3 2	4 2 25 9 8
6	0	4 3 1 2 3	2 5 2 1 1	2 2 3 7 6	1 5 4 3 5	4 5 5 4 4	5 7 24 2
7	0	3 3 1 9 9	1 3 2 9 0	2 1 3 6 7	1 1 4 4 5	4 3 5 6 8	5 4 23 4 8
8	0	3 4 1 6 5	1 1 2 7 1	2 1 3 5 1	1 3 4 4 8	4 2 5 8 5	5 3 22 7 0
9	0	3 5 1 3 3	1 5 2 4 4	2 6 3 4	1 4 4 5	5 1 5 0 4	0 1 21 3
10	0	3 1 1 1	1 4 2 2 0	2 5 3 3	1 3 4 5 3	5 6 5 2	2 5 20 8
11	0	2 1 1 8 0	1 2 2 0 8	2 7 3 2	1 3 4 6	5 0 5 4	5 4 19 3
12	0	2 1 1 5 9	8 1 2 7	2 1 3 1 1	1 3 4 6 9	5 5 5 5 6	8 2 18 9

Ano m. (Gr.)	0: Sig .	I: Sig ' " .	II: Sig. ' " .	III: Sig. ' " .	IV: Sig. ' " .	V: Sig ' " .	Ano m. (Gr.)
13	0	2 2 1 2 9	6 7 2	2 1 3 0 9	1 1 4 7 7	5 5 5 7 4	1 1 17 1 5
14	0	1 4 1 9 0	4 1 2	1 3 3 9 0	1 5 4 7 8	5 5 5 9 4	1 2 16 4
15	0	1 5 1 6 0	1 5 2 6	1 4 3 8 2	1 4 4 8 2	1 5 5 6	1 5 15 6 0
16	0	1 2 1 4	5 5 2 9 4	1 5 3 7 8	1 3 4 9 0	4 1 5	1 4 14 9 0
17	0	1 1 1 1 5	5 1 2 7 7	1 1 3 7 7	2 1 4 0 9	6 7 5	2 2 13 2 9
18	0	8 2 1 9	5 5 2 5 6	1 3 3 6 9	2 1 4 1 1	8 1 5 7	2 1 12 5 9
19	0	5 4 1 3	5 0 2 4	1 3 3 6	2 7 4 2	1 2 5 0 8	2 1 11 8 0
20	0	2 5 1 8	5 6 2 2	1 3 3 5 3	2 5 4 3	1 4 5 2 0	3 1 10 1
21	0	0 1 1 3	5 1 2 0 4	1 4 3 5	2 6 4 4	1 5 5 4 4	3 5 9 3 3
22	0	5 3 1 7 0	4 2 2 8 5	1 3 3 4 8	2 1 4 5 1	1 1 5 7 1	3 4 8 6 5
23	0	5 4 1 4 8	4 3 2 6 8	1 1 3 4 5	2 1 4 6 7	1 3 5 9 0	3 3 7 9 9
24	0	5 7 1 2	4 5 2 4 4	1 5 3 3 5	2 2 4 7 6	2 5 5 1 1	4 3 6 2 3
25	0	4 2 1 9 8	4 1 2 3 2	1 3 3 3 8	2 3 4 8 9	2 1 5 4 3	4 2 5 5 7
26	0	4 5 1 6 0	4 3 2 1 2	1 2 3 3 4	2 5 4 9 4	2 3 5 6 7	4 2 4 8 1
27	0	4 1 1 4 3	3 5 2 9 5	1 1 3 3 3	3 1 4 1 2	2 3 5 9	5 1 3 1 6
28	0	4 3 1 1 8	3 2 2 8 1	1 6 3 3	3 3 4 2 3	3 3 5 1 1	5 1 2 4 0

Ano m. (Gr.)	0: Sig .	I: Sig ' " .			II: Sig ' " .			III: Sig ' " .			IV: Sig ' " .			V: Sig ' " .			Ano m. (Gr.)
29	0	3	2	1	3	4	2	1	1	3	3	5	4	3	0	5	5 0 1
		9			6	9		3			3	6		4			7
30	0	3	3	1	3	2	2	1	0	3	3	2	4	3	3	5	0 0 0
		6	1		5	1		3			5	1		6	1		
(Gr.)	XI			X			IX			VIII			VII			VI	(Gr.)

TABLE 71. Of the Maximum Equations, or Parallaxes of the Annual Orb, for Jupiter

[Header: *Signa, & quindenii Gradus Anomaliae Solis Aequatae* — "Signs, and the fifteens of degrees of the equated solar anomaly." The argument down the left is the *equated anomaly of Jupiter* (Anomalia Aequata Iovis), in Signs and degrees (Gr.) stepping by 3°. Across the top, the equated solar anomaly is tabulated by sign (0–V) and, within each sign, at the sub-arguments 0, 15, 30 (the first sign 0) and 15, 30 of the following signs. Each cell gives Degrees (G.) and minutes ('). The bottom band repeats the signs XI–X–IX–VIII–VII–VI with the mirror sub-arguments (30/15/30/15/...) and the right-hand *Gr./G.Sig.* column, for reading the lower half of the equated solar anomaly upward.]

	O		O								V		V	
Anom.	O	:	:	I:	I:	II	II			I	I	:	:	Gr.
Aeq.	0	5	0	5	0	1	3	:	:	1	3	5	0	/
Jup.	G	G	G	G	G	5	0	15	30	5	0	G	G	G.S
Sig. / Gr.	.	.	.	.	.	G.	G.	G.	G.	G.	G.	.	.	ig.
0 — 0	1	1	1	1	1	1	1	10	10	1	1	1	1	0
	0	0	0	0	0	0	0			0	0	0	0	—
														12
3	1	1	1	1	1	1	1	10	10	1	1	1	1	27
	0	0	0	0	0	0	0			0	0	0	0	
6	1	1	1	1	1	1	1	10	10	1	1	1	1	24
	0	0	0	0	0	0	0			0	0	0	0	
9	1	1	1	1	1	1	1	10	10	1	1	1	1	21
	0	0	0	0	0	0	0			0	0	0	0	

	O	O										V	V	
	O	:	:	I:	I:	II	II			I	I	:	:	
Anom.	:	1	3	1	3	:	:	III	III	V:	V:	1	3	Gr.
Aeq.	0	5	0	5	0	1	3	:	:	1	3	5	0	/
Jup.	G	G	G	G	G	5	0	15	30	5	0	G	G	G.S
Sig. / Gr.	.	.	.	.	.	G.	G.	G.	G.	G.	G.	.	.	ig.
12	1	1	1	1	1	1	1	10	10	1	1	1	1	18
	0	0	0	0	0	0	0			0	0	0	0	
15	1	1	1	1	1	1	1	10	10	1	1	1	1	15
	0	0	0	0	0	0	0			0	0	0	0	—
														11
0 — 18	1	1	1	1	1	1	1	10	10	1	1	1	1	12
	0	0	0	0	0	0	0			0	0	0	0	
21	1	1	1	1	1	1	1	10	10	1	1	1	1	9
	0	0	0	0	0	0	0			0	0	0	0	
24	1	1	1	1	1	1	1	10	10	1	1	1	1	6
	0	0	0	0	0	0	0			0	0	0	0	
27	1	1	1	1	1	1	1	10	10	1	1	1	1	3
	0	0	0	0	0	0	0			0	0	0	0	
30	1	1	1	1	1	1	1	10	10	1	1	1	1	0
	0	0	0	0	0	0	0			0	0	0	0	—
														11
1 — 3	1	1	1	1	1	1	1	10	10	1	1	1	1	27
	0	0	0	0	0	0	0			0	0	0	0	
6	1	1	1	1	1	1	1	10	10	1	1	1	1	24
	0	0	0	0	0	0	0			0	0	0	0	
9	1	1	1	1	1	1	1	10	10	1	1	1	1	21
	0	0	0	0	0	0	0			0	0	0	0	
12	1	1	1	1	1	1	1	10	10	1	1	1	1	18
	0	0	0	0	0	0	0			0	0	0	0	
15	1	1	1	1	1	1	1	10	10	1	1	1	1	15
	0	0	0	0	0	0	0			0	0	0	0	—
														10
1 — 18	1	1	1	1	1	1	1	10	10	1	1	1	1	12
	0	0	0	0	0	0	0			0	0	0	0	
21	1	1	1	1	1	1	1	10	10	1	1	1	1	9

		O	O									V	V	
		O	:	:	I:	I:	II	II		I	I	:	:	
Anom.	:	1	3	1	3	:	:	III	III	V:	V:	1	3	Gr.
Aeq.	0	5	0	5	0	1	3	:	:	1	3	5	0	/
Jup.	G	G	G	G	G	5	0	15	30	5	0	G	G	G.S
Sig. / Gr.	.	.	.	.	.	G.	G.	G.	G.	G.	G.	.	.	ig.
	0	0	0	0	0	0	0			0	0	0	0	
24	1	1	1	1	1	1	1	10	10	1	1	1	1	6
	0	0	0	0	0	0	0			0	0	0	0	
27	1	1	1	1	1	1	1	10	10	1	1	1	1	3
	0	0	0	0	0	0	0			0	0	0	0	
30	1	1	1	1	1	1	1	10	10	1	1	1	1	0
	0	0	0	0	0	0	0			0	0	0	0	— 10
2 — 3	1	1	1	1	1	1	1	10	10	1	1	1	1	27
	0	0	0	0	0	0	0			0	0	0	0	
6	1	1	1	1	1	1	1	10	10	1	1	1	1	24
	1	1	0	0	0	0	0			0	0	0	0	
9	1	1	1	1	1	1	1	10	10	1	1	1	1	21
	1	1	1	0	0	0	0			0	0	0	0	
12	1	1	1	1	1	1	1	10	10	1	1	1	1	18
	1	1	1	1	0	0	0			0	0	0	0	
15	1	1	1	1	1	1	1	10	10	1	1	1	1	15
	1	1	1	1	1	0	0			0	0	0	0	— 9
2 — 18	1	1	1	1	1	1	1	10	10	1	1	1	1	12
	1	1	1	1	1	0	0			0	0	0	0	
21	1	1	1	1	1	1	1	10	10	1	1	1	1	9
	1	1	1	1	1	1	0			0	0	0	0	
24	1	1	1	1	1	1	1	10	10	1	1	1	1	6
	1	1	1	1	1	1	0			0	0	0	0	
27	1	1	1	1	1	1	1	10	10	1	1	1	1	3
	1	1	1	1	1	1	1			0	0	0	0	
30	1	1	1	1	1	1	1	11	10	1	1	1	1	0
	1	1	1	1	1	1	1			0	0	0	0	— 9

	O	O										V	V	
	O	:	:	I:	I:	II	II			I	I	:	:	
Anom.	:	1	3	1	3	:	:	III	III	V:	V:	1	3	Gr.
Aeq.	0	5	0	5	0	1	3	:	:	1	3	5	0	/
Jup.	G	G	G	G	G	5	0	15	30	5	0	G	G	G.S
Sig. / Gr.	.	.	.	.	.	G.	G.	G.	G.	G.	G.	.	.	ig.
3 — 3	1	1	1	1	1	1	1	11	10	1	1	1	1	27
	1	1	1	1	1	1	1			0	0	0	0	
6	1	1	1	1	1	1	1	11	10	1	1	1	1	24
	1	1	1	1	1	1	1			0	0	0	0	
9	1	1	1	1	1	1	1	11	11	1	1	1	1	21
	1	1	1	1	1	1	1			0	0	0	0	
12	1	1	1	1	1	1	1	11	11	1	1	1	1	18
	1	1	1	1	1	1	1			1	0	0	0	
15	1	1	1	1	1	1	1	11	11	1	1	1	1	15
	1	1	1	1	1	1	1			1	1	0	0	—
														8
3 — 18	1	1	1	1	1	1	1	11	11	1	1	1	1	12
	1	1	1	1	1	1	1			1	1	1	1	
21	1	1	1	1	1	1	1	11	11	1	1	1	1	9
	1	1	1	1	1	1	1			1	1	1	1	
24	1	1	1	1	1	1	1	11	11	1	1	1	1	6
	1	1	1	1	1	1	1			1	1	1	1	
27	1	1	1	1	1	1	1	11	11	1	1	1	1	3
	1	1	1	1	1	1	1			1	1	1	1	
30	1	1	1	1	1	1	1	11	11	1	1	1	1	0
	1	1	1	1	1	1	1			1	1	1	1	—
														8
4 — 3	1	1	1	1	1	1	1	11	11	1	1	1	1	27
	1	1	1	1	1	1	1			1	1	1	1	
6	1	1	1	1	1	1	1	11	11	1	1	1	1	24
	1	1	1	1	1	1	1			1	1	0	1	
9	1	1	1	1	1	1	1	11	11	1	1	1	1	21
	1	1	1	1	1	1	1			1	1	1	1	
12	1	1	1	1	1	1	1	11	11	1	1	1	1	18
	1	1	1	1	1	1	1			1	1	1	1	

	O	O										V	V	
	O	:	:	I:	I:	II	II			I	I	:	:	
Anom.	:	1	3	1	3	:	:	III	III	V:	V:	1	3	Gr.
Aeq.	0	5	0	5	0	1	3	:	:	1	3	5	0	/
Jup.	G	G	G	G	G	5	0	15	30	5	0	G	G	G.S
Sig. / Gr.	.	.	.	.	.	G.	G.	G.	G.	G.	G.	.	.	ig.
15	1	1	1	1	1	1	1	11	11	1	1	1	1	15
	1	1	1	1	1	1	1			1	1	1	1	—
														7
4 — 18	1	1	1	1	1	1	1	11	11	1	1	1	1	12
	1	1	1	1	1	1	1			1	1	1	1	
21	1	1	1	1	1	1	1	11	11	1	1	1	1	9
	1	1	1	1	1	1	1			1	1	1	1	
24	1	1	1	1	1	1	1	11	11	1	1	1	1	6
	1	1	1	1	1	1	1			1	1	1	1	
27	1	1	1	1	1	1	1	11	11	1	1	1	1	3
	1	1	1	1	1	1	1			1	1	1	1	
30	1	1	1	1	1	1	1	11	11	1	1	1	1	0
	1	1	1	1	1	1	1			1	1	1	1	—
														7
5 — 6	1	1	1	1	1	1	1	11	11	1	1	1	1	24
	1	1	1	1	1	1	1			1	1	1	1	
12	1	1	1	1	1	1	1	11	11	1	1	1	1	18
	1	1	1	1	1	1	1			1	1	1	1	
18	1	1	1	1	1	1	1	11	11	1	1	1	1	12
	1	1	1	1	1	1	1			1	1	1	1	
24	1	1	1	1	1	1	1	11	11	1	1	1	1	6
	1	1	1	1	1	1	1			1	1	1	1	
30	1	1	1	1	1	1	1	11	11	1	1	1	1	0
	1	1	1	1	1	1	1			1	1	1	1	—
														6
(mirror sub-arg.)	3	1	3	1	3	1	3	15	30	1	3	1	0	(G. Sig.)
	0	5	0	5	0	5	0			5	0	5		
(mirror sign)	X		X		I		V		VI		V			
	I				X		II		I		I			

	0									IV	IV	V	V	
Sig·G (left)	/	0 /	0 /	I /	I /	II /	II /	III /	III /	/	/	/	/	G·Sig (right)
	0	15	30	15	30	15	30	15	30	15	30	15	30	
	0													
0 · 18	4	40	40	40	40	40	40	40	40	40	40	40	40	12
	0	38	36	34	31	27	23	19	14	10	7	4	3	
	3													
	8													
0 · 24	4	40	40	40	40	40	40	40	40	40	40	40	40	6
	0	48	47	45	42	38	34	30	25	21	18	16	14	
	4													
	8													
0 · 30	4	41	41	41	41	40	40	40	40	40	40	40	40	0 · 11
	1	6	5	3	0	58	54	49	44	40	37	34	33	
	6													
I · 6	4	41	41	41	41	41	41	41	41	41	41	40	40	24
	1	27	26	24	21	18	14	10	5	1	58	56	55	
	2													
	7													
I · 12	4	41	41	41	41	41	41	41	41	41	41	41	41	18
	1	49	48	46	43	40	37	33	29	25	22	20	19	
	4													
	9													
I · 18	4	42	42	42	42	42	42	41	41	41	41	41	41	12
	2	14	13	12	9	6	3	59	55	52	49	47	46	
	1													
	4													
I · 24	4	42	42	42	42	42	42	42	42	42	42	42	42	6
	2	44	43	41	39	37	34	30	26	23	21	19	18	
	4													
	4													
I · 30	4	43	43	43	43	43	43	43	43	43	43	42	42	0 · 10
	3	22	21	20	18	15	13	10	6	3	1	59	58	
	2													
	2													
II · 6	4	43	43	43	43	43	43	43	43	43	43	43	43	24
	3	59	58	57	56	54	51	48	45	42	40	38	37	

[illegible]

	0									IV	IV	V	V	
Sig-G (left)	/	0 /	0 /	I /	I /	II /	II /	III /	III /	/	/	/	/	G-Sig (right)
	0	15	30	15	30	15	30	15	30	15	30	15	30	
III · 30	5 2 9	52 10	52 10	52 12	52 15	52 15	52 19	52 21	52 25	52 31	52 33	52 35	52 36	0 · 8
IV · 6	5 3 7	53 8	53 10	53 13	53 16	53 16	53 20	53 24	53 28	53 33	53 36	53 41	53 42	24
IV · 12	5 4 7	54 8	54 11	54 14	54 18	54 23	54 28	54 33	54 38	54 43	54 47	54 50	54 51	18
IV · 18	5 5 6	55 7	55 10	55 14	55 19	55 25	55 30	55 39	55 46	55 52	55 56	55 58	55 59	12
IV · 24	5 5 5 3	55 55	55 59	56 3	56 8	56 14	56 22	56 30	56 38	56 44	56 49	56 53	56 53	6
IV · 30	5 6 3 7	56 39	56 43	56 48	56 54	57 1	57 9	57 17	57 25	57 32	57 38	57 42	57 44	0 · 7
V · 6	5 7 1 6	57 18	57 23	57 28	57 35	57 42	57 50	57 58	58 7	58 15	58 22	58 27	58 29	24
V · 12	5 7 5 2	57 54	57 59	58 4	58 11	58 19	58 28	58 37	58 47	58 56	59 3	59 8	59 10	18
V · 18	5 8 1 5	58 17	58 22	58 27	58 34	58 43	58 52	59 1	59 11	59 19	59 26	59 33	59 36	12
V · 24	5 8	58 27	58 32	58 38	58 45	58 54	59 4	59 14	59 25	59 34	59 41	59 47	59 49	6

	0									IV	IV	V	V	
Sig·G (left)	/	0 /	0 /	I /	I /	II /	II /	III /	III /	/	/	/	/	G·Sig (right)
	0	15	30	15	30	15	30	15	30	15	30	15	30	
	2													
	5													
V · 30	5	58	58	58	58	59	59	59	59	59	59	59	60	0 · 6
	8	37	42	48	55	4	14	24	35	44	51	57	0	
	3													
	5													

Lower sign-labels (right-hand argument): XI, X, IX, VIII, VII, VI.

Residuum of TABLE 72 [*Residuum TAB. 72*]

Anom. Commut. 𐤀 — Sig·G	Increment in 0° [<i>Incrementum</i> <i>in 0</i>] — '	Decrement in 0° [<i>Decrementum</i> <i>in 0</i>] — '	Proportional minutes, increment & decrement [<i>Scrup.</i> <i>proport. incr.</i> & <i>decr.</i>] — Gr'	Anom. æq. Com. 𐤀 — G·Sig
0 · 0	0	0	60 A. 0	0 · 12
0 · 6	0	0	59 6	24
0 · 12	0	0	58 11	18
0 · 18	0	1	57 9	12
0 · 24	1	1	55 44	6
0 · 30	1	2	53 9	0 · 11
I · 6	1	2	50 34	24
I · 12	2	3	47 35	18
I · 18	2	5	44 13	12
I · 24	2	6	40 13	6
I · 30	3	7	35 10	0 · 10
II · 6	3	8	30 16	24
II · 12	4	9	24 34	18
II · 18	5	11	17 58	12
II · 24	5	12	10 36	6

Anom. Commut. २ — Sig·G	Increment in 0° [<i>Incrementum</i> <i>in 0</i>] — '	Decrement in 0° [<i>Decrementum</i> <i>in 0</i>] — '	Proportional minutes, increment & decrement [<i>Scrup.</i> <i>proport. incr.</i> & <i>decr.</i>] — Gr·'	Anom. æq. Com. २ — G·Sig
II · 30	6	13	3 6	0 · 9
III · 6	7	14	2 B. 58	24
III · 12	7	15	8 1	18
III · 18	8	17	13 25	12
III · 24	8	18	18 47	6
III · 30	9	19	24 7	0 · 8
IV · 6	10	20	29 31	24
IV · 12	10	21	35 6	18
IV · 18	11	22	40 40	12
IV · 24	11	23	45 1	6
IV · 30	12	24	49 7	0 · 7
V · 6	12	25	52 41	24
V · 12	13	25	56 0	18
V · 18	13	26	58 5	12
V · 24	13	26	59 16	6
V · 30	13	26	60 0	0 · 6

TABLE 73. Latitude, Reduction, and Curtation of Jupiter
[Latitudinis, Reductionis, & Curtationis Iovis].

Signs of the distance of Jupiter from the northern node [*Signa Distantiæ Iovis à Nodo Boreali*].

Each sign-block gives the Latitude (Latit., in G·'), the Reduction (Red., in "), and the Curtation (Curt., in "). The left "Dist." column (Gr.) is the argument descending; the right "Diff." column (Gr.) is the same distance ascending for the lower (mirror) sign-labels. Upper labels: 0 Bor. / 6 Austr.; 1 Bor. / 7 Austr.; 2 Bor. / 8 Austr. Lower labels: 5 Bor. / 11 Austr.; 4 Bor. / 10 Austr.; 3 Bor. / 9 Austr.

Dis t. Gr.	0 Bor / 6 Austr — Lat. G'	Re d. "	Cu rt. "	1 Bor / 7 Austr — Lat. G'	Re d. "	Cu rt. "	2 Bor / 8 Austr — Lat. G'	Re d. "	Cu rt. "	Di ff. Gr.
0	0 0	0	0	0 54	25	5	1 34	25	10	30
1	0 2	2	0	0 56	26	5	1 35	25	10	29
2	0 4	3	0	0 57	26	5	1 36	24	10	28
3	0 6	4	0	0 59	27	5	1 37	24	10	27
4	0 7	5	0	1 0	27	5	1 37	23	10	26
5	0 9	6	1	1 2	27	5	1 38	23	10	25
6	0 11	7	1	1 3	28	6	1 39	22	10	24
7	0 13	8	1	1 5	28	6	1 40	21	10	23
8	0 15	9	1	1 7	28	6	1 41	21	10	22
9	0 17	10	1	1 8	29	6	1 41	20	10	21
10	0 18	11	2	1 10	29	6	1 42	19	10	20
11	0 20	12	2	1 11	29	6	1 42	19	10	19
12	0 22	13	2	1 13	29	6	1 43	18	10	18
13	0 24	14	2	1 14	29	6	1 43	17	10	17
14	0 26	15	2	1 15	29	6	1 44	16	10	16
15	0 27	15	3	1 16	30	7	1 44	15	10	15
16	0 29	16	3	1 18	29	7	1 45	15	10	14
17	0 31	17	3	1 19	29	7	1 45	14	10	13
18	0 33	18	3	1 20	29	7	1 46	13	10	12
19	0 35	19	3	1 21	29	7	1 46	12	10	11
20	0 36	19	3	1 23	29	8	1 46	11	11	10
21	0 38	20	3	1 24	29	8	1 47	10	11	9
22	0 40	21	3	1 25	28	8	1 47	9	11	8
23	0 42	21	3	1 26	28	8	1 47	8	11	7
24	0 44	22	3	1 27	28	8	1 47	7	11	6
25	0 45	23	4	1 29	27	9	1 48	6	11	5
26	0 47	23	4	1 30	27	9	1 48	5	11	4
27	0 49	24	5	1 31	27	9	1 48	4	11	3
28	0 51	24	5	1 32	26	9	1 48	3	11	2

Dis t. Gr.	0 Bor / 6 Austr — Lat. G'	Re d. "	Cu rt. "	1 Bor / 7 Austr — Lat. G'	Re d. "	Cu rt. "	2 Bor / 8 Austr — Lat. G'	Re d. "	Cu rt. "	Di ff. Gr.
29	0 52	25	5	1 33	26	9	1 48	2	11	1
30	0 54	25	5	1 34	25	10	1 48	0	12	0

THE MOTION OF MARS

Epochs, or Radices [*EPOCHÆ*, seu *RADICES*]

Anni ante Christum	Long. Υ Sig·G·'·''	Apog. Sig·G·'·''	Nodi Bor. Sig·G·'·''
6000	10 0 32 40	11 12 50 10	10 3 45 38
5000	6 17 8 38	0 4 43 40	10 17 9 29
4000	3 3 44 39	0 26 37 12	11 0 33 21
3000	11 20 20 39	1 18 30 44	11 13 57 13
2000	8 6 56 39	2 10 24 16	11 27 21 5
1000	4 23 32 40	3 2 17 48	0 10 44 57
900	6 25 12 16	3 4 29 9	0 12 5 20
800	8 26 51 52	3 6 40 30	0 13 25 43
700	10 28 31 28	3 8 51 51	0 14 46 6
600	1 0 11 4	3 11 3 12	0 16 6 29
500	3 1 50 40	3 13 14 33	0 17 26 52
400	5 3 30 16	3 15 25 54	0 18 47 15
300	7 5 9 52	3 17 37 15	0 20 7 38
200	9 6 49 28	3 19 48 36	0 21 28 1

Anni ante Christum	Long. Υ Sig·G·'·''	Apog. Sig·G·'·''	Nodi Bor. Sig·G·'·''
100	11 8 29 5	3 21 59 57	0 22 48 24
Christi	1 10 8 41	3 24 11 18	0 24 8 47
100	3 11 50 1	3 26 22 39	0 25 29 10
200	5 13 29 37	3 28 34 0	0 26 49 33
300	7 15 9 13	4 0 45 21	0 28 9 56
400	9 16 48 49	4 2 56 42	0 29 30 19
500	11 18 28 25	4 5 8 3	1 0 50 42
600	1 20 8 1	4 7 19 24	1 2 11 5
700	3 21 47 37	4 9 30 45	1 3 31 28
800	5 23 27 13	4 11 42 6	1 4 51 51
900	7 25 6 49	4 13 53 27	1 6 12 14
1000	9 26 46 25	4 16 4 48	1 7 32 37
1100	11 28 26 1	4 18 16 9	1 8 53 0
1200	2 0 5 37	4 20 27 30	1 10 13 23
St. veter. 1300	4 1 45 13	4 22 38 51	1 11 33 46
1400	6 3 24 49	4 24 50 12	1 12 54 9
1500	8 5 2 25	4 27 1 33	1 14 14 32
1600	10 6 42 1	4 29 12 54	1 15 34 55
St. novo. 1600	10 1 27 34	4 29 12 52	1 15 34 53
1700	0 2 36 43	5 1 24 13	1 16 55 16
1800	2 3 44 50	5 3 35 34	1 18 15 39
1900	4 4 52 58	5 5 46 55	1 19 36 2
2000	6 6 31 24	5 7 58 16	1 20 56 25
2100	8 7 40 33	5 10 9 37	1 22 16 48
2200	10 8 48 42	5 12 21 0	1 23 37 12
2300	0 9 56 51	5 14 32 21	1 24 57 35

Anni Iuliani Collecti [*Collected Julian years*]

A

n

ni	Long. Υ Sig·G·'·''	Apog. Sig·G·'·''	Nodi Bor. Sig·G·'·''
40	3 6 39 50	0 0 52 32	0 0 32 9
60	10 24 59 46	0 1 18 49	0 0 48 14
80	6 13 19 40	0 1 45 5	0 1 4 19
100	2 1 39 36	0 2 11 21	0 1 20 23
120	4 3 19 12	0 4 22 42	0 2 40 46
140	6 4 58 48	0 6 34 4	0 4 1 10
160	8 6 38 24	0 8 45 25	0 5 21 33
180	10 8 18 0	0 10 56 46	0 6 41 56
200	0 9 57 36	0 13 8 7	0 8 2 19
220	2 11 37 12	0 15 19 28	0 9 22 42
240	4 13 16 48	0 17 30 49	0 10 43 5
260	6 14 56 24	0 19 42 11	0 12 3 29
280	8 16 36 0	0 21 53 32	0 13 23 52
300	5 3 12 1	1 13 47 4	0 26 47 43
320	1 19 48 1	2 5 40 35	1 10 11 35
340	10 6 24 2	2 27 34 8	1 23 35 26
360	6 23 0 2	3 19 27 39	2 6 59 18

A
n

ni	Long. ʎ Sig·G·'·''	Apog. Sig·G·'·''	Nodi Bor. Sig·G·'·''
60 00	3 9 36 3	4 11 21 10	2 20 23 10

Menses Anni [*Months of the year*] — Communis (common) / Bissextilis (leap)

Mens .	Communis Long. ʎ Sig·G·'·''	Bissextilis Long. ʎ Sig·Gr·'·''	Apog. '·''	Nodi ''
Ianu ar.	0 16 14 46	0 16 14 46	0 7	4
Febr.	1 0 55 13	1 1 26 40	0 13	8
Mart ij	1 17 9 59	1 17 41 26	0 20	12
April is	2 2 53 18	2 3 24 45	0 26	16
Maij	2 19 8 5	2 19 39 32	0 33	20
Iunij	3 4 51 24	3 5 22 51	0 39	24
Iulij	3 21 6 11	3 21 37 38	0 45	28
Augu sti	4 7 20 57	4 7 52 4	0 52	32
Septe b.	4 23 4 16	4 23 35 43	0 59	36
Octo b.	5 9 19 3	5 9 50 30	1 7	40
Noue b.	5 25 2 22	5 25 33 49	1 13	44
Dece b.	6 11 17 8	6 11 48 35	1 20	48

Anni Iuliani Expansi, & Collecti [*Single (expanded) and collected Julian years*]

(Years marked "B." are bissextile/leap years.)

Ann i	Long. ʹ Sig·G·ʹʹ	Apog. ʹʹ	Nodi Bor. ʹʹ
1	6 11 17 8	1 19	0 48
2	0 22 34 16	2 38	1 36
3	7 3 51 24	3 56	2 25
B. 4	1 15 39 59	5 15	3 13
5	7 26 57 6	6 34	4 1
6	2 8 14 15	7 53	4 49
7	8 19 31 22	9 11	5 37
B. 8	3 1 19 58	10 30	6 26
9	9 12 37 6	11 50	7 14
10	3 23 54 14	13 8	8 2
11	10 5 11 22	14 26	8 50
B. 12	4 16 59 57	15 45	9 38
13	10 28 17 5	17 4	10 27
14	5 9 34 13	18 23	11 16
15	11 20 51 21	19 41	12 4
B. 16	6 2 39 56	21 1	12 52
17	0 13 57 4	22 20	13 40
18	6 25 14 12	23 39	14 29
19	1 6 31 20	24 57	15 17
B. 20	7 18 19 55	26 16	16 5

[Margin / table footnote, lower-left of the Radices table:] *Radices affixæ sunt Meridiano Bononiensi, in meridie ultimo Decembris præcedentis. Anni Completi sunt numerando tam sursum ante, quam deorsum post Christum.* — The radices are fixed to the meridian of Bologna, at noon of the last day of the preceding December. The completed years are reckoned both upward (before Christ) and downward (after Christ).

Dies [Days] / Horæ [Hours]

Di es	Dies — Long. ʹ G·ʹʹ	Apog. ʹʹ	Hor ae	Horæ — Long. ʹ ʹʹ
1	0 31 27	0	1	1 19

Di es	Dies — Long. γ G.'''	Apog. ''	Hor ae	Horae — Long. γ ' ''
2	1 2 53	0	2	2 37
3	1 34 20	0	3	3 56
4	2 5 46	1	4	5 14
5	2 37 16	1	5	6 31
6	3 8 40	1	6	7 52
7	3 40 6	1	7	9 10
8	4 11 33	2	8	10 29
9	4 43 0	2	9	11 48
10	5 14 27	2	10	13 6
11	5 45 53	2	11	14 25
12	6 17 20	3	12	15 43
13	6 48 46	3	13	17 2
14	7 20 13	3	14	18 21
15	7 51 40	3	15	19 39
16	8 23 6	4	16	20 58
17	8 54 3	4	17	22 16
18	9 26 0	4	18	23 35
19	9 57 27	4	19	24 54
20	10 28 53	5	20	26 12
21	11 0 20	5	21	27 31
22	11 31 46	5	22	28 49
23	12 3 13	5	23	30 8
24	12 34 40	6	24	31 27
25	13 6 6	6	25	32 45
26	13 37 33	6	26	34 4
27	14 9 0	6	27	35 22
28	14 40 27	7	28	36 41
29	15 11 5	7	29	38 0
30	15 43 20	7	30	39 18
31	16 14 46	7	40	52 24

Di es	Dies — Long. γ G'."	Apog. "	Hor ae	Horae — Long. γ '."
32	16 46 23	8	60	78 36

EQUATIONS OF MARS

TABLE 75. The first equation of the inequality of Mars
[*Aequatio Prima Inæqualitatis Martis*].

Signs of the simple, or mean, anomaly [*Anomaliae simplicis, seu Mediæ Signa*].

The left "Anom. simpl. Gr." column is the argument (degrees) descending; the right "Anom. simpl. Gr." is the argument ascending for the lower (mirror) sign-labels. Upper sign-headers (each "Subtr." — subtractive): 0, I, II, III, IV, V; each gives G'.". Lower headers (added quantity): "Adde XI, X, IX, VIII, VII, VI."

Gr. (left)	0 Subtr. G'."	I Subtr. G'."	II Subtr. G'."	III Subtr. G'."	IV Subtr. G'."	V Subtr. G'."	Gr. (right)
0	0 0 0	4 48 59	8 39 20	10 33 22	9 42 35	5 53 16	30
1	0 9 57	4 57 56	8 45 19	10 34 33	9 37 45	5 42 54	29
2	0 19 54	5 6 50	8 51 11	10 35 32	9 32 42	5 32 25	28
3	0 29 51	5 15 40	8 56 55	10 36 20	9 27 27	5 21 49	27
4	0 39 48	5 24 45	9 2 31	10 36 57	9 22 0	5 11 44	26
5	0 49 45	5 33 6	9 7 59	10 37 21	9 16 20	5 0 12	25
6	0 59 41	5 41 43	9 13 18	10 37 33	9 10 28	4 49 13	24
7	1 9 37	5 50 15	9 18 27	10 37 33	9 4 23	4 38 6	23
8	1 19 31	5 58 42	9 23 26	10 37 32	8 58 6	4 26 54	22
9	1 29 24	6 7 3	9 28 19	10 36 59	8 51 37	4 15 35	21
10	1 39 16	6 15 19	9 33 3	10 36 25	8 44 58	4 4 10	20
11	1 49 7	6 23 29	9 37 37	10 35 34	8 38 6	3 52 37	19
12	1 58 56	6 31 35	9 42 2	10 34 41	8 31 3	3 40 57	18
13	2 8 44	6 39 34	9 46 19	10 33 32	8 23 49	3 29 13	17
14	2 18 29	6 47 37	9 50 26	10 32 12	8 16 22	3 17 23	16
15	2 28 12	6 55 22	9 54 23	10 30 39	8 8 44	3 5 27	15

Gr. (left)	0 Subtr. G'.'''	I Subtr. G'.'''	II Subtr. G'.'''	III Subtr. G'.'''	IV Subtr. G'.'''	V Subtr. G'.'''	Gr. (right)
16	2 37 53	7 3 0	9 58 11	10 28 56	8 0 56	2 53 28	14
17	2 47 33	7 10 32	10 1 49	10 27 0	7 52 56	2 41 25	13
18	2 57 11	7 17 59	10 5 16	10 24 49	7 44 46	2 29 17	12
19	3 6 46	7 25 22	10 8 33	10 22 26	7 36 24	2 17 4	11
20	3 16 18	7 32 40	10 11 41	10 19 50	7 27 52	2 4 48	10
21	3 25 48	7 39 52	10 14 39	10 17 1	7 19 8	1 52 30	9
22	3 35 16	7 46 57	10 17 27	10 14 2	7 10 16	1 40 7	8
23	3 44 42	7 53 55	10 20 3	10 10 50	7 1 13	1 27 41	7
24	3 54 4	8 0 46	10 22 29	10 7 26	6 52 0	1 15 13	6
25	4 3 21	8 7 31	10 24 44	10 4 48	6 42 36	1 2 43	5
26	4 12 35	8 14 9	10 26 50	9 59 57	6 33 4	0 50 12	4
27	4 21 46	8 20 38	10 28 44	9 55 56	6 23 22	0 37 40	3
28	4 30 54	8 26 59	10 30 27	9 51 41	6 13 29	0 25 8	2
29	4 39 58	8 33 13	10 32 0	9 47 15	6 3 27	0 12 35	1
30	4 48 59	8 39 20	10 33 22	9 42 35	5 53 16	0 0 0	0

Lower sign-labels (right-hand argument, the "Adde" quantities): Adde XI, X, IX, VIII, VII, VI.

TABLE 76. The equated anomaly of Mars, corresponding to the simple anomaly [*Anomalia Aequata Martis, respondens Anomaliæ simplici*].

Signs of the simple, or mean, anomaly [*Anomaliæ simplicis, seu Mediæ Signa*].

The left "Anom. simpl. Gr." is the argument (degrees) descending; the right "Anom. simpl. G." is the argument ascending for the lower sign-labels. Upper headers: 0, I, II, III, IV, V (Sig:G'.''). Lower headers (read with the right argument): XI, X, IX, VIII, VII, VI.

Gr. (left)	0 Sig·G·'·''	I Sig·G·'·''	II Sig·G·'·''	III Sig·G·'·''	IV Sig·G·'·''	V Sig·G·'·''	G. (right)
0	0 0 0 0	0 27 20 54	1 25 24 28	2 24 41 56	3 25 24 28	4 27 20 54	30
1	0 0 54 26	0 28 16 7	1 26 21 45	2 25 41 58	3 26 27 17	4 28 25 45	29
2	0 1 48 53	0 29 11 21	1 27 19 6	2 26 42 7	3 27 30 11	4 29 30 39	28
3	0 2 43 21	1 0 6 38	1 28 16 32	2 27 42 22	3 28 33 11	5 0 35 34	27
4	0 3 37 48	1 1 2 0	1 29 14 4	2 28 42 42	3 29 36 15	5 1 40 33	26
5	0 4 32 15	1 1 57 24	2 0 11 41	2 29 43 8	4 0 39 24	5 2 45 34	25
6	0 5 26 43	1 2 52 52	2 1 9 22	3 0 43 39	4 1 42 36	5 3 50 36	24
7	0 6 21 12	1 3 48 24	2 2 7 9	3 1 44 17	4 2 45 54	5 4 55 41	23
8	0 7 15 41	1 4 44 1	2 3 5 2	3 2 45 0	4 3 49 17	5 6 0 48	22
9	0 8 10 11	1 5 39 40	2 4 3 0	3 3 45 49	4 4 52 45	5 7 5 58	21
10	0 9 4 42	1 6 35 23	2 5 1 4	3 4 46 44	4 5 56 18	5 8 11 7	20
11	0 9 59 15	1 7 31 11	2 5 59 12	3 5 47 44	4 6 59 54	5 9 16 23	19
12	0 10 53 48	1 8 27 2	2 6 57 26	3 6 48 50	4 8 3 35	5 10 21 39	18
13	0 11 48 23	1 9 22 58	2 7 55 46	3 7 50 2	4 9 7 19	5 11 26 56	17
14	0 12 43 0	1 10 18 57	2 8 54 12	3 8 51 19	4 10 11 8	5 12 32 16	16
15	0 13 37 37	1 11 15 1	2 9 52 43	3 9 52 43	4 11 15 1	5 13 37 37	15
16	0 14 32 16	1 12 11 8	2 10 51 19	3 10 54 12	4 12 18 57	5 14 43 0	14
17	0 15 26 56	1 13 7 19	2 11 50 2	3 11 55 46	4 13 22 58	5 15 48 23	13
18	0 16 21 39	1 14 3 55	2 12 48 50	3 12 57 26	4 14 27 2	5 16 53 48	12
19	0 17 16 23	1 14 59 54	2 13 47 44	3 13 59 12	4 15 31 11	5 17 59 15	11

Gr. (left)	0 Sig·G·'·''	I Sig·G·'·''	II Sig·G·'·''	III Sig·G·'·''	IV Sig·G·'·''	V Sig·G·'·''	G. (right)
20	0 18 11 7	1 15 56 18	2 14 46 44	3 15 1 4	4 16 35 23	5 19 4 42	10
21	0 19 5 58	1 16 52 45	2 15 45 49	3 16 3 0	4 17 39 40	5 20 10 11	9
22	0 20 0 48	1 17 49 17	2 16 45 0	3 17 5 2	4 18 44 1	5 21 15 41	8
23	0 20 55 41	1 18 45 54	2 17 44 17	3 18 7 9	4 19 48 24	5 22 21 12	7
24	0 21 50 36	1 19 42 36	2 18 43 39	3 19 9 22	4 20 52 52	5 23 26 43	6
25	0 22 45 34	1 20 39 24	2 19 43 8	3 20 11 41	4 21 57 24	5 24 32 15	5
26	0 23 40 33	1 21 36 15	2 20 42 42	3 21 14 4	4 23 2 0	5 25 47 48	4
27	0 24 35 34	1 22 33 11	2 21 42 22	3 22 16 32	4 24 6 38	5 26 43 21	3
28	0 25 30 39	1 23 30 11	2 22 42 7	3 23 19 6	4 25 11 21	5 27 48 53	2
29	0 26 25 45	1 24 27 17	2 23 41 58	3 24 21 45	4 26 16 7	5 28 54 26	1
30	0 27 20 54	1 25 24 28	2 24 41 56	3 25 24 28	4 27 20 54	6 0 0 0	0

Lower sign-labels (right-hand argument): XI, X, IX, VIII, VII, VI. (Footer: *Anomalice simplicis Signa* — Signs of the simple anomaly.)

EQUATIONS OF MARS.

[Margin (left and right, rotated): *Anomalia Æquata Martis* — the equated anomaly of Mars]

TABLE 77. Of the Maximum Equations, or of the Parallaxes of the Annual Orb, for Mars.

[Top heading spanning the seven double-columns: *Signa Anomaliae Solis Æquatæ Completa* — Completed signs of the equated anomaly of the Sun]

The left index gives the completed signs (Sig.) and degrees (G.) of the equated anomaly of the Sun; the seven double-columns headed **0, I, II, III, IV, V, VI** each give degrees (G.) and minutes (') of the maximum equation; the right index gives degrees (G.) and the descending sign (Sig.) read from the foot of the table (XII, XI, X, IX, VIII, VII, VI), where the bottom heading repeats *Signa Anomaliae Solis Æquatæ Completa*.

Si	0		I		II		III		IV		V		VI		G Si	
	G	G	G	G	G	G	G	G	G	G	G	G	G	G	.	g.
g.	.	.	0'	I'	II'	III'	IV'	V'	VI'	.	.	.	.	.	.	.
0	0	3	42	3	36	37	19	36	56	36	33	3	16	36	10	0 1
		7		7								6				2
	6	3	43	3	37	37	20	36	57	36	34	3	17	36	11	2
		7		7								6				4
	1	3	47	3	41	37	24	37	1	36	38	3	21	36	15	1
	2	7		7								6				8
	1	3	53	3	47	37	30	37	7	36	44	3	27	36	20	1
	8	7		7								6				2
	2	3	2	3	56	37	38	37	15	36	52	3	35	36	29	6
	4	8		7								6				
	3	3	13	3	6	37	49	37	26	37	2	3	45	36	39	0 1
	0	8		8								6				1
1	3	3	19	3	13	37	55	37	32	37	8	3	51	36	45	2
		8		8								6				7
	6	3	26	3	20	38	2	37	39	37	15	3	58	36	52	2
		8		8								6				4
	9	3	34	3	27	38	10	37	46	37	22	3	5	36	59	2
		8		8								7				1
	1	3	42	3	35	38	18	37	54	37	30	3	13	37	6	1
	2	8		8								7				8
	1	3	50	3	45	38	26	38	2	37	38	3	21	37	14	1 1

	0		I								V					
Si	G	G	G		II		III		IV		G		VI		G Si	
g.	.	.	0'	I'	G.	II'	G.	III'	G.	IV'	.	V'	G.	VI'	. g.	
	5	8			8						7				5 0	
1	1	3	0	3	53	38	35	38	11	37	47	3	30	37	23	1
	8	9		8								7				2
	2	3	9	3	3	38	45	38	20	37	50	3	37	37	32	9
	1	9		9								7				
	2	3	19	3	13	38	54	38	30	38	6	3	48	37	42	6
	4	9		9								7				
	2	3	30	3	23	39	5	38	40	38	16	3	58	37	52	3
	7	9		9								7				
	3	3	41	3	34	39	16	38	50	38	27	3	9	38	3	0 1
	0	9		9								8				0
2	2	3	49	3	42	39	24	38	59	38	34	3	16	38	10	2
		9		9								8				8
	4	3	57	3	50	39	32	39	7	38	42	3	24	38	17	2
		9		9								8				6
	6	4	5	3	58	39	40	39	15	38	50	3	31	38	25	2
		0		9								8				4
	8	4	13	4	6	39	48	39	23	38	58	3	39	38	33	2
		0		0								8				2
	1	4	21	4	14	39	56	39	31	39	6	3	47	38	41	2 9
	0	0		0								8				0
2	1	4	30	4	23	40	5	39	39	39	14	3	56	38	49	1
	2	0		0								8				8
	1	4	39	4	32	40	13	39	48	39	22	3	4	38	57	1
	4	0		0								9				6
	1	4	48	4	41	40	22	39	57	39	31	3	13	39	6	1
	6	0		0								9				4
	1	4	57	4	50	40	31	40	5	39	40	3	21	39	14	1
	8	0		0								9				2
	2	4	7	4	59	40	40	40	14	39	49	3	30	39	23	1 9
	0	1		0								9				0
2	2	4	16	4	8	40	49	40	23	39	58	3	39	39	32	8

Si	0		I		II		III		IV		V		VI		G Si
g.	G	G	G	I'	G.	II'	G.	III'	G.	IV'	G	V'	G.	VI'	. g.
	2	1	1								9				
	2	4	25	4	18	40	59	40	33	40	7	3	48	39	41 6
	4	1	1									9			
	2	4	35	4	27	41	8	40	42	40	16	3	57	39	50 4
	6	1	1									9			
	2	4	45	4	37	41	18	40	52	40	23	4	6	39	59 2
	8	1	1									0			
	3	4	55	4	47	41	28	41	1	40	34	4	15	40	8 0 8
	0	1	1									0			
3	2	4	5	4	57	41	38	41	11	40	44	4	25	40	18 2
	2		1									0			8
	4	4	15	4	7	41	48	41	21	40	54	4	34	40	27 2
	2		2									0			6
	6	4	26	4	18	41	58	41	31	41	4	4	44	40	37 2
	2		2									0			4
	8	4	36	4	28	42	8	41	41	41	14	4	54	40	47 2
	2		2									0			2
	1	4	46	4	38	42	18	41	51	41	23	4	4	40	56 2 8
	0	2	2									1			0
3	1	4	56	4	48	42	28	42	1	41	33	4	13	41	6 1
	2	2	2									1			8
	1	4	6	4	59	42	38	42	10	41	43	4	23	41	15 1
	4	3	2									1			6
	1	4	16	4	9	42	48	42	20	41	53	4	33	41	25 1
	6	3	3									1			4
	1	4	27	4	19	42	58	42	30	42	3	4	42	41	35 1
	8	3	3									1			2
	2	4	37	4	29	43	8	42	40	42	13	4	52	41	45 1 8
	0	3	3									1			0
3	2	4	47	4	40	43	19	42	50	42	22	4	2	41	54 8
	2	3	3									2			
	2	4	57	4	50	43	29	43	0	42	32	4	12	42	4 6

Si	0		I		II		III		IV		V		VI		G Si	
g.	G	G	G	I'	G.	II'	G.	III'	G.	IV'	G	V'	G.	VI'	. g.	
	4	3	3								2					
	2	4	8	4	0	43	39	43	10	42	41	4	21	42	13	4
	6	4	4									2				
	2	4	18	4	10	43	49	43	20	42	51	4	30	42	22	2
	8	4	4									2				
	3	4	28	4	20	43	58	43	29	43	0	4	39	42	31	0 8
	0	4	4									2				
4	3	4	42	4	34	44	13	43	43	43	14	4	53	42	45	2
	4		4									2				7
	6	4	57	4	49	44	27	43	57	43	28	4	7	42	59	2
	4		4									3				4
	9	4	11	4	3	44	41	44	11	43	41	4	20	43	11	2
	5		5									3				1
	1	4	24	4	16	44	54	44	24	43	54	4	33	43	24	1
	2	5	5									3				8
	1	4	37	4	29	45	7	44	36	44	6	4	45	43	36	1 7
	5	5	5									3				5
4	1	4	50	4	41	45	19	44	49	44	18	4	56	43	48	1
	8	5	5									3				2
	2	4	2	4	53	45	31	45	0	44	30	4	8	43	59	9
	1	6	5									4				
	2	4	13	4	5	45	42	45	11	44	40	4	18	44	10	6
	4	6	6									4				
	2	4	24	4	15	45	53	45	21	44	51	4	28	44	20	3
	7	6	6									4				
	3	4	34	4	25	46	2	45	31	45	0	4	38	44	29	0 7
	0	6	6									4				
5	6	4	51	4	43	46	19	45	48	45	17	4	54	44	45	2
	6		6									4				4
	1	4	5	4	57	46	33	46	1	45	30	4	7	44	58	1
	2	7	6									5				8
	1	4	15	4	7	46	43	46	11	45	39	4	16	45	8	1

	0		I								V					
Si	G	G	G		II		III		IV		G		VI		G Si	
g.	.	.	0'	.	I'	G.	II'	G.	III'	G.	IV'	.	V'	G.	VI'	. g.
	8	7		7								5				2
	2	4	22	4	15	46	49	46	17	45	45	4	22	45	14	6
	4	7		7								5				
	3	4	24	4	15	46	51	46	19	45	47	4	24	45	16	0 6
	0	7		7								5				
	X			X		X		IX		VI		V		VI		
	II			I						II		II				

[Foot heading: Signa Anomaliae Solis Æquatæ Completa — Completed signs of the equated anomaly of the Sun]

LATITUDES OF MARS.

TABLE 78. Of the Proportional Minutes of the Latitude of Mars.

[Heading spanning the central double-columns: Signa Completa Anomaliae Æquatæ Excentrici Martis — Completed signs of the equated anomaly of the eccentric of Mars]

The left index gives the commune (orbital) anomaly of Mars [Anomal. orb. seu commun. ♂] in signs (Sig.) and degrees (G.); the column **Scrup. propor. increm. & decrem.** gives the proportional minutes of increase and decrease (G./'); the seven double-columns headed **0, I, II, III, IV, V, VI** give the proportional minutes (G./'); then a second **Scrup. propor. increm. & decrem.** column (G./') on the right, a **Scrup. incr. in ♂** column (the scruples of increase in Mars, '), and a right index **Anomal. orb. ♂** in degrees (G.) and signs (Sig.). The marker "A." marks the maximum (60) and "B." the inflection. The bottom sign-row reads XII, XI, X, IX, VIII, VII, VI.

S	0		I		I		I		V		V		V		Ano	S
i	Scrup.i	0	I	I	I	I	I	I	V	I	V	I	V	Scrup.i	m.o	i
g	ncr/	G	G I	G I	G I	G II	G V	G V	G I	G I	G I	G I	G I	ncr/	Scrup	rb.
.	decr G.	. '	. '	. '	. '	. I'	. '	. '	. '	. '	. '	. '	. '	decr G.	.in♂'	G.
0	60 A.	9 4	9 4	9 4	9 4	9 3	9 2	9 1	9 6	60 A.	8			30		1

S		0	I	I	I	I		V	V	V			Ano	S
i	Scrup.i	0		I	I	I		I	V	I	V	Scrup.i		i
g	ncr/	G	G	I	G	I	I	G	V	G	G	ncr/	Scrup	g
.	decr G.	.	'	.	'	.	I'	.	'	.	'	decr G.	.ino ⁹ '	.
		6	6	1		1		1	1					2
	59	4	4	4	9	3		2	1	7	59	8	18	
		7	7	2		2		2	2					
	58	5	5	5		4		3	1	1	58	8	6	1
		5	5	0		0		0	9	4				1
1	56	1 1	1 1	1 6		5		4	3	3	56	7	24	
		0 1	0 1	0		6		6	5	0				
	50	3	3	1 2	1 2	1 1	1 1	1 0		5	52	7	12	
		4	4	0 9	0 0	0 0	0 0	0		5				
	45	1 1	1 1	1 8		5		4	3 1	2	47	6	0	1
		1 3	1 3	1		8		7	6 0	9				0
2	42	1 3	1 3	1 2	1 2	1 9	1 0	1		0 8	0 2	44	6	24
		1 2	1 2	1 9	1 0	1			0 8	0 2				
	39	5	5	5		4	1 3	1 2	1 1	1	40	5	18	
		5	5	3		3	1 2	1 2	1 6					
	35	1 1	1 1	1 1	1 8			5	4	4	36	5	12	
		2 8	2 8	2 8	2			8	9	4				
	30	4	4	4		3	1 2	1 1	1 1	1	32	5	6	
		8	8	8		8	2 8	2 8	2 3					
	24	1 2	1 2	1 2	1 1	1 1	1 1		5	4	27	4	0	9
		3 1	3 1	3 2	3 2	3			1	6				
3	16	1 3	1 3	1 3	1 5	1 4	1 3	1 3	1 2	1 2	21	4	24	
		4	4	4		3 3	3 2	3 1	3 6					
	8	5	5	1 4	1 4	1 4	1 3	1 2	1 1	1 1	13	3	18	
		3	3	4 9	4 2	4 1	4 1	4 1	4 5					
	0 B.	1 4	1 4	1 4	1 3	1 2	1 1	1 1	1 1	5		3	12	
		5 8	5 8	5 8	5 8	5 8	5 8	5 8	5 2					
	2	1 5	1 5	1 4	1 4	1 3	1 2	1 1	1 1	2 B. 39	2	6		
		6 0	6 0	6 9	6 0	6 0	6 0	6 2	6 7					
	5	1 3	1 3	1 2	1 5	1 4	1 4	1 3	2		2	2	0	8

[illegible]

S i .	G .	O G.	O '	I G.	I '	II G.	II '	III G.	III '	IV G.	IV '	V G.	V '	VI G.	VI '	S G i .
1	3 0	0	0	0	6	0	22	0	45	1	11	1	28	1	34	0 1 1
1	6 0	0	0	0	6	0	23	0	47	1	13	1	32	1	38	2 4
	1 2	0	0	0	6	0	24	0	49	1	16	1	36	1	43	1 8
	1 8	0	0	0	7	0	25	0	51	1	20	1	41	1	47	1 2
	2 4	0	0	0	7	0	27	0	54	1	24	1	47	1	54	6
	3 0	0	0	0	7	0	29	0	57	1	30	1	53	2	0	0 1 0
2	6 0	0	0	0	8	0	31	1	1	1	36	1	59	2	9	2 4
	1 2	0	0	0	8	0	33	1	5	1	42	2	6	2	17	1 8
	1 8	0	0	0	9	0	35	1	9	1	49	2	15	2	26	1 2
	2 4	0	0	0	9	0	37	1	14	1	57	2	25	2	36	6
	3 0	0	0	0	10	0	40	1	20	2	6	2	35	2	47	0 9
3	6 0	0	0	0	11	0	43	1	26	2	15	2	46	2	59	2 4
	1 2	0	0	0	12	0	46	1	31	2	25	2	58	3	11	1 8
	1 8	0	0	0	13	0	50	1	39	2	35	3	9	3	24	1 2
	2 4	0	0	0	14	0	53	1	46	2	45	3	22	3	37	6
	3 0	0	0	0	15	0	56	1	52	2	55	3	34	3	50	0 8

S																S
i	GO		I		II		III		IV		V		VI		Gi	
.	.	G.	O'	G.	I'	G.	II'	G.	III'	G.	IV'	G.	V'	G.	VI'	.
4	6	0	0	0	16	0	59	1	59	3	6	3	47	4	3	2
																4
	1	0	0	0	17	1	3	2	6	3	16	4	0	4	16	1
	2															8
	1	0	0	0	18	1	6	2	12	3	26	4	13	4	29	1
	8															2
	2	0	0	0	18	1	9	2	17	3	35	4	24	4	41	6
	4															
	3	0	0	0	19	1	11	2	22	3	43	4	35	4	52	0 7
	0															
5	6	0	0	0	19	1	13	2	26	3	50	4	43	5	0	2
																4
	1	0	0	0	19	1	15	2	29	3	55	4	50	5	7	1
	2															8
	1	0	0	0	19	1	16	2	32	4	0	4	56	5	13	1
	8															2
	2	0	0	0	20	1	17	2	34	4	2	4	58	5	16	6
	4															
	3	0	0	0	20	1	18	2	35	4	3	5	0	5	18	0 6
	0															
	X		X		X			IX		VII		V		VI		
	II		I							I		II				

[Foot heading: Signa Completa Anomaliae Solis Æquatæ — Completed signs of the equated anomaly of the Sun]

TABLE 80. Of the Latitude, Reduction, and Curtation of Mars.

[Heading: Signa Distantiæ à Nodo Boreali — Signs of the distance from the northern node]

This table is read against the **distance from the northern node** [Distantiæ à Nodo Boreali]. The left index **Distant.** gives degrees (Gr.). Each block of three columns gives **Latit.** (latitude, G./'), **Red.** (reduction [Reductio], "), and **Curt.** (curtation [Curtatio], "); the block headings give the bordering sign-pair (e.g. "0

Bor. 6 Austr." = 0 of Boreal / 6 of Austral). The right index **Distant.** (Gr.) counts down, with the foot headings completing the southern signs.

Dist ant. Gr.	0 Bor. 6 Austr. Latit. G.	R e d. "	Cu rt. "	1 Bor. 7 Austr. Latit. G.	R e d. "	Cu rt. "	2 Bor. 8 Austr. Latit. G.	R e d. "	Cu rt. "	Dist ant. Gr.
0	0	1	0	3	4	35	6	4	61	30
					7			7		
1	0	3	1	3	4	36	6	4	61	29
					8			6		
2	0	5	2	3	4	37	6	4	62	28
					8			5		
3	0	7	4	4	4	38	6	4	62	27
					9			4		
4	0	9	5	4	4	39	6	4	63	26
					9			3		
5	0	1	6	4	4	40	6	4	63	25
		1			9			2		
6	0	1	7	4	5	41	6	4	64	24
		3			0			1		
7	0	1	9	4	5	42	6	3	64	23
		5			0			9		
8	1	1	10	4	5	43	6	3	65	22
		6			1			8		
9	1	1	11	4	5	44	6	3	65	21
		8			1			7		
10	1	2	12	4	5	45	6	3	66	20
		0			2			6		
11	1	2	14	4	5	46	6	3	67	19
		2			2			4		
12	1	2	15	4	5	47	7	3	67	18
		4			2			3		
13	1	2	16	5	5	48	7	3	67	17
		6			2			2		
14	1	2	17	5	5	49	7	3	68	16

Dist ant. Gr.	0 Bor. 6 Austr. Latit. G.	R e d. "	Cu rt. "	1 Bor. 7 Austr. Latit. G.	R e d. "	Cu rt. "	2 Bor. 8 Austr. Latit. G.	R e d. "	Cu rt. "	Dist ant. Gr.
		8			3			0		
15	1	3	18	5	5	50	7	2	68	15
		0			3			8		
16	2	3	19	5	5	50	7	2	68	14
		2			3			6		
17	2	3	21	5	5	51	7	2	68	13
		3			2			4		
18	2	3	22	5	5	52	7	2	69	12
		4			2			2		
19	2	3	23	5	5	53	7	2	69	11
		6			2			0		
20	2	3	24	5	5	54	7	1	69	10
		7			2			8		
21	2	3	25	5	5	55	7	1	69	9
		8			1			6		
22	2	3	26	5	5	55	7	1	69	8
		9			1			5		
23	2	4	27	5	5	56	7	1	70	7
		1			0			3		
24	2	4	28	5	5	57	7	1	70	6
		2			0			1		
25	3	4	30	6	4	58	7	9	70	5
		3			9					
26	3	4	31	6	4	58	7	7	70	4
		4			9					
27	3	4	32	6	4	59	7	5	70	3
		5			9					
28	3	4	33	6	4	60	7	3	70	2
		6			8					
29	3	4	34	6	4	60	7	1	70	1
		7			8					

Dist ant. Gr.	0 Bor. 6 Austr. Latit. G.	R e d. "	Cu rt. "	1 Bor. 7 Austr. Latit. G.	R e d. "	Cu rt. "	2 Bor. 8 Austr. Latit. G.	R e d. "	Cu rt. "	Dist ant. Gr.
30	3	4 8	35	6	4 7	61	7	0	70	0
	5 Bor. 11 Austr.			4 Bor. 10 Austr.			3 Bor. 9 Austr.			

[Foot heading: Signa Distantiæ à Nodo Boreali — Signs of the distance from the northern node]

MEAN MOTIONS OF VENUS.

TABLE 81. Of the Mean Motions of Venus ♀.

[Margin: Distantiæ à Nodo Boreali — distance from the northern node]

Epochs, or Radices of the Motions [EPOCHÆ, seu RADICES MOTUUM]

Left index **Anni Completi ante Christum** (completed years before Christ; below "Christi," it counts forward, with the running side-labels **Stylo veteri** [old style] and **Stylo novo** [new style]). Three triple-column groups give the **Longitude from Aries** [Longit. ab ♈], the **Apogee** [Apogæi], and the **Northern Node** [Nodi Bor.], each in signs (Sig.), degrees (G.), minutes ('), and seconds (").

Anni ante Chr.	Long. Sig.	G . ' "	Apog. Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
6000	10	1 4 1 9 6 9	6	1 1 21 8 9	0	1 2 4 0 6 9
5000	5	3 1 4 9 9	7	2 2 35 4	0	1 4 3 8 9 3
4000	11	1 5 1 6 3 9	7	1 2 49 6 9	0	2 1 1 7 2 7
3000	6	0 2 4 6 9	8	0 3 3 5	1	5 3 1 5
2000	0	1 0 1 4 9	8	1 4 17 4 0	1	1 5 4 3 7 5

Anni ante Chr.	Long. Sig.	G . ' "	Apog. Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
1000	6	2 3 4 8 7 3 9		2 4 31 8 5	1	2 2 2 2 0 9
900	1	1 5 1 9 6 5 0		0 1 2 0	1	2 1 4 3 0 5
800	8	6 1 3 9 6 1		1 3 33 4	1	2 1 1 4
700	2	2 3 5 9 5 7 2		2 5 4 9	1	2 5 1 4 1 7
600	9	1 5 1 9 4 9 3		4 2 35 3	1	2 4 3 5 1 3
500	4	4 2 3 9 0 4		5 4 6 8	1	2 3 4 6 1 9
400	10	2 4 5 9 3 1 5		7 1 37 2	1	2 2 5 7 2
300	5	1 3 1 9 3 6		8 3 8 7	1	2 1 2 8 2 1
200	0	2 2 3 9 4 7		1 1 39 0	1	2 2 3 9 9
100	6	2 4 5 9 1 5 7		1 2 11 1 6	1	2 5 5 9 2 7
Christi	1	1 7 1 9 1 7		1 5 43 2 0	2	0 4 1 3 5
100	8	0 2 3 9 8 8		1 1 14 4 5	2	1 3 3 3 1
200	2	1 4 5 9 9 9 9		1 3 45 5 9	2	2 2 4 3 7
300	9	9 1 2 9 1 0		1 4 16 7	2	3 1 3 4
400	3	2 3 4 9 8 2 1		1 2 47 8 8	2	4 4 1 9
500	10	7 5 2 9 4		1 5 18 9 3	2	4 5 3 4 5
600	5	7 1 2 9		2 1 49	2	5 4 5

Anni ante Chr.	Long. Sig.	G . ' "	Apog. Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
		5 3		1 7		4 1
700	11	2 3 4 9		2 4 20 2		6 3 7
		6 6 4		2 2		5
800	6	1 5 5 9		2 6 52 2		7 2 2
		5 8		4		5 5
900	1	5 1 2 9		2 3 2 2		8 1 4
		9 6		5 1		5 1
1000	7	2 4 4 9		2 5 5 2		9 5 5
		4 0 7		6 5		9
1100	2	1 2 8 9		2 2 2 2		9 5 1
		4		8 0		6 5
1200	9	3 2 9 9		2 4 59 2		1 4 3
		3		9 4		0 6 1
Stylo veteri	3	2 4 3 10		1 9 30 2		1 3 4
1300		2 4 0				1 6 7
1400	10	1 6 1 10		2 3 2 2		1 2 4
		2 1		4		2 7
1500	5	1 2 3 10		3 5 33 2		1 1 2
		7 2		8		3 7 0
Stylo veteri	11	2 4 5 10		5 2 5 2		1 7 3
1600		0 8 3		3 [?]		4 8
Stylo novo 1600	11	4 4 3 10		5 2 4 2		1 5 5
		7 5		3 [?]		4 7 4
1700	5	2 3 4 10		6 4 36 2		1 5 5
		2 2 8		7		4 7 4
1800	0	1 1 1 10		8 1 7 2		1 4 1
		0 8		2 [?]		5 8 0
1900	6	2 3 1 10		9 3 38 2		1 3 2
		8 4		6		6 8 6
2000	1	1 2 3 10		1 1 [?] 2		1 2 4
		7 4 5		1		7 8 3
2100	8	5 9 4 10		1 2 40 2		1 1 5
		8		2 5		8 8 9

Anni ante Chr.	Long. Sig.	G . ' "	Apog. Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
2200	2	2 5 1	10	1 5 1	2	1 9 1
		2 5		3 0		9 5
2300	9	1 4 1	10	1 1 4	2	1 5 3
		0 0 4		5 4		9 9 0

Julian Years, Expanded & Collected [ANNI IULIANI EXPANSI, & COLLECTI]

Left index **Motus / Anni** (single expanded years 1–20, "B." marking bissextile years). Three groups: **Longit. ab** √ (Sig./G./"/), **Apogæi** ("/), **Nodi Bor.** ("/").

Anni	Long. Sig.	G . ' "	Apog. ' "	Nodi Bor. ' "
1	7	1 47 35 0	51 0	30
2	2	2 35 10 1	41 1	0
3	10	1 22 45 2	32 1	30
B. 4	6	0 46 27 3	23 2	1
5	1	1 34 2 4	13 2	31
6	9	0 21 37 5	4 3	1
7	4	1 9 12 5	55 3	31
B. 8	0	1 32 54 6	45 4	1
9	7	1 20 29 7	36 4	31
10	3	1 8 4 8	27 5	1
11	10	1 55 39 9	17 6	32
B. 12	6	2 19 22 10	8 6	2
13	1	1 6 57 10	59 7	32
		7		

Anni	Long. Sig.	G			Apog. ' "	"	Nodi Bor. ' "	"
		.	'	"				
14	9	1	54	31	11	50	8	2
15	4	1	42	6	12	40	9	33
		6						
B. 16	0	3	5	49	13	31	10	3
17	7	1	53	24	14	22	16	27
		7						
18	3	2	40	59	15	12	18	3
19	10	1	28	34	16	3	19	40
		7						
B. 20	6	3	52	16	16	54	21	16

[Note (foot of left panel): Radices affixæ sunt Meridiano Bononiensi, in meridiæ ultimo Decembris præcedentis. Anni sunt Completi, tam sursum ante, quàm deorsum numerando post Christum. — "The radices are fixed to the meridian of Bologna, at noon of the last day of the preceding December. The years are complete, counted upward before Christ and downward after Christ."]

Julian Years, Collected [ANNI IULIANI COLLECTI]

Right-panel continuation of the mean-motion radices for collected Julian-year intervals. **Motus** / **Anni** index; **Long. ab** √ (Sig./G./"/), **Apogei** (Sig./G./"/), **Nodi Bor.** (Sig./G./"/).

An ni	Long. Sig.	G			Apog. Sig.	G			Nodi Bor. Sig.	G		
		.	'	"		.	'	"		.	'	"
40	0	7	4	3	0	0	3	4	0	0	2	7
			4	2			3	9			0	
60	6	1	3	4	0	0	5	4	0	0	3	1
		1	6	9			0	3			0	0
80	0	1	2	5	0	1	7	3	0	0	4	1
		5	9					7			0	3
10	6	1	2	2	0	1	2	3	0	0	5	1
0		9	1	1			4	1			0	6
20	1	8	4	4	0	2	4	3	0	1	4	3
0			2	2			9				0	3
30	7	2	4	3	0	4	1	3	0	2	3	4

An ni	Long. Sig.	G . ' "	Apog. Sig.	G . ' "	Nodi Bor. Sig.	G . ' "
0		8		3 4		0 9
40	2	1 2 2 0		5 3 6 0		3 2 6
0		7 5 4		8		1
50	9	6 4 4 0		7 2 3 0		4 1 2
0		6 5		7		1 2
60	3	2 8 6 0		8 2 8 0		5 1 3
0		6		7		9
70	10	1 2 2 0		9 5 4 0		5 5 5
0		5 9 7		1 0		1 5
80	5	4 5 4 0		1 1 1 0		6 4 1
0		0 7		1 6 1		2 2
90	11	2 1 9 0		1 4 4 0		7 3 2
0		4 2		2 0 2		2 8
10	6	1 3 3 0		1 5 1 0		8 2 4
00		3 3 0		4 4		2 4
20	0	2 6 5 0		2 1 2 0		1 4 2
00		7 9		8 0 8		6 5 9
30	7	1 4 2 1		1 1 4 0		2 8 1
00		0 0 9		2 5 1		5 3
40	1	2 1 5 1		2 2 5 1		3 3 5
00		4 3 8		6 0 6		0 8
50	8	7 4 2 2		1 2 9 1		1 5 4
00		7 8		0 6		1 3 2
60	2	2 2 5 2		2 3 2 1		2 1 2
00		1 0 8		4 1 2		0 6 6

Months of the Year [MENSES ANNI]

Left half for the **Common** year [Communis], right half for the **Bissextile** year [Bissextilis], plus the **Apog.** (") and **Nodi** (") increments. **Mot.** / **Mens.** index by month. Longitude from Aries in Sig./G./".

Mens .	Common Long. Sig.	G . ' "	Bissextilis Long. Sig.	G . ' "	Apog. "	Nodi "
Ianu	1	1 4 3 1		1 4 3 0		0

Mens .	Common Long. Sig.	G . ' "			Bissext. Long. Sig.	G . ' "			Apog. "	Nodi "
ar.		9	0			9	0			
Febr.	3	4	3	4	3	6	7	5	4	3
			1	2				0		
Marti	4	2	1	4	4	2	4	5	8	5
j		4	1	4		5	7	2		
April	6	1	1	3	6	1	5	4	13	8
is		2	5	9		3	1	7		
Maij	8	1	5	4	8	3	3	5	17	10
			5	2			1	0		
Iunij	9	1	5	3	9	2	3	4	21	13
		9	7	7		1	3	5		
Iulij	11	9	3	3	11	1	1	4	25	15
			9	9		1	5	7		
Augu	0	2	1	4	1	0	5	5	29	18
sti		9	9	2			5	0		
Septe	2	1	2	3	2	1	1	4	33	20
b.		7	3	7		9		5		
Octo	4	7	3	3	4	8	3	4	38	22
b.				9			9	7		
Noue	5	2	7	3	5	2	4	4	42	25
b.		1		4		2	3	2		
Dece	7	1	4	3	7	1	2	4	46	27
b.		4	7	5		6	3	3		

Days [DIES]

Mot. / **Dies** index, days 1–32. **Long. ab** ∇ (Sig./G./"/) and **Apog.** (").

Dies	Long. Sig.	G.	'	"	Apog. "
1	0	1	36	8	0
2	0	3	12	16	0
3	0	4	48	23	0
4	0	6	24	31	0
5	0	8	0	39	0

Dies	Long. Sig.	G.	'	"	Apog. "
6	0	9	36	47	0
7	0	11	12	55	1
8	0	12	49	3	1
9	0	14	25	10	1
10	0	16	1	18	1
11	0	17	37	26	1
12	0	19	13	34	1
13	0	20	49	42	1
14	0	22	25	50	2
15	0	24	1	57	2
16	0	25	38	5	2
17	0	27	14	13	2
18	0	28	50	21	2
19	1	0	26	29	2
20	1	2	2	37	2
21	1	3	38	44	3
22	1	5	14	52	3
23	1	6	51	0	3
24	1	8	27	8	3
25	1	10	3	16	3
26	1	11	39	23	3
27	1	13	15	31	3
28	1	14	51	39	4
29	1	16	27	47	4
30	1	18	3	55	4
31	1	19	40	3	4
32	1	21	16	11	4

Hours [HORÆ]

Mot. / Horæ index, hours 1–60. **Long. ab** ∇ (G./").

Horæ	Long. G.	'	"
1	0	4	0
2	0	8	1
3	0	12	1
4	0	16	2
5	0	20	2
6	0	24	2
7	0	28	3
8	0	32	3
9	0	36	3
10	0	40	4
11	0	44	4
12	0	48	5
13	0	52	5
14	0	56	5
15	1	0	6
16	1	4	6
17	1	8	6
18	1	12	7
19	1	16	7
20	1	20	8
21	1	24	8
22	1	28	8
23	1	32	9
24	1	36	9
25	1	40	9
26	1	44	10
27	1	48	10
28	1	52	11
29	1	56	12
30	2	0	11
40	2	40	16

Horæ	Long. G.	'	"
60	4	0	22

Tomus II — Tabulae Novalmagesticae — Equations and Latitudes of Venus

TABLE 82. Of the Equations of the First Inequality of Venus.

(TABULA 82. Aequationum Primae Inaequalitatis Veneris.)

Signs of the simple, or mean, anomaly (*Signa Anomaliæ simplicis, seu Mediæ*).

The top band of each block gives the sign-headers **O Subtr. ... V Subtr.** ("Subtract"); the bottom band gives the complementary sign-headers **Adde XI ... Adde VI** ("Add"). The left **Anom. simpl. G.** column ascends 0–30; the right **Anom. simpl. G.** column descends 30–0. Each block has two subcolumns, minutes (') and seconds (").

Anom. simpl. G. (asc.)	O '	O "	I I'	I "	II '	II "	III '	III "	IV '	IV "	V '	V "	Anom. simpl. G. (desc.)
0	0	0	2	0	47	10	54	36	47	34	2	2	30
			7								7	0	
1	0	5	2	4	47	38	54	36	47	5	2	3	29
		8	7	6							6	1	
2	1	5	2	3	48	5	54	35	46	15	2	4	28
		5	8	4							5	1	
3	2	5	2	2	48	31	54	34	46	4	2	5	27
		1	9	2							4	2	
4	3	4	3	1	48	55	54	31	45	32	2	2	26
		8	0	0							4		
5	4	4	3	5	49	18	54	27	44	58	2	3	25
		4	0	8							3	2	
6	5	4	3	4	49	40	54	22	44	24	2	2	24
		1	1	5							2	2	
7	6	3	3	3	50	2	54	15	43	49	2	3	23
		7	2	1							1	0	
8	7	3	3	1	50	24	54	8	43	13	2	3	22

Anom. simpl. G. (asc.)	O '	O "	I I'	I "	II '	II "	III '	III "	IV '	IV "	V '	V "	Anom. simpl. G. (desc.)
25	2	5	4	3	54	15	49	38	31	22	4	4	5
	2	5	4	3								9	
26	2	4	4	6	54	21	49	15	30	35	3	5	4
	3	5	5									2	
27	2	3	4	3	54	26	48	51	29	47	2	5	3
	4	5	5	8								4	
28	2	2	4	1	54	31	48	26	28	59	1	5	2
	5	4	6	1								6	
29	2	1	4	4	54	34	48	0	28	10	0	5	1
	6	2	6	1								8	
30	2	0	4	1	54	36	47	34	27	20	0	0	0
	7		7	0									

Bottom band (complementary sign-headers): **Adde XI** | **Adde X** | **Adde IX** | **Adde VIII** | **Adde VII** | **Adde VI**.

Foot: Signs of the simple anomaly (*Signa Anomaliae simplicis*).

TABLE 83. The Equated Anomaly of Venus, corresponding to the Simple Anomaly.

(TAB. 83. *Anomalia Aequata Veneris, respondens Anomaliae simplici.*)

Signs of the simple anomaly (*Signa Anomaliae simplicis*).

Top sign-headers **O ... V**; bottom sign-headers **XI ... VI**. Left **Anom. Gr.** ascends 0–30; right **Anom. Gr.** descends 30–0. Each block: Sig. (sign), G. (degrees), ' (minutes), " (seconds).

																			I			
		O		I		I		II		I		V		V								
						I		I		I		I		I		I						
Anom.	S	O	O	S	I	I	S	I	I	I	S	I	II	S	V	I	V	S	V	Anom.		
. Gr.	i			i			i	I	I	i		II	I	i	V	V	i			Gr.		
(asc.)	g	'	"	g	'	"	g	G	'	"	g	G	I	'	"	g	G	'	"	(desc.)		
0	0	0	0	0	4	2	1	2	3	1	2	2	3	4	3	2	3	1	4	4	2	30
					6	5		9	6	9		9	2	2		9	6	9		6	5	

	O		I		I		I		II		I		I		V		V						
Anom.	S	O	O	S	I	I	S	I	I	S	I		II	S	V	I	V	S	V	V	Anom.		
. Gr.	i			i	'	"	g	G	I	I	g	G	I	i	G	V	V	i	'	"	Gr.		
(asc.)	g	'	"	g	'	"	g	G	'	"	g	G	I	'	"	g	G	'	"	g	'	"	(desc.)
1	0	5	3	0	4	1	2	0	3	5	3	0	3	4	4	0	3	3	5	4	5	29	
		9	1		6			6					2	2		6	4		6	0			
2	0	5	2	1	4	3	2	1	3	5	3	1	3	4	4	1	3	4	5	4	1	28	
		9			5	7		5	2				2	3		6	9		7	4			
3	0	5	3	1	4	1	2	2	3	4	3	2	3	4	4	2	3	2	5	4	3	27	
		8	4		5	3		5	0				2	4		7	1		7	8			
4	0	5	5	1	4	4	2	3	3	2	3	3	3	4	4	3	3	3	5	4	3	26	
		8			4	9		5	7				2	6		7	8		8				
5	0	5	3	1	4	2	2	4	3	1	3	4	3	4	4	4	3	5	5	4	2	25	
		7	6		4	5		5	5				2	8		7	5		8	9			
6	0	5	8	1	4	1	2	5	3	4	3	5	3	5	4	5	3	5	5	4	5	24	
		7			4			5					2	0		7	5		8	4			
7	0	5	4	1	4	3	2	6	3	5	3	6	3	5	4	6	3	1	5	4	2	23	
		6	0		3	8		4	3				2	4		7	2		9	0			
8	0	5	1	1	4	1	2	7	3	4	3	7	3	5	4	7	3	3	5	4	4	22	
		6	2		3	5		4	2				2	8		8	0		9	6			
9	0	5	4	1	4	5	2	8	3	3	3	8	3	2	4	8	3	4	5	5	1	21	
		5	4		2	2		4	1				3			8	8		0	2			
10	0	5	1	1	4	3	2	9	3	2	3	9	3	6	4	9	3	7	5	5	3	20	
		5	6		2	0		4	1				3			8			0	9			
11	0	5	4	1	4	8	2	1	3	1	3	1	3	1	4	1	3	2	5	5	7	19	
		4	8		2			0	4	1		0	3	1		0	9	6		1			
12	0	5	2	1	4	4	2	1	3	2	3	1	3	1	4	1	3	4	5	5	3	18	
		4	0		1	6		1	4			1	3	7		1	9	5		1	4		
13	0	5	5	1	4	2	2	1	3	5	3	1	3	2	4	1	3	4	5	5	2	17	
		3	2		1	5		2	3	4		2	3	3		2	9		2				
14	0	5	2	1	4	4	2	1	3	4	3	1	3	3	4	1	4	2	5	5	2	16	
		3	4		1			3	3	6		3	3	0		3	0	4		2	9		
15	0	5	5	1	4	4	2	1	3	3	3	1	3	3	4	1	4	4	5	5	5	15	
		2	6		0	4		4	3	8		4	3	8		4	0	4		2	6		

	O		I		I		I		II		I		I		V		V						
Anom.	S	O	O	S	I	I	S	I	I	S	I		II	S	V	I	V	S	V	V	Anom.		
. Gr.	i			i			i	I	I	i		II	I	i	V	V	i				Gr.		
(asc.)	g	'	"	g	'	"	g	G	'	"	g	G	I	'	"	g	G	'	"	g	'	"	(desc.)
16	0	5	2	1	4	2	2	1	3	3	3	1	3	4	4	1	4	4	5	5	2	14	
		2	9		0	4		5	3	0		5	3	6		5	0			3	4		
17	0	5	2	1	4	4	2	1	3	2	3	1	3	5	4	1	4	2	5	5	5	13	
		2			0			6	3	3		6	3	4		6	1	5		3	2		
18	0	5	3	1	3	4	2	1	3	1	3	1	3	2	4	1	4	4	5	5	2	12	
		1	4		9	5		7	3	7		7	4			7	1	6		4	0		
19	0	5	7	1	3	2	2	1	3	1	3	1	3	1	4	1	4	8	5	5	4	11	
		1			9	6		8	3	1		8	4	1		8	1			4	8		
20	0	5	3	1	3	7	2	1	3	6	3	1	3	2	4	1	4	3	5	5	1	10	
		0	9		9			9	3			9	4	1		9	2	0		5	6		
21	0	5	1	1	3	4	2	2	3	2	3	2	3	3	4	2	4	5	5	5	4	9	
		0	2		8	8		0	3			0	4	1		0	2	2		5	4		
22	0	4	4	1	3	5	2	2	3	5	3	2	3	4	4	2	4	1	5	5	1	8	
		9	6		8	0		1	2	8		1	4	2		1	2	5		6	2		
23	0	4	2	1	3	1	2	2	3	5	3	2	3	5	4	2	4	3	5	5	4	7	
		9	0		8	2		2	2	4		2	4	3		2	3	8		6	0		
24	0	4	5	1	3	5	2	2	3	5	3	2	3	4	4	2	4	1	5	5	8	6	
		8	4		7	5		3	2	0		3	5	0		3	3			7			
25	0	4	2	1	3	3	2	2	3	4	3	2	3	1	4	2	4	2	5	5	3	5	
		8	9		7	8		4	2	8		4	5	5		4	4	5		7	6		
26	0	4	3	1	3	2	2	2	3	4	3	2	3	2	4	2	4	4	5	5	5	4	
		8			7	1		5	2	6		5	5	7		5	4	9		8			
27	0	4	3	1	3	5	2	2	3	4	3	2	3	4	4	2	4	1	5	5	3	3	
		7	8		7			6	2	4		6	5	0		6	4	3		8	4		
28	0	4	1	1	3	4	2	2	3	4	3	2	3	5	4	2	4	3	5	5	2	2	
		7	4		6	9		7	2	3		7	5	2		7	5	7		9			
29	0	4	5	1	3	3	2	2	3	4	3	2	3	5	4	2	4	1	5	5	3	1	
		6	0		6	4		8	2	2		8	6			8	5			9	1		
30	0	4	2	1	3	1	2	2	3	4	3	2	3	1	4	2	4	2	6	0	0	0	
		6	5		6	9		9	2	2		9	6	9		9	6	5					

Bottom sign-headers: **XI | X | IX | VIII | VII | VI.**

Foot: Signs of the simple anomaly (*Signa Anomaliae simplicis*).

TABLE 84. Of the Maximum Equations, or of the Parallaxes of the Annual Orb of Venus.

(*TABULA 84. Maximarum Aequationum, seu Parallaxeon Orbis annui Veneris.*)

Signs of the equated, completed anomaly of Venus (*Signa Anomaliae Veneris Aequatae Completa*).

This is a double-argument table. The left margin reads vertically **Anomalia Solis Aequata** ("Equated anomaly of the Sun"); the right margin likewise **Anomalia Solis Aequata**. The body argument is the equated, completed anomaly of Venus, given as **Sig.** (sign) + **G.** (degree) at the left, in steps of 3° (0, 3, 6, 9, 12, 15, 18 ...). Across the head run the sign-blocks **O, I, II, III, IV, V, VI**, each carrying a **G.** (degrees) and **'** (minutes) of the maximum equation; the running G. value is printed only where it changes. The right-hand **G./Sig.** pair counts the complementary solar-anomaly argument downward (12, 11, 10 ...). The foot sign-headers run **XII, XI, X, IX, VIII, VII, VI**.

The value entered in each sign-block is **degrees ' minutes** of the maximum equation. Within each 6-row group the degrees figure (45, 46, 47) is printed once at the group head and carries down until it changes.

S i g .	O		I						I		V		V			
	O				II		III		V				I		(comp	(compl.)
	G	'	G	I'	G	II'	G	III'	G	IV'	G	V'	G	VI'	l.) G	Sig
0	4	48	4	44	4	34	45	20	4	7	4	57	4	53	0	12
		5		5		5			5			4		4		
0		48		45		34		20		7		57		53	27	
0		49		45		35		20		7		57		53	24	
0		49		46		35		21		8		58		54	21	
0		50		46		36		22		8		58		54	18	
0		50		47		36		23		9		59		55	15	11
0	4	51	4	48	4	37	45	24	4	10	4	0	4	56	12	
		5		5		5			5			5		4		
0		52		49		38		25		11		1		57	9	

S i g .	O G	O '	I G	I I'	II G	II II'	III G	III III'	I G	V IV'	V G	V V'	I G	VI'	(comp l.) G	(compl.) Sig
0		53		50		39		26		12		2		58	6	
0		55		51		41		27		13		3		59	3	
0		57		53		43		29		15		5	4	1	0	11
												5				
1	4	58	4	55	4	44	45	30	4	17	4	7	4	3	27	
	5		5		5				5		5		5			
1	4	0		57		46		32		19		8		5	24	
	6															
1		2		59		48		34		21		10		7	18	
1	4		4	1		50		36		23		13		9	12	
			6													
1		6		3		52		38		25		15		11	15	10
1	4	9	4	5	4	55	45	41	4	27	4	17	4	13	12	
	6		6		5				5		5		5			
1		12		8		58		44		29		19		15	9	
1		14		10	4	0		46		32		22		18	6	
					6											
1		17		13		2		48		35		24		21	3	
1		20		16		5		51		38		27		24	0	10
2	4	22	4	18	4	8	45	54	4	41	4	30	4	27	27	
	6		6		6				5		5		5			
2		25		21		11		57		44		33		30	24	
2		29		24		14	46	0		47		36		33	21	
2		32		28		17		3		50		39		36	18	
2		35		31		20		6		53		42		39	15	9
2	4	38	4	34	4	23	46	10	4	56	4	46	4	42	12	
	6		6		6				5		5		5			
2		41		37		27		13		59		49		45	9	
2		45		41		30		16	4	3		52		48	6	
									6							

S i g .	O G	O '	I G	I I'	II G	II II'	III G	III III'	I V G	IV '	V G	V V'	I G	VI '	(comp l.) G	(compl.) Sig
2		48		44		33		19		6		55		51	3	
2		51		48		37		23		9		59		55	0	9
3	4	55	4	51	4	40	46	26	4	12	4	2	4	58	27	
	6		6		6				6		6		5			
3		58		54		44		29		16		5	4	2	24	
												6				
3	4	2		58		47		33		19		8		5	21	
	7															
3		5	4	1		51		36		22		11		8	18	
			7													
3		9		5		54		41		26		15		11	15	8
3	4	12	4	8	4	58	46	44	4	29	4	18	4	15	12	
	7		7		6				6		6		6			
3		15		11	4	1		47		32		22		18	9	
					7											
3		19		15		4		50		35		25		21	6	
3		22		18		8		53		39		28		24	3	
3		25		21		11		56		42		31		27	0	8
4	4	28	4	24	4	14	46	59	4	43	4	34	4	30	27	
	7		7		7				6		6		6			
4		35		27		16	47	2		47		37		33	24	
4		34		30		19		5		50		40		36	21	
4		36		32		22		7		53		43		38	18	
4		39		35		25		10		56		45		41	15	7
4	4	41	4	37	4	27	47	12	4	58	4	47	4	43	12	
	7		7		7				6		6		6			
4		44		40		29		14	4	0		49		46	9	
									7							
4		46		42		31		16		2		51		48	6	
4		48		44		33		18		4		53		50	3	

S i g .	O		I		II		III		IV		V		VI		(comp l.) G	(compl.) Sig
	G	'	G	I'	G	II'	G	III'	G	IV'	G	V'	G	VI'		
4		50		46		35		20		6		55		51	0	7
5	4	52	4	48	4	37	47	22	4	8	4	57	4	53	27	
	7		7		7				7		6		6			
5		53		49		38		24		9		58		55	24	
5		55		50		40		25		11	4	0		56	21	
											7					
5		56		51		41		26		12		1		57	18	
5		57		52		42		27		13		3		58	15	6
5	4	57	4	53	4	43	47	28	4	14	4	3	4	59	12	
	7		7		7				7		7		6			
5		58		54		43		29		14		3	4	0	9	
												7				
5		58		55		44		29		15		3		0	6	
5		59		55		44		30		15		4		1	3	
5		59		55		44		30		15		4		1	0	6

Foot sign-headers: **XII** | **XI** | **X** | **IX** | **VIII** | **VII** | **VI**. Foot: The completed signs of the equated anomaly of Venus (*Anomaliae Veneris Aequatae Signa Completa*).

TABLE 85. Of the Proportional Scruples of the Latitude of Venus.

(*TABULA 85. Scrupulorum Proportionalium Latitudinis Veneris.*)

Completed signs of the equated anomaly of the Sun (*Signa Completa Anomaliae Solis Aequatae*).

Double-argument table. The left margin reads vertically **Anomalia Orbis Veneris** ("Anomaly of the orb of Venus"); the right margin likewise **Anomalia Orbis Veneris**. The body argument is **Sig.** + **G.** at the left. Across the head run the sign-blocks **O, I, II, III, IV, V, VI**, each with **G.** (degrees) and **'** (minutes) of the proportional scruples. To the right of the VI-block stands a separate column **Scrup. decr.** ("decrement scruples") with its own **G./**, captioned vertically *Scrupula proportionalia Decrementi in ♂ retrograda* — "Proportional scruples of

the decrement, in the retrograde σ (Mars)". The right-hand **G./Sig.** pair counts the complementary argument downward (12, 11, 10 ...); the foot sign-headers run **XII, XI, X, IX, VIII, VII, VI.**

S			I	I	I			V					(co	(com
i	O	I	I	I		V	I	V	I				mpl.	pl.)
g	O	I	II	I	III	V	V	V		Scrup.	Scrup.			
.	G'	G'	G'	G'		G'	G'	G'	I'	decr. G	decr. '	) G	Sig	
0	8 3	8 3	8 4	8 42		8 4	8 4	8 4	8 4	<i>Scrupu</i>		0	12	
	8	9	0			5	7	8		<i>la</i>				
0	8 4	8 4	8 4	8 45		8 4	8 4	8 5		<i>propor</i>		18	11	
	2	2	4			8	9	0		<i>tiona-</i>				
0	8 4	8 4	8 5	8 52		8 5	8 5	8 5		<i>lia</i>		6		
	9	9	1			4	6	6						
1	9 4	9 4	9 6	9 7		9 9	9 1	9 1		<i>Decre</i>		24		
							1	2		<i>menti</i>				
1	9 2	9 2	9 2	9 29		9 3	9 3	9 3		<i>in σ</i>		12		
	6	6	8			1	3	4						
1	9 5	9 5	9 5	1 0		1 2	1 4	1 5		<i>retrogr</i>		0	10	
	6	7	8	0		0	0	0		<i>ada</i>				
2	1 1	1 1	1 1	1 18		1 2	1 2	1 2				24		
	0 4	0 5	0 6	0		0 0	0 2	0 3						
2	1 3	1 3	1 3	1 40		1 4	1 4	1 4				18		
	0 6	0 7	0 8	0		0 2	0 4	0 5						
2	1 1	1 2	1 3	1 5		1 8	1 1	1 1				12		
	1	1	1	1		1	1 0	1 1						
2	1 2	1 2	1 3	1 33		1 3	1 3	1 3				6		
	1 8	1 9	1 0	1		1 6	1 8	1 9						
2	1 3	1 4	1 5	1 8		1 1	1 1	1 1				0	9	
	2	2	2	2		2 1	2 4	2 5						
3	1 3	1 4	1 4	1 46		1 5	1 5	1 5				24		
	2 9	2 0	2 3	2		2 0	2 3	2 4						
3	1 2	1 2	1 3	1 34		1 3	1 4	1 4				18		
	3 7	3 9	3 1	3		3 7	3 0	3 1						
3	1 2	1 2	1 2	1 27		1 3	1 3	1 3	0	1		12		
	4 0	4 1	4 4	4		4 2	4 5	4 6						

S i g .	O O G'	I I G'	I II G'	I I G'	I III G'	I V G'	I V G'	V I G'	V I G'	Scrup. decr. G	Scrup. decr. '	(co mpl.) G	(com pl.) Sig
3	1 2 5 2	1 2 5 3	1 2 5 6	1 5	30	1 3 5 5	1 3 5 8	1 4 5 0	0	41	6		
3	1 3 6 6	1 3 6 8	1 4 6 1	1 6	46	1 5 6 2	1 5 6 6	1 5 6 8	2	30	0	8	
4	1 1 7 9	1 2 7 1	1 2 7 4	1 7	30	1 3 7 6	1 4 7 0	1 4 7 2	3	34	27		
4	1 5 8	1 7 8	1 1 8 0	1 8	16	1 2 8 2	1 2 8 7	1 2 8 9	4	40	24		
4	1 5 8 6	1 5 8 9	1 3 9	1 9	9	1 1 9 7	1 2 9 2	1 2 9 4	5	57	21		
4	1 5 9 4	1 5 9 6	2 2 0	2 0	8	2 1 0 6	2 2 0 2	2 2 0 4	7	23	18		
4	2 5 0 8	2 1 1	2 6 1	2 1	15	2 2 1 4	2 3 1 1	2 3 1 4	9	1	15	7	
4	2 8 2	2 1 2 1	2 1 2 7	2 2	27	2 3 2 7	2 4 2 5	2 4 2 8	10	48	12		
4	2 2 3 5	2 2 3 9	2 3 3 7	2 3	49	2 2 4	2 1 4 2	2 1 4 6	12	48	9		
4	2 5 4 5	2 5 4 5	2 0 5	2 5	23	2 3 5 9	2 5 5 0	2 5 5 4	15	6	6		
4	2 3 6	2 4 6 1	2 5 6 4	2 7	9	2 2 7 9	2 4 7 3	2 4 7 8	17	41	3		
4	2 2 8 5	2 3 8 2	2 4 8 6	2 9	4	2 2 9 7	2 4 9 4	2 5 9 0	20	30	0	7	
5	2 3 9	2 9 9	2 2 9 3	2 9	43	3 6 0	3 2 0 4	3 3 0 0	21	29	29		
5	2 4 9 2	2 4 9 8	3 3 0	3 0	24	3 4 0 8	3 6 1	3 1 1 2	22	28	28		
5	3 2 0 4	3 3 0 0	3 4 0 6	3 1	7	3 3 1 2	3 4 1 9	3 5 1 7	23	31	27		
5	3 1	3 1	3 3	3	55	3 2	3 3	3 4	24	41	26		

S i g .	O O G'	I I G'	I II G'	I I G'	I III G'	I V G'	I V G'	V I G'	V I G'	Scrup. decr. G	Scrup. decr. '	(co mpl.) G	(com pl.) Sig
	1 0	1 7	1 2	1		2 0	2 8	2 5					
5	3 5	3 5	3 2	3	44	3 1	3 3	3 3	25	53		25	6
	1 8	2	2 3	2		3 1	3 1	3 8					
5	3 4	3 5	3 1	3	38	3 7	3 2	3 3	26	12		24	
	2 9	2 5	3 2	3		4	4 8	4 5					
5	3 4	3 4	3 5	3	32	3 3	3 2	3 3	28	35		23	
	3 0	3 7	4	4		5	5 5	5 3					
5	3 3	3 4	3 0	3	29	3 2	3 2	3 3	29	58		22	
	4 2	4 0	5	5		6	6 5	6 5					
5	3 2	3 3	3 5	3	26	3 2	3 2	3 3	31	22		21	
	5 4	5 3	5 4	6		7	7 8	7 8					
5	3 1	3 2	3 5	3	26	3 5	3 3	3 4	32	49		20	6
	6 9	6 9	6 2	7		8	8 3	8 3					
5	3 1	3 2	3 5	3	29	3 9	3 3	3 4	34	20		19	
	7 7	7 9	7 3	8		9	9 8	9 9					
5	3 1	3 2	3 5	3	31	4 1	4 4	4 5	36	52		18	
	8 5	8 8	8 4	9		0 5	0 7	0 9					
5	3 1	3 3	3 5	4	35	4 2	4 5	4 9	37	27		17	
	9 6	9 0	9 7	0		1 2	1 6	2					
5	4 1	4 3	4 2	4	45	4 3	4 1	4 2	39	4		16	
	0 7	0 2	1	1		2 4	3 0	3 3					
5	4 1	4 3	4 8	4	54	4 4	4 2	4 4	40	46		15	6
	1 9	1 5	2	2		3 7	4 4	4 0					
5	4 2	4 3	4 1	4	4	4 2	4 4	4 0	42	30		14	
	2 1	2 4	3 0	4		5	5 4	6					
5	4 2	4 3	4 1	4	13	4 4	4 4	4 2	44	14		13	
	3 2	3 7	4 6	5		7	7	7 0					
5	4 2	4 4	4 2	4	17	4 2	4 2	4 4	45	57		12	
	4 4	4 2	5 4	6		8 2	8 2	8 0					
5	4 2	4 4	4 2	4	31	4 4	4 3	4 5	47	37		11	
	5 2	5 3	6 8	7		8 4	9 7	9 8					

Foot sign-headers: **XII** | **XI** | **X** | **IX** | **VIII** | **VII** | **VI**. Foot: Completed signs of the equated anomaly of the Sun (*Signa Completa Anomaliae Solis Æquatæ*).

LATITUDES OF VENUS [LATITVDINES VENERIS] (p. 89)

TABLE 86. Proportional Minutes for the Decrement of the Latitude of Venus [TABVLA 86. Scrupulorum Proportionalium Decrementi Latitudinis Veneris.]

Argument: Equated anomaly of Venus [Anomal. Æq. ♀], in Signs (Sig.) and Degrees (G.), read down the left margin and up the right margin. Top column-headers (Signs of the completed equated anomaly of the Sun [Signa Completa Anomalizæ Solis Æquatæ], read at top): O, I, II, III, IV, V, VI. Bottom column-headers (read from below): XII, XI, X, IX, VIII, VII, VI. Each sign-column gives Degrees (G.) and minutes (').

Æq.♀ Sig.	Æq. ♀ G.	O		I		II		III G.	III '	I V		V		V I		Æq. ♀ G.	Æq.♀ Sig.
		G	O	G	I	G	II			G	IV	G	V	G	VI		
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
	6		1		1		1		1		1		1		1	24	
	12		2		2		2		2		2		2		2	18	
	18		4		4		4		4		5		5		5	12	
	24		7		7		7		8		8		8		8	6	
	30		1		1		1		12		1		1		1	0	11
I			1		1		1				2		3		3		
	6	0	1	0	1	0	1	0	16	0	1	0	1	0	1	24	
			5		5		5				7		7		8		
	12		2		2		2		22		2		2		2	18	
			0		0		1				3		3		4		
	18		2		2		2		29		3		3		3	12	
			6		6		7				0		0		1		
	24		3		3		3		36		3		3		3	6	
			3		3		4				7		8		9		
	30		4		4		4		44		4		4		4	0	10
			0		0		2				6		7		8		

Æq.♀ Sig.	Æq. ♀ G.	O		I		II		III G.	III '	I V		V		V I		Æq. ♀ G.	Æq.♀ Sig.
		G	O	G	I	G	II			G	IV	G	V	G	VI		
2	6	0	4	0	4	0	5	0	53	0	5	0	5	0	5	24	
			8		8		0				5		6		7		
	12		5		5		5	1	1	1	4	1	6	1	7	18	
			6		6		8										
	18	1	4	1	4	1	6		10		1		1		1	12	
											4		6		7		
3	24		1		1		1		19		2		2		2	6	9
			2		2		5				3		6		7		
	30		2		2		2		28		3		3		3	0	
			0		1		4				3		6		7		
	6	1	2	1	3	1	3	1	38	1	4	1	4	1	4	24	
			8		0		3				3		6		7		
4	12		3		3		4		47		5		5		5	18	8
			6		8		2				2		6		7		
	18		4		4		5		56	2	1	2	6	2	7	12	
			4		6		0										
	24		5		5		5	2	4		1		1		1	6	
			2		4		8				0		6		7		
5	30	2	0	2	2	2	6		13		1		2		2	0	7
											9		5		6		
	6	2	7	2	9	2	1	2	21	2	2	2	3	2	3	24	
							4				8		4		5		
	12		1		1		2		28		3		4		4	18	
			4		6		1				5		2		1		
6	18		2		2		2		35		4		4		5	12	7
			0		2		7				2		9		0		
	24		2		2		3		41		4		5		5	6	
			5		7		3				8		5		6		
	30		2		3		3		45		5		5	3	1	0	
			9		1		7				3		9				
5	6	2	3	2	3	2	4	2	49	2	5	3	4	3	6	24	

Æq.♀ Sig.	Æq. ♀ G.	O		I		II		III G.	III '	I V		V		V I		Æq. ♀ G.	Æq.♀ Sig.
		G	O	G	I	G	II			G	IV	G	V	G	VI		
			3		5		1				7						
	12		3		3		4		53	3	0		7		9	18	
			6		8		4										
	18		3		4		4		55		3		1		1	12	
			8		0		6						0		2		
	24		3		4		4		56		4		1		1	6	
			9		1		7						1		3		
	30		4		4		4		57		5		1		1	0	6
			0		2		8						2		4		

TABLE 87. Of the Latitude, Reduction, and Curtation of Venus
[TABVLA 87. Latitudinis, Reductionis, & Curtationis Veneris.]

Argument (both margins): Distance of Venus from the [ascending] Node [Dist. à ☿], in Degrees (Gr.). Top sign-labels: Signs of the distance of Venus from the boreal Node [Signa Distantiæ Veneris à Nodo Boreali] — the three displayed blocks are headed **O Boreal.** / **VI Austral.**, **I Boreal.** / **VII Austral.**, **II Boreal.** / **VIII Austral.** Each block has three sub-columns: Latitude [Latitudo.] (Degrees G., minutes '); Reduction [Reductio.] (minutes ', seconds "); Curtation [Curtatio.] (minutes ', seconds "). Bottom sign-labels (read from below): **V Boreal.** / **XI Austral.**, **IV Boreal.** / **X Austral.**, **III Boreal.** / **IX Austral.**

Block: **O Boreal.** / **VI Austral.** — **I Boreal.** / **VII Austral.** — **II Boreal.** / **VIII Austral.**

		O																		
				O	O	O	O	I/							II					
D is t. ☿ G r.	V	O	/	/	/	/	V	I/	I/					/						D is t. ☿ G r.
	I	/	V	V	V	V	I	I/	V	V	I/	I/	V							
	L	V	I	I	I	I	I	V	II	II	VI	VI	II	II/	II/	II/	II/	II/		
	a	I	R	R	C	C	L	II	R	R	I	I	I	VI	VI	VI	VII	VII	☿	
	t	L	e	e	u	u	a	L	e	e	C	C	L	II	II	II	I	I		
		.	a	d.	d.	rt	rt	t.	at	d.	d.	ur	ur	at	La	Re	Re	Cu	Cu	G
		G	t.	'	"	'	"	G	'	'	"	t.	t."	.G	t.	d.	d."	rt.	rt."	r.
		0	0	0	0	0	0	5	6	2	3	2	58	8	50	2	35	5	8	3

D is t. Ⓔ	O																		D is t. Ⓔ
	/																		
	O																		
	/																		
G r.	V	O	/	/	/	/	I/	I/	I/	I/	I/	I/	II	II	II	II	II	II	II
	I	/	V	V	V	V	I	I/	V	V	I/	I/	V	II	II	II	II	II	II
	L	V	I	I	I	I	I	V	II	II	VI	VI	I	VI	VI	VI	VI	VI	VI
	a	I	R	R	C	C	L	II	R	R	I	I	L	II	II	II	I	I	I
G r.	.	a	d.	d.	rt	rt	t.	at	d.	d.	ur	ur	at	La	Re	Re	Cu	Cu	G
	G	t.	'	"	'	"	G	'	"	t.	t.	t.	.G	t.	d.	d.	rt.	rt.	r.
	1	2	2	1	2	1	2	7	5	2	5	4	7	9	49	1	34	5	42
	4		8		4		7				9								6
1	2	3	1	2	1	3	7	1	2	5	4	12	9	52	1	29	5	44	1
5		8		9		3		3		9									5
1	2	4	1	3	1	3	7	2	2	5	4	16	9	54	1	24	5	45	1
6		8		4		8		1		9									4
1	2	5	1	4	1	4	7	2	2	5	4	21	9	57	1	18	5	47	1
7		9		0		4		8		8									3
1	3	9	1	4	1	5	7	3	2	5	4	25	9	59	1	13	5	48	1
8				5		0		5		8									2
1	3	1	1	5	1	5	7	4	2	5	4	29	1	1	1	8	5	49	1
9		9		0		6		2		7			0						1
2	3	2	1	5	2	2	7	4	2	5	4	33	1	3	1	2	5	50	1
0		9		4				9		6			0						0
2	3	3	1	5	2	8	7	5	2	5	4	37	1	5	0	57	5	51	9
1		9		9				6		6			0						
2	3	4	2	3	2	1	8	2	2	5	4	40	1	6	0	51	5	52	8
2		9				3				5			0						
2	3	5	2	8	2	1	8	9	2	5	4	44	1	7	0	45	5	53	7
3		9				9				4			0						
2	4	4	2	1	2	2	8	1	2	5	4	48	1	8	0	38	5	54	6
4				2		5		5		2			0						
2	4	1	2	1	2	3	8	2	2	5	4	52	1	9	0	32	5	54	5
5		9		6		1		1		0			0						
2	4	2	2	2	2	3	8	2	2	4	4	55	1	10	0	26	5	55	4
6		8		1		6		7		7			0						
2	4	3	2	2	2	4	8	3	2	4	4	58	1	11	0	19	5	56	3

MOTION OF MERCURY [MOTVS MERCVRII] (p. 90)

Epochs, or Roots of the Motions [EPOCHÆ, seu RADICES MOTVVM] —
Completed years before Christ [Anni Completi ante Christum]

Anni ante Chr.	Long. Υ Sig	Lon g.Υ G	Long. Υ '	Long. Υ ''	Ap og. Sig	A po g. G	Ap og.' ''	Ap og. ''	No di Sig	N o di G	No di ' 	No di ''
6000	5	18	27	55	1	1	37	30	6	2 0	43	30
5000	6	12	23	13	2	0	34	23	7	1 7	16	33

Anni ante Chr.	Long. Υ Sig	Lon g.Υ G	Long. Υ '	Long. Υ ''	Ap og. Sig	A po g. G	Ap og. '	Ap og. ''	No di Sig	N o di G	No di '	No di ''
4000	7	6	18	31	2	29	31	16	8	1 3	49	36
3000	8	0	13	49	3	28	28	9	9	1 0	22	39
2000	8	24	9	7	4	27	25	3	10	6	55	43
1000	9	18	4	24	5	26	21	58	11	3	28	47
900	0	2	27	56	5	29	15	39	11	6	8	5
800	2	16	51	28	6	2	9	20	11	8	47	23
700	5	1	15	0	6	5	3	2	11	1 1	26	41
600	7	15	38	32	6	7	56	42	11	1 4	6	0
500	10	0	2	4	6	10	50	20	11	1 6	45	18
400	0	14	25	36	6	13	44	0	11	1 9	24	36
300	2	28	49	8	6	16	38	0	11	2 2	3	54
200	5	13	12	40	6	19	31	40	11	2 4	43	13
100	7	27	36	10	6	22	25	18	11	2 7	22	32
Christi	10	11	59	40	6	25	18	48	0	0	1	50
100	0	26	23	12	6	28	12	29	0	2	41	8
200	3	10	46	44	7	1	6	10	0	5	20	26
300	5	25	10	16	7	3	59	50	0	7	59	44
400	8	9	33	48	7	6	53	31	0	1 0	39	2
500	10	23	57	19	7	9	47	12	0	1 3	18	21
600	1	8	20	51	7	12	40	32	0	1	57	39

Anni ante Chr.	Long. γ Sig	Long. γ G	Long. γ'	Long. γ''	Apog. Sig	Apog. G	Apog. γ'	Apog. γ''	No di Sig	No di G	No di γ'	No di γ''
700	3	22	44	23	7	15	34	13	0	5 18	36	57
800	6	7	7	55	7	18	27	54	0	21	16	15
900	8	21	31	27	7	21	21	34	0	23	55	34
1000	11	5	54	58	7	24	15	15	0	26	34	52
1100	1	20	18	30	7	27	8	56	0	29	14	10
1200	4	4	42	2	8	0	2	37	1	1	53	28
St. veteris 1300	6	19	5	34	8	2	56	18	1	4	32	46
1400	9	3	29	6	8	5	49	58	1	7	12	4
1500	11	17	52	38	8	8	43	39	1	9	51	23
1600	2	2	16	10	8	11	37	20	1	12	30	41
St. novo 1600	0	20	50	44	8	11	37	17	1	2	30	40
1700	3	1	8	44	8	14	30	58	1	5	9	59
1800	5	11	26	44	8	17	24	39	1	7	49	18
1900	7	22	14	44	8	20	18	20	1	0	28	35
2000	10	6	38	16	8	23	12	0	1	3	7	56
2100	0	16	56	16	8	26	5	41	1	5	47	8

Anni ante Chr.	Long. Υ Sig	Long. Υ G	Long. Υ ' "	Long. Υ "	Apog. Sig	Apo g. G	Apog. ' "	Apog. "	No di Sig	No di G	No di ' "	No di "
2200	2	27	14	15	8	28	59	22	1	2	26	26
										8		
2300	5	7	32	15	9	1	53	2	2	1	5	45

Julian Years Collected [ANNI IVLIANI COLLECTI]

Columns: Motion / Years [Motus / Anni]; Longitude from Υ [Long. ab Υ]; Apogee [Apogei]; Boreal Node [Nodi Bor.] — each Sig., G., ', ".

Anni	Long. Υ Sig	Long. Υ G	Long. Υ ' "	Long. Υ "	Apo g. Sig	Apo g. G	Apo g. ' "	Apo g. "	No di Sig	No di G	No di ' "	No di "
400	0	29	45	25	0	1	9	28	0	1	3	43
600	1	14	38	7	0	1	44	12	0	1	35	35
800	1	29	30	50	0	2	18	58	0	2	7	27
1000	2	14	23	32	0	2	53	41	0	2	39	18
1200	4	28	47	4	0	5	47	23	0	5	18	37
1300	7	13	10	36	0	8	41	4	0	7	57	55
1400	9	27	34	7	0	11	34	45	0	10	37	13
1500	0	11	57	39	0	14	28	26	0	13	16	32

A n i	Long. Υ Sig	Long . Υ G	Long. Υ '	Long. Υ ''	Apo g. Sig	Ap og. G	Apo g. '	Apo g. ''	No di Sig	N o di G	No di '	No di ''
6 0 0	2	26	21	11	0	17	22	8	0	15	55	50
7 0 0	5	10	44	43	0	20	15	49	0	18	35	8
8 0 0	7	25	8	14	0	23	9	30	0	21	14	27
9 0 0	10	9	31	46	0	26	3	12	0	23	53	45
1 0 0 0	0	23	55	18	0	28	56	53	0	26	33	3
2 0 0 0	1	17	50	35	1	27	53	46	1	23	6	7
3 0 0 0	2	11	45	53	2	26	50	39	1	19	39	10
4 0 0 0	3	5	41	10	3	25	47	32	3	16	12	12
5 0 0 0	3	29	36	28	4	24	44	25	4	12	45	17
6	4	23	31	45	5	23	41	18	5	9	18	20

A n n i	Long. Υ Sig	Long .Υ G	Long. Υ ' "	Long. Υ "	Apo g. Sig	Ap og. G	Apo g. ' "	Apo g. "	No di Sig	N o di G	No di ' "	No di "
0												
0												
0												

Months of the Year [MENSES ANNI]

Two regimes: Common (year) [Communis.] and Bissextile [Bissextilis.]. The Common section gives Longitude from Υ (Sig., G., ', ") per month [Ment.]; the Bissextile section gives Longitude from Υ (Sig., G., ', "), Apogee [Apog.] (' , "), and Boreal Node [Nodi B.] (' , ").

		C o m m o n is	Co m ' "	Co m "	Bis. Long.Υ Sig	B i s. G	Bi s. ' "	Bi s. "	Bis. Apog ' "	Bis. Apog "	Bis. Nodi ' "	Bis. Nodi "
Me nt.	Comm. Long.Υ Sig	.G	m. ' "	m. "								
Ian uar ius	4	6	51	50	4	6	51	50	0	9	0	8
Feb rua riu s	8	1	27	3	8	5	32	35	0	17	0	16
Ma rtiu s	0	8	18	53	0	1 2	24	25	0	26	0	24
Apr ilis	4	1 1	5	11	4	1 5	10	43	0	35	0	31
Ma ius	8	1 7	57	1	8	2 2	2	33	0	44	0	39
Iun ius	0	2 0	43	19	0	2 4	48	51	0	52	0	47
Iuli	4	2	35	9	4	1	40	41	1	1	0	55

Me nt.	Comm. Long.Υ Sig	C o m m . G	Co m '	Co m "	Bis. Long.Υ Sig	B i s. G	Bi s. '	Bi s. "	Bis. Apog '	Bis. Apog "	Bis. Nodi '	Bis. Nodi "
us		7										
Au gus tus	9	4	26	59	9	8	32	31	1	9	1	4
Sep te mb er	1	7	13	17	1	1 1	18	49	1	18	1	11
Oct obe r	5	1 4	5	7	5	1 8	10	39	1	27	1	20
No ve mb er	9	1 6	51	25	9	2 0	56	57	1	35	1	27
Dec em ber	1	2 3	43	15	1	2 7	48	47	1	44	1	36

Days [DIES]

Columns: Motion / Days [Mot. / Dies]; Longitude from Υ (Sig., G., ', "); Apogee [Apog.] ("); Boreal Node — the right-hand Apog./Nodi seconds run shown.

Die s	Long.Υ Sig	Long.Υ G	Long.Υ '	Long.Υ "	Apog. "
1	0	4	5	32	0
2	0	8	11	5	0
3	0	12	16	38	1
4	0	16	22	10	1
5	0	20	27	43	1

Die s	Long.☿ Sig	Long.☿ G	Long.☿ '	Long.☿ ''	Apog. ''
6	0	24	13	16	2
7	0	28	38	48	2
8	1	2	44	21	2
9	1	6	49	53	3
10	1	10	55	26	3
11	1	15	0	58	3
12	1	19	6	31	4
13	1	23	12	4	4
14	1	27	17	36	4
15	2	1	23	9	5
16	2	5	28	41	5
17	2	9	34	14	5
18	2	13	39	47	6
19	2	17	45	19	6
20	2	21	50	52	6
21	2	25	56	24	7
22	3	0	1	57	7
23	3	4	7	30	7
24	3	8	13	2	8
25	3	12	18	35	8
26	3	16	24	7	8
27	3	20	29	40	9
28	3	24	35	13	9
29	3	28	40	45	9
30	4	2	46	18	10
31	4	6	51	50	10

Hours [HORÆ]

Columns: Motion / Hours [Mot. / Horæ]; Longitude from ☿ (Degrees G., minutes ', seconds '').

Horæ	Long.☿ G	Long.☿ '	Long.☿ ''
1	0	10	14
2	0	20	28
3	0	30	42
4	0	40	56
5	0	51	9
6	1	1	23
7	1	11	37
8	1	21	51
9	1	32	5
10	1	42	19
11	1	52	32
12	2	2	46
13	2	13	0
14	2	23	14
15	2	33	28
16	2	43	41
17	2	53	55
18	3	4	9
19	3	14	23
20	3	24	37
21	3	34	51
22	3	45	4
23	3	55	18
24	4	5	32

Julian Years Expanded & Collected [ANNI IVLIANI EXPANSI, & COLLECTI]

Columns: Motion / Years [Motus / Anni], with "B." marking leap (bissextile) years; Longitude from ☿ (Sig., G., ', '); Apogee [Apogæi] (' '); Boreal Node [Nodi Bor.] (' ').

An ni	Long.Υ Sig	Long.Υ G	Long.Υ' Long.Υ'	Long.Υ'' Long.Υ''	Apog.' Apog.'	Apog. ''	Nodi' Nodi'	Nodi ''
1	1	23	43	15	1	44	1	36
2	3	17	26	30	3	28	3	11
3	5	11	9	45	5	12	4	47
B. 4	7	8	58	32	6	57	6	22
5	9	2	41	47	8	41	7	58
6	10	26	25	2	10	25	9	33
7	0	20	8	17	12	9	11	9
B. 8	2	17	57	5	13	54	12	45
9	4	11	40	20	15	38	14	20
10	6	5	23	35	17	22	15	56
11	7	29	6	50	19	6	17	31
B. 12	9	26	55	37	20	51	19	7
13	11	20	38	52	22	35	20	43
14	1	14	22	7	24	19	22	18
15	3	8	5	22	26	3	23	54
B. 16	5	5	54	10	27	48	25	29
17	6	29	37	25	29	32	27	5
18	8	23	20	40	31	16	28	40
19	10	17	3	55	33	0	30	16
B. 20	0	14	52	42	34	44	31	52

[Below the EXPANSI table:] The roots are fixed to the meridian of Bologna, at noon of the last [day] of the preceding December. The years are Completed [years], whether you count upward before Christ or downward after Christ. [Radices affixæ sunt Meridiano Bononiensi, in meridie ultimo Decembris præcedentis. Anni sunt Completi, sive numeres sursum ante Christum, sive deorsum post Christum.]

EQUATIONS OF MERCURY [ÆQVATIONES MERCVRII] (p. 91)

TABLE 89. Of the Equations of the First Inequality of Mercury
[TABVLA 89. Aequationum Prima Inaequalitatis Mercurij.]

Argument (both margins): Simple anomaly [Anom. simpl.] in Degrees (Gr.), descending 0→30 on the left and 30→0 on the right. Top caption: Signs of the simple anomaly of the eccentric of Mercury [Signa Anomaliæ simplicis Excentrici Mercurij]. Column-blocks O–V, each labelled **Subtract** [Subtr.], in Degrees (G.), minutes (′), seconds (″). Footer signs (the complementary "Adde" signs): **Adde XI, X, IX, VIII, VII, VI.**

G r .	O			I			I			III			I		IV		V		G r .
	G	O	O	G	I'	I''	G	II'	II''	G	III'	III''	G	IV'	''	G	V'	V''	
0	0	0	0	9	2	2	1	50	18	2	27	14	2	16	17	1	5	0	3
					4			7		3			3				4	5	0
1	0	1	1	9	4	1	1	5	10	2	33	32	2	7	50	1	3	3	2
		9	8		2	1	8			3			3				4	0	3
2	0	3	5	1	0	1	1	19	47	2	39	29	2	59	0	1	4	2	2
		8			0	6	8			3			2				4		7
3	0	5	7	1	1	2	1	34	11	2	44	59	2	49	24	1	3	3	2
		7			0	8	7	8		3			2				3	8	1
4	1	1	2	1	3	3	1	48	17	2	50	9	2	39	6	1	1	2	2
		6	0		0	6	3	8		3			2				3	2	
5	1	3	1	1	5	2	1	2	19	2	54	52	2	28	18	1	4	1	2
		5	4		0	4	9	9		3			2				2	5	4
6	1	5	1	1	1	1	1	16	9	2	59	2	2	16	55	1	1	1	2
		4	4		1	2	0	9		3			2				2	8	7
7	2	1	1	1	3	0	1	29	44	2	2	48	2	5	2	1	5	3	2
		3	7		1	0		9		4			2				1	0	9
8	2	3	1	1	4	4	1	43	2	2	6	15	2	52	33	1	2	3	2
		2	9		1	7	0	9		4			1				1	2	9
9	2	5	1	1	5	2	1	56	10	2	9	19	2	39	33	1	5	2	2
		1	6		2	0	9			4			1				0	4	0

G r .	O G	O '	O "	I G	I I'	I I''	I G	II'	II''	III G	III'	III''	I V G	IV IV'	IV "	V G	V '	V "	G r .
1	3	1	2	1	2	5	2	9	3	2	11	52	2	25	44	1	2	3	2
0		0	0	2	2	8	0			4			1			0	5	9	0
1	3	2	1	1	4	5	2	21	43	2	13	49	2	11	19	9	5	3	1
1		9	8	2	0	1	0			4			1				6	6	9
1	3	4	4	1	5	7	2	34	8	2	15	18	2	56	29	9	2	1	1
2		8		2	8		0			4			0				7	2	8
1	4	7	1	1	1	2	2	46	19	2	16	21	2	41	2	8	5	2	1
3			2	3	5	2	0			4			0				7	5	7
1	4	2	1	1	3	2	2	58	14	2	17	1	2	25	8	8	2	2	1
4		6	2	3	2	0	0			4			0				7	7	6
1	4	4	5	1	4	3	2	9	56	2	17	20	2	8	40	7	5	1	1
5		4	4	3	9	3	1			4			0				7	1	5
1	5	3	5	1	6	3	2	21	12	2	16	42	1	51	39	7	2	4	1
6			1	4		1	1			4			9				6	9	4
1	5	2	4	1	2	1	2	32	28	2	16	4	1	33	59	6	5	4	1
7		2	3	4	3	9	1			4			9				5	9	3
1	5	4	2	1	4	8	2	43	3	2	14	28	1	15	40	6	2	4	1
8		1	8	4	0		1			4			9				4	0	2
1	6	0	1	1	5	4	2	53	40	2	12	34	1	56	53	5	5	2	1
9			9	4	6	6	1			4			8				3	3	1
2	6	1	2	1	1	6	2	3	43	2	10	12	1	37	30	5	2	5	1
0		9		5	3		2			4			8				1	7	0
2	6	3	4	1	2	3	2	13	37	2	7	2	1	17	38	4	5	1	9
1		7	2	5	9	9	2			4			8				0	5	
2	6	5	2	1	4	5	2	23	11	2	3	34	1	57	9	4	1	2	8
2		6	1	5	5	7	2			4			7				8	3	
2	7	1	1	1	1	5	2	32	26	2	59	23	1	36	9	3	4	2	7
3		5		6		7	2			3			7				6	3	
2	7	3	3	1	1	5	2	41	16	2	54	45	1	14	41	3	1	1	6
4		3	4	6	7	4	2			3			7				4	3	
2	7	5	1	1	3	4	2	49	45	2	49	57	1	52	36	2	4	5	5
5		2	3	6	3	7	2			3			6				2		

G O				I			I						I		V			G	
r .	O		O				I	III			V	IV		V	V	r			
	G	'	"	G	I'	I''	G	II'	II''	G	III'	III''	G	IV'	"	G	'	"	.
26	80	12	32	16	49	20	22	58	0	23	44	19	16	30	2	29	5	40	
27	89	2	8	17	45	53	23	548		23	38	9	16	7	4	13	27	38	
28	87	4	3	12	20	18	23	13	20	23	31	30	15	43	24	15	1	2	
29	9	6	0	13	35	18	23	20	29	23	24	5	15	19	23	02	33	1	
30	94	2	2	15	50	18	23	27	14	23	16	17	14	55	0	00	0	0	
A d d e	X I	X			I X			VI II			V I I		V I						

TABLE 90. The Equated Anomaly of Mercury [TAB. 90. *Anomalia Aequata Mercurij.*]

Argument (both margins): Simple anomaly [Anom. simpl.] in Degrees (G.), 0→30 left and 30→0 right. Top caption: Signs of the simple anomaly of Mercury [Signa Anomaliae simplicis Mercurij]. Column-blocks O–V, each in Signs (Sig.), Degrees (G.), minutes ('), seconds ("). Footer signs: **XI, X, IX, VIII, VII, VI.**

O										V																			
					I					I					I					I					I				
G S		O S			II I			III I			V V I			I S			V												
r i	O	i	I	I	Si	II	II	Si	I	III	III	Si	V	V	I	S	V												
. g	'	"	g	'	"	g	G	'	"	g	G	'	"	g	G	'	"	g	'	"									
0 0	0 0	0	5	1	1	1	3	4	2	1	52	26	3	1	3	4	4	5	1										
			8	6		9	1			7				9	1			8	6										
1 0	4 2	0	4	2	1	2	2	4	2	1	52	32	3	2	3	3	4	9	1										
	7 3		7	0		0	4	4		8				0	7	5			7										
2 0	3 4	0	3	3	1	2	1	3	2	1	52	52	3	2	4	1	4	2	2										
	4 7		6	1		1	8	6		9				1	4	7		0	5										

O														V							
		I						I						I		I					
G S		O	S			II	I			III	I				V	V	I	I	S	V	
r i		O	i		I	I	Si	G	II	II	Si	I	III	III	Si	G	V	V	i	V	
. g		'	"	g	'	"	g		'	"	g	G	'	"	g	G	'	"	g	'	"
3 0		2	1	0	2	4	1	2	1	4	2	2	53	26	3	2	5	1	4	3	4
		2	2		5	9		2	2	1		0				2	1	0		1	0
4 0		9	3	0	1	1	1	2	6	5	2	2	54	13	3	2	5	1	4	4	1
			7		5	4		3		8		1				3	8	4		3	
5 0		5	3	0	4	4	1	2	1	2	2	2	55	13	3	2	5	2	4	5	2
		7				6		4		7		2				5		9		4	7
6 0		4	3	0	5	2	1	2	5	8	2	2	56	27	3	2	1	5	5	5	5
		4	0		4	5		4	6			3				6	2	4			6
7 0		3	5	0	4	1	1	2	5	1	2	2	57	56	3	2	2	2	5	1	3
		1	8		4	2		5	1			4				7	0	9		7	1
8 0		1	2	1	3	7	1	2	4	6	2	2	59	35	3	2	2	1	5	2	1
		9	8		4			6	6			5				8	8	6		9	1
9 0		7	0	1	2	1	1	2	4	2	2	2	1	30	3	2	3	1	5	4	5
					4	1		7	1	3		7				9	6	4		0	6
1 0		5	3	1	1	2	1	2	3	5	2	2	3	36	4	0	4	2	5	5	4
0		4	4		4	3		8	6	3		8					4	4		2	6
1 0		4	1	1	4	4	1	2	3	3	2	2	5	57	4	1	5	4	5	4	4
1		2	0			2		9	2	5		9				2	1				1
1 0		2	4	1	5	1	2	0	2	3	3	0	8	32	4	3	1	8	5	1	4
2		9	9		5	0			8	0										6	0
1 0		1	3	1	4	4	2	1	2	3	3	1	11	22	4	4	9	4	5	2	4
3		7	0		5	7			4	8								5		8	4
1 0		5	1	1	3	3	2	2	2	5	3	2	14	22	4	5	1	3	5	4	5
4			4		6	3			0	9						8	1			0	0
1 0		5	0	1	2	2	2	3	1	3	3	3	17	34	4	6	2	2	5	5	0
5		3			7	7			7	4						7	7			3	
1 0		4	4	1	1	3	2	4	1	2	3	4	20	59	4	7	3	3	5	5	1
6		0	0		8	1			4	2						6	3				4
1 0		2	4	1	9	4	2	5	1	2	3	5	24	38	4	8	4	4	5	1	3
7		8	4			5			1	2						5	7			7	0
1 0		1	4	1	1	8	2	6	8	3	3	6	28	30	4	9	5	1	5	2	4

[illegible]

Mercury Equation and Latitude Tables (Tabulae 91–93, 87)

TABLE 91. Of the Maximum Equations, or Parallaxes of the Orb of Mercury (*Maximarum Aequationum, seu Parallaxium Orbis Mercurij*)

[Left side-label: Anomalia Aequata Mercurij (Equated Anomaly of Mercury). Right side-label: Anomalia Aequata Mercurij.]

Top argument heading: **Signa Completa Anomaliae Solis Aequatae** (Completed signs of the equated solar anomaly), running 0–VI across the top and XII–VI across the bottom.

The left double argument is *Sig.* (sign) and *G.* (degree); the right double argument is *G.* and *Sig.* read from the bottom. Each completed-sign column gives the maximum equation in *G.* (degrees) and ' (minutes). A degree value carried in a column applies down the column until the next printed degree value.

	0		I		II		III		IV		V		VI		G Si	
Si	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	Si
g.	.	.	0'	.	I'	II'	III'	IV'	V'	VI'	.	.	.	.	.	g.
0	0	2	18	2	23	27	34	27	51	28	7	2	19	28	23	0 1
		7		7								8				2
	6		17		21		33		49		5		17		21	2
																4
	1		11		16		28		44		0		12		16	1
	2															8
	1		3		8		19		35	27	51		3		8	1
	8															2
	2	2	52	2	56		8		23		39	2	51	27	55	6
	4	6		6								7				
	3	2	37		41	26	53		8		24		36		40	0 1
	0	6														1
1	3	2	29	2	33	26	44	27	0	27	15	2	27	27	31	2
		6		6								7				7
	6		20		24		35	26	51		6		18		22	2

	0		I				III		IV		V		VI		G Si
Si	G	G	G	I'	II	II'	G.	III'	G.	IV'	G	V'	G.	VI'	. g.
g.	.	.	0'	.	G.	II'	G.	III'	G.	IV'	.	V'	G.	VI'	
															4
	9	10		14		25		41	26	56		7		12	2
															1
	1	0		4		15		30		45	2	57		1	1
	2										6				8
	1 2	49	2	53	26	4		18		34		45	26	49	1 1
	5 5		5												5 0
1	1 2	37		41	25	52	26	7	26	22	2	33	26	37	1
	8 5										6				2
	2	25		29		40	25	55		10		21		15	9
	1													[?]	
	2	12		16		27		42	25	57		7		12	6
	4														
	2 2	59	2	3		14		29		43	2	54	25	58	3
	7 4		4								5				
	3 2	46	2	50	25	0		15		29		40		44	0 1
	0 4		4												0
2	2 2	37	2	41	24	51	25	5	25	20	2	31	25	35	2
	4		4								5				8
	4	28		32		41	24	55		10		21		26	2
															6
	6	18		22		32		46		0		11		15	2
															4
	8	9		12		22	24	36	24	50		1		5	2
															2
	1 2	0	2	2		11		26		40	2	51	24	55	2 9
	0 3	[?]	3								4				0
2	1 2	59	2	52	24	2	24	16	24	30	2	40	24	44	1
	2 3		3								4				8
	1	49	2	42	23	52		6		20		30		34	1
	4		3												6
	1	39		32		41	23	56		10		20		23	1

Si	0		I		II		III		IV		V		VI		G Si
g.	G	G	G		G.	II'	G.	III'	G.	IV'	G	V'	G.	VI'	. g.
	6														4
	1	29		22		32		45	23	59		10		12	1
	8														2
	2	18		12		22		35		49	2	59	23	2	1 9
	0										3				0
2	2 2	58	2	12	23	2	23	25	23	38	2	48	23	51	8
	2 2		3								3				
	2	48	2	1		51		14		27		37		41	6
	4		2												
	2	38		41		41		4		16		27		30	4
	6														
	2	28		31	22	41	22	54		6		16		19	2
	8														
	3	17		20		30		43	22	53		5		8	0 9
	0														
3	2 2	7	2	10	22	19	22	33	22	46	2	55	22	58	2
	2		2								2				8
	4 2	56	2	59	21	8		22		35		44		47	2
	1		1												6
	6	46		49		54		11		24		33		36	2
															4
	8	36		39		48		1		14		23		26	2
															2
	1	25		28		37	21	50		3		11		15	2 8
	0														0
3	1 2	15	2	18	21	27	21	40	21	52	2	1	22	4	1
	2 1		1								2				8
	1 2	5	2	8		16		29		41		0	21	53	1
	4 0		0									[?]			6
	1	56		59		7		19		32	2	50		43	1
	6										1				4
	1	46		50	20	59		9		22		42		33	1

Si	0		I		II		III		IV		V		VI		G Si
g.	G	G	G		G.		G.		G.		G		G.		. g.
	.	.	0'	I'		II'		III'		IV'	.	V'		VI'	
	8														2
	2	36		40		47	20	59		12		32		23	1 8
	0														0
3	2 2	26	2	30	20	37	20	49	21	2	2	10	21	13	8
	2 0		0								1				
	2	17		21		28	20	40	20	52		0		3	6
	4														
	2	8		12		18		30		42	2	50		53	4
	6										0				
	2 1	59		3		9		21		32		41		44	2
	8 9														
	3 1	50	1	54	19	0	19	12		23		32		35	0 8
	0 9		9			[?]									
4	3 1	37	1	40	19	47	19	59	20	10	2	19	20	22	2
	9		9								0				7
	6	24		28		34		46	19	57	1	5		8	2
											9	[?]			4
	9	12		15		21		34		45	1	53	19	56	2
											9				1
	1	1		4		10		22		33		41		44	1
	2														8
	1 1	50	1	54		0	18	10		21		29		33	1 7
	5 8		8			[?]		[?]							5
4	1 1	39	1	42	18	50	19	0	19	11	1	18	19	22	1
	8 8		8								9				2
	2	30		33		40	18	50		1	1	8		11	9
	1										8	[?]			
	2	20		23		31		41	18	52		59		2	6
	4											[?]			
	2	12		15		23		32		43		50	18	53	3
	7														
	3	4		7		14		24		35		42		45	0 7

	0		I								V					
Si	G	G		G	II		III		IV		G		VI		G	Si
g.	.	.	0'	.	I'	G.	II'	G.	III'	G.	IV'	.	V'	G.	VI'	. g.
	0															
5	6	1	50	1	55	18	0	18	10	18	21	1	28	18	31	2
		7		7								8				4
	1		40		43	17	49	17	59		9	1	16		19	1
	2											7				8
	1		32		35		41		51		1		8		11	1
	8															2
	2		27		30		37		47	17	57		4		6	6
	4															
	3		25		28		35		45		55		2		5	0
	0															6

Bottom argument heading (right-to-left): XII | XI | X | IX | VIII | VII | VI — **Signa Completa Anomaliae Solis Æquatae.**

TABLE 92. Of the Proportional Minutes of the Latitude of Mercury (*Scrupulorum Proportionalium Latitudinis Mercurij*)

Top argument heading: **Signa Completa Anomaliae Excentrici Mercurij Æquatae** (Completed signs of the equated eccentric anomaly of Mercury), running O–VI across the top and XII–VI across the bottom.

Left double argument: *Anom. orbis* ☿ — *Sig.* and *G.* Adjacent to it, *Scrup. propot. incr. & decr.* (proportional minutes, increasing and decreasing) in *G.* and *'*. The central blocks give *G.* and *'* per completed sign. To the right, a second *Scrup. propot. incr. & decr.* column, then *Decr. in ♂ directa* (decrement in direct Mars [motion]) in *'*, then *Anom. orbis* ☿ — *G.* and *Sig.* (read from below).

				I		I		I		V									
				I		I		I		V		I							
Anom.	Scrup.i	O	I	I	I	I	I	V	V	V	Scrup.i	Dec	Anom						
orbis ☿	ncr.&d			G	I	G	I	G		G	I	ncr.&d	r.♂	.orbis					
Sig.	ecr. G.	'	'	.	'	.	'	.	'	'	.	ecr. G.	'	☿ G.					
0	60 A.	5	1	1	2	1	5	2	2	1	2	3	60 A.	36	0				
		3	7	7	5	8	6	0	0	9	1	7							

Anom. orbis ♂ Sig.	Scrup.i ncr.&d ecr. G.	O '	I		I		I		V		Scrup.i ncr.&d ecr. G.	Dec r.♂ '	Anom .orbis ♂ G.			
			I '	I '	I '	I '	V '	I '								
1	59	5 4	1 8	2 7		5 8		2 2	2 1	3 9	59	36	24			
	59	5 6	2 0	2 9	1 9	1		2 5	2 4	4 2	59	36	18			
	58	1	2 5	3 6		8		3 2	3 2	5 0	58	35	12			
	56	8	3 3	4 5		1 7		4 2	4 2	2 2	57	35	6			
	54	1 8	4 3	5 8		3 0		5 5	5 5	1 3	56	34	0			
	52	2 8	5 4	1 8	1 2	1 9	4 5	2 1	1 3	2 3	3 1	54	33	24		
	50	3 9	5	2 4	2 0	4		3 3	3 5	5 4	52	32	18			
	47	5 4	2 1	1 9	6		2 4		5 4	0 3	2 0	49	30	12		
	44	1 1	4 0	3 4	2 1	1 5	2 2	1 8	2 5	4 9	46	29	6			
	40	3 1	3 9	1 4	3 4		4 9		4 9	5 8	2 4	2 3	43	28	0	
	2								[?]							
		35	5 4	2 8	2 0	4 0	2 1	4 7	2 3	2 5	3 6	2 5	2 5	39	26	24
		30	1 9	5 4	3 6	2 2	2 1	2 4	5 4	1 8	4 4	35	25	18		
		24	4 8	2 6	2 1	1 3		5 8		4 9	6 6	2 3	2 3	30	23	12
18		2	0	2	1	2	4	2	3	2	2	8	24	21	6	

Anom. orbis ♂ Sig.	Scrup.i ncr.&d ecr. G.	O	I		I		I		V		Scrup.i ncr.&d ecr. G.	Dec r.♂ '	Anom .orbis ♂ G.		
			I	I	I	I	V	I							
									G	I				G	I
		'	'	.	'	.	'	.	'	'	.	'			
		0		2	8	3	2	5	7		7				
				[											
				?											
				]											
3	11	5	3	2	3	2	3	2	3	2	2	2	18	19	0
		1	4	2	8	4	0	6	3		8				
	7	9	5	2	1	2	5	2	4	3	2	1	14	18	27
			3	3		4	6	7		6	9	0			
	4	2	1		2	2	2		3	1	2	4	10	17	24
		8	4		5	5	3		6	3	9	8			
3	0 B.	4	3		5		5	2	1	5	3	2	6	16	21
		8	5		1		2	8	1	1	0	8			
	2	9	0	2	1	2	2		4	3	3	1	2	15	18
				4	9	6	3		8	5	1	1			
				[											
				?											
3				]											
	4	3	2		4		5	2	1	1	3	5	0 B.	14	15
		0	1		7		6	9	7	7	1	8			
	6	5	4	2	1	2	3	3	9	5	3	4	4	13	12
		2	5	5	6	7	0	0			2	8			
	9	1	9		4	2	5		5	8	3	3	8	12	9
3		5			6	8			2		3	8			
	11	3	3	2	1		4	3	3	0	3	2	12	12	6
		8	4	6	6		2	1	7		4	8			
										[					
										?					
										]					
3	14	2	0		4	2	2	3	2	3	3	2	7	11	3
					8	9	2	2	4	3	5	2			

Anom. orbis ♂ Sig.	Scrup.i ncr.&d ecr. G.	O	I		I		I		V		V		Scrup.i ncr.&d ecr. G.	Dec r.♂ '	Anom .orbis ♂ G.
			I	I	I	I	I	V	V	I	V	I			
4	17	2	2	2	2	3	3	3	1	3	3	2	11	10	0
		6	8	7	2	0		3	3	2	6	4			
	19	5	5	2	5	3	4	3	5	3	3	2	12	9	27
		0	4	7	3	0	4	3	4	3	7	6			
	22	1	2	2	2	3	2	3	4	3	3	3	14	8	24
		5	0	8	4	1	7	4	9	7	8	2			
	25	4	4		5	3	1	3	4	4	3	4	17	8	21
		1	7		6	2	2	5	5	3	9	3			
	27	7	1	2	3	3	5	3	4	5	4	5	19	7	18
			6	9	0	2	8	6	3	3	0	6			
4	30	3	4	3	4	3	4	3	4	7	4	1	22	6	15
		3	4	0		3	7	7	5		2	4			
	33	5	1	3	3	3	3	3	4	2	4	3	26	5	12
		9	2	0	9	4	5	8	8	5	3	4			
	36	2	3	3	1	3	2	3	5	4	4	5	28	4	9
		5	9	1	1	5	4	9	5	7	4	8			
	39	5	9	3	4	3	1	4	2	9	4	2	31	4	6
		2		1	7	6	5	1	4		6	6			
	41	1	3	3	2	3	5	4	1	3	4	3	34	3	3
		7	7	2	1	7		2	4	0	7	5			
5	44	4	3	3	5		5	4	1	4	4	2	37	3	0
		0		2	2		5	3	8	7	9	4			
	47	4	2	3	2	3	4	4	2	1	5	5	40	2	27
			7	3	3	8	4	4	6	5	0	2			
	49	5	5		5	3	3	4	3	3	5	2	43	2	24
		4	4		5	9	1	5	3	6	2	6			
	52	4	1	3	2	4	1	4	3	2	5	5	47	1	21
			4	4	3	0	4	6	8		3	4			
	53	3	4	3	4	4	1	4	3	1	5	1	49	1	18
		8	7	5		1	7	7	6	6	5	6			

Anom. orbis ☿ Sig.	Scrup.i ncr.&d ecr. G.	O	I		I		I		V		Scrup.i ncr.&d ecr. G.	Dec r.♂ '	Anom .orbis ☿ G.	
			I	I	I	I	V	I	I	I				
			G	I	G	I	G		G	I				
	55	3 0	1 1	3 5	4	4 1	2 7	4 8	2 9	2 3 5 6	3 1	52	1	15
5	56	2 9	0	3 5	2 1	4 1	5 7	4 9	1 7	3 3 5 7	4 0	54	0	12
	57	4 0	1 2	3 5	3 5	4 2	2 1	5 6	1 6	1 6 5 8	3 8	57	0	9
	58	4 9	2 2	3 6	1 2	4 3	1	5 0	2 5	1 7 5 9	1 7	58	0	6
	59	5 6	3 0	3 6	5 3	4 3	4 1	5 1	0 1	3 4 5 9	4 2	59	0	3
	60	1	3 6	3 6	7 6	4 3	4 3	5 1	0 1	3 4 6 0	0	60	0	0

Bottom argument heading (right-to-left): XII | XI | X | IX | VIII | VII | VI — **Signa Completa Anomaliae Excentrici Æquatae Mercurij.**

TABLE 93. Of the Decrement of the Proportional Minutes of the Latitude of Mercury in Retrograde Mars [Motion]; When the Anomaly of the Orb Corresponds to the Lower Minutes of the Penultimate Column of the Preceding Table (*Decrementi Scrupulorum Proportionalium Latitudinis Mercurij in ♂ retrograda; Quando Anomalia Orbis respondet scrupulis inferioribus penultima columnae Tabulae praecedentis*)

Top argument heading: **Signa Completa Anomaliae Aequatae Excentrici Mercurij** (Completed signs of the equated eccentric anomaly of Mercury), running O–VI across the top and XII–VI across the bottom.

Left double argument: *Anomal. ☉ Aeq.* (equated solar anomaly) — *Sig.* and *G.*

Right double argument: *Anomal. Aeq. ♀* — *G.* and *Sig.* (read from below).

	O								V								S
			I							I			V				i
⊙ Æq.	G	O	G		II		III		V	IV	G	V	I	VI	Æq.♀	g	
Sig.	.	'	.	I'	G.	II'	G.	III'	G.	'	.	'	G.	'	G.	.	
0	3	4	3	3	3	18	2	46	2	10	1	3	1	29	0	1	
		6		8								9				2	
		4		3		17		45		10		3		29	24		
		5		7								9					
		4		3		15		44		9		3		28	18		
		3		5								8					
		4		3		13		43		8		3		28	12		
		1		3								8					
		3		3		10		40		6		3		26	6		
		7		0								6					
	3	3		2		7		37		3		3		24	0	1	
		3		6								3				1	
1	3	2	3	2	3	2	2	33	1	59	1	2	1	22	24		
		8		1								9					
		2		1	2	57		29		56		2		20	18		
		2		5								6					
		1		9		51		25		52		2		17	12		

⊙ Æq. Sig.	O								V						S i g .
	G	O	I	II	III			I	IV	G	V	V	VI	Æq.♀	
	.	'	.	I'	G.	II'	G.	III'	G.	'	.	'	G.	'	G.
2		5									3				
		8		2		45		19		48	2		14	6	
											1				
	2	0	2	5		38		12		43	1		11	0	1
				4							9				0
	2	5	2	4	2	29	2	5	1	38	1	1	1	7	24
		0		4							6				
		4		3		20	1	58		33	1		3	18	
		0		5							2				
		3		2		11		51		27	0	5	0	59	12
3		0		5							9				
		1		1		2		43		20	5		55	6	
		9		5							7				
	2	8	2	4	1	52		35		13	5		50	0	9
											0				
	1	5	1	5	1	41	1	26	1	7	0	5	0	46	24
		6		2							2				
		4		3		31		17	1	0	4		41	18	
		4		9							7				
		2		2		19		8		53	4		35	12	
4		9		5							2				
		1		1		8	0	59		46	3		31	6	
		7		3							6				
	1	6	1	4		0		49		38	3		27	0	8
						[?]					0				
	0	5	0	5	0	48	0	40	0	32	0	2	0	22	24
		5		3							5				
		4		4		38		32		25	2		18	18	
		4		2							0				
		3		3		28		24		18	1		13	12	
		3		1							4				

[illegible]

TABLE 87. Of the Latitude, Reduction, and Curtation of Mercury (*Latitudinis, Reductionis, & Curtationis Mercurij*)

Each block is headed by a Boreal sign (top) and an Austral sign (bottom): *Latitudo.* in *G.* and *'*; *Reductio.* in *'* and *"*; *Curtatio.* in *'* and *"*. The outer columns are *Dist. Gr.* (distance in degrees), ascending on the left, descending on the right.

[illegible]

D	O					I													D
is	L	O	O	O	O	L	I	I	I	I	II	II	II	II	II	II	II	is	
t.	a	L	R	R	C	a	I	R	R	I	L	II	II	II	II	II	II	t.	
G	t.	at	e	e	ur	t.	at	e	e	ur	t.	G.	at	ed	ed	rt.	rt.	G	
r.	.	'	'	"	t.'	"	.	'	"	t.'	"		'	.'	."	'	"	r.	
1	0	7	0	2	0	11	3	2	1	1	5	21	5	32	10	49	9	4	2
				8				0	1	6								9	
2	0	1	0	5	0	22	3	2	1	2	5	30	5	42	10	34	9	9	2
		3		4				5	1	7								8	
3	0	2	1	2	0	33	3	3	1	3	5	39	5	45	10	19	9	14	2
		0		2				1	1	9								7	
4	0	2	1	4	0	44	3	3	1	5	5	48	5	48	10	3	9	19	2
		7		6				6	1	0								6	
5	0	3	2	1	0	55	3	4	1	5	5	57	5	51	9	46	9	24	2
		4		3				2	1	9								5	
6	0	4	2	3	1	5	3	4	1	8	6	6	5	54	9	28	9	28	2
		1		9				8	2									4	
7	0	4	3	5	1	16	3	5	1	1	6	15	5	57	9	10	9	32	2
		7						4	2	5								3	
8	0	5	3	3	1	26	3	5	1	2	6	23	5	59	8	51	9	36	2
		4		0				9	2	2								2	
9	1	0	3	5	1	37	4	4	1	2	6	32	6	2	8	32	9	40	2
				6					2	8								1	
10	1	7	4	2	1	48	4	9	1	3	6	40	6	4	8	12	9	44	2
				1					2	3								0	
11	1	1	4	4	1	59	4	1	1	3	6	48	6	6	7	51	9	48	1
		4		7				4	2	8								9	
12	1	2	5	1	2	10	4	1	1	4	6	56	6	8	7	29	9	52	1
		1		1				9	2	0								8	
13	1	2	5	3	2	20	4	2	1	4	7	4	6	10	7	8	9	55	1
		7		6				4	2	3								7	
14	1	3	5	5	2	30	4	2	1	4	7	12	6	12	6	46	9	58	1
		4		9				9	2	4								6	
15	1	4	6	2	2	41	4	3	1	4	7	20	6	14	6	23	10	1	1
		0		3				4	2	5								5	

D is t. G r.	O L a t. G r.	O R e d. '	O R e d. "	O C u r t. '	O C u r t. "	I L a t. G r.	I L a t. '	I R e d. '	I R e d. "	I C u r t. '	I C u r t. "	II L a t. G.	II L a t. '	II R e d. '	II R e d. "	II C u r t. '	II C u r t. "	D is t. G r.	
1 6	1	4 6	6	4 6	2	51	4	3 8	1 2	4 4	7	28	6	15	5	59	10	4	1 4
1 7	1	5 3	7	8	3	2	4	4 3	1 2	4 3	7	35	6	17	5	36	10	7	1 3
1 8	1	5 9	7	2 9	3	12	4	4 7	1 2	4 0	7	42	6	18	5	11	10	9	1 2
1 9	2	6	7	5 1	3	23	4	5 2	1 2	3 8	7	50	6	19	4	47	10	11	1 1
2 0	2	1 2	8	1 2	3	33	4	5 6	1 2	3 3	7	57	6	20	4	21	10	13	1 0
2 1	2	1 9	8	3 2	3	43	5	1	1 2	2 8	8	4	6	22	3	56	10	15	9
2 2	2	2 5	8	5 1	3	53	5	5	1 2	2 2	8	11	6	23	3	30	10	16	8
2 3	2	3 1	9	1 0	4	3	5	9	1 2	1 5	8	17	6	24	3	5	10	17	7
2 4	2	3 7	9	2 8	4	13	5	1 3	1 2	8	8	23	6	25	2	39	10	18	6
2 5	2	4 4	9	4 6	4	23	5	1 7	1 1	5 9	8	29	6	25	2	13	10	19	5
2 6	2	5 0	1 0	3	4	33	5	2 1	1 1	5 0	8	35	6	26	1	46	10	20	4
2 7	2	5 6	1 0	1 9	4	43	5	2 5	1 1	3 9	8	41	6	26	1	22	10	21	3
2 8	3	2	1 0	3 4	4	52	5	2 8	1 1	2 7	8	47	6	27	0	54	10	21	2
2 9	3	8	1 0	4 9	5	2	5	3 2	1 1	1 6	8	53	6	27	0	27	10	22	1
3 0	3	1 4	1 1	3	5	11	5	3 5	1 1	3	8	59	6	27	0	0	10	22	0

Bottom argument heading: V Boreal. / XI Austral. — IV Boreal. / X Austral. — III Boreal. / IX Austral. — **Signa Distantiae Mercurij à Nodo Boreali.**

TABULA 95 — Prosthaphaeresis of the Orb (Saturn, Jupiter, Mars, Venus, and Mercury)

TABVLA 95. Prosthaphaeresis of the Orb [Prosthaphaeresis Orbis] for ♄ [Saturn], ♃ [Jupiter], ♂ [Mars], ♀ [Venus], and ☿ [Mercury] — devised by the most distinguished Dn. de S. Legier of Avignon [à Clariss. Dn. de S. Legier, Auenion.], and exactly computed.

Sub-heading: **Maximum, or composite, equation** [Æquatio maxima, seu composita]. — **ADD** [ADDE] (across the top); **SUBTRACT** [SVBTRAHE] (across the foot).

This is a single continuous table spanning the three pages of this opening. The left-hand argument column (S | G.) gives the degree of argument 1–30 within each sign-block; the descending argument (S | G.) on the right edge gives the complementary degree 29...0 with its own sign-number. The body columns are headed by the whole-degree value of the argument's sign-position (5, 6, 7, 8, 9, 10, 11, 12, 17, 18), each subdivided into G. (degrees) · ' (minutes) · " (seconds). Read the top sign-headers and "ADD" when the argument enters from the top; read the foot sign-headers and "SUBTRACT" when it enters from the bottom.

argument-blocks (top header signs 5–18; foot header signs 5–18)

Top sign-headers (degrees): 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18. Right-edge sign marker: 12. Foot sign-headers (degrees): 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18. Bottom legend: **SVBTRAHE**. Catchword/signature foot: R 2, PRO-.

5 °: G	6 °: G	7 °: G	8 °: G	9 °: G	10 °: G	11 °: G	12 °: G	17 °: G	18 °: G
0 4 4 0	5 4 0	6 3 0	7 2 0	8 7 0	8 5 0	9 3 0	1 2 0	1 3 0	1 1
9	1	1	0		2	6	0 0	3 4	4 1
0 9 3 0	1 2 0	1 2 0	1 4 0	1 1 0	1 4 0	1 1 0	2 3 0	2 9 0	2 2
7	1 2	3	4 0	6 4	7 5	9 3	0 9	7	8 0
0 1 2 0	1 2	1 3 0	2 0	2 2 0	2 3 0	2 4 0	3 5	4 4	4 3

5 °: G	6 °: G	7 °: G	8 °: G	9 °: G	10 °: G	11 °: G	12 °: G	17 °: G	18 °: G	
' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
	4 6	7	9 3	2	4 1	6 8	8 9	0 9	0 3	2 0
0	1 1	2 4	2 3	2 1	3 2	3 3	3 2	4 1 0	5 1 0	5 3
	9 4	2 2	6	9 9	2 8	5 0	8 5	1 8	4 7	6 8
0	2 2	2 2	3 3	3 3	4 3	4 2	4 0 0	5 3 1	7 5 1	1 4
	4	8 2	2 3	6 8	0 4	4 1	8	1 6	0	0 7
0	2 4	3 1	3 3	4 5	4 3 0	5 1 0	5 3 1	1 5 1	2 2 1	2 5
	8 9	4	9	3 6	8 8	3 2	7 5	4	1 3	4 5
	3 3	3 4	4 3	5 1 0	5 4 1	2 3 1	7 1 1	1 1	3 5	3 3
	3 6	9 1	5 3	1 4	6 3		1	2 1	4 5	9
	3 2	4 2	5 2 0	5 3 1	4 4 1	1 5 1	1 4 1	2 2	4 2 1	5 1
	8 3	5 0	2	8 1	8	0 3	6 5	2 8	8 7	3 0
	4 9	5 5 0	5 3 1	5 4 1	1 5 1	1 4 1	2 1	3 4 2	1 5 2	7 1
	3	0 7	8 0	8	2 1	9 2	6 8	2 4	7	6
	4 5 0	5 3 1	4 5 1	1 3	2 5	2 3	3 5	4 0 2	1 2 2	2 2
	7 5	6 4	7	3	0 4	8 0	5 1	3	5 7	1 1
	5 4 1	2 1 1	1 2 1	2 1	2 5	3 1	4 2 1	5 1	2 5	3 2
	2 0	1	1 3	0 8	8 6	7 7	5 3	3 4	8 6	5 5
0	5 2 1	7 4	1 4	2 3	3 5	4 3 1	5 5	3 2	4 2	4 2
	7 4	6	7 8	7 2	6 7	6	4 3	7	2 3	9 8
1	2 7 1	1 2	2 1	3 4	4 5	5 5 2	4 2 1	1 3	5 4 3	3 3
		3 1	4 3	4 5	4 6	4 3	2	3 7	5 9	0
1	6 4	1 5	3 3	4 5 1	5 5	3 3 1	1 5	2 4 3	9 1 3	1 1
	9	8 5	0 7	1 7	2 4	2	3 0	3 7	4	7 0
1	1 3	2 2	3 5	4 7 2	0 5	1 1 2	2 1	3 5 3	2 3	3 2
	1 1	4 8	6 9	9	2	2 5	3 6	3 6	2 7	1 9
1	1 2	3 0	4 2 1	5 1 2	8 4	2 5 2	3 4	4 3	3 5	4 2
	6 2	0	3 1	6 7	8	0 6	2 0	4	5 9	5 6
	2 5	3 3	4 4 2	3 2	1 4	2 3	4 3	5 9 3	4 1 3	5 2
	0 1	5 0	9 0	5	6 2	9 5	2	4	9 9	9 2
	2 2	4 5 1	5 5 2	1 3	2 3	3 1	5 2 2	4 1 4	2 3 4	1 1
	5 9	0 8	5 8	0 1	4 4	8 2	1 5	3	6	3 6
	3 6	4 2 2	2 1 2	1 3	3 2	4 4 3	0 4	1 1	1 5	2 7

5 °: G	6 °: G	7 °: G	8 °: G	9 °: G	10 °: G	11 °: G	12 °: G	17 °: G	18 °: G	
' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
0	6 6	5	7 5	2 5	6 8	5	4 6	5 3	7	
3 4	5 5 2	8 3	2 3	4 1	5 2 3	1 3	2 1	2 8	4 5	
4 2	1 3	1	4 8	0 4	5 2	0	4 6	9	0 7	
1 3 1 1	5 1 2	1 4	3 3	4 2 3	3 5 3	1 1	3 1	4 2 4	5 4	
9 6	7 7	4 4	1 9	8	4	9 9	4 3	2 0	4 5	
4 4 2	2 4	2 5	3 3 2	5 4 3	1 2	2 2	4 8	5 3 5	8 3	
3 9	0	0 6	8 8	5 7	2 5	8 2	4	5 0	0	
4 2 2	8 2	2 6	4 3 3	3 3	2 5 3	3 4	5 2 5	8 3	2 1	
8 1		7	5 6	0	0 3	7 4	4	8	2 3	
1 5 5 2	1 2	3 1 2	5 3 3	1 1	2 1 3	4 5 4	3 5	2 4	5 1	
2 1	3 2	3 4	2 1	1 2	9 8	6 2	4	1 2	1 4	
1 5 1 2	1 3	3 2 2	5 2	1 4	3 4 3	5 5 4	1 4	3 4	4 3	
7 9	8 9	9 0	9 3	8 9	7 1	5 9	3 3	4 4	9 2	
2 1 4	2 5	4 2 3	6 1	2 2	4 2 4	5 2 4	2 5 5	4 4 6	3 7	
6	3 5	5 4	5	6 6	6		3 5	7 4		
2 6 1	2 9 2	5 2 3	1 3	3 0 3	5 2 4	1 3	3 1	1 3	1 3	
0	9	1 6	3	4	4 0	4	3 2	5	6 9	
1 3	3 2 2	5 2	1 4	4 3 4	2 3 4	2 1	4 5 6	1 3	3 9	
0 3	4 1	7 5	9 9	1 1	5	3	2 2	5	0	
1 5	3 3 3	3 2	2 3	4 0 4	1 4	3 5	5 2 7	1 2	4 3	
4 4	9 1	2	6 2	9	0 8	1 8	2 8	7 6	3 6	
2 1 1 2	4 3 3	9 1	3 1 3	5 2 4	1 5 4	4 5 5	2 4	3 1 6	5 5	
9 3	4 8	7	3 4	6 5	8 8	0 1		9 3	6 9	
2 2 3 2	4 4 3	1 9 3	3 5 4	3 4 4	2 5 4	4 4 5	1 3 6	5 5 7	1 1	
3 1	9 2	5	9 1	8	7	9 0	1 7	1 7	0 9	
2 2 4 2	5 4 3	2 5 3	4 2 4	1 8 4	3 8 4	5 2	2 3 7	7 1	2 3	
7 6	4 6	0 9	6 7	1	5	8 6	1	4	3 6	
3 5 2	5 4 3	2 4	5 0 4	1 2	4 9 5	7 9	3 2	1 1 7	3 4	
1 9	9 8	6 6	3	8 6	3		0 7	7 4	6 9	
3 9 3	4 4	3 3	5 2 4	2 4	5 6 5	1 4	3 4 7	4 5	4 5	
6	5	2 1	9 9	5 0	1	5 9	9 8	7 7	9 7	
4 1 3	9 4	3 1 4	5 5	3 5 4	5 0	2 2	4 5 8	3 3 8	3 3	

5 °: G	6 °: ' " G	7 °: ' " G	8 °: ' " G	9 °: ' " G	10 °: ' " G	11 °: ' " G	12 °: ' " G	17 °: ' " G	18 °: ' " G	' "
	0 8	0	8 2	6	2 1	9	4 5	9		
	4 2 3	1 3	4 5 4	1 1	3 5 5	6 5	3 5	5 2 8	1 4	2 1
	4 4	4 2	3 0	2 9	9 8	0	2 8	8 0	6	9
	4 2	1 2	4 2	1 3	4 2 5	1 3	4 2 7	6 3	2 1	4 3
	8 8	9 3	9 6	8 9	7	4 2	1 7	0	9	3 6
	5 2	2 1 3	5 5	2 5 4	5 2	2 2	4 5 7	1 3 8	4 5	5 4
	2 9	4 0	4 8	4 5	4	2 0	9 1	6 5	1 6	7 7
2	5 2	2 5 4	0 2	3 9 5	0 5	2 1	5 1	2 3	5 4 9	1 5
	6 7	8 3	7	1	8	9 5	8 1	5 7	4 4	1 0
3	0 2	3 3 4	5 5	3 1 5	7 5	3 3 6	6 2	3 3 9	7 5	2 4
	3	3 5	3	7 9	1	7 4	8	4 5	0	5 1
3	4 1	3 1 4	1 1	4 2	1 4	4 4 6	1 4	4 2	2 8	3 2
	6	8 3	1 5	3 4	4 0	5	4 1	3 8	0	9 2
	8 7	4 4	1 3	4 2	2 2	5 2	2 4	5 1 9	3 4	4 7
		2 8	6 4	9 7	1 5	2 2	2 9	2 6	2 3	9
	1 5	4 2	2 5	5 2	2 5 5	5 5 6	3 5 7	1 1	4 1 10	5 3
	1 4	7 0	1 1	5 6	8	9 5	0 3		5	9
	1 3	5 4	2 3 5	1 2	3 4 6	7 1	3 5 7	9 4	5 3	1 3
	5 9	1 9	7	1	4 3	3	8 2	0	7 9	7 9
	1 2 3	5 1	3 1 5	7 1	4 1 6	1 2	4 4 7	1 1 10	9 1 10	1 6
	9 1	6 5	2 4	2	1 6	4 8	6 6	8 4	9	9
3	2 0 4	0 3 4	3 1	1 5 5	4 4	2 3 6	5 3	2 4 9	5 5 10	2 1
	3	6	7 8	2 9	7 4	1 7	4 6	6 4	4 8	2 4
	2 3 4	4 5	4 1	1 4 5	5 7	2 4 7	2 2	3 8	6 3	3 2
	6 6	4	2 7	8 1	4	8 1	1	5		4 4
	3 9	9 1	4 1	2 1 6	0 2	3 4 7	1 1	4 2	1 3	4 2
	0	0	7 2	4 9	7	5 1	0	3 8	7 6	5 8
	3 3	1 2	5 4	2 5 6	6 4	4 3 7	1 3	5 4 10	2 1	5 2
	3 9	3 1	2	9 3	1	2 6	7 6	1 2	7 4	6 8
	3 5	1 2 4	5 5	3 2	1 5 4	4 2 7	2 6 7	5 5	4 3 11	1 1
	7	7 9	6 4	5 2	2 1	9 6	5	9 1	0 9	0 9
3	4 2	2 3 5	1 3	4 4	1 5 6	5 1 7	3 3 8	7 5	1 5	2 8

5 °: G	6 °: G	7 °: G	8 °: G	9 °: G	10 °: G	11 °: G	12 °: G	17 °: G	18 °: G	
	0 8	1 3	7	0 7	8 6	6 1	2 0	4	8 6	0
3	4 4	2 3 5	6 1	4 6	2 5 7	2 5 7	3 4	1 5	2 5	3 4
	3 7	5 2	7	6	4 5	0	9 8	5 1	4 5	2 3
3	4 3	2 2	1 5 5	5 2	3 5 7	9 2 7	4 1	2 4	3 5	4 1
	7	9 7	0 3	1 1	0 0	3	7	3 2	0 0	5 8
	5 1	3 1	1 2 5	5 3	3 3 7	1 5 7	5 8	3 2	3 3	5 4
	0 4	3 9	5 4	6 1	6 9	5 1	4	1 8	6 9	6 5
	5 2 4	3 7	1 5 6	1 3	4 2	2 1 8	1 9	3 8 7	5 8 12	8 6
	3 3	7	9 0	7	2 3	2 4		9	4	
	5 3	4 5	2 1 6	6 3	4 3	2 3 8	8 4	4 4 8	8 4	1 2
	6 0	0 2	4 2	8	8	8 2		6 1		9 0
3	5 3	4 3	2 3 6	1 3	5 3	3 4 8	1 5	5 7 14	5 30	2 3
	9 2	4 0	8 0	1 3	3 7	4 4	4 3	3	3	8
4	2 2	4 5	3 4 6	1 2	5 3	4 4	2 3 8	5 3 21	3 41	2 2
	9	8	2 2	6 3	9	0 9	1 6	9	6	7
4	5 2	5 3	3 4	2 8 7	4 2	4 4 8	2 1 9	8 4 28	1 52	1 1
	4	1 6	6 9	1	4	6 8	8 2	2	2	9
4	8 1 4	5 2 5	4 5 6	2 4 7	9 4	5 4 8	3 4 9	1 4 34	4 1 3	3 0
	4	5	0 0	5 7	1	2 0	4 2	5 8	2 3	
5	0 6	0 7	0 8	0 9	0 10	0 11	0 12	0 17	0 18	0 G

continuation of TABULA 95

TABVLA 95. Prosthaphaeresis of the Orb ♄, ♃, ♂, ♀, & ☿. — Maximum, or composite, equation. **ADDE.** Top sign-headers (degrees): 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18. Right-edge sign marker: 10. Foot sign-headers: 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18 — **SVBTRAHE.** Catchword foot: PRO-.

5 °: G	6 °: G	7 °: G	8 °: G	9 °: G	10 °: G	11 °: G	12 °: G	17 °: G	18 °: G	
4	1 0 4	5 2 5	4 4 6	3 2 7	1 5 7	5 2 8	4 6 9	2 4 12	3 2 13	1 4
	1	8 3	4 9	0 0	4 1	8 7	1	2 8	7 7	3 1

5 °: G	6 °: ' " G	7 °: ' " G	8 °: ' " G	9 °: ' " G	10 °: ' " G	11 °: ' " G	12 °: ' " G	17 °: ' " G	18 °: ' " G	' "
4	1 4 5 3 2	1 4 1	4 4 6 8 1	3 4 8 4 7	4 7 8	4 7	4 2 7 3	2 4 9 1	4 2 13 7 0	2 9 4
4	1 2 5 6 0	4 5 2	5 2 2 9	3 1 9 0	9 4 0	9 4 0	5 3 3 2	3 2 12 6 6	5 7 7	3 3 4 1
4	1 5 8 4	8 0	5 1 6 0	4 2 3 6	1 7 5	1 7 8 5	5 3 9 5	4 5 13 3	6 4 4	4 4 4 4
	2 2 1 4	1 3 5 1	5 4 9 7	4 3 7 7	2 2 0 7	2 2 9 0 7	5 3 0	4 3 9 7	1 1 13 6 3	5 4 4 7
	2 5 5 3 0	1 1 6 4	3 1 9	5 4 1 1	2 4 5 0	2 4 5 0	1 1 9 1 8	5 0 6	2 3 14 5 2	4 4 5
4	2 1 5 6 2	1 5 6 6 5	6 4 6 3	5 3 5 9	3 4 0 8	3 4 0 8	1 5 10 6 9	2 1 5	3 4 14 4 3	1 2 4 9
	2 2 8 9	1 4 9 2	1 3 6 0	5 3 9 2	3 4 5 6	3 4 5 6	2 3 2 3	8 2 5	4 4 3 6	2 6 4
4	3 4 0 2	2 2 2 6	1 1 7 3 8	3 1 9	4 3 0 9	4 3 0 9	2 5 7 8	1 2 13 4 3	5 4 2 1	3 3 3 5
	3 5 5 2 0	2 3 5	1 2 7 6 6	6 5 7	4 2 5 1	4 2 5 1	3 1 3 5	2 1 14 0 4	1 2 4	4 5 2 4
	3 5 4 4	2 3 7 5	1 2 7 9 8	1 3 8 0 0	0 4 0	4 5 9 9	3 2 8 5	2 5 14 5 6	9 5 14 9	5 3 2
4	3 5 6 4	3 2 0	2 2 2 2	1 5 8 3 6	4 2 8	5 1 4 6	4 2 3 5	3 3 1 1	1 2 15 8 5	1 4
	3 4 5 8 8	3 2 6 2 5	2 1 5 4	1 1 8 7 6	8 5 0	5 5 8 0	4 1 10 8 9	3 5 6 6	2 3 15 6 9	9 5 4
	4 3 0 8	3 4 4 2	2 5 7 8	2 3 0 0	1 1 9 2 2	3 2	5 4 3	4 1 2 4	3 4 4 5	1 3 8 4
	4 2 2 4	3 5 6 3	3 3 0 6	2 3 3 6	1 1 6 3	7 8 9	5 4 7 2	4 2 7 2	4 3 2 8	2 0 7
4	4 4 5 4	3 5 6 8 7	3 8 7 3	2 3 8 6 7	1 1 9 9 4	1 6 10 1	2 9 10	5 2 14 2 1	9 5 14 9	5 3 2
	4 4 5 0	4 5 0 8	3 3 5 4	2 2 9 5	2 3 3	1 5 4 5	6 2 7	5 1 14 7 1	1 5 15 7 6	1 4

5 °: G	6 °: ' " G	7 °: ' " G	8 °: ' " G	9 °: ' " G	10 °: ' " G	11 °: ' " G	12 °: ' " G	17 °: ' " G	18 °: ' " G	' "
	4 1	4 5	3 5	3 1	2 4	1 1 10	1 3 11	1 5	2 3	9 5
	7 2	2 1	7 4	2 1	5 6	8 6	0 7	1	6 9	4
4	4 3 5	4 4 6	4 5	3 5	2 3	2 1	1 3	6 2 13	5 4	1 3
	8 8	4 1	0	4 0	8 5	1 6	4 9	2	2 1	8 4
	4 5	4 2	4 1	3 2	3 4	2 3	1 3	1 4 14	1 2 16	6 3
	9 9	6 5	2 3	7 1	1 8	5 1	8 0	0 3	4	7
	5 1	4 3 6	4 1	3 4	3 3	3 4	2 1	1 5	2 1 16	1 5
	1 5	8	4 1	9 3	4 5	8 6	2 2	4 4	6 5	3 6
4	5 2 5	4 3	4 8	4 5	3 1	3 5	2 4	1 5	2 5	2 5
	2 6	9 4	7	1 9	7 5	1 2	5 5	8 5	1	1
	5 3	5 5	4 4	4 6	3 4	3 4	2 8	2 4 15	4 2	2 0
	3 3	0 7	7 8	4	9 7	4 9	9	2 6	5 3	8
	5 3	5 1	4 2	4 7	4 1	3 3 10	3 2	2 2	5 2	3 4
	4 3	2 6	9 8	6	2 0	7 7	2 2	6 6	1 3	4 3
4	5 3	5 3 6	5 0	4 0	4 2	4 1	3 2	2 5	5 1	4 1
	5 0	3 0	1	8	4 5	0 4	5 7	9 7	1 9	1 4
	5 2	5 3	5 2	4 4	4 3	4 4	3 2	3 1 15	5 5	4 3
	6 1	4 7	2 6	9 4	6 0	2 3	8 0	3 6	7	7 0
	5 7 5	5 3	5 4	5 2	4 2	4 3	4 3	3 2 16	2 3	5 3
	7	5 5	3 3	1 1	8 8	5	1	6 4	7	3 4
4	5 4	5 3	5 5	5 5	5 1	4 1 10	4 3	3 2	7 5 16	5 2
	7 7	6 2	4 4	2 0	0 6	7 3	3 5	9 1	5	9 3
	5 2	5 2	5 5	5 1	5 5	4 1	4 5	4 6	1 5 17	4 5
	8 3	7 0	5 7	4 0	1 6	9 3	6	2	2 9	8
4	5 5 5	5 2 6	5 5 7	5 2 8	5 2 9	5 3 10	4 1 11	4 4 16	1 5 17	1 2
	8 2	8	6 4	5 4	3 7	1	8 0	4 2	7 0	0 0
4	5 1 5	5 3 6	5 4 7	5 2 8	5 4 9	5 4 10	5 9 11	4 6 16	2 2 17	1 2
	9 7	8 9	7 3	6 8	4 4	2 4	0	7	2 8	5 6
	5 3 5	5 8	5 2	5 2	5 1	5 1	5 0	4 1	2 4	2 1
	9 6	9	8 5	7 3	6	4 6	2	9 9	6 7	0 8
	5 4 5	5 3	5 5	5 1	5 5	5 3	5 4	5 1 16	3 5	2 5
	9 9	9 0	8 9	8 1	7	5 5	3 1	1 8	0 7	4 3

5 °: G	6 °: ' "	7 °: G	8 °: ' "	9 °: G	10 °: ' "	11 °: G	12 °: ' "	17 °: G	18 °: ' "	
4	5 5 9 7	5 4 9 7	5 2 8 9 5	0 0	5 5 7 8	5 4 6 4	5 8 5	5 0 3	3 2 5 4	2 3 8 9
5	0 0	5 5 9 7	5 4 9 4	0 0	5 3 8 9	5 4 7 3	5 2 6 5	5 0 4	3 1 9 3	3 0 2
4	5 5 6 9 7	0 0 6	5 5 7 9 6	5 5 8 9 5	5 3 9 8 3	5 3 11 7 1	5 0 11 6	5 0 16 6	4 0 17 4	3 8 7
4	5 4 6 9 9	0 0 7	0 0 8	0 0 9	0 0	5 3 12 7 1	0 0	5 1 7	4 4 4 2	4 4 0 0
	5 3 9 5	5 4 6 9 8	5 5 8 9 6	0 0	5 9 9	5 6 9	5 2 8 4	5 8 8	4 4 7 0	4 5 3 6
	5 1 9 6	5 3 6 9 1	5 5 7 9 5	5 5 9 5	5 5 9 4	5 3 9 5	5 6 9	5 0 9	5 1 0 3	4 5 6 9
	5 5 8 0	5 7 9	5 2 9 4	5 4 1 9 2 0	0 0 10	0 0 11	5 3 11 9 5	5 5 9 4	5 2 2 7	5 4 2
	5 2 8 0	5 3 8 7	5 5 8 7	5 2 9 9 0	5 5 11 9 4	0 0	5 2 8 5	5 2 9 0	5 2 17 4 5	5 0 6
	5 4 7 5	5 5 7 9	5 2 8 2	5 4 8 8	5 3 9 7	0 0	5 2 8 4	5 4 16 8 8	5 6 17 6	5 1 7
4	5 4 7	5 1 7 6	5 3 7 8	5 8 8	5 9 10 9	5 3 9 5	5 3 11 7 8	5 1 7 6	5 1 18 6 5	1 4
	5 1 6 4	5 2 6 7	5 4 6 8	5 1 7 9	5 2 8 9	5 6 9	5 4 6 8	5 2 6 7	5 3 18 2 0	4 1 4
4	5 2 5 5 1	5 3 6 5 0	5 5 7 5 1	5 2 8 6 1	5 3 9 7 9	5 2 11 8 0	5 5 11 5 1	5 5 5 0	5 3 1 1	5 2 4
	5 2 4 2	5 2 4 5	5 4 4 3	5 1 5 2	5 3 6 5	5 2 7 3	5 4 4 3	5 1 16 5 2	5 3 18 0 0	0 4
	5 1 3 9	5 1 3 5	5 2 3 7	5 1 5 1	5 2 5 2	5 1 6 5	5 2 3 7	5 3 4 5	1 5 3 4	3 5 7
4	5 9 2	5 5 1 6	5 4 2	5 3 3 0	5 5 10 3 1	5 5 4	5 4 2	5 1 16 3 9	5 2 9 3	9 5 4
	5 5 0 4	5 3 0 2	5 3 0 3	5 3 2 0	5 2 2 0	5 9 2	5 3 0 3	5 4 17 2	4 5 8 8	5 3 8

5	6	7	8	9	10	11	12	17	18	
°:	°:	°:	°:	°:	°:	°:	°:	°:	°:	
G	' "	G	' "	G	' "	G	' "	G	' "	G
	4 3	4 1	4 5	4 1	5 3	5 3	4 5	4 1	1 2 8	1 5
	9 2	9	8 2	9 0	0 0	1 1	8 2	9 0	0 9	3 6
4	4 4 5	4 2 6	4 5	4 1	4 4	4 2	4 5	5 4 17	1 2	2 3
	8	7 1	7	7 6	7 0	9 8	7	0	5 6	3 6
	4 3	4 3	4 9 7	4 1	4 1	4 1 11	4 4	4 1	2 4	3 2
	6 2	5 7	5	5 0	6 5	7 6	3 9	9 9	6 7	0 8
	4 5	4 4	4 4	4 5	4 4	4 4	4 2	5 1 16	3 5	3 1
	4 2	3 4	3	2 5	3 9	4 6	1 7	1 8	0 7	3 6
	4 1 5	4 4 6	4 5	4 3	4 1 10	4 5 12	1 1	5 1	3 6	1 5
	3 0	1 5	0 2	0 3	1 1	2	7 4	1 8	6	2 9
4	4 2	3 3	3 3 7	3 1	3 2	3 1	2 8	2 8	2 5	1 2
	1 0	9 9	8 2	8	8 1	9 0	1	1	5 0	9 8
	3 2	3 2	3 1	3 1	3 1	3 1 11	2 6	3 0	1 5	2 5
	9 4	7 5	6	5 8	5 9	6	2	7	3 6	5 0
	3 2 5	3 5 6	3 2	3 2	3 4 10	3 3	3 4	3 3 16	2 3	1 5
	7 2	5	3 4	2 6	2	2 9	3 5	3 2	7	3 4
	3 1	3 3	3 4	2 2	2 3 10	2 1	2 1	2 5	7 5 16	5 2
	5 4	2 7	0 0	9 4	8 5	9	9	9 1	5	9 3
4	3 4	3 4 6	2 4 7	2 1 9	2 5	2 1 11	2 1	2 5	2 4 17	2 1
	3	0	7 7	6 4	4 8	5 2	5 2	5 7	6 7	0 8
4	3 4 5	2 2 6	2 4 7	2 5 9	2 8 10	2 8 11	2 8 11	2 4 16	3 4 17	3 5
	0 6	7 3	4 6	2 2	1	1	1	1 3	1	3 0
5	0 6	0 7	0 8	0 9	0 10	0 11	0 12	0 17	0 18	0 G

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continuation of TABULA 95

TABVLA 95. Prosthaphaeresis of the Orb ♄, ♃, ♂, ♀, & ☿. — Maximum, or composite, equation. **ADDE.** Top sign-headers (degrees): 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18. Right-edge sign marker: 8. Foot sign-headers: 5 · 6 · 7 · 8 · 9 · 10 · 11 · 12 · 17 · 18 — **SVBTRAHE.** Catchword foot: PRO-.

5 °: G	6 °: ' " G	7 °: ' " G	8 °: ' " G	9 °: ' " G	10 °: ' " G	11 °: ' " G	12 °: ' " G	17 °: ' " G	18 °: ' " G	' "
4	2 2 5 8 1	2 3 6 4 5	2 3 7 1 5	1 2 8 9 2	1 5 9 7 0	1 0 10 7	1 4 11 6 9	1 1 16 7 3	2 1 17 6 8	2 7 9
4	2 5 5 5 2	2 4 6 1 0	1 1 8 8	1 4 8 5 2	1 5 9 3 0	1 4 10 2 3	1 1 2 5	1 2 16 2 8	2 8 17 1	2 0 4
4	2 1 3 8	1 3 8 9	1 5 4 2	1 5 1 3	9 4 9 0	8 1 10 3	7 3 11 0	7 2 16 6	1 3 17 5 3	1 2 8 9
	2 3 0 8	1 3 5 1	1 1 1 6	7 5 4	5 1 9 8	3 3 10 1	2 3 11 0	2 1 16 0	9 3 17 3	1 3 2 0
	1 5 5 7 4	1 1 6 2 8	7 3 7 3	3 4 8 8	0 4 8 8	5 3 9 8 9	5 1 10 7 7	5 4 16 6 0	3 9 17	6 5
4	1 2 5 5	8 5 6 6	3 4 6 4	5 3 7 9 0	5 4 8 6	5 3 9 3 1	5 4 10 1 9	5 5 15 0 2	5 2 16 6 5	5 1 9 5
	1 6 5 2	5 2 5 8	5 4 6 9 5	5 2 7 5	5 1 1 0	4 1 8 2	4 5 6	4 4 15 4 8	4 1 16 9 6	5 1 2
	9 4 5	1 5 5 4	5 3 5 9	5 2 7 0 3	4 4 6	4 3 2 8	4 8 0	3 2 15 8 7	4 3 1 8	4 1 4 4
4	5 5 4 8	5 1 5 8 2	5 2 6 1 5	4 3 5 7	4 4 8 0 8	3 5 6 5	3 5 3 7	3 5 15 1 2	3 3 3 6	3 6 6
4	2 4 4 4	5 2 4 3	4 2 7	4 4 0 2	3 1 5 9	3 5 0 6	2 3 10 7 0	2 0 15 5	2 1 5 0	2 2 7 5
3	5 2 9 7	5 2 5 0 8	4 3 2 2	3 3 5 7	2 4 9 1	2 4 4 6	2 5 10 0 0	1 5 15 7 2	1 1 16 6 6	1 1 8 9
3	5 4 6	4 2 6 8	3 5 6 7 3	3 2 7 0 3	2 5 9 3 2	1 2 10 8 3	1 5 10 3 8	1 2 15 0 9	6 5 16 9	8 4 5
	5 3 4 2 8	4 2 2 1	3 8 3	2 0 5	1 5 7 3	1 5 10 1 0	6 5 10 0	2 5 14 0	5 1 15 7 4	5 4 8 4
	4 5 9	3 8 8	2 1 8 5	1 2 9 8	1 4 9 1 2	6 0 9	5 2 9 9 8	5 4 14 4 4	4 4 15 7	4 1 8 5
3	4 2 5 7	3 4 5 3 8	2 1 3 4	1 4 7 3 6	5 2 7 1	5 5 9 8	5 5 9 1 2	4 4 14 6 4	3 2 6 8	3 1 7 8
3	4 4 1 4	2 2 9 3	1 6 6 8	7 5 6 6	5 5 7 8 1	5 5 8 0 4	4 3 9 4	3 1 14 8 8	2 2 5 5	2 5 5 0

5 °: G	6 °: ' " G	7 °: ' " G	8 °: ' " G	9 °: ' " G	10 °: ' " G	11 °: ' " G	12 °: ' " G	17 °: ' " G	18 °: ' " G	' "
	3 5	2 5	1 5 6	1 5	5 1	4 3	3 0	2 3 14	1 5	1 5
	7 8	4 1	2 1	7	2 0	3 1	6	9 6	3 7	3 4
3	3 7 4	2 1 5	7 2 5	5 4	4 1	3 5 8	2 4	2 3 14	2 1 15	1 3
	4	0 3	8	5 9	5 8	5 6	7 3	0 8		0
	3 1	1 3 5	1 5 5	4 3	3 1	2 9	1 1 9	1 2 13	4 3 14	4 3
	0 0	5 0	7	9 2	8 5	8	9 2	1 5	9 9	8 6
	1 8	1 4 4	5 2 4	4 7	3 3	2 1	1 2 9	1 5 13	3 5 14	3 1
	6	0 0	6 0	3	1	0 0	0 8	6	6 0	5 4
	2 2 4	5 4 4	5 3 4	3 3 6	2 4 7	1 0 8	1 3 8	5 1 13	2 3 14	2 2
	2	5	0 6	6 3	3 0	2	0	2 2	3 4	1 1
3	1 5 4	0 4 4	4 4	2 5	1 7 7	3 3 7	5 1 8	4 1 13	9 5 14	7 0
	7 1	3	4 3	9 0	6	6	2 8	2 2	2	
3	1 3 3	5 3	3 4	2 0 6	8 2 6	5 3 7	4 5 8	3 5 12	5 4 13	5 1
	3 7	5 6	8 3	3	5	5	2 4	1 8	5 4	2 0
	9 1 3	5 2	3 3	1 2 6	0 3	4 2 7	3 1 8	2 3 12	4 1 13	3 5
	8	0 4	2 7	6	2	6 0	3 8	1 0	1 0	6 1
3	4 5	4 5 4	2 2 5	8 5 5	5 3	3 2 7	2 2 8	1 4 12	2 2 13	2 1
	3	5	6 5	4	2 2	7 3	3 7	0 6	6 6	1
3	0 2	3 4	2 7 5	1 4 5	4 2	2 1	1 2 7	5 4 12	1 4 13	4 4
	5	9 3	0	0	4 3	8 7	3 5	9 7	0 0	4
2	5 5 3	3 1	1 4 4	5 1 5	3 2 6	1 5 7	3 9 7	4 3 11	5 4 12	4 5
	5 5	4 4	3 2	4 8	6	8 9		8 3	4 6	7 6
2	5 1	2 4	7 1 4	4 4 5	2 3 6	9 3 6	5 4 7	3 8 11	3 2 12	3 4
	1 9	8 1	1	6 9	7 5	2	2 0	7	8 9	0 3
2	4 3	2 4 4	0 3 4	3 1 5	1 5 6	9 3 6	4 3 7	2 2 11	2 4 12	1 5
	6 9	3	4	9 2	8 8	2	2	5 7	1 4	2 9
2	4 5 3	1 2 3	5 5 4	3 2 5	1 1 5	5 5 6	3 1 7	1 3 11	4 3 11	5 4
	1 5	7 1	3 0	1 7	0 0	0	1 2	3 3	3	4 6
2	3 7 3	1 3 3	4 1 4	2 3 5	1 1 5	4 6 6	2 1 7	1 2 10	4 5 11	3 4
	7	1 2	7	3 6	6	0	0 0	5	6 8	6
	3 1 3	5 4 3	4 7 4	1 3 4	5 1 5	2 5 6	8 5	4 1 10	2 5 11	1 5
	2 7	1	0	5 7	2 3	9 9	5	9 9	8 8	6 8

5	6	7	8	9	10	11	12	17	18										
°:	°:	°:	°:	°:	°:	°:	°:	°:	°:										
G	' "	G	' "	G	' "	G	' "	G	' "	G	' "	G	' "	G	' "	G	' "	G	' "
	2 2 2	5 4 3	3 6 4	7 3 4	4 2 5	1 4 5	5 2 6	3 1 10	1 0 10	5 3									
	7 3	9 4	3	1	3	9 1	7 2	6 4	1	7 8									

[Table continues — the lower portion of p. 99 runs the argument 4–30 down columns 5°–18° to the foot legend **SVBTRAHE**. and the foot sign-headers 5·6·7·8·9·10·11·12·17·18. The lower-block cells crowd toward the binding gutter and ink show-through; many seconds digits there are not separable at native resolution and The foot-block descending argument runs 27...0 on the right edge.]

Tabulae Novalmagesticae — TAB. 95 (Prosthaphaeresis of the Orb), continued

TABVLA 95. *Prosthaphaeresis Orbis* ♄, ♃, ♂, ♀, ♁ **et** ☉. [The composite prosthaphaeresis (parallax) of the orb for the five planets and the Sun.]

Æquatio maxima, seu composita — The maximum, or composite, equation.

Sub-heading **ADDE** (Add) at the top of each page; **SVBTRAHE** (Subtract) at the foot.

The table is a double-entry equation table. The interior columns are headed by the degree of the argument (19, 20, 21, 22, 23, 24, 25, 26, 27, 28), each subdivided into G(°) | ' (minutes) | " (seconds). The leftmost rail gives the sign-number **S** and the argument-degree **G**. (1–30); the rightmost rail gives the complementary descending degree and sign. Read top-down under the upper sign and **add**; read bottom-up under the lower sign and **subtract**.

top sign **S 0** / foot **S 11**

Upper block (argument 1–30, sign S 0; complement at right S 11)

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
0 14	0 15	0 15	0 16	0 16	0 17	0 17	0 18	0 18	0 19
44	18	50	21	52	21	49	17	44	10
0 29	0 30	0 31	0 32	0 33	0 34	0 35	0 36	0 37	0 38
28	35	39	42	43	42	38	34	28	20
0 44	0 45	0 47	0 49	0 50	0 52 2	0 53	0 54	0 56	0 57

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
12	52	29	3	34		27	52	11	30
0 58	1 1 9	1 3 18	1 5	1 7 25	1 9 23	1 11	1 13	1 14	1 16
56			23			17	8	54	40
1 13	1 16	1 19 7	1 21	1 24	1 26	1 29 5	1 31	1 33	1 35
39	25		44	15	43		24	38	49
1 28	1 31	1 34	1 38	1 41 5	1 44 2	1 46	1 49	1 52	1 54
21	41	55	3			53	40	21	58
1 43 3	1 46	1 50	1 54	1 57	2 1 21	2 4 40	2 7	2 11 3	2 14 6
	56	42	22	55			55		
1 57	2 2	2 6 29	2 10	2 14	2 18	2 22	2 26	2 29	2 33
44	11		40	43	39	28	10	45	14
2 12	2 17	2 22	2 26	2 31	2 35	2 40	2 44	2 48	2 52
25	25	16	57	31	56	14	23	26	21
2 27 5	2 32	2 38 1	2 43	2 48	2 53	2 57	3 2	3 7 6	3 11
	38		14	18	13	59	36		27
2 41	2 47	2 53	2 59	3 5 4	3 10	3 15	3 20	3 25	3 30
43	50	45	30		28	43	48	44	32
2 56	3 3 0	3 9 28	3 15	3 21	3 27	3 33	3 39	3 44	3 49
20			45	49	43	26	0	23	37
3 10	3 18	3 25	3 31	3 38	3 44	3 51 9	3 57	4 3 0	4 8 40
56	10	10	58	33	56		10		
3 25	3 33	3 40	3 48	3 55	4 2 8	4 8 50	4 15	4 21	4 27
31	18	50	10	15			18	36	42
3 40 4	3 48	3 56	4 4	4 11	4 19	4 26	4 33	4 40	4 46
	24	29	21	57	19	29	26	11	43
3 54	4 3	4 12 7	4 20	4 28	4 36	4 44 7	4 51	4 58	5 5 43
36	30		29	36	29		32	44	
4 9 5	4 18	4 27	4 36	4 45	4 53	5 1 44	5 9	5 17	5 24
	33	43	37	14	36		37	16	41
4 23	4 33	4 43	4 52	5 1 49	5 10	5 19	5 27	5 35	5 43
34	35	17	43		43	19	40	46	38
4 38 0	4 48	4 58	5 8	5 18	5 27	5 36	5 45	5 54	6 2 33
	34	49	47	24	47	53	41	15	
4 52	5 3	5 14	5 24	5 34	5 44	5 54	6 3	6 12	6 21

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
24	32	20	48	58	50	24	41	42	27
5 6 46	5 18	5 29	5 40	5 51	6 1 50	6 11	6 21	6 31 7	6 40
	28	48	48	29		53	39		18
5 21 7	5 33	5 45	5 56	6 7 57	6 18	6 29	6 39	6 49	6 59 8
	22	14	47		49	21	35	30	
5 35	5 48	6 0 38	6 12	6 24	6 35	6 46	6 57	7 7 52	7 17
24	13		42	24	45	46	28		56
5 49	6 3 2	6 16 0	6 28	6 40	6 52	7 4 9	7 15	7 26	7 36
40			35	48	39		20	11	42
6 3 53	6 17	6 31	6 44	6 57	7 9 31	7 21	7 33	7 44	7 55
	48	19	26	10		31	9	27	25
6 18 4	6 32	6 46	7 0	7 13	7 26	7 38	7 50	8 2 42	8 14 7
	32	35	15	29	20	50	56		
6 32 9	6 47	7 1 49	7 16	7 29	7 43 7	7 56 5	8 8	8 20	8 32
	43		0	46			41	54	46
6 46	7 1	7 16	7 31	7 45	7 59	8 13	8 26	8 39 4	8 51
12	50	59	42	59	51	19	22		23
7 0 14	7 16	7 32 6	7 47	8 1 31	8 16	8 30	8 44	8 57	9 9 56
	25		22		31	29	1	11	
7 14	7 30	7 47	8 2	8 18	8 33	8 47	9 1	9 15	9 28
12	57	12	59	18	10	37	38	15	28

Lower block (argument 1–30, sign S 1; complement at right S 10)

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
7 28 7	7 45	8 2 13	8 18	8 34	8 49	9 4 41	9 19	9 33	9 46
	25		32	22	45		11	16	56
7 41	7 59	8 17	8 34	8 50	9 6 17	9 21	9 36	9 51	10 5
57	50	11	2	23		43	41	14	22
7 55	8 14	8 32 6	8 49	9 6 22	9 22	9 38	9 54	10 9	10 23
45	12		30		46	42	9	10	45
8 9 30	8 28	8 46	9 4	9 22	9 39	9 55	10 11	10 27	10 42
	30	57	53	17	11	38	33	2	4
8 23	8 42	9 1 44	9 20	9 38	9 55	10 12	10 28	10 44	11 0
10	45		13	11	32	28	53	51	21

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
8 36	8 56	9 16	9 35	9 53	10 11	10 29	10 46	11 2	11 18
46	55	28	28	55	50	16	10	56	33
8 50	9 11	9 31 8	9 50	10 9	10 28	10 46	11 3	11 20	11 36
19	2		40	39	5	0	24	18	43
9 3 47	9 25	9 45	10 5	10 25	10 44	11 2	11 20	11 37	11 54
	4	43	45	19	15	41	34	56	49
9 17	9 39	10 0	10 20	10 40	11 0	11 19	11 37	11 55	12 12
11	2	15	52	54	22	17	39	31	51
9 30	9 52	10 14	10 35	10 56	11 16	11 35	11 54	12 13	12 30
30	55	41	51	25	24	49	41	1	50
9 43	10 6	10 29	10 50	11 11	11 32	11 52	12 11	12 30	12 48
46	44	4	47	52	22	18	39	28	44
9 56	10 20	10 43	11 5	11 27	11 48	12 8	12 28	12 47	13 6
55	29	22	37	15	15	42	32	50	35
10 10	10 34	10 57	11 20	11 42	12 4 4	12 25	12 45	13 5 7	13 24
1	8	35	23	33		1	21		21
10 23	10 47	11 11	11 35	11 57	12 19	12 41	13 2	13 22	13 42
1	43	42	4	46	48	16	6	22	3
10 35	11 1	11 25	11 49	12 12	12 35	12 57	13 18	13 39	13 59
57	14	46	39	54	28	26	46	31	41
10 48	11 14	11 39	12 4	12 27	12 51	13 13	13 35	13 56	14 17
47	37	45	11	57	3	31	21	36	14
11 1	11 27	11 53	12 18	12 42	13 6	13 29	13 51	14 13	14 34
32	57	37	37	55	32	31	52	35	42
11 14	11 41	12 7	12 32	12 57	13 21	13 45	14 8	14 30	14 52
11	10	24	57	47	56	27	17	30	6
11 26	11 54	12 21	12 47	13 12	13 37	14 1	14 24	14 47	15 9
45	18	6	12	35	14	16	37	19	24
11 39	12 7	12 34	13 1	13 27	13 52	14 17	14 40	15 4 3	15 26
11	20	42	20	16	27	0	51		37
11 51	12 20	12 48	13 15	13 41	14 7	14 32	14 57	15 20	15 43
33	16	12	24	52	35	39	0	43	46
12 3	12 33	13 1	13 29	13 56	14 22	14 48	15 13	15 37	16 0
48	6	35	20	21	36	11	3	16	48

19°''	20°''	21°''	22°''	23°''	24°''	25°''	26°''	27°''	28°''
12 15 57	12 45 49	13 14 52	13 43 10	14 10 44	14 37 31	15 3 38	15 29 0	15 53 43	16 17 44
12 27 59	12 58 25	13 28 2	13 56 55	14 25 0	14 52 20	15 18 58	15 44 52	16 10 4	16 34 35
12 39 54	13 10 56	13 41 7	14 10 33	14 39 11	15 7 3	15 34 13	15 59 41	16 26 20	16 51 21
12 51 44	13 23 20	13 54 6	14 24 5	14 53 16	15 21 40	15 49 21	16 16 17	16 42 30	17 8 0
13 3 26	13 35 36	14 6 56	14 37 29	15 7 13	15 36 10	16 4 23	16 31 49	16 58 33	17 24 33
13 15 0	13 47 45	14 19 39	14 50 45	15 21 3	15 50 32	16 19 17	16 47 15	17 14 29	17 41 0
13 26 27	13 59 48	14 32 15	15 3 55	15 34 13	16 4 47	16 34 4	17 2 34	17 30 19	17 57 19
13 37 47	14 11 41	14 44 44	15 16 57	15 48 21	16 18 56	16 48 43	17 17 45	17 46 1	18 13 32
19 0	20 0	21 0	22 0	23 0	24 0	25 0	26 0	27 0	28 0

top sign **S 2** / foot **S 9**

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
13 48 59	14 23 28	14 57 4	15 29 52	16 1 49	16 32 56	17 3 16	17 32 50	18 1 37	18 29 38
14 0 4	14 35 7	15 9 18	15 42 40	16 15 10	16 46 50	17 17 42	17 47 47	18 17 5	18 45 38
14 10 59	14 46 38	15 21 23	15 55 18	16 28 22	17 0 34	17 31 59	18 2 36	18 32 26	19 1 29
14 21 47	14 58 0	15 33 20	16 7 49	16 41 26	17 14 11	17 46 9	18 17 18	18 47 39	19 17 13
14 32 26	15 9 14	15 45 8	16 20 10	16 54 21	17 27 40	18 0 11	18 31 51	19 2 44	19 32 49
14 42	15 20	15 56	16 32	17 7 8	17 41	18 14	18 46	19 17	19 48

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
56	19	48	24		0	5	17	4	17
14 53	15 31	16 8	16 44	17 19	17 54	18 27	19 0	19 32	20 3
19	16	19	28	48	12	50	34	30	38
15 3	15 42	16 19	16 56	17 32	18 7	18 41	19 14	19 47	20 18
30	22	40	24	14	15	25	42	10	49
15 13	15 52	16 30	17 8	17 44	18 20	18 54	19 28	20 1	20 33
34	40	52	11	37	9	51	42	42	52
15 23	16 3	16 41	17 19	17 56	18 32	19 8 9	19 42	20 16	20 48
27	8	54	47	47	53		31	4	46
15 33	16 13	16 52	17 31	18 8	18 45	19 21	19 56	20 30	21 3
11	27	48	14	48	27	17	12	17	31
15 42	16 23	17 3	17 42	18 20	18 57	19 34	20 9	20 44	21 18
45	34	31	32	40	52	14	43	21	7
15 52	16 33	17 14	17 53	18 32	19 10	19 47	20 23	20 58	21 32
9	34	4	39	20	7	0	0	17	35
16 1	16 43	17 24	18 4	18 43	19 22	19 59	20 36	21 11	21 46
24	23	25	36	51	11	40	16	59	55
16 10	16 53	17 34	18 15	18 55	19 34	20 12	20 49	21 25	22 0
15	0	37	21	11	4	8	16	32	56
16 19	17 2	17 44	18 25	19 6	19 45	20 24	21 2	21 38	22 14
17	25	37	56	19	47	24	6	55	52
16 27	17 11	17 54	18 36	19 17	19 57	20 36	21 14	21 52	22 28
57	40	27	28	7	19	29	44	7	37
16 36	17 20	18 4 5	18 46	19 28	20 8	20 48	21 27	22 5 9	22 42
28	44		31	2	39	23	12		11
16 44	17 29	18 13	18 56	19 38	20 19	21 0 6	21 39	22 18	22 55
47	35	29	31	38	48		30	0	55
16 52	17 38	18 22	19 6	19 49	20 30	21 11	21 51	22 30	23 8
52	14	45	20	0	44	37	34	37	46
17 0	17 46	18 31	19 15	19 59	20 41	21 22	22 3	22 43	23 21
45	45	46	55	10	28	55	25	2	45
17 8	17 54	18 40	19 25	20 9 7	20 52	21 34	22 15	22 55	23 34
27	59	34	19		0	1	6	17	33
17 15	18 3	18 49	19 34	20 18	21 2	21 44	22 26	23 7	23 47

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
55	0	10	28	50	18	54	32	17	8
17 23	18 10	18 57	19 43	20 28	21 12	21 55	22 37	23 19	23 59
11	50	33	25	22	23	33	46	6	30
17 30	18 18	19 5	19 52	20 37	21 22	22 6 0	22 48	23 30	24 11
14	26	44	8	40	16		47	41	40
17 37	18 25	19 13	20 0	20 46	21 31	22 16	22 59	23 42	24 23
2	44	38	39	43	53	12	33	1	35
17 43	18 32	19 21	20 8	20 55	21 41	22 26	23 10	23 53	24 35
39	55	21	53	33	17	10	6	9	17
17 50	18 39	19 28	20 16	21 4 8	21 50	22 35	23 20	24 4 2	24 46
0	49	49	55		26	54	24		44
17 56	18 46	19 36	20 24	21 12	21 59	22 45	23 30	24 14	24 57
7	29	0	41	23	20	21	28	40	57
18 2 0	18 52	19 42	20 32	21 20	22 7	22 54	23 40	24 25	25 8
	54	58	10	32	59	36	16	3	55

Lower block (argument 1–30, sign S 3; complement at right S 8)

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
18 7	18 59	19 49	20 39	21 28	22 16	23 3	23 49	24 35	25 19
38	4	40	27	22	23	33	49	10	37
18 13	19 4	19 56	20 46	21 35	22 24	23 12	23 59	24 45	25 30
0	58	4	26	55	30	14	5	2	4
18 18	19 10	20 2	20 53	21 43	22 32	23 20	24 8	24 54	25 40
6	36	16	8	11	20	39	5	37	14
18 22	19 15	20 8	20 59	21 50	22 39	23 28	24 16	25 3	25 50
58	58	11	34	12	54	47	48	56	9
18 27	19 21	20 13	21 5	21 56	22 47	23 36	24 25	25 12	25 59
31	2	46	44	53	9	38	13	55	43
18 31	19 25	20 19	21 11	22 3	22 54	23 44	24 33	25 21	26 9 3
50	50	7	26	18	9	12	22	39	
18 35	19 30	20 24	21 17	22 9	23 0	23 51	24 41	25 30	26 18
51	20	8	10	25	49	26	11	3	3
18 39	19 34	20 28	21 22	22 15	23 7	23 58	24 48	25 38	26 26
34	34	53	31	13	10	22	41	9	44

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
18 43 1	19 38 30	20 33 18	21 27 21	22 20 43	23 13 13	24 4 58	24 55 53	25 45 57	26 35 7
18 46 8	19 42 8	20 37 25	21 32 0	22 25 52	23 18 56	24 11 14	25 2 44	25 53 23	26 43 9
18 48 59	19 45 27	20 41 12	21 36 19	22 30 42	23 24 19	24 17 12	25 9 16	26 0 9	26 50 52
18 51 31	19 48 25	20 44 40	21 40 17	22 35 12	23 29 22	24 22 49	25 15 27	26 7 16	26 58 14
18 53 44	19 51 3	20 47 49	21 43 57	22 39 22	23 34 4	24 28 4	25 21 17	26 13 41	27 5 16
18 55 37	19 53 23	20 50 36	21 47 13	22 43 8	23 38 24	24 32 58	25 26 44	26 19 48	27 11 53
18 57 10	19 55 25	20 53 3	21 50 8	22 46 34	23 42 22	24 37 31	25 31 48	26 25 23	27 18 9
18 58 23	19 57 2	20 55 10	21 52 42	22 49 50	23 45 56	24 41 36	25 36 30	26 30 39	27 24 1
18 59 16	19 58 17	20 56 52	21 54 54	22 52 21	23 49 10	24 45 20	25 40 49	26 35 33	27 29 30
18 59 49	19 59 15	20 58 14	21 56 42	22 54 39	23 51 58	24 48 42	25 44 43	26 40 1	27 34 34
19 0 0	19 59 49	20 59 13	21 58 8	22 56 32	23 54 23	24 51 39	25 48 12	26 44 5	27 39 13
18 59 49	20 0 0	20 59 49	21 59 10	22 58 3	23 56 22	24 54 10	25 51 23	26 47 42	27 43 25
18 59 14	19 59 49	21 0 0	21 59 48	22 59 8	23 57 55	24 56 13	25 53 52	26 50 52	27 47 11
18 58 20	19 59 14	20 59 49	22 0 0	22 59 47	23 59 4	24 57 50	25 56 3	26 53 38	27 50 30
18 57 1	19 58 16	20 59 11	21 59 48	23 0 0	23 59 46	24 59 2	25 57 45	26 55 53	27 53 21
18 55 21	19 56 53	20 58 13	21 59 5	22 59 47	24 0 0	24 59 46	25 59 0	26 57 40	27 55 42
18 53 16	19 55 6	20 56 45	21 58 5	22 59 7	23 59 46	25 0 0	25 59 45	26 58 58	27 57 34

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
18 50	19 52	20 54	21 56	22 57	23 59	24 59	26 0	26 59	27 58
46	53	48	32	59	2	46	0	44	55
18 47	19 50	20 52	21 54	22 56	23 57	24 59	25 59	27 0 0	27 59
53	15	28	32	18	50	0	45		43
18 44	19 47	20 49	21 52	22 54	23 56	24 57	25 58	26 59	28 0 0
34	10	40	4	15	5	44	57	44	
18 40	19 43	20 46	21 49	22 51	23 53	24 55	25 57	26 58	27 59
52	41	26	8	40	55	58	39	53	43
18 36	19 39	20 42	21 45	22 48	23 51	24 53	25 55	26 57	27 58
42	43	42	42	33	11	39	46	32	52
19 0	20 0	21 0	22 0	23 0	24 0	25 0	26 0	27 0	28 0

Foot of page 2: **SVBTRAHE**.

top sign S 4 / foot S 7 (descending branch)

On this page the print is fainter and several leading degree-digits failed to ink; where the degree integer is dropped from the type it is reconstructed from the smooth column progression and flagged, or marked [?] where not recoverable.

Upper block (argument 1–30, sign S 4; complement at right S 8)

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
18 32	19 35	20 38	21 41	22 44	23 47	24 50	25 53	26 55	27 57
7	18	30	45	55	55	45	19	34	25
18 27	[19]	[20]	21 37	22 40	23 44	24 47	25 50	26 53	27 55
5	30 25	33 50	19	46	5	19	19	1	21
[18]	[19]	[20]	22 32	22 36	23 39	24 43	25 46	26 49	27 52
21 37	25 4	28 38	21	5	42	18	41	50	41
[18]	19 19	[20]	21 26	22 30	23 34	24 38	25 42	26 46	27 49
15 41	15	22 58	52	50	45	43	29	4	22
[18] 9	[19]	[20]	21 20	22 25	23 29	24 33	25 37	26 41	27 45
20	12 58	16 48	52	4	15	32	49	40	25
18 2	19 6	[20]	21 14	22 18	23 23	24 27	25 32	26 36	27 40
30	10	10 5	19	42	8	42	11	35	48
17 55	18 58	20 2	21 7	22 11	23 16	24 21	25 26	26 30	27 35
10	51	50	11	44	24	14	2	49	28

19°''	20°''	21°''	22°''	23°''	24°''	25°''	26°''	27°''	28°''
17 47 21	18 51 0	19 55 2	20 59 28	22 4 10	23 9 1	24 14 7	25 19 13	26 24 40	27 29 23
[17] 39 6	18 42 40	19 46 45	20 51 13	21 56 2	23 1 0	24 6 22	25 11 44	26 17 12	27 22 38
[17] 30 18	18 33 50	19 37 50	20 42 20	21 47 14	22 52 24	23 57 54	25 3 31	26 9 17	27 15 5
[17] 21 2	18 24 25	19 28 23	20 32 53	21 37 49	22 43 5	23 48 45	24 54 36	26 0 38	27 6 45
[17] 11 17	18 14 32	19 18 22	20 22 50	21 27 47	22 33 7	23 38 55	24 44 57	25 51 14	26 57 40
17 1 1	18 4 5	19 7 48	20 12 10	21 17 5	22 22 28	23 28 22	24 34 33	25 41 4	26 47 46
16 50 14	17 53 11	18 56 38	20 0 53	21 5 45	22 11 9	23 17 12	24 23 23	25 30 6	26 37 2
16 38 57	17 41 31	18 44 49	19 48 57	20 53 41	21 59 11	23 5 23	24 11 25	25 18 15	26 25 23
16 27 10	17 29 26	18 32 50	19 36 24	20 41 22	21 46 47	22 52 15	23 58 41	25 5 38	26 12 59
16 14 50	17 16 46	18 19 32	19 23 12	20 27 39	21 33 47	22 38 39	23 45 7	24 52 8	25 59 37
16 2 0	17 3 32	18 5 58	19 9 21	20 13 31	21 19 4	22 24 8	23 30 43	24 37 45	25 45 20
15 48 58	16 49 43	17 51 46	18 54 49	19 58 45	21 4 4	22 9 8	23 15 27	24 22 29	25 30 6
15 34 45	16 35 20	17 36 58	18 39 38	19 43 14	20 47 44	21 53 10	22 59 21	24 6 18	25 13 55
15 20 17	16 20 22	17 21 30	18 23 46	19 27 9	20 31 36	21 36 20	22 42 41	23 49 10	24 56 45
15 5 18	16 4 49	17 5 25	18 7 10	19 9 49	20 14 32	21 18 40	22 24 17	23 31 0	24 38 24
14 49 46	15 48 42	16 48 43	17 49 57	18 51 50	19 55 4	20 59 14	22 5 36	23 12 26	24 20 17
14 33 47	15 32 0	16 31 23	17 32 11	18 34 4	19 36 37	20 40 48	21 45 56	22 53 2	24 1 28

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
14 17 11	15 14 35	16 13 23	17 13 22	18 15 8	19 16 57	20 20 34	21 25 14	22 33 0	23 41 28
14 0 6	14 56 48	15 54 46	16 54 41	17 54 38	18 56 23	19 59 27	21 3 39	22 9 27	23 19 1
13 42 26	14 38 19	15 35 29	16 34 1	17 33 52	18 36 25	19 37 25	20 41 4	21 47 12	22 55 4
13 24 18	14 19 18	15 15 37	16 13 20	17 12 23	18 14 32	19 14 32	20 17 34	21 23 14	22 31 35
13 5 36	13 59 39	14 55 4	15 51 54	16 50 42	17 49 41	18 50 42	19 53 12	20 58 8	22 6 41
12 46 22	13 39 26	14 33 52	15 29 46	16 27 4	17 25 49	18 25 58	19 27 33	20 30 32	21 34 53

19°''	20°''	21°''	22°''	23°''	24°''	25°''	26°''	27°''	28°''
12 26 39	13 18 40	14 12 4	15 6 57	16 3 16	17 1 4	18 0 21	19 1 5	20 3 16	21 6 54
12 6 24	12 57 18	13 49 36	14 43 26	15 38 43	16 35 24	17 33 48	18 33 36	19 34 54	20 37 43
11 45 58	12 35 22	13 26 32	14 19 13	15 13 23	16 9 4	17 6 20	18 5 7	19 5 28	20 7 21
11 24 23	12 12 53	13 2 50	13 54 19	14 47 19	15 41 50	16 37 58	17 35 39	18 34 57	19 35 50
11 2 40	11 49 53	12 38 33	13 28 46	14 20 31	15 13 48	16 8 43	17 5 14	18 3 22	19 3 9
10 40 24	11 26 18	12 13 36	13 2 30	13 52 58	14 44 53	15 38 30	16 33 44	17 30 38	18 29 13
10 17 41	11 2 12	11 48 8	12 35 37	13 24 51	14 15 12	15 7 54	16 1 18	16 56 52	17 54 38
9 54 32	10 37 35	11 22 38	12 8 51	12 56 38	13 44 42	14 35 29	15 27 54	16 22 1	17 17 49
9 30 55	10 12 28	10 55 25	11 39 54	12 25 58	13 13 36	14 2 40	14 53 32	15 46 6	16 40 31
9 6 51	9 46	10 28	11 11	11 55	12 41	13 28	14 18	15 9	16 1

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
	50	13	1	28	23	58	12	11	50
8 42	9 20	10 0	10 41	11 24	12 8	12 54	13 41	14 31	15 22
23	44	29	41	23	35	27	56	8	5
8 17	8 54	9 32	10 11	10 52	11 35	12 19	13 4	13 52	14 41
27	10	11	40	36	1	4	44	5	12
7 52	8 27	9 3 26	9 41	10 20	11 0	11 42	12 26	13 12	13 59
10	9		11	31	47	55	40	5	14
7 26	7 59	8 34 9	9 10	9 47	10 25	11 5	11 47	12 31	13 13
29	41		12	11	49	59	43	5	41
7 0 27	7 31	8 4 26	8 38	9 13	9 50	10 28	11 7	11 49	12 32
	50		43	34	12	20	57	11	4
6 34 3	7 3	7 34	8 6	8 39	9 13	9 49	10 27	11 6	11 46
	34	15	16	24	57	56	22	22	57
6 7 20	6 34	7 3 40	7 33	8 4 42	8 37 5	9 10	9 46	10 22	11 0
	57		31			51	1	41	53
5 40	6 5	6 32	7 0	7 29	7 59	8 31 8	9 3	9 38	10 13
13	58	40	30	28	39		56	10	52
5 13 0	5 36	6 1 18	6 27	6 53	7 20	7 50	8 21	8 52	9 26 0
	40		0	46	40	48	11	53	
4 45	5 7 3	5 29	5 53	6 17	6 43	7 9 54	7 37	8 6 52	8 37
24		36	6	37	11		45		18
4 17	4 37	4 57	5 18	5 41 4	6 4 14	6 28	6 53	7 20	7 47
34	10	34	51			27	44	11	50
3 49	4 7 1	4 25	4 44	5 4 8	5 24	5 46	6 9	6 32	6 57
32		15	16		52	33	12	54	41
3 21	3 36	3 52	4 9	4 26	4 45 7	5 4 13	5 24	5 45 3	6 6 54
17	39	39	24	53			9		
2 52	3 6 5	3 19	3 34	3 49	4 5 2	4 21	4 38	4 56	5 15
51		52	16	19		28	41	42	33
2 24	2 35	2 46	2 58	3 11	3 24	3 38	3 52	4 7 54	4 23
17	20	51	54	29	38	25	48		44
1 55	2 4	2 13	2 23	2 33	2 44 0	2 55 4	3 6	3 18	3 31
34	26	41	21	27			38	46	29
1 26	1 33	1 40	1 47	1 55	2 3 11	2 11	2 20	2 29	2 38

19° ' "	20° ' "	21° ' "	22° ' "	23° ' "	24° ' "	25° ' "	26° ' "	27° ' "	28° ' "
46	26	23	45	14		30	12	20	54
0 57	1 2	1 6 59	1 11	1 16	1 22	1 47	1 33	1 39	1 46 4
53	20		50	54	12	45	35	41	
0 28	0 31	0 33	0 35	0 38	0 41 8	0 43	0 46	0 49	0 53 5
58	12	30	57	28		54	49	52	
0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
19 0	20 0	21 0	22 0	23 0	24 0	25 0	26 0	27 0	28 0

Foot of page 3: **SVBTRAHE**.

PROSTHAPHAERESES OF THE ORB [PROSTAPHÆERESES ORBIS]

TAB. 95. Prosthaphaeresis of the Orb ♄, ♃, ♂, ♀, & ☿ (*continued*)

[Margin / column-band labels: across the top of each page the operation marker reads **ADDE** ("ADD"); along the bottom it reads **SUBTRAHE** ("SUBTRACT"). The leftmost banner reads **Æquatio maxima, seu composita** ("The maximum, or composite, equation"). The running header reads **PROSTAPHÆERESES ORBIS**.]

These three pages continue the composite prosthaphaeresis table (TAB. 95) introduced earlier, now carrying the high-degree argument columns for the maximum (composite) equation common to the five planets (Saturn ♄, Jupiter ♃, Mars ♂, Venus ♀, and Mercury ☿). Each page is a single table: the left-hand index gives the sign **S** and degree **G.** of the argument (1–30), and each value cell is a triple **G. ' "** (degrees, minutes, seconds) of the equation. The descending index and sign-block on the right edge serve the inverse reading (argument-complement), with the operation reversing from ADD (above) to SUBTRACT (below). The body argument columns are headed **29, 30, 34, 35, 36, 37, 38, 39, 40, 41** (degrees of the argument).

Page 1 (source PDF p. 553; printed p. 101)

[Left sign-block index: rows 1–30 under **S 0**, then rows 1–30 under **S 1**. Right descending index: **S 12** at top down to **S 11**. Operation: ADDE above, SUBTRAHE below.]

Argument-degree columns: 29 · 30 · 34 · 35 · 36 · 37 · 38 · 39 · 40 · 41 (each cell = G ' '')

Sign block S 0 (left index G 1–30)

G	29	30	34	35	36	37	38	39	40	41	(G.)
1 0 19	0 20	0 21	0 21	0 22	0 22	0 22	0 23	0 23	0 23	0 23	2
35	0	31	52	13	32	51	10	28	46	46	9
2 0 39	0 40	0 43	0 43	0 44	0 45 5	0 45	0 46	0 46	0 46	0 47	2
10	0	2	44	26		43	20	57	32	32	8
3 0 58	1 0 0	1 4	1 5 36	1 6 38	1 7 38	1 8 35	1 9 31	1 10	1 11	1 11	2
46		33						25	18	18	7
4 1 18	1 19	1 26	1 27	1 28	1 30	1 31	1 32	1 33	1 34 4	1 34 4	2
21	59	4	28	50	10	26	41	54			6
5 1 37	1 39	1 47	1 49	1 51 2	1 52	1 54	1 55	1 57	1 58	1 58	2
55	58	35	19		41	17	51	22	50	50	5
6 1 57	1 59	2 9 5	2 11	2 13	2 15	2 17 8	2 19 0	2 20	2 22	2 22	2
30	57		11	14	13			50	35	35	4
7 2 17	2 19	2 30	2 33 1	2 35	2 37	2 39	2 42	2 44	2 46	2 46	2
3	55	34		25	44	59	10	17	20	20	3
8 2 36	2 39	2 52	2 54	2 57	3 0 15	3 2 49	3 5 19	3 7 45	3 10 5	3 10 5	2
36	53	3	52	36							2
9 2 56	2 59	3 13	3 16	3 19	3 22	3 25	3 28	3 31	3 33	3 33	2
9	50	31	42	47	45	39	27	11	49	49	1
1 3 15	3 19	3 34	3 38	3 41	3 45	3 48	3 51	3 54	3 57	3 57	2
0 41	47	59	31	56	15	28	35	37	33	33	0
1 3 35	3 39	3 56	4 0 19	4 4 5	4 7 44	4 11	4 14	4 18 2	4 21	4 21	1
1 12	43	26				16	42		16	16	9
1 3 54	3 59	4 17	4 22 7	4 26	4 30	4 34 4	4 37	4 41	4 44	4 44	1
2 42	37	53		13	12		49	27	58	58	8
1 4 14	4 19	4 39	4 43	4 48	4 52	4 56	5 0 55	5 4 51	5 8 40	5 8 40	1
3 11	30	18	53	29	40	51					7
1 4 33	4 39	5 0	5 5 39	5 10	5 15 6	5 19	5 24 0	5 28	5 32	5 32	1
4 38	22	43		26		37		15	21	21	6
1 4 53	4 59	5 22	5 27	5 32	5 37	5 42	5 47 4	5 51	5 56 2	5 56 2	1

G										(
. 29	30	34	35	36	37	38	39	40	41	G.)
5 4	14	6	24	32	32	22		37		5
1 5 12	5 19	5 43	5 49 8	5 54	5 59	6 5 7	6 10 7	6 14	6 19	1
6 29	4	29		37	57			59	41	4
1 5 31	5 38	6 4	6 10	6 16	6 22	6 27	6 33	6 38	6 43	1
7 53	53	50	51	41	21	50	10	19	20	3
1 5 51	5 58	6 26	6 32	6 38	6 44	6 50	6 56	7 1 39	7 6 57	1
8 15	40	10	32	43	43	32	11			2
1 6 10	6 18	6 47	6 54	7 0 44	7 7 4	7 13	7 19	7 24	7 30	1
9 36	26	29	13			13	11	58	34	1
2 6 29	6 38	7 8	7 15	7 22	7 29	7 35	7 42	7 48	7 54	1
0 56	11	46	52	44	25	53	10	15	10	0
2 6 49	6 57	7 30	7 37	7 44	7 51	7 58	8 5 8	8 11	8 17	9
1 14	53	2	29	43	44	32		32	44	
2 7 8	7 17	7 51	7 59 5	8 6 40	8 14 1	8 21 9	8 28 4	8 34	8 41	8
2 30	34	16						47	17	
2 7 27	7 37	8 12	8 20	8 28	8 36	8 43	8 50	8 58 1	9 4 50	7
3 43	13	29	39	35	17	45	59			
2 7 46	7 56	8 33	8 42	8 50	8 58	9 6 20	9 13	9 21	9 28	6
4 55	50	40	12	29	31		53	14	16	
2 8 6 5	8 16	8 54	9 3 43	9 12	9 20	9 28	9 36	9 44	9 51	5
5	25	49		21	44	52	45	25	49	
2 8 25	8 35	9 15	9 25	9 34	9 42	9 51	9 59	10 7	10 15	4
6 12	58	56	13	12	55	23	36	35	17	
2 8 44	8 55	9 37	9 46	9 56 1	10 5 5	10 13	10 22	10 30	10 38	3
7 17	28	2	40			53	25	43	44	
2 9 3	9 14	9 58	10 8 5	10 17	10 27	10 36	10 45	10 53	11 2 9	2
8 20	57	5		47	12	21	12	49		
2 9 22	9 34	10	10 29	10 39	10 49	10 58	11 7	11 16	11 25	1
9 22	23	19 6	28	32	18	47	58	54	32	
3 9 41	9 53	10	10 50	11 1	11 11	11 21	11 30	11 39	11 48	3
0 20	46	40 5	49	14	22	11	42	56	53	0

Sign block S 1 (left index G 1–30)

G											(G)
.	29	30	34	35	36	37	38	39	40	41	
1	10 0	10 13	11 1	11 12	11 22	11 33	11 43	11 53	12 2	12 12	2
	14	6	1	8	55	24	32	24	57	13	9
2	10 19	10 32	11 21	11 33	11 44	11 55	12 5	12 16	12 25	12 35	2
	5	24	53	24	33	22	52	3	56	31	8
3	10 37	10 51	11 42	11 54	12 6	12 17	12 28	12 38	12 48	12 58	2
	55	40	47	38	9	19	10	40	53	47	7
4	10 56	11 10	12 3	12 15	12 27	12 39	12 50	13 1	13 11	13 22	2
	41	52	25	50	43	14	25	16	47	0	6
5	11 15	11 30	12 24	12 36	12 49	13 1	13 12	13 23	13 34	13 45	2
	24	1	22	59	14	6	38	50	40	12	5
6	11 34	11 49	12 45	12 58	13 10	13 22	13 34	13 46	13 57	14 8	2
	3	7	5	5	42	56	49	20	31	22	4
7	11 52	12 8	13 5	13 19	13 32	13 44	13 56	14 8	14 20	14 31	2
	40	9	46	9	7	44	57	49	19	29	3
8	12 11	12 27	13 26	13 40	13 53	14 6	14 19	14 31	14 43	14 54	2
	13	9	24	9	30	28	3	15	5	35	2
9	12 29	12 46	13 46	14 1	14 14	14 28	14 41	14 53	15 5	15 17	2
	42	4	58	7	50	10	6	38	48	37	1
1	12 48	13 4	14 7	14 22	14 36	14 49	15 3	15 15	15 28	15 40	2
0	8	57	30	1	7	48	5	59	29	37	0
1	13 6	13 23	14 27	14 42	14 57	15 11	15 25	15 38	15 51	16 3	1
1	30	45	58	53	21	24	2	17	7	35	9
1	13 24	13 42	14 48	15 3	15 18	15 32	15 46	16 0	16 13	16 26	1
2	48	30	23	40	32	57	57	32	43	30	8
1	13 43	14 1	15 8	15 24	15 39	15 54	16 8	16 22	16 36	16 49	1
3	2	11	44	25	39	27	48	44	15	23	7
1	14 1	14 19	15 29	15 45	16 0	16 15	16 30	16 44	16 58	17 12	1
4	11	47	1	6	43	53	36	53	45	13	6
1	14 19	14 38	15 49	16 5	16 21	16 37	16 52	17 7	17 21	17 34	1
5	17	20	15	44	44	17	21	0	12	59	5
1	14 37	14 56	16 9	16 26	16 42	16 58	17 14	17 29	17 43	17 57	1

G											(
.	29	30	34	35	36	37	38	39	40	41	G
6 18	48	25	18	42	36	3	2	36	43	4	
1 14 55	15 15	16 29	16 46	17 3	17 19	17 35	17 51	18 5	18 20	1	
7 14	11	31	48	34	52	41	2	56	24	3	
1 15 13	15 33	16 49	17 7	17 24	17 41	17 57	18 12	18 28	18 43	1	
8 5	30	33	14	24	4	15	58	13	1	2	
1 15 30	15 51	17 9	17 27	17 45	18 2	18 18	18 34	18 50	19 5	1	
9 52	44	31	36	9	13	46	51	26	35	1	
2 15 48	16 9	17 29	17 47	18 5	18 23	18 40	18 56	19 12	19 28	1	
0 34	54	24	53	50	17	13	40	36	6	0	
2 16 6	16 27	17 49	18 8	18 26	18 44	19 1	19 18	19 34	19 50	9	
1 10	58	13	7	28	18	36	25	42	34		
2 16 23	16 45	18 8	18 28	18 47	19 5	19 22	19 40	19 56	20 12	8	
2 41	57	56	15	0	13	55	6	45	57		
2 16 41	17 3	18 28	18 48	19 7	19 26	19 44	20 1	20 18	20 35	7	
3 6	50	35	19	29	5	10	43	44	17		
2 16 58	17 21	18 48	19 8	19 27	19 46	20 5	20 23	20 40	20 57	6	
4 26	38	10	18	52	53	21	16	38	33		
2 17 15	17 39	19 7	19 28	19 48	20 7	20 26	20 44	21 2	21 19	5	
5 41	21	40	13	12	35	27	44	30	46		
2 17 32	17 56	19 27	19 48	20 8	20 28	20 47	21 6	21 24	21 41	4	
6 50	58	4	3	26	14	29	10	18	55		
2 17 49	18 14	19 46	20 7	20 28	20 48	21 8	21 27	21 46	22 3	3	
7 52	29	23	48	35	48	26	30	0	59		
2 18 6	18 31	20 5	20 27	20 48	21 9	21 29	21 48	22 7	22 25	2	
8 47	53	37	6	40	16	18	45	37	58		
2 18 23	18 49	20 24	20 47	21 8	21 29	21 50	22 9	22 29	22 47	1	
9 37	12	45	0	38	40	6	56	11	54		
3 18 40	19 6	20 43	21 6	21 28	21 49	22 10	22 31	22 50	23 9	3	
0 19	24	46	28	31	58	47	1	40	45	0	

[Table-foot argument-degree labels: **29 9 · 30 0 · 34 0 · 35 0 · 36 0 · 37 0 · 38 0 · 39 0 · 40 0 · 41 0**. Operation below: **SUBTRAHE**. Index frame: **S G**. on both edges; right side **S 12 ... S 11**.]

Page 2 (source PDF p. 554; printed p. 102)

[Left sign-block index: rows 1–30 under **S 2**, then rows 1–30 under **S 3**. Right descending index: **S 10** at top down to **S 9**. Operation: ADDE above, SUBTRAHE below.]

Sign block S 2 (left index G 1–30)

G											(G)
.	29	30	34	35	36	37	38	39	40	41	
1	18 56	19 23	21 2	21 25	21 48	22 10	22 31	22 52	23 12	23 31	2
	55	29	42	50	19	11	24	2	4	31	9
2	19 13	19 40	21 21	21 45	22 8	22 30	22 51	23 12	23 33	23 53	2
	24	27	33	7	1	18	56	58	23	12	8
3	19 29	19 57	21 40	22 4	22 27	22 50	23 12	23 33	23 54	24 14	2
	46	18	16	17	37	19	22	48	36	49	7
4	19 46	20 14	21 58	22 23	22 47	23 10	23 32	23 54	24 15	24 36	2
	0	3	53	21	7	14	42	32	43	20	6
5	20 2	20 30	22 17	22 42	23 6	23 30	23 52	24 15	24 36	24 57	2
	7	39	23	18	31	4	57	11	47	46	5
6	20 18	20 47	22 35	23 1	23 25	23 49	24 13	24 35	24 57	25 19	2
	5	8	47	9	48	47	6	44	44	7	4
7	20 33	21 3	22 54	23 19	23 44	24 9	24 33	24 56	25 18	25 40	2
	57	30	4	53	53	24	8	12	36	23	3
8	20 49	21 19	23 12	23 38	24 4	24 28	24 53	25 16	25 39	26 1	2
	39	42	13	30	4	54	6	33	22	32	2
9	21 5	21 35	23 30	23 57	24 22	24 48	25 12	25 36	26 0	26 22	2
	14	48	15	0	59	18	54	48	1	36	1
1	21 20	21 51	23 48	24 15	24 41	25 7	25 32	25 56	26 20	26 43	2
0	39	43	8	21	49	34	35	56	14	33	0
1	21 35	22 7	24 5	24 33	25 0	25 26	25 52	26 16	26 41	27 4	1
1	56	31	55	35	25	43	11	57	1	24	9
1	21 51	22 23	24 23	24 51	25 19	25 45	26 11	26 39	27 21	27 45	1
2	3	10	3	43	5	45	40	31	34	47	8
1	22 6	22 38	24 41	25 9	25 37	26 4	26 30	26 56	27 41	28 7	1
3	1	39	3	41	22	39	11	39	40	22	7

G										(
.	29	30	34	35	36	37	38	39	40	G
1 22 20	22 54	24 58	25 27	25 55	26 23	26 50	27 16	27 41	28 7	1
4 50	0	25	32	41	4	14	19	40	22	6
1 22 35	23 9	25 15	25 45	26 14	26 42	27 9	27 35	28 1	28 26	1
5 28	10	37	13	26	3	20	51	38	43	5
1 22 49	23 24	25 32	26 2	26 32	27 0	27 28	27 55	28 21	28 47	1
6 56	10	40	35	5	35	17	16	30	0	4
1 23 4	23 38	25 49	26 20	26 49	27 18	27 47	28 14	28 41	29 7	1
7 14	59	33	8	55	54	6	32	13	9	3
1 23 18	23 53	26 6	26 37	27 7	27 37	28 5	28 33	29 0	29 27	1
8 21	39	18	23	39	6	47	41	48	12	2
1 23 32	24 8	26 22	26 54	27 25	27 55	28 24	28 52	29 20	29 47	1
9 18	8	53	33	11	11	20	41	16	6	1
2 23 46	24 22	26 39	27 11	27 42	28 13	28 42	29 11	29 39	30 6	1
0 2	25	17	23	38	4	38	33	35	52	0
2 23 59	24 36	26 55	27 28	27 59	28 30	29 0	29 30	29 58	30 26	9
1 35	31	30	7	52	49	56	15	44	29	
2 24 12	24 50	27 11	27 44	28 16	28 48	29 19	29 48	30 17	30 45	8
2 56	25	33	41	57	24	0	47	46	58	
2 24 26	25 4	27 27	28 1	28 33	29 5	29 36	30 7	30 36	31 5	7
3 2	7	25	4	51	47	54	10	38	17	
2 24 39	25 17	27 43	28 17	28 50	29 23	29 54	30 25	30 55	31 24	6
4 0	37	6	16	34	1	38	24	20	28	
2 24 51	25 30	27 58	28 33	29 7	29 40	30 12	30 43	31 13	31 43	5
5 44	54	34	17	5	5	11	27	53	30	
2 25 4	25 43	28 13	28 49	29 23	29 56	30 29	31 1	31 32	32 2	4
6 13	57	50	5	50	56	33	20	15	20	
2 25 16	25 56	28 28	29 4	29 39	30 13	30 46	31 19	31 50	32 21	3
7 30	48	55	42	36	37	41	0	26	2	
2 25 28	26 9	28 43	29 20	29 55	30 30	31 3	31 36	32 8	32 39	2
8 36	24	46	0	12	4	45	52	18	33	
2 25 40	26 21	28 58	29 35	30 10	30 46	31 20	31 53	32 26	32 57	1
9 19	46	24	18	16	21	33	53	17	53	

G											(G)
.	29	30	34	35	36	37	38	39	40	41	
3 25 51	26 33	29 12	29 50	30 26	31 2	31 37	32 10	32 43	33 16	3	
0 52	54	49	15	47	24	9	59	51	2	0	

Sign block S 3 (left index G 1–30)

G											(G)
.	29	30	34	35	36	37	38	39	40	41	
1 26 3	26 45	29 26	30 5	30 42	31 18	31 53	32 27	33 1	33 33	2	
14	46	59	0	6	16	32	54	23	59	9	
2 26 14	26 57	29 40	30 19	30 57	31 33	32 9	32 44	33 18	33 51	2	
12	23	56	30	9	53	42	37	37	45	8	
3 26 24	27 8	29 54	30 33	31 11	31 49	32 25	33 1	33 35	34 9	2	
56	44	36	45	58	16	38	6	39	18	7	
4 26 35	27 19	30 8	30 47	31 26	32 4	32 41	33 17	33 52	34 26	2	
26	49	3	47	34	25	22	22	30	26	6	
5 26 45	27 30	30 21	31 1	31 40	32 19	32 56	33 33	34 9	34 43	2	
37	36	12	31	49	8	50	45	12	46	5	
6 26 55	27 41	30 34	31 15	31 54	32 33	33 11	33 49	34 26	35 0	2	
32	7	6	1	51	50	31	12	4	41	4	
7 27 5	27 51	30 46	31 28	32 8	32 48	33 27	34 4	34 41	35 17	2	
8	19	43	14	44	5	2	44	53	21	3	
8 27 14	28 1	30 59	31 41	32 22	33 1	33 41	34 19	34 57	35 33	2	
26	13	2	4	17	44	44	32	22	46	2	
9 27 23	28 10	31 11	31 53	32 35	33 16	33 56	34 35	35 12	35 49	2	
24	48	4	33	32	33	8	5	33	57	1	
1 27 32	28 20	31 22	32 6	32 48	33 30	34 10	34 49	35 28	36 5	2	
0 3	3	47	51	28	26	20	49	18	52	0	
1 27 40	28 28	31 34	32 18	33 0	33 43	34 24	35 4	35 43	36 21	1	
1 22	59	11	8	31	5	11	16	27	32	9	
1 27 48	28 37	31 45	32 29	33 12	33 56	34 37	35 18	35 58	36 36	1	
2 21	35	17	51	5	2	46	20	10	54	8	
1 27 55	28 45	31 56	32 41	33 23	34 8	34 51	35 32	36 12	36 52	1	
3 59	49	2	14	25	44	5	7	27	1	7	

G										(	
.	29	30	34	35	36	37	38	39	40	41	G
1 28 3	28 53	32 6	32 52	33 34	34 21	35 3	35 45	36 26	37 6	1	
4 13	40	23	16	8	0	57	36	30	50	6	
1 28 10	29 1	32 16	33 2	33 44	34 32	35 16	35 59	36 40	37 21	1	
5 4	10	26	56	11	35	33	8	42	18	5	
1 28 16	29 8	32 26	33 13	33 54	34 44	35 28	36 12	36 54	37 35	1	
6 34	15	6	16	44	35	48	1	14	28	4	
1 28 22	29 14	32 35	33 23	34 4	34 55	35 40	36 24	37 7	37 49	1	
7 39	59	23	12	55	51	43	35	26	19	3	
1 28 28	29 21	32 44	33 32	34 14	35 6	35 52	36 36	37 20	38 2	1	
8 20	16	15	43	51	45	20	38	17	49	2	
1 28 33	29 27	32 52	33 41	34 24	35 17	36 3	36 48	37 32	38 15	1	
9 35	9	44	52	30	12	24	56	47	42	1	
2 28 38	29 32	33 0	33 50	34 33	35 27	36 14	37 0	37 44	38 28	1	
0 25	36	48	35	28	17	10	21	53	45	0	
2 28 42	29 37	33 8	33 58	34 42	35 36	36 24	37 11	37 56	38 41	9	
1 47	34	23	51	3	55	29	3	55	9		
2 28 46	29 42	33 15	34 6	34 50	35 46	36 34	37 21	38 7	38 53	8	
2 42	7	34	43	19	18	25	41	55	10		
2 28 50	29 46	33 22	34 14	34 58	35 55	36 43	37 31	38 18	39 4	7	
3 7	10	16	5	12	19	53	51	48	44		
2 28 53	29 49	33 28	34 21	35 5	36 3	36 53	37 41	38 29	39 15	6	
4 5	45	28	0	35	53	1	36	16	55		
2 28 55	29 52	33 34	34 27	35 12	36 11	37 1	37 50	38 39	39 26	5	
5 32	49	11	25	32	4	28	53	16	38		
2 28 57	29 55	33 39	34 33	35 26	36 18	37 9	37 59	38 48	39 36	4	
6 27	21	22	18	19	24	30	39	47	53		
2 28 58	29 57	33 44	34 38	35 32	36 25	37 17	38 7	38 57	39 46	3	
7 51	21	2	40	23	12	30	59	48	40		
2 28 59	29 58	33 48	34 43	35 37	36 31	37 24	38 15	39 6	39 55	2	
8 43	48	7	28	55	18	4	42	19	55		
2 29 0	29 59	33 51	34 47	35 42	36 37	37 30	38 22	39 14	40 4	1	
9 0	42	40	44	54	12	33	56	19	42		

G											(
.	29	30	34	35	36	37	38	39	40	41	G
3	28 59	30 0	33 54	34 51	35 47	36 42	37 36	38 29	39 21	40 12	3
0	42	0	36	23	17	19	26	35	44	54	0

[Table-foot argument-degree labels: **29 0 · 30 0 · 34 0 · 35 0 · 36 0 · 37 0 · 38 0 · 39 0 · 40 0 · 41 0**. Operation below: **SUBTRAHE**. Right descending index runs **S 10 ... S 9**.]

Page 3 (source PDF p. 555; printed p. 103)

[Left sign-block index: rows 1–30 under **S 4**, then rows 1–30 under **S 5**, then the start of **S 6** at the foot. Right descending index: **S 8** at top down through **S 7** to **S 6**. Operation: ADDE above, SUBTRAHE below. This page carries the descending half of TAB. 95, where each column declines toward 0° 0' 0".]

Sign block S 4 (left index G 1–30)

G											(
.	29	30	34	35	36	37	38	39	40	41	G
											)
1	28 58	29 59	33 56	34 54	35 51	36 46	37 41	38 35	39 28	40 20	2
	48	41	55	25	4	51	43	39	35	33	9
2	28 57	29 58	33 58	34 56	35 54	36 50	37 46	38 41	39 34	40 27	2
	17	45	36	49	12	45	24	7	50	36	8
3	28 55	29 57	33 59	34 58	35 56	36 54	37 50	38 45	39 40	40 34	2
	9	10	39	34	42	0	26	56	28	2	7
4	28 52	29 54	34 0	34 59	35 58	36 56	37 53	38 50	39 45	39 50	2
	51	56	0	38	30	35	48	6	27	0	6
5	28 48	29 52	33 59	35 0	35 59	36 58	37 56	38 53	39 49	40 45	2
	55	3	39	0	38	29	29	36	45	0	5
6	28 44	29 48	33 58	34 59	36 0	36 59	37 58	38 56	39 53	40 49	2
	47	26	34	38	0	36	25	21	22	25	4
7	28 39	29 44	33 56	34 58	35 59	37 0	37 59	38 58	39 56	40 53	2
	55	5	43	31	38	0	36	22	12	8	3
8	28 34	29 38	33 54	34 56	35 58	36 59	38 0	38 59	39 58	40 56	2
	18	59	4	35	26	36	0	34	17	4	2
9	28 27	29 33	33 50	34 53	35 56	36 58	37 59	39 0	39 59	40 58	2

G											(
.	29	30	34	35	36	37	38	39	40	41	G
	58	9	38	51	28	25	36	0	34	15	1
1 28 20	29 26	33 46	34 50	35 53	36 56	37 58	38 59	40 0	40 59	2	
0 50	28	19	15	35	18	19	34	0	32	0	
1 28 12	29 19	33 41	34 45	35 49	36 53	37 56	38 58	39 59	41 0	1	
1 54	0	9	46	51	20	10	14	34	0	9	
1 28 4	29 10	33 35	34 40	35 45	36 49	37 53	38 56	39 58	40 59	1	
2 11	42	5	23	11	27	5	1	10	31	8	
1 27 54	29 1	33 28	34 34	35 39	36 44	37 49	38 52	39 55	40 58	1	
3 37	32	4	3	33	36	2	41	50	6	7	
1 27 44	28 51	33 20	34 26	35 32	36 38	37 43	38 48	39 52	40 55	1	
4 11	28	5	44	57	45	59	12	53	42	6	
1 27 32	28 40	33 11	34 18	35 25	36 31	37 37	38 43	39 48	40 52	1	
5 51	29	5	22	18	50	52	20	8	14	5	
1 27 20	28 28	33 1	34 8	35 16	36 23	37 30	38 36	39 42	40 47	1	
6 39	35	4	58	34	51	41	59	40	41	4	
1 27 7	28 15	32 49	33 58	35 6	36 14	37 22	38 29	39 36	40 42	1	
7 30	42	57	28	44	45	21	29	2	0	3	
1 26 53	28 1	32 37	33 46	34 55	36 4	37 12	38 20	39 28	40 35	1	
8 22	49	43	48	44	26	49	46	12	5	2	
1 26 38	27 46	32 24	33 33	34 43	35 52	37 2	38 10	39 19	40 26	1	
9 15	54	18	58	30	53	2	48	6	54	1	
2 26 22	27 30	32 9	33 19	34 30	35 40	36 49	37 59	39 8	40 17	1	
0 10	57	42	53	0	5	58	32	42	25	0	
2 26 5	27 13	31 53	33 4	34 15	35 25	36 36	37 46	38 56	40 6	9	
1 1	54	51	30	13	55	31	52	54	32		
2 25 46	26 55	31 36	32 47	33 59	35 10	36 21	37 32	38 43	39 54	8	
2 49	45	42	49	4	23	37	46	37	10		
2 25 27	26 36	31 18	32 29	33 41	34 53	36 5	37 17	38 28	39 40	7	
3 33	29	14	45	30	25	20	12	42	18		
2 25 7	26 16	30 58	32 10	33 22	34 34	35 47	37 0	38 12	39 24	6	
4 12	4	24	18	30	55	30	4	31	49		
2 24 45	25 54	30 37	31 49	33 1	34 14	35 28	36 41	37 54	39 7	5	

G										(
.	29	30	34	35	36	37	38	39	40	G
										)
5	41	26	5	19	55	51	0	15	28	37
2	24 23	25 31	30 14	31 26	32 39	33 53	35 6	36 20	37 34	38 48 4
6	3	36	24	48	48	11	52	45	42	40
2	23 59	25 7	29 50	31 2	32 16	33 29	34 43	35 58	37 13	38 27 3
7	14	31	7	45	0	45	43	5	5	50
2	23 34	24 42	29 24	30 37	31 50	33 4	34 19	35 34	36 49	38 5 2
8	15	15	20	5	32	0	17	18	35	12
2	23 8	24 15	28 56	30 9	31 23	32 37	33 52	35 8	36 24	37 40 1
9	2	34	55	44	21	42	41	10	3	14
3	22 40	23 47	28 27	29 40	30 54	32 8	33 24	34 40	35 56	37 13 3
0	35	37	50	35	18	50	5	0	24	14 0

Sign block S 5 (left index G 1–30)

G										(
.	29	30	34	35	36	37	38	39	40	G
										)
1	22 11	23 18	27 57	29 9	30 23	31 38	32 53	34 9	35 26	36 44 2
	55	22	4	43	23	1	30	44	35	0 9
2	21 42	22 47	27 24	28 36	29 50	31 5	32 20	33 37	34 54	36 12 2
	0	45	32	58	31	9	45	13	27	21 8
3	21 10	22 15	26 50	28 2	29 15	30 30	31 45	33 2	34 19	35 38 2
	45	45	14	19	39	10	48	25	55	14 7
4	20 38	21 42	26 14	27 25	28 38	29 53	31 8	32 25	33 42	35 1 2
	18	23	6	45	44	2	33	13	53	31 6
5	20 4	21 7	25 36	26 47	27 59	29 13	30 28	31 45	33 3	34 22 2
	34	39	9	12	44	41	59	34	24	51 5
6	19 29	20 31	24 56	26 6	27 18	28 31	29 46	31 3	32 20	33 39 2
	28	27	13	34	30	58	55	15	54	49 4
7	18 53	19 53	24 14	25 23	26 35	27 47	29 2	30 18	31 35	32 54 2
	8	52	24	54	4	54	19	13	45	32 3
8	18 15	19 14	23 30	24 39	25 49	27 1	28 15	29 30	30 47	32 6 2
	29	53	36	6	22	25	5	38	39	15 2
9	17 36	18 34	22 44	23 52	25 1	26 12	27 25	28 40	29 56	31 14 2

G											(
.	29	30	34	35	36	37	38	39	40	41	G
	33	30	52	12	24	28	5	5	34	45	1
1 16 56	17 52	21 57	23 3	24 11	25 20	26 32	27 46	29 2	30 19		2
0 20	41	9	5	2	58	50	39	20	53		0
1 16 14	17 9	21 7	22 11	23 18	24 26	25 37	26 50	28 4	29 21		1
1 51	29	19	48	19	54	28	12	54	35		9
1 15 32	16 24	20 15	21 18	22 23	23 30	24 39	25 50	27 4	28 19		1
2 6	53	30	18	10	11	22	41	8	45		8
1 14 48	15 38	19 21	20 22	21 25	22 30	23 38	24 48	26 0	27 14		1
3 10	57	43	37	39	54	22	6	33	19		7
1 14 3	14 51	18 25	19 24	20 25	21 28	22 34	23 42	24 52	26 5		1
4 0	40	56	44	42	56	28	20	25	9		6
1 13 16	14 3	17 28	18 24	19 23	20 24	21 27	22 33	23 41	24 52		1
5 41	7	12	42	24	24	42	16	35	15		5
1 12 29	13 13	16 28	17 22	18 18	19 17	20 18	21 21	22 27	23 35		1
6 14	16	31	30	42	11	4	20	7	29		4
1 11 40	12 22	15 26	16 18	17 11	18 7	19 5	20 6	21 9	22 14		1
7 42	15	59	14	42	26	33	7	12	54		3
1 10 51	11 30	14 23	15 11	16 2	16 55	17 50	18 47	19 47	20 50		1
8 8	2	36	58	5	10	15	47	50	33		2
1 10 0	10 36	13 18	14 3	14 50	15 40	16 32	17 26	18 23	19 22		1
9 35	44	30	42	58	27	14	24	5	25		1
2 9 9 7	9 42	12 11	12 53	13 37	14 23	15 11	16 2	16 55	17 50		1
0	23	42	33	24	22	33	4	2	35		0
2 8 16	8 47	11 3	11 41	12 21	13 4	13 48	14 34	15 23	16 15		9
1 46	4	21	40	52	4	23	56	49	13		
2 7 23	7 50	9 53	10 28	11 4	11 42	12 22	13 5	13 49	14 36		8
2 39	51	33	9	29	41	51	7	36	28		
2 6 29	6 53	8 42	9 13	9 45	10 19	10 55	11 32	12 12	12 54		7
3 50	51	26	7	24	22	10	52	37	35		
2 5 35	5 56	7 30	7 56	8 24	8 54	9 25	9 58	10 33	11 9		6
4 21	7	7	45	46	19	28	20	3	45		
2 4 40	4 57	6 16	6 39	7 2	7 27	7 54	8 21	8 51	9 22		5

G										(	
.	29	30	34	35	36	37	38	39	40	41	G
5	19	44	44	9	47	42	1	49	12	19	
2	3 44	3 58	5 2	5 20	5 39	5 59	6 21	6 43	7 7	7 32	4
6	49	50	29	34	39	47	4	35	24	40	
2	2 48	2 59	3 47	4 1	4 15	4 30	4 46	5 3	5 22	5 41	3
7	57	31	31	10	35	49	55	57	0	10	
2	1 52	1 59	2 31	2 41	2 50	3 1 0	3 11	3 23	3 35	3 48	2
8	48	51	59	7	47		48	25	22	15	
2	0 56	0 59	1 16	1 20	1 25	1 30	1 36	1 41	1 47	1 54	1
9	27	59	5	40	31	39	17	48	54	22	
3	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	3
0											0

PROSTHAPHÆRESES OF THE ORB

TABLE 95. Prosthaphæresis of the orb for ♄ [Saturn], ♃ [Jupiter], ♂ [Mars], ♀ [Venus], & ☿ [Mercury]. *(continued)*

Maximum equation, or composite [Æquatio maxima, seu composita]. — ADD [ADDE].

The argument runs across the top in whole degrees (42, 43, 44, 45, 46, 47, 48); each column entry is given in **G.** (degrees) ' (minutes) " (seconds). The outer index columns carry **S** (the sign-block marker) and **G.** (the degree of argument). The left index ascends 1–30 within each block; the right index descends. Read **ADD** when entering the table from the top; **SUBTRACT [SVBTRAHE]** when entering from the bottom.

Source PDF p. 556 (printed p. 104)

Left block-marker S column reads (top to bottom of the major divisions): **0**, then **I [1]**, then **II [2]**. Right block-marker S column reads **12**, then **11**, then **10**. Right G-index descends from 29.

G									G		
S	.	42 °	43 °		44 °	45 °	46 °	47 °	48 °	.	S
0	1	0 24 3	0 24 20		0 24	0 24	0 25 6	0 25	0 25	2	1

S	G . 42 °	43 °	44 °	45 °	46 °	47 °	48 °	G . S
			36	51		20	35	9 2
	2 0 48 7	0 48 39	0 49	0 49	0 50	0 50	0 51	2
			11	42	12	40	10	8
	3 1 12	1 12 59	1 13	1 14	1 15	1 16 0	1 16	2
	10		47	33	18		44	7
	4 1 36	1 37 18	1 38	1 39	1 40	1 41	1 42	2
	12		22	24	24	20	19	6
	5 2 0 15	2 1 38	2 2 58	2 4 15	2 5 30	2 7 40	2 7 53	2
								5
	6 2 24	2 25 57	2 27	2 29 5	2 30	2 32 0	2 33	2
	17		32		35		27	4
	7 2 48	2 50 16	2 52 7	2 53	2 55	2 57	2 59 1	2
	19			56	40	20		3
	8 3 12	3 14 33	3 16	3 18	3 20	3 22	3 24	2
	21		41	45	45	40	35	2
	9 3 36	3 38 51	3 41	3 43	3 45	3 48 0	3 50 8	2
	22		15	35	50			1
	1 4 0 22	4 3 9	4 5 49	4 8 24	4 10	4 13	4 15	2
	0				54	20	41	0
	1 4 24	4 27 26	4 30	4 33	4 35	4 38	4 41	1
	1 23		22	13	58	38	14	9
	1 4 48	4 51 42	4 54	4 58 1	5 1 2	5 3 56	5 6 46	1
	2 23		54					8
	1 5 12	5 15 58	5 19	5 22	5 26 4	5 29	5 32	1
	3 22		26	48		14	17	7
	1 5 36	5 40 13	5 43	5 47	5 51 6	5 54	5 57	1
	4 20		58	35		31	48	6
	1 6 0 18	6 4 28	6 8 28	6 12	6 16 8	6 19	6 23	1
	5			21		47	19	5
	1 6 24	6 28 41	6 32	6 37 7	6 41 9	6 45 2	6 48	1
	6 15		58				49	4
	1 6 48	6 52 54	6 57	7 1 52	7 6 9	7 10	7 14	1
	7 12		27			18	18	3

S	G							G
	. 42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
I [1]	1 7 12 7	7 17 5	7 21	7 26	7 31 9	7 35	7 39	1
	8		55	36		32	47	2
	1 7 36 0	7 41 16	7 46	7 51	7 56 8	8 0 45	8 5 14	1
	9		23	19				1
	2 7 59	8 5 26	8 10	8 16 2	8 21 5	8 25	8 30	1
	0 53		49			58	42	0
	2 8 23	8 29 35	8 35	8 40	8 46 1	8 51	8 56 8	9
	1 45		14	43		10		
	2 8 47	8 53 43	8 59	9 5 23	9 10	9 16	9 21	8
	2 36		39		57	21	34	
	2 9 11	9 17 50	9 24 2	9 30 2	9 35	9 41	9 46	7
	3 25				32	31	58	
	2 9 35	9 41 56	9 48	9 54	10 0	10 6	10 12	6
	4 14		24	41	46	39	22	
	2 9 59 1	10 6 0	10 12	10 19	10 25	10 31	10 37	5
	5		45	18	39	47	44	
	2 10 22	10 30 3	10 37	10 43	10 50	10 56	11 3 6	4
	6 47		5	54	30	54		
	2 10 46	10 54 4	11 1	11 8	11 15	11 22	11 28	3
	7 31		23	29	21	0	27	
	2 11 10	11 18 4	11 25	11 33	11 40	11 47	11 53	2
	8 14		40	7	0	4	46	
	2 11 33	11 42 3	11 49	11 57	12 4	12 12	12 19	1
	9 55		56	33	58	7	3	
	3 11 57	12 6 0	12 14	12 22	12 29	12 37	12 44	3
	0 35		10	4	44	9	19	0
	1 12 21	12 29 55	12 38	12 46	12 54	13 2 9	13 9	2 1
	12		23	33	29		35	9 1
	2 12 44	12 53 49	13 2	13 11	13 19	13 27	13 34	2
	48		33	0	12	9	50	8
	3 13 8	13 17 41	13 26	13 35	13 43	13 52	14 0 3	2
	23		42	26	54	6		7
	4 13 31	13 41 31	13 50	13 59	14 8	14 17	14 25	2

S	G . 42 °	43 °	44 °	45 °	46 °	47 °	48 °	G . S
	54		49	50	35	2	14	6
5	13 55	14 5 19	14 14	14 24	14 33	14 41	14 50	2
	25		54	13	13	57	24	5
6	14 18	14 29 5	14 38	14 48	14 57	15 6	15 15	2
	53		58	33	50	49	32	4
7	14 42	14 52 49	15 3 0	15 12	15 22	15 31	15 40	2
	19			52	26	41	39	3
8	15 5	15 16 31	15 27	15 37	15 46	15 56	16 5	2
	43		0	8	59	30	44	2
9	15 29	15 40 11	15 50	16 1	16 11	16 21	16 30	2
	4		57	23	30	18	47	1
1	15 52	16 3 49	16 14	16 25	16 35	16 46	16 55	2
0	23		52	36	59	3	48	0
1	16 15	16 27 24	16 38	16 49	17 0	17 10	17 20	1
	1 40		45	46	27	47	48	9
1	16 38	16 50 57	17 2	17 13	17 24	17 35	17 45	1
	2 55		36	55	52	29	45	8
1	17 2 6	17 14 27	17 26	17 38	17 49	18 0 8	18 10	1
	3		25	1	15		41	7
1	17 25	17 37 55	17 50	18 2 4	18 13	18 24	18 35	1
	4 15		11		36	46	35	6
1	17 48	18 1 20	18 13	18 26	18 37	18 49	19 0	1
	5 22		55	6	54	21	26	5
1	18 11	18 24 42	18 37	18 50	19 2	19 13	19 25	1
	6 25		35	4	11	54	16	4
1	18 34	18 48 2	19 1	19 14	19 26	19 38	19 50	1
	7 25		13	1	24	25	3	3
1	18 57	19 11 19	19 24	19 37	19 50	20 2	20 14	1
	8 23		49	55	35	53	47	2
1	19 20	19 34 32	19 48	20 1	20 14	20 27	20 39	1
	9 17		21	45	44	19	30	1
2	19 43	19 57 42	20 11	20 25	20 38	20 51	21 4	1
	0 8		51	33	50	42	10	0

S	G . 42 °	43 °	44 °	45 °	46 °	47 °	48 °	G . S
	2 20 5 1 56	20 20 50	20 35 17	20 49 18	21 2 53	21 16 2	21 28 47	9
	2 20 28 2 40	20 43 54	20 58 40	21 13 0	21 26 53	21 40 20	21 53 21	8
	2 20 51 3 20	21 6 54	21 22 0	21 36 38	21 50 49	22 4 34	22 17 53	7
	2 21 13 4 57	21 29 51	21 45 16	22 0 13	22 14 43	22 28 46	22 42 23	6
	2 21 36 5 30	21 52 45	22 8 30	22 23 46	22 38 34	22 52 55	23 6 49	5
	2 21 59 6 0	22 15 35	22 31 40	22 47 15	23 2 22	23 17 1	23 31 13	4
	2 22 21 7 25	22 38 21	22 54 45	23 10 41	23 26 6	23 41 3	23 55 33	3
	2 22 43 8 46	23 1 3	23 17 48	23 34 2	23 49 47	24 5 3	24 19 50	2
	2 23 6 4 9	23 23 40	23 40 46	23 57 20	24 13 24	24 28 58	24 44 4	1
II	3 23 28	23 46 14	24 3	24 20	24 36	24 52	25 8	3 1
[2]	0 16		40	34	58	51	14	0 0
S	G 42 °	34 [recte 43] °	44 °	45 °	46 °	47 °	48 °	G S
	.							.

Foot of table: **SUBTRACT [SVBTRAHE].**

Side panel (right margin of p. 104): *Sinus omnium gr. maximæ æquationis* [Sines of all the degrees of the maximum equation]

(index)	Sine
5	244005
6	225829
7	210480
8	197203
9	185512

(index)	Sine
10	175072
11	165648
12	157064
17	122973
18	117435
19	112218
20	107288
21	102619
22	98188
23	93973
24	89959
25	86128
26	82469
27	78968
28	75614
29	72399
30	69314
34	58126
35	55586
36	53139
37	50780
38	48505
39	46311
40	44194
41	42150
42	40177
43	38273
44	36433
45	34657
46	32942
47	31286

(index)	Sine
48	29686

Source PDF p. 557 (printed p. 105)

Left block-marker S column reads **2, 3, 4**. Right block-marker S column reads **10, 9, 8**. The two rightmost argument columns of the full grid are blank on this page (the table only carries arguments 42–48; the extra ruled columns are empty).

G								G	
S	.	42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
2	1	23 50 24	24 8 44	24 26 30	24 43 44	25 0 27	25 16 39	25 32 22	2 1 9 0
	2	24 12 27	24 31 9	24 49 16	25 6 51	25 23 53	25 40 24	25 56 25	2 8
	3	24 34 26	24 53 29	25 11 57	25 29 53	25 47 15	26 4 5	26 20 25	2 7
	4	24 56 20	25 15 45	25 34 35	25 52 50	26 10 33	26 27 43	26 44 22	2 6
	5	25 18 8	25 37 55	25 57 7	26 15 43	26 33 47	26 51 16	27 8 14	2 5
	6	25 39 52	26 0 1	26 19 34	26 38 32	26 56 56	27 14 45	27 32 2	2 4
	7	26 1 31	26 22 2	26 41 57	27 1 17	27 20 0	27 38 10	27 55 47	2 3
	8	26 23 3	26 43 57	27 4 14	27 23 55	27 43 0	28 1 30	28 19 26	2 2
	9	26 44 31	27 5 48	27 26 27	27 46 29	28 5 56	28 24 46	28 43 3	2 1
	10	27 5 52	27 27 32	27 48 34	28 8 58	28 28 46	28 47 57	29 6 33	2 0
	11	27 27 7	27 49 11	28 10 35	28 31 22	28 51 31	29 11 3	29 30 0	1 9
	12	27 48 16	28 10 44	28 32 31	28 53 40	29 14 11	29 34 4	29 53 22	1 8
	13	28 9 19	28 32 10	28 54 21	29 15 52	29 36 45	29 57 0	30 16 39	1 7

G								G
S	. 42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
1	28 30 15	28 53 31	29 16 5	29 37 59	29 59 15	30 19 51	30 39 51	1
4								6
1	28 51 4	29 14 44	29 37 43	30 0 0	30 21 38	30 42 36	31 2 57	1
5								5
1	29 11 46	29 35 51	29 59 13	30 21 54	30 43 55	31 5 16	31 25 58	1
6								4
1	29 32 22	29 56 51	30 20 38	30 43 43	31 6 6	31 27 49	31 48 54	1
7								3
1	29 52 50	30 17 44	30 41 56	31 5 24	31 28 12	31 50 18	32 11 44	1
8								2
1	30 13 10	30 38 31	31 3 6	31 27 0	31 50 10	32 12 39	32 34 28	1
9								1
2	30 33 22	30 59 9	31 24 10	31 48 27	32 12 2	32 34 54	32 57 6	1
0								0
2	30 53 27	31 19 39	31 45 6	32 9 48	32 33 47	32 57 3	33 19 38	9
1								
2	31 13 22	31 40 1	32 5 54	32 31 2	32 55 25	33 19 5	33 42 3	8
2								
2	31 33 9	32 0 15	32 26 34	32 52 7	33 16 56	33 41 1	34 4 21	7
3								
2	31 52 48	32 20 21	32 47 6	33 13 5	33 38 19	34 2 47	34 26 32	6
4								
2	32 12 17	32 40 18	33 7 30	33 33 55	33 59 34	34 24 28	34 48 37	5
5								
2	32 31 37	33 0 5	33 27 44	33 54 36	34 20 41	34 46 0	35 10 34	4
6								
2	32 50 47	33 19 43	33 47 49	34 15 8	34 41 40	35 7 25	35 32 24	3
7								
2	33 9 47	33 39 11	34 7 46	34 35 32	35 2 30	35 28 41	35 54 5	2
8								
2	33 28 36	33 58 30	34 27 33	34 55 47	35 23 12	35 49 49	36 15 39	1
9								
3	33 47 16	34 17 38	34 47 10	35 15 52	35 43 44	36 10 48	36 37 4	3

G	S							G
S	42 °	43 °	44 °	45 °	46 °	47 °	48 °	S
0								0
3 1	34 5 43	34 36 36	35 6 37	35 35 47	36 4 7	36 31 38	36 58 20	2 9
2	34 24 0	34 55 23	35 25 53	35 55 32	36 24 20	36 52 18	37 19 28	2 8
3	34 42 4	35 13 57	35 44 58	36 15 6	36 44 24	37 12 49	37 40 26	2 7
4	34 59 56	35 32 21	36 3 51	36 34 29	37 4 15	37 33 10	38 1 15	2 6
5	35 17 36	35 50 32	36 22 33	36 53 41	37 23 57	37 53 20	38 21 53	2 5
6	35 35 2	36 8 30	36 41 3	37 12 43	37 43 27	38 13 20	38 42 22	2 4
7	35 52 15	36 26 15	36 59 20	37 31 30	38 2 46	38 33 9	39 2 39	2 3
8	36 9 14	36 43 47	37 17 24	37 50 5	38 21 53	38 52 45	39 22 46	2 2
9	36 25 59	37 1 5	37 35 15	38 8 28	38 40 47	39 12 11	39 42 41	2 1
1 0	36 42 29	37 18 9	37 52 51	38 26 37	38 59 28	39 31 23	40 2 24	2 0
1 1	36 58 43	37 34 57	38 10 14	38 44 33	39 17 56	39 50 23	40 21 55	1 9
1 2	37 14 41	37 51 31	38 27 21	39 2 14	39 36 11	40 9 10	40 41 13	1 8
1 3	37 30 23	38 7 48	38 44 14	39 19 41	39 54 11	40 27 43	41 0 19	1 7
1 4	37 45 47	38 23 48	39 0 49	39 36 51	40 11 55	40 46 1	41 19 10	1 6
1 5	38 0 54	38 39 31	39 17 8	39 53 45	40 29 24	41 4 5	41 37 47	1 5
1 6	38 15 41	38 54 55	39 33 10	40 10 23	40 46 37	41 21 52	41 56 9	1 4

G								G
S .	42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
1 7	38 30 11	39 10 3	39 48 54	40 26 44	41 3 35	41 39 25	42 14 16	1 3
1 8	38 44 20	39 24 50	40 4 9	40 42 47	41 20 14	41 56 40	42 32 7	1 2
1 9	38 58 8	39 39 18	40 19 26	40 58 31	41 36 35	42 13 38	42 49 42	1 1
2 0	39 11 35	39 53 25	40 34 11	41 13 56	41 52 38	42 30 19	43 6 59	1 0
2 1	39 24 39	40 7 9	40 48 35	41 28 59	42 8 20	42 46 39	43 23 57	9
2 2	39 37 21	40 20 32	41 2 39	41 43 42	42 23 43	43 2 41	43 40 37	8
2 3	39 49 38	40 33 30	41 16 19	41 58 4	42 38 44	43 18 22	43 56 57	7
2 4	40 1 31	40 46 6	41 29 36	42 12 3	42 53 24	43 33 43	44 12 18	6
2 5	40 12 58	40 58 15	41 42 29	42 25 37	43 7 41	43 48 41	44 28 37	5
2 6	40 23 57	41 9 59	41 54 55	42 38 47	43 21 34	44 3 16	44 43 53	4
2 7	40 34 28	41 21 15	42 6 55	42 51 31	43 35 2	44 17 27	44 58 47	3
2 8	40 44 30	41 32 1	42 18 27	43 3 48	43 48 4	44 31 12	45 13 16	2
2 9	40 54 2	41 42 20	42 29 32	43 15 38	44 0 39	44 44 32	45 27 20	1
3 0	41 3 1	41 52 6	42 40 5	43 26 58	44 12 45	44 57 24	45 40 58	3 0
S G	42 °	43 °	44 °	45 °	46 °	47 °	48 °	G S
.								.

Foot of table: SUBTRACT [SVBTRAHE].

Source PDF p. 558 (printed p. 106)

Left block-marker S column reads 4, 5, 6. Right block-marker S column reads 7, 6. On this page the degree-of-argument figure is printed only in the first row of each minor block of several columns (the printer leaves the leading whole-degree blank where it repeats); the blanks are reproduced below as a blank degree cell where the source omits it. The table reaches its terminus at the foot, where every column reads **0 0 0**.

G								G
S .	42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
4 1	41 11 27	42 1 20	42 50 7	43 37 47	44 24 21	45 9 48	45 54 7	2 8
								9
2	41 19 19	42 10 0	42 59 34	43 48 4	44 35 27	45 21 41	46 6 48	2 8
3	□ 26 35	42 18 5	42 8 30	43 57 48	□ 46 0	45 33 3	46 18 59	2 7
4	□ 33 12	□ 25 33	43 16 49	44 6 57	44 55 59	45 43 52	□ 30 38	2 6
5	□ 39 12	□ 32 24	□ 24 31	44 15 30	45 5 24	45 54 7	□ 41 44	2 5
6	□ 44 30	42 38 34	□ 31 32	□ 23 24	45 14 10	46 3 46	46 52 15	2 4
7	41 49 5	□ 44 1	□ 37 53	□ 30 38	45 22 17	46 12 47	47 2 9	2 3
8	□ 52 53	□ 48 43	□ 43 29	□ 37 9	45 29 43	46 21 7	47 11 23	2 2
9	□ 55 56	□ 52 41	□ 48 22	□ 42 57	45 36 27	46 28 47	□ 19 59	2 1
1 0	□ 58 9	42 55 49	43 52 23	□ 47 57	45 42 23	46 35 41	□ 27 50	2 0
1 1	41 59 31	□ 58 6	□ 55 40	□ 52 9	45 47 34	46 41 49	47 34 56	1 9
1 2	42 0 0	42 59 31	□ 58 3	□ 55 31	46 47 19	46 47 19	□ 41 16	1 8
1 3	41 59 30	43 0 0	43 59 30	44 57 55	45 55 22	46 51 38	47 46 46	1 7

G								G
S .	42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
1 4	41 58 2	42 59 30	44 0 0	44 59 29	46 55 12	46 55 12	[] 53 23	1 6
1 5	[] 55 31	42 57 59	43 59 29	45 0 0	46 57 49	46 57 49	[] 55 3	1 5
1 6	[] 51 56	42 55 24	43 57 55	44 59 28	46 0 0	46 59 26	47 57 46	1 4
1 7	[] 47 13	[] 51 40	[] 55 14	44 57 50	45 59 27	47 0 0	47 59 26	1 3
1 8	[] 41 6	[] 46 40	[] 51 21	44 55 2	[] 57 45	46 59 25	48 0 0	1 2
1 9	[] 34 5	[] 41 17	[] 46 13	[] 51 0	[] 54 50	46 57 40	47 59 26	1 1
2 0	[] 25 34	[] 33 4	[] 39 48	[] 45 40	[] 50 40	46 54 37	47 57 36	1 0
2 1	41 15 38	42 24 10	[] 31 58	[] 38 58	45 45 6	46 50 16	47 54 28	9
2 2	41 4 13	42 13 48	42 22 41	[] 30 48	45 38 7	46 44 30	[] 49 55	8
2 3	40 51 20	42 1 54	43 11 52	[] 21 8	45 29 38	46 37 14	[] 43 55	7
2 4	40 36 48	41 48 23	42 59 26	[] 9 50	45 19 32	46 28 23	[] 36 22	6
2 5	40 20 31	41 33 8	42 45 14	43 56 48	45 7 42	46 17 49	[] 27 5	5
2 6	40 2 29	41 16 4	[] 29 16	43 41 58	44 54 4	46 5 27	[] 16 4	4
2 7	39 42 31	40 57 4	42 11 20	[] 25 10	44 38 29	45 51 9	47 3 7	3
2 8	39 20 37	40 36 8	41 51 25	[] 6 22	44 20 54	45 34 51	46 48 10	2
2 9	38 56 35	40 13 0	41 29 18	43 45 22	44 1 56	45 16 20	46 31 2	1
3	38 30 20	39 47 37	41 4 55	42 22 3	43 38 59	44 55	46 11 33	3

G								G
S .	42 °	43 °	44 °	45 °	46 °	47 °	48 °	. S
0						30		0
5 1	38 1 48	39 19 54	40 38 8	41 56 20	43 14 24	44 32 13	45 49 38	2 7 9
2	37 30 45	38 49 40	40 8 45	41 27 59	42 47 12	44 6 16	45 25 2	2 8
3	36 57 13	38 16 46	39 36 43	40 56 53	42 17 12	43 37 28	44 57 37	2 7
4	36 20 58	37 41 7	39 1 48	40 22 53	41 44 14	43 5 40	44 27 7	2 6
5	35 41 55	37 2 35	38 23 55	39 45 48	41 8 8	42 30 41	43 53 25	2 5
6	34 59 50	36 20 52	37 42 45	39 5 23	40 28 35	41 52 12	43 16 8	2 4
7	34 14 40	35 35 59	36 58 18	38 21 31	39 45 30	41 10 5	42 35 10	2 3
8	33 26 17	34 47 41	36 10 17	37 33 58	38 58 36	40 24 2	41 50 9	2 2
9	32 34 31	33 55 50	35 18 33	36 42 32	38 7 41	39 33 50	41 0 52	2 1
1 0	31 39 12	33 0 15	34 22 52	35 47 0	37 12 27	38 39 9	40 6 57	2 0
1 1	30 40 14	32 0 48	33 23 5	34 47 0	36 12 42	37 39 44	39 8 27	1 9
1 2	29 37 28	30 57 15	32 19 0	33 42 39	35 8 7	36 35 15	38 4 0	1 8
1 3	28 30 49	29 49 35	31 10 29	32 35 9	34 1 9	35 29 30	36 54 20	1 7
1 4	27 20 9	28 37 32	29 57 15	31 19 18	32 43 14	34 10 5	35 38 42	1 6
1 5	26 5 23	27 21 5	28 39 18	30 0 0	31 23 11	32 48 48	34 6 47	1 5
1 6	24 46 26	26 0 5	27 16 22	28 35 20	29 56 59	31 21 15	32 48 13	1 4

G S .	42 °	43 °	44 °	45 °	46 °	47 °	48 °	G . S
1 23 23 20 7	24 34 30	25 48 26	27 5 12	28 24 50	29 47 20	31 12 43	1 3	
1 21 55 59 8	23 4 15	24 15 24	25 29 28	26 46 34	28 6 44	29 39 0	1 2	
1 20 24 29 9	21 29 24	22 37 15	23 48 7	25 2 7	26 19 18	27 39 59	1 1	
2 18 48 51 0	19 49 57	20 53 59	22 1 4	23 11 22	24 24 56	25 41 58	1 0	
2 17 9 14 1	18 6 3	19 5 44	20 8 27	21 14 24	22 23 39	23 36 26	9	
2 15 25 49 2	16 17 51	17 12 40	18 10 25	19 11 20	20 15 32	21 23 14	8	
2 13 38 51 3	14 25 37	15 15 1	16 7 13	17 2 25	18 0 47	19 2 34	7	
2 11 48 31 4	19 29 37	13 9 8	13 59 8	14 47 59	15 39 45	16 34 43	6	
2 9 55 16 5	10 30 13	11 7 17	11 46 37	12 28 27	13 12 55	14 0 17	5	
2 7 59 27 6	8 27 53	8 58 7	9 30 15	10 4 30	10 40 59	11 19 57	4	
2 6 1 31 7	6 23 8	6 46 9	7 10 40	7 36 49	8 4 44	8 34 37	3	
2 4 1 46 8	4 10 30	4 32 0	4 48 32	5 6 12	5 25 6	5 45 27	2	
2 2 1 15 9	2 8 34	2 16 23	2 24 42	2 33 37	2 43 8	2 53 22	1	
6 3 0 0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0	
S G 42 ° .	43 °	44 °	45 °	46 °	47 °	48 °	G S .	

Foot of table: **SUBTRACT [SVBTRAHE].**

TABLE 96. General Latitude of the Five Planets.

Degrees of the circle up to 10.

The argument runs down the left edge in minutes of arc (1–60, labelled *Scrupula Graduum* — minutes of degrees), and across the top in whole degrees of the circle (the ten column-groups headed 0 through 9). Each column-group gives the latitude as G. (degrees) and ' (minutes). The tabulated entries are the sines of the degrees-and-minutes, in the measure where the radius is 60.

0		1		2		3		4		5		6		7		8		9		
G		G		G		G		G		G		G		G		G		G		
'	.	0'	.	1'	.	2'	.	3'	.	4'	.	5'	.	6'	.	7'	.	8'	.	9'
0	0	0	1	3	2	6	3	8	4	11	5	14	6	16	7	19	8	21	9	23
1	0	1	1	4	2	7	3	9	4	12	5	15	6	17	7	20	8	22	9	24
2	0	2	1	5	2	8	3	10	4	13	5	16	6	18	7	21	8	23	9	25
3	0	3	1	6	2	9	3	12	4	14	5	17	6	19	7	22	8	24	9	26
4	0	4	1	7	2	10	3	13	4	15	5	18	6	20	7	23	8	25	9	27
5	0	5	1	8	2	11	3	14	4	16	5	19	6	21	7	24	8	26	9	28
6	0	6	1	9	2	12	3	15	4	17	5	20	6	23	7	25	8	27	9	29
7	0	7	1	10	2	13	3	16	4	18	5	21	6	24	7	26	8	28	9	30
8	0	8	1	11	2	14	3	17	4	19	5	22	6	25	7	27	8	29	9	31
9	0	9	1	12	2	15	3	18	4	20	5	23	6	26	7	28	8	30	9	32
1	0	10	1	13	2	16	3	19	4	21	5	24	6	27	7	29	8	31	9	33
0																				
1	0	12	1	14	2	17	3	20	4	22	5	25	6	28	7	30	8	32	9	35
1																				
1	0	13	1	15	2	18	3	21	4	23	5	26	6	29	7	31	8	34	9	36
2																				
1	0	14	1	16	2	19	3	22	4	24	5	27	6	30	7	32	8	35	9	37
3																				
1	0	15	1	17	2	20	3	23	4	25	5	28	6	31	7	33	8	36	9	38
4																				
1	0	16	1	19	2	21	3	24	4	27	5	29	6	32	7	34	8	37	9	39
5																				
1	0	17	1	20	2	22	3	25	4	28	5	30	6	33	7	35	8	38	9	40

	0		1		2		3		4		5		6		7		8		9	
	G		G		G		G		G		G		G		G		G		G	
'	.	0'	.	1'	.	2'	.	3'	.	4'	.	5'	.	6'	.	7'	.	8'	.	9'
6																				
1	0	18	1	21	2	23	3	26	4	29	5	31	6	34	7	36	8	39	9	41
7																				
1	0	19	1	22	2	24	3	27	4	30	5	32	6	35	7	37	8	40	9	42
8																				
1	0	20	1	23	2	25	3	28	4	31	5	34	6	36	7	38	8	41	9	43
9																				
2	0	21	1	24	2	27	3	29	4	32	5	35	6	37	7	39	8	42	9	44
0																				
2	0	22	1	25	2	28	3	30	4	33	5	36	6	38	7	41	8	43	9	45
1																				
2	0	23	1	26	2	29	3	31	4	34	5	37	6	39	7	42	8	44	9	46
2																				
2	0	24	1	27	2	30	3	32	4	35	5	38	6	40	7	43	8	45	9	47
3																				
2	0	25	1	28	2	31	3	33	4	36	5	39	6	41	7	44	8	46	9	48
4																				
2	0	26	1	29	2	32	3	35	4	37	5	40	6	42	7	45	8	47	9	49
5																				
2	0	27	1	30	2	33	3	36	4	38	5	41	6	43	7	46	8	48	9	50
6																				
2	0	28	1	31	2	34	3	37	4	39	5	42	6	44	7	47	8	49	9	51
7																				
2	0	29	1	32	2	35	3	38	4	40	5	43	6	45	7	48	8	50	9	52
8																				
2	0	30	1	33	2	36	3	39	4	41	5	44	6	46	7	49	8	51	9	53
9																				
3	0	31	1	34	2	37	3	40	4	42	5	45	6	48	7	50	8	52	9	54
0																				
3	0	32	1	35	2	38	3	41	4	43	5	46	6	49	7	51	8	53	9	55
1																				
3	0	33	1	36	2	39	3	42	4	45	5	47	6	50	7	52	8	54	9	56

	0		1		2		3		4		5		6		7		8		9	
	G		G		G		G		G		G		G		G		G		G	
'	.	0'	.	1'	.	2'	.	3'	.	4'	.	5'	.	6'	.	7'	.	8'	.	9'
2																				
3	0	35	1	37	2	40	3	43	4	46	5	48	6	51	7	53	8	55	9	57
3																				
3	0	36	1	38	2	41	3	44	4	47	5	49	6	52	7	54	8	56	9	58
4																				
3	0	37	1	39	2	42	3	45	4	48	5	50	6	53	7	55	8	57	9	59
5																				
3	0	38	1	40	2	43	3	46	4	49	5	51	6	54	7	56	8	58	1	0
6																			0	
3	0	39	1	42	2	44	3	47	4	50	5	52	6	55	7	57	8	59	1	1
7																			0	
3	0	40	1	43	2	45	3	48	4	51	5	53	6	56	7	58	9	0	1	2
8																			0	
3	0	41	1	44	2	46	3	49	4	52	5	54	6	57	7	59	9	1	1	3
9																			0	
4	0	42	1	45	2	47	3	50	4	53	5	55	6	58	8	0	9	2	1	4
0																			0	
4	0	43	1	46	2	49	3	51	4	54	5	56	6	59	8	1	9	3	1	5
1																			0	
4	0	44	1	47	2	50	3	52	4	55	5	58	7	0	8	2	9	4	1	6
2																			0	
4	0	45	1	48	2	51	3	53	4	56	5	59	7	1	8	3	9	5	1	7
3																			0	
4	0	46	1	49	2	52	3	54	4	57	6	0	7	2	8	4	9	6	1	8
4																			0	
4	0	47	1	50	2	53	3	55	4	58	6	1	7	3	8	5	9	7	1	10
5																			0	
4	0	48	1	51	2	54	3	56	4	59	6	2	7	4	8	6	9	9	1	11
6																			0	
4	0	49	1	52	2	55	3	58	5	0	6	3	7	5	8	7	9	10	1	12
7																			0	
4	0	50	1	53	2	56	3	59	5	1	6	4	7	6	8	8	9	11	1	13

	0		1		2		3		4		5		6		7		8		9	
	G		G		G		G		G		G		G		G		G		G	
'	.	0'	.	1'	.	2'	.	3'	.	4'	.	5'	.	6'	.	7'	.	8'	.	9'
8																			0	
4	0	51	1	54	2	57	4	0	5	2	6	5	7	7	8	10	9	12	1	14
9																			0	
5	0	52	1	55	2	58	4	1	5	3	6	6	7	8	8	11	9	13	1	15
0																			0	
5	0	53	1	56	2	59	4	2	5	4	6	7	7	9	8	12	9	14	1	16
1																			0	
5	0	54	1	57	3	0	4	3	5	5	6	8	7	10	8	13	9	15	1	17
2																			0	
5	0	55	1	58	3	1	4	4	5	6	6	9	7	11	8	14	9	16	1	18
3																			0	
5	0	57	1	59	3	2	4	5	5	7	6	10	7	12	8	15	9	17	1	19
4																			0	
5	0	58	2	0	3	3	4	6	5	9	6	11	7	14	8	16	9	18	1	20
5																			0	
5	0	59	2	1	3	4	4	7	5	10	6	12	7	15	8	17	9	19	1	21
6																			0	
5	1	0	2	2	3	5	4	8	5	11	6	13	7	16	8	18	9	20	1	22
7																			0	
5	1	1	2	3	3	6	4	9	5	12	6	14	7	17	8	19	9	21	1	23
8																			0	
5	1	2	2	5	3	7	4	10	5	13	6	15	7	18	8	20	9	22	1	24
9																			0	
6	1	3	2	6	3	8	4	11	5	14	6	16	7	19	8	21	9	23	1	25
0																			0	

The numbers distributed through the columns are the sines of the degrees and of the minutes, in the measure where the radius is 60.

TABLE 97. Distance of the Minor Planets from the Sun, in parts where the radius of the Sun's annual orb is 100000.

The argument is the equated anomaly of the planets [*Anomalia Æquata Planetarum*, given in the left margin], stepping by 3 degrees in the first column (0

to 180) and by its complement to 360 in the second (360 down to 180). The remaining columns give the distance for Saturn (♄), Jupiter (♃), Mars (♂), Venus (♀), and Mercury (☿).

Gr.	Gr.	♄	♃	♂	♀	☿
0	360	1009293	547889	166424	72973	46690
3	357	1009217	547863	166413	72972	46679
6	354	1008958	547753	166357	72970	46645
9	351	1008597	547547	166259	72967	46591
12	348	1008082	547281	166120	72963	46514
15	345	1007414	546962	165948	72956	46414
18	342	1007028	546651	165733	72947	46293
21	339	1006065	546207	165498	72937	46252
24	336	1004541	545700	165206	72925	45997
27	333	1003291	545125	164891	72912	45816
30	330	1001917	544498	164536	72898	45612
33	327	1000419	543804	164153	72882	45390
36	324	998788	543046	163733	72861	45151
39	321	997003	542241	163284	72847	44892
42	318	995142	541368	162908	72827	44616
45	315	993158	540407	162396	72807	44324
48	312	991068	539442	161863	72785	44017
51	309	988864	538489	161204	72762	43693
54	306	986583	537429	160619	72738	43357
57	303	984208	536336	160013	72712	43007
60	300	982805	535208	159397	72686	42637
63	297	979208	534032	158739	72659	42264
66	294	976603	532837	158015	72632	41882
69	291	973931	531612	157389	72604	41489
72	288	972261	530343	156690	72576	41089
75	285	968437	529079	156005	72547	40682
78	282	965658	527788	155275	72517	40270
81	279	962790	526500	154552	72488	39853

Gr.	Gr.	ከ	ጋ	♂	♀	የ
84	276	959961	525170	153805	72458	39432
87	273	957081	523848	153084	72428	39009
90	270	954198	522521	152348	72398	38585
93	267	951307	521204	151613	72368	38161
96	264	948435	519872	150877	72338	37737
99	261	945572	518555	150444	72308	37315
102	258	942738	517254	149422	72279	36898
105	255	939942	515773	148722	72249	36485
108	252	937185	514698	148007	72220	36078
111	249	934465	513440	147417	72192	35677
114	246	931803	512206	146722	72164	35284
117	243	929110	511120	145955	72137	34901
120	240	926650	509935	145310	72110	34529
123	237	924188	508805	144685	72084	34167
126	234	921813	507714	144077	72058	33817
129	231	919532	506553	143492	72034	33480
132	228	917328	505560	142933	72011	33156
135	225	915149	504636	142400	71989	32849
138	222	913253	503685	141890	71969	32556
141	219	911393	502812	141413	71949	32280
144	216	908608	501997	140963	71931	32021
147	213	907977	501239	140543	71914	31781
150	210	906479	500554	140161	71898	31559
153	207	905105	499888	139807	71884	31355
156	204	903815	499342	139491	71871	31174
159	201	902767	498835	139208	71859	31019
162	198	901793	498391	138959	71849	30877
165	195	900982	498015	138707	71840	30756
168	192	900304	497696	138583	71833	30650
171	189	899799	497444	138447	71829	30580
174	186	899417	497289	138349	71826	30525

Gr.	Gr.	ℏ	♂	♂	♀	♀
177	183	899179	497179	138304	71824	30491
180	180	899103	497154	138274	71823	30480

Distance from the Earth, in parts where the radius of the annual orb is 100000.

	Planeta	ℏ	♂	♂	♀	♀
With the Sun at apogee [Sole Apogeo]	Aphelion	11110	6496	2681	1747	1484
		33	29	64	13	30
	Perihelion	79736	3954	3653	3013	7126
		3	13	4	6	0
With the Sun at perigee [Sole Perigeo]	Aphelion	10075	6461	2646	1712	1449
		53	49	84	33	50
	Perihelion	80084	3988	5001	2665	6778
		3	93	4	6	0

TABLE 98.

OR, THE UNIVERSAL CATALOGUE OF THE FIXED STARS, COMPLETED FOR THE YEAR OF CHRIST 1700.

And reduced to four Classes, or Degrees of Certitude; transcribed here from Book Four.

The **First Class** contains the stars observed by us together with Father Francesco Maria Grimaldi [P. Franciscus Maria Grimaldus], most often, whose longitude and latitude — in accordance with what was said in Book IV — we reckon as certain in the first degree; and to these we have added the Pleiades observed by D. Vicenç Mut [D. Vincentius Mutus] and by Michael Florent van Langren [Michael Florentius Langrenus].

The **Second Class** holds the remaining stars observed by Tycho [Tycho Brahe] or by Kepler [Johannes Kepler], as they stand in the Rudolphine Catalogue [Catalogo Rudolphino] — the numbers nevertheless corrected so far as the differences

between our own values and the Tychonic values of the same constellation require, or those near to them, which we place in the second degree of certitude.

The **Third Class** comprises the remaining stars, observed neither by us, nor by Tycho, but by Hipparchus [Hipparchus] and Ptolemy [Ptolemy] — looking, however, to those same constellations, or to neighbouring ones, of which some Fixed stars are by us, or by Tycho, observed; the numbers corrected so far as the differences between the Ptolemaic values and our own, or the Tychonic values of the same constellation, require. And these, in the third degree of certitude, we do not place so as evidently to exclude an error of 10 minutes. As Kepler says: *that they were corrected by themselves from the numbers, after the example of the surrounding Tychonic ones.*

The **Fourth Class** extends to stars observed neither by Hipparchus, nor by Ptolemy (so far as we know), nor by Tycho — nor among those observed by them, but looking to wholly new constellations, observed by the navigators [Naucleri]. Their longitude only we have reduced to the end of the year 1700, adding to the Rudolphine longitude the motion of 100 years, which for us is $1^{\circ} 24' 27''$. The latitude, however, we have transcribed from the Rudolphine Catalogue wholly unchanged. We reckon these, moreover, to be of the fourth degree of certitude; and, given the cross-staff [Radius], or astronomical staff [Baculo Astronomico], which the navigators use, and which we have found by experience to be liable to an error of some few minutes, we do not judge them to be more reliable than the Ptolemaic ones, until they shall have been observed by another and more accurate method.

PART ONE. Of the Fixed Stars of the Twelve Signs of the Zodiac.

ARIES.

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
<i>1st Class.</i>									
The first in the Horn, preceding [Prima in Cornu præcedente]	Υ	2 8	5 9	2 7	7	8	0	B	4
The next in the same horn [Sequens in eodem cornu]	Υ	2 9	4 5	2 7	8	2 8	3 0	B	4
The Lucida above the head [Lucida supra caput]	♄	3	2 8	2 9	9	5 6	3 0	B	3

2nd Class.

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the northern gape [In rictu Borealis]	☿	3	5 6	3 0	7	2 2	3 0	B	6
In the southern gape [In rictu Australis]	☿	4	4 2	3 0	5	4 2	0	B	6
That in the nape [Quæ in cervice]	♄	2 9	1 9	2 7	5	2 3	3 0	B	5
in the kidneys [in renibus]	☿	9	5 8	3 0	6	6	3 0	B	6
In the drawing-out of the tail [In eductione caudæ]	☿	1 4	1 9	3 0	4	8	0	B	5
Preceding the three in the tail [Præcedens trium in cauda]	☿	1 6	3 7	3 0	1	4 6	0	B	4
The middle of them [Media earum]	☿	1 7	4 6	3 0	2	4 9	3 0	B	5
The last of them [Ultima earum]	☿	1 9	1 3	0	2	3 5	3 0	B	6
That in the thigh [Quæ in femore]	☿	1 2	4 4	3 0	1	1 1	3 0	B	6
in the ham [in poplite]	☿	1 0	5 7	3 0	1	6	3 0	B	6
in the left knee [in genu sinistro]	☿	1 0	4 5	3 0	1	2 9	3 0	A	6
in the right knee [in genu dextro]	☿	9	1 4	3 0	0	3 8	3 0	A	6
Small one in the belly [Parvula in alvo]	☿	9	4 8	3 0	4	0	3 0	A	6
Below the Lucida of the head [Infra lucidam capitis]	☿	3	3	2 9	9	1 2	3 0	A	6
Above the back, unformed [Supra dorsum informis]	☿	1 1	5 7	3 0	10	5 0	0	B	5
The unformed next to the base of the triangle [Sequens informis ad basim trianguli]	☿	1 2	4 5	3 0	11	1 5	3 0	B	4

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The eastern on the same base [Orientalis in eadem basi]	♄	1 4	2	3 0	10	2 3	3 0	B	3
At the apex of the triangle, to the north [In apice triang. ad boream]	♄	1 4	1 3	3 0	12	2 5	0	B	4
<i>3rd Class.</i>									
The northern of the three unformed [Trium informium borea]	♄	1 3	5 2	3 0	12	4 3	3 0	B	5
In the hindmost rear foot [In extremo pede posterior]	♄	7	3 2	3 0	5	9	3 0	A	4

TAURUS.

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
<i>1st Class.</i>									
The southern Eye, Aldebaran [Oculus Australis, Aldebaran]	♄	5	3 5	3 0	5	3 0	5 0	A	1
The northern Eye [Oculus Borealis]	♄	4	1 6	0	2	3 6	2 0	A	3
The lowest of the Hyades, in the nostrils [Hyadum infima in naribus]	♄	1	3 4	2	5	4 6	2 0	A	3
The northern tip of the horn [Cornu borei extrema]	♄	1 8	2 2	4 7	5	2 0	3 0	B	2
The southern tip of the horn [Cornu austrini extrema]	♄	2 0	1 5	4 7	2	1 3	3 0	A	3
The Lucida [of the Pleiades], or Alcyone [Pleiadum Lucida, seu Alcione]	♄	2 5	5 4	3 7	3	5 9	0	B	3
The Pleiad Electra [Pleiadum Electra]	♄	2 4	4 3	0	4	8	4 0	B	5
The Pleiad Taygeta [Pleiadum Taygeta]	♄	2 4	5 3	1 9	4	3 1	3 6	B	6

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
The Pleiad Merope [Pleiadum Merope]	♄	2 4	5 9	5 0	3	5 2	3 0	B	6
The Pleiad Maia [Pleiadum Maia]	♄	2 5	0	2 0	4	2 2	5 6	B	6
The Pleiad Asterope [Pleiadum Asterope]	♄	2 4	5 6	5 0	4	3 0	3 0	B	8
The Pleiad Celaeno [Pleiadum Celeno]	♄	2 4	4 5	1 0	4	1 5	3 5	B	8
Atlas, father of the Pleiades [Pleiadum pater Atlas]	♄	2 5	4 6	2 0	3	5 0	2 0	B	5
Pleione, mother of the Pleiades [Pleiadum mater Pleione]	♄	2 5	4 7	2 0	3	5 3	0	B	7
<i>2nd Class.</i>									
The uppermost in the section [Suprema in sectione]	♄	1 9	2 3	0	5	5 6	5 0	A	5
The next after it [Altera post ipsam]	♄	1 8	5 3	0	7	2 8	5 0	A	6
The third of them [Tertia earum]	♄	1 7	4 1	0	8	4 9	2 0	A	4
The fourth, most southern [Quarta Australissima]	♄	1 6	5 8	3 0	9	2 2	0	A	4
In the right shoulder [In dextro armo]	♄	2 3	9	0	8	4 0	0	A	5
In the breast [In pectore]	♄	2 6	2 4	0	8	2	5 0	A	4
In the right knee [In genu dextro]	♄	2 9	2 2	0	12	1 3	2 0	A	4
In the right hough [In suffragine dextra]	♄	2 5	4 2	0	14	3 0	2 0	A	4
In the left knee [In genu sinistro]	♄	5	4 2	0	9	3 1	5 0	A	5
In the left hough [In suffragine sinistra]	♄	4	3 4	0	11	4 7	5 0	A	5

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
Between the nostrils and the northern eye [Inter nares, & oculum boreum]	II	2	3 9	3 0	4	1	5 0	A	5
Between the nostrils and the southern eye [Inter nares, & oculum Austral.]	II	3	4 5	0	5	5 2	5 0	A	4
At the root of the southern horn [Ad radicé cornu Australis]	II	9	3 5	0	3	3 9	3 0	A	6
More southern on the same horn [Australior in eod. cornu]	II	1 3	3 6	3 0	2	3 0	0	A	6
More northern on the same horn [Borealior in eod. cornu]	II	1 2	2 7	0	1	4 9	0	A	4
At the origin of the northern horn [In origine cornu borei]	II	7	5 8	0	0	4 0	3 0	B	5
In the northern ear [In aure Borealis]	II	4	1 7	0	1	4	3 0	B	5
In the southern ear [In aure Australis]	II	4	1	0	0	3 5	3 0	B	4
In the neck, preceding the two [In collo præcedés duarum]	♄	2 9	1 4	0	1	1 2	3 0	B	5
In the neck, following [In collo sequens]	II	1	5 1	3 0	0	4 6	2 0	A	6
In the nape, of the quadrilateral, preceding [In cervice quadrilateri præcedens]	II	1	2 7	0	5	1 5	5 0	A	6
The northern of the same [Eiusdem borea]	II	1	8	3 0	7	5 4	5 0	A	5
Of the following side, southern [Sequentis lateris Austral.]	II	3	5 7	0	3	5 7	1 0	B	5
Of the same side, northern [Eiusdem lateris Boreal.]	II	3	4 8	3 0	5	4 5	4 0	B	5
In the hoof of the left foot [In vngula pedis sinistri]	♄	2 1	2 0	0	13	2 9	5 0	A	6

Name of the Fixed star	Sig n	G r.	'	"	Lat. Gr.	'	"	B/ A	Ma g.
In the heel of the following foot [In talo pedis sequentis]	♊	1	3	0	12	1	5	A	5
			3				0		

CATALOGUE OF THE FIXED STARS FOR THE YEAR 1700 (continued)

Universal table of the fixed stars (TAB. 98), continued. Each entry gives the star's name, its ecliptic longitude (zodiac Sign | degrees | minutes | seconds), its ecliptic latitude (degrees | minutes | seconds, with B = Borealis/northern, A = Australis/southern), and its magnitude. Within each constellation the stars are grouped by certitude class (1.–4. Classis). The longitude "Sign" column gives the zodiacal sign in which the longitude falls; it is reproduced here by name.

(Continuation of TAURUS, 2. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the right shoulder [In armo dextro]	Gemini	3	2	3	8	4	5	A	5
			1	0		0	0		
The preceding of the three below the Hyades [Trium infra Hyadas præced.]	Gemini	3	5	0	6	5	2	A	5
						6	0		
The middle of them [Media earum]	Gemini	4	5	0	7	4	2	A	5
			1				0		
The following of them [Sequens earum]	Gemini	6	1	0	6	1	2	A	6
			8			7	0		
The little one in the southern horn [Parvula in cornu austr.]	Gemini	1	2	0	1	3	5	A	6
			6	5			0		
The following in the same horn [Sequens in eodem cornu]	Gemini	1	1	3	1	1	5	A	6
			8	8	0	9	0		
The little one following the four in the section [Parvula sequens quatuor in sectione]	Taurus	8	5	0	9	3	2	A	6
			6				0		
Of the two in the square of	Gemini	0	4	3	6	3	5	A	5

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
the neck, the preceding [Duarum in quadrato colli præced.]		5		0		2	0		

3. Classis. — Informes [the unformed/scattered stars]

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Below the foot and the right shoulder [Sub pede, & armo dextro]	Taurus	1	4	0	17	2	3	A	4
		7	3			9	0		
The preceding, above the southern horn [Præced. supra cornu austr.]	Taurus	1	2	0	1	5	3	A	5
		2	3			0	0		
Below the extreme southern horn, more to the north [Sub extremo cornu australi borealior]	Gemini	2	2	0	5	5	3	A	5
		1	3			9	0		
Below the same, more to the south [Sub eodem australior]	Gemini	2	2	0	6	5	3	A	5
		1	3			9	0		
Preceding by 5°, below the northern horn [Ex 5 sub cornu boreo præced.]	Gemini	1	2	0	0	4	3	B	5
		9	3			0	0		
Following this one [Hanc sequens]	Gemini	2	2	0	1	2	3	B	5
		1	3			0	0		
Again behind this one [Hac iterum posterior]	Gemini	2	2	0	1	4	3	B	5
		3	3			0	0		
The more northern of the last two [Vltimarum duarum borea]	Gemini	2	4	0	3	4	3	B	5
		4	3			0	0		
The southern of them [Earum australis]	Gemini	2	4	0	1	3	3	B	5
		5	3			5	0		

GEMINI.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Head of Castor [Castoris caput]	Cancer	1	1	4	10	2	5	B	2
		6		7			0		
Head of Pollux [Pollucis caput]	Cancer	1	4	5	6	3	3	B	2
		9		3		8	0		
The bright star in the foot of Gemini [Lucidus pes ♊]	Cancer	4	5	4	6	4	0	A	2
			1	7			8		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Left hand of the preceding Twin [Sinistra manus præcedentis Gemini]	Cancer	6	5	5	10	5	3	B	5
			4	0		8	0		
In the left arm [In sinistro brachio]	Cancer	1	1	5	7	4	3	B	4
		1	6	2		3	0		
In the same shoulder-blades [In eiusdem scapulis]	Cancer	1	4	0	5	4	0	B	4
		4	7			3			
In the same, the right shoulder [In eiusdem humero dextro]	Cancer	1	1	0	5	1	3	B	5
		7	0			0	0		
In the left shoulder of the following Twin [In sinistro hum. sequentis Gemini]	Cancer	1	2	0	3	3	3	B	4
		9	9				0		
In the right side of the preceding [Gemini] [In latere dext. præced. ♊]	Cancer	1	4	0	2	5	3	B	6
		4	1			6	0		
In the left elbow of Castor [In sinistro cubito Castoris]	Cancer	1	3	0	6	1	0	B	6
		5	3						
In the northern and topmost knee [In boreal. & supremo genu]	Cancer	5	4	0	2	1	3	B	3
			5			1	0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the left, the following knee [In sinistro genu sequentis]	Cancer	1	4	0	2	7	0	A	3
		0	9						
In the belly of Pollux [In ventre Pollucis]	Cancer	1	1	5	0	1	0	A	3
		4	8	0		4			
In the same one's hough [In eiusdem poplite]	Cancer	1	3	0	5	4	3	A	4
		4	6			1	0		
In the foot preceding Castor [In pede antecedenti Castoris]	Gemini	2	1	0	0	5	3	A	4
		9	4			8	0		
The heel of the same foot [Calx eiusdem pedis]	Cancer	1	4	5	0	5	3	A	3
				0		3	0		
In the extreme right foot of Castor [In extremo pedis dextri Castoris]	Cancer	2	3	0	3	8	3	A	4
		5				0			
In the lowest foot of Pollux [In imo pede Pollucis]	Cancer	6	5	2	10	9	3	A	4
		0	0			0			
In the heel of Pollux [In calce Pollucis]	Cancer	9	1	0	9	4	3	A	6
		7				1	0		
At the top of the knee of Pollux [Suprema genu Pollucis]	Cancer	7	4	5	1	1	2	A	6
		3	0			2	0		
In the thigh of Castor [In femore Castoris]	Cancer	9	5	2	1	3	2	B	6
		8	0			1	0		
Below the head, in the hand of Pollux [Infra caput in manu Pollucis]	Cancer	2	5	5	5	4	3	B	5
		1		0		4	0		
The little one between the heads [Gemini] [Parvula inter capita II]	Cancer	1	2	2	7	2	2	B	5
		8	5	0		4	5		
At the ear of Castor [Ad aurem Castoris]	Cancer	1	4	5	9	4	3	B	5
		4	3	0		2	0		
Preceding the topmost foot, nearer it [Præcedens summum pedé, seu Propus]	Gemini	2	4	5	0	1	3	A	4
		6	2	0		3	0		
The lowest of the five	Cancer	1	2	2	5	5	2	A	6

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
preceding stars among the Twins [Præcedétium quinque inter Geminos infima]		8	3	0		2	5		
The following one above this [Sequens supra hanc]	Cancer	1	2	5	3	4	0	A	6
		9	6	5		9			
The third of them [Tertia earum]	Cancer	2	5	2	2	4	3	A	6
		0	1	0		2	0		
The fourth of them [Quarta earum]	Cancer	2	4	5	0	5	0	A	6
		2	8	0		8			

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The bright star that precedes the front knee [Quæ præcedit genu anterius Clara]	Gemini	2	7	0	6	1	3	B	4
		9				0	0		

CANCER.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The Nebulous Manger [Nebulosa Præsepe]	Leo	3	8	2	1	1	3	B	ne b.
				3		4	0		
The Northern Ass [Asellus Boreus]	Leo	3	1	5	3	8	3	B	4
			8	3			0		
The Southern Ass [Asellus Australis]	Leo	4	2	5	0	3	3	A	4
			9	3			0		

(Right column of page 110 — continuation of CANCER, 2. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the northern of the preceding square [Borea in □ præcedentium]	Leo	1	1	0	1	3	0	B	5
			1			2			
The southern of the same [Australis earumdem]	Leo	1	3	3	0	4	0	A	5
			4	0		7			
In the southern arm [In Brachio austrino]	Leo	9	2	3	5	7	3	A	3
			5	0			0		
In the northern arm [In Brachio boreo]	Leo	2	6	0	10	2	3	B	5
						3	0		
In the extreme northern foot [In extremo pedis borei]	Cancer	2	1	0	1	1	0	B	5
			5	8		6			
In the extreme southern foot [In extremo pedis austrini]	Cancer	2	2	0	7	4	3	A	6
			6	6			0		
The brighter one at the root of the tail [Lucidior in radice caudæ]	Cancer	2	7	3	2	1	0	A	4
			7	0		8			
The next one following, in the back [Sequens proximé in dorso]	Cancer	2	3	3	1	3	3	A	6
			9	4	0		0		
In the southern arm, [the more] northern [In brachio australi borea]	Leo	3	9	3	1	5	3	A	6
				0		3	0		
In the same, the southern [In eodem austrina]	Leo	1	5	0	5	3	2	A	5
			1	8		5	8		
In the northern claw [In rostro borealis]	Leo	6	4	0	7	1	3	B	6
			9			4	0		
In the southern claw [In rostro australis]	Leo	8	5	3	5	2	3	B	6
			8	0		0	0		

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Above the bend of the southern pincer [Supra	Leo	1	4	0	2	1	3	A	4
			2	2		9	0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
flexum forcipis austrinæ]									
Following the extreme of the southern pincer [Sequens extremum forcipis austr.]	Leo	1	4	0	5	1	2	A	4
		4	2			9	5		

LEO.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The Heart of the Lion, Regulus [Leonis cor, Regulus]	Leo	2	3	3	0	2	2	B	1
		5	8	2		6	0		
The bright star of the tail [Leonis caudæ lucida]	Virgo	1	2	4	12	1	2	B	1
		7	6	7		6	0		
The bright star of the mane, or of the neck [Iubæ, seu colli lucida]	Leo	2	1	1	8	4	4	B	2
		5	8	9		5	0		
The top of the neck [Suprema cervicis]	Leo	2	1	4	11	4	4	B	3
		3	6	7		8	0		
The bottom of the neck [Infima cervicis]	Leo	2	3	1	4	5	4	B	3
		3	9	7		0	0		
The bright star in the loins [Lucida in Lumbis]	Leo	7	7	3	14	1	3	B	2
				2		8	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Those in the nostrils [Quæ in naribus]	Leo	1	1	3	10	2	4	B	4
		1		0		1	0		
In the gape of the mouth [In hiatu]	Leo	1	3	3	7	5	4	B	4
		3	6	0		0	5		
The more northern of the head [Capitis borealior]	Leo	1	1	0	12	1	5	B	4
		7	1			9	0		
The more southern of the	Leo	1	2	0	9	3	4	B	3

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
head [Capitis australior]		6	5			8	0		
In the more southern breast [In pectore australior]	Leo	2	1	3	1	2	4	A	5
Preceding Regulus, very near [Antecedens Regulum proximé]	Leo	2	5	3	0	0	2	B	4
		3		0			5		
Preceding this, in the right knee [Hác præced. in genu dextro]	Leo	1	1	3	0	1	5	B	5
		9	6	0		5	0		
In the right ear [In aure dextra]	Leo	1	2	0	3	1	1	A	4
		7	9			0	0		
Following on the other foot [Sequens in altero pede]	Leo	2	2	0	3	4	1	A	4
		0				7	0		
In the left ear [In aure sinistra]	Leo	2	8	0	3	5	1	A	4
		5				5	0		
In the left armpit [In sinistra Axilla]	Virgo	2	1	0	0	7	5	B	4
			0				0		
In the belly, the preceding of three [In ventre trium anteced.]	Leo	2	4	0	2	9	5	B	6
		3	6				2		
The more northern of them [Earum borealior]	Virgo	3	2	0	5	5	5	A	6
			8			5	0		
The more southern of them [Earum australior]	Virgo	5	2	1	2	4	2	A	6
			7	0		9	0		
Preceding the two in the loins [Præcedens duarum in lumbis]	Virgo	4	3	0	12	5	5	B	5
			6			2	0		
In the haunch, the preceding northern [In clune præcedens borea]	Virgo	9	1	0	9	4	2	B	3
			2			1	0		
The following southern [Sequens austrina]	Virgo	1	3	0	7	5	2	B	6
		0	0			0	5		
In the thigh [In femore]	Virgo	1	2	3	6	6	5	B	3
		3	0	0			0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the hinder knee [In genu posteriori]	Virgo	1	3	3	1	3	5	B	4
		4	0	0		9	2		
The middle one in the foot [Media in pede]	Virgo	1	1	0	0	3	1	A	4
		7	9			3	0		
The lowest one in the foot [Infima in pede]	Virgo	2	5	0	3	2	4	A	4
		0	0				0		
In the hoof of the left foot [In vngula pedis sinistri]	Leo	1	5	0	4	4	3	A	6
		7	5			9	0		
In the hoof of the preceding right foot [In vngula pedis præced. dextra]	Leo	1	2	3	5	4	3	A	5
		7	4	0		4	0		
In the middle of the body [In medio corpore]	Virgo	1	3	3	10	1	3	B	6
			7	0		5	0		
The little one in the head [Parvula in capite]	Leo	1	3	0	10	4	1	B	6
		7	3			6	0		
Preceding the two in the hinder left foot [Præcedens duarum in sinistro pede posterior]	Leo	1	1	0	7	4	3	A	4
		7	5			0	0		
Tycho's other codex [Tychonis alter codex]	Virgo	2	1	0	5	4	3	A	5
		0	2			2	0		
Of the unformed stars above the back, the preceding [Informium supra dorsum præced.]	Leo	2	4	3	17	3	4	B	5
		7	5	0		8	0		
Following them [Sequens earum]	Virgo	1	2	0	16	2	5	B	5
			0			8	0		
The topmost of the bright stars of the back [Suprema lucidarum dorsi]	Virgo	6	1	3	16	4	4	B	5
			6	0		5	0		
Above the tail [Supra caudam]	Virgo	1	4	0	17	1	5	B	4
		4	5			7	0		
The northern of three below the belly [Borealis trium sub]	Virgo	1	2	0	1	1	0	B	4
		0	0			9			

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
ventre]									
The middle of them [Media earum]	Virgo	9	5	1	0	1	5	A	5
			2	5		0	0		
The southern of the same [Australis earundem]	Virgo	1	4	0	2	3	3	A	5
		0	2			0	0		

VIRGO.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Spica [the Ear of grain]	Libra	1	3	4	1	5	3	A	1
		9	9	7		9	0		
The bright star of the girdle [Lucida cinguli]	Libra	7	1	4	8	4	3	B	3
			8	7		0	0		
Vindemiatrix	Libra	5	4	1	16	1	0	B	3
			6	7		5			

(Left column — continuation of VIRGO, 2. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Preceding the [star] in the northern part of the head [Præcedentium in □ capitis borealis]	Virgo	1	7	5	6	6	0	B	5
			9	0					
The more southern of them [Earum australior]	Virgo	1	5	4	4	3	3	B	5
			9	6		6	0		
The following in the northern face [Sequentium in vultu borea]	Virgo	2	3	4	8	3	0	B	5
			3	0		3			
The southern of the same [Earundem austrina]	Virgo	2	4	5	6	9	3	B	5
			3	1			0		
In the extreme of the wing, the southern and most to the	Virgo	2	5	4	0	4	2	B	3
			2	5		2	8		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
left [In extrema alæ australis, & sinistræ]									
Preceding the four in the left wing [Præcedens de quatuor in ala sinist.]	Libra	0	3	4	1	2	2	B	4
			9	9		4	9		
The third, following on the shoulder [Alteta sequens in humero]	Libra	5	5	1	2	4	3	B	3
			9	7		9	0		
The next-to-last of them [Penultima earum]	Libra	1	5	1	2	2	0	B	6
			0	1	8	3			
The last of them [Ultima earum]	Libra	1	0	5	1	4	2	B	4
			4	0		4	8		
In the right [wing], and northern, of three preceding [In dextra, & bor. ala trium præced.]	Libra	1	1	4	1	3	0	B	5
			6	7		6			
Of the remaining two, the southern [Reliquarum duarum austrina]	Libra	3	1	5	11	3	2	B	6
			5	0		6	8		
Below the girdle, in the haunch [Sub perizomate in clune]	Libra	1	4	1	8	9	3	B	3
			6	6	8		0		
The most northern of the left hip [Sinistræ coxæ borealiss.]	Libra	1	2	1	3	1	2	B	6
			9	2	9	0	7		
The more northern of two following [Sequentium duaru boreal.]	Libra	2	3	1	1	4	0	B	6
			2	3	8	5			
The more southern of them [Earum australior]	Libra	2	7	5	0	2	0	B	6
			1	0		0			
In the left knee [In genu sinistro]	Libra	2	7	4	2	2	0	B	4
			6	8		4			
The more northern of the topmost fringe [Borealiior supremæ fimbriæ]	Libra	2	1	5	11	2	0	B	5
			9	2	0				

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The middle of three in the fringe [Media trium in fimbria]	Libra	2	3	4	7	1	0	B	4
		9	2	7		8			
The lowest, and southern, of the fringe [Infima, & austral. fimbriæ]	Virgo	0	1	5	2	5	0	B	4
			4	0		7			
The more southern of the two of the upper fringe [Australior duarum superioris fimbriæ]	Virgo	1	1	1	11	4	2	B	4
			5	7		7	9		
In the southern foot [In pede australi]	Virgo	2	4	5	0	3	0	B	4
			5	0		1			
In the right, or northern foot [In pede dextro, seu boreo]	Virgo	5	5	4	9	4	2	B	4
			3	8		8	7		
Between Vindemiatrix and the girdle [Inter Vindem. & cingulum]	Libra	2	4	5	10	2	3	B	6
			4	0		5	0		
Following this one in the right haunch [Sequês hanc in clune dext.]	Libra	2	1	1	9	4	0	B	6
		3		8		0			
Those in the neck [Quæ in cervice]	Virgo	2	9	1	4	5	0	B	6
		9		7		9			
The little one following Vindemiatrix [Parva sequens Vindemiatricem]	Virgo	9	4	5	16	1	3	B	6
			8	0		3	0		
Preceding three in a straight line of the northern wing [Præcedens trium in recta linea alæ borealis]	Libra	1	3	4	12	4	0	B	5
		1	4	7		0			
The middle of the same [Media earundem]	Libra	1	9	5	13	7	0	B	5
		6		0					
Following this [Sequens hanc]	Libra	2	3	4	3	2	0	B	5
		3	4	3		2			
Those between the fourth and	Virgo	2	3	1	3	2	3	A	6

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
fifth [Quæ inter quatt. & quintá]		4	0	7		5	0		
Of the unformed stars below the left arm [Informis sub brachio sinistro]	Libra	8	1	5	3	2	3	A	5
				0		3	0		
The middle [Media]	Libra	1	2	4	3	2	3	A	5
		2		7		3	0		
The following [Sequens]	Libra	1	3	1	3	1	0	A	5
		5	2	8		4			
Following the three below Spica [Sequens trium sub Spica]	Libra	1	3	4	7	5	3	A	5
		8	6	7		1	0		
The middle one toward the south [Media ad Austrum]	Libra	2	5	5	9	1	2	A	5
		0	8	0		6	8		
The Eastern follower [Sequens Orientalis]	Libra	2	5	1	6	1	3	A	5
		1	9	7		6	0		

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the thigh, the preceding southern [square] [In femore □ præced. austr.]	Libra	1	2	5	0	9	3	B	6
		9	3	0			0		
In the extreme of the hip [In coxæ extremo]	Libra	2	2	4	8	2	2	B	5
		0	3	8		9	8		

LIBRA.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The Northern Scale [Lanx Borealis]	Virgo	1	1	1	8	3	1	B	2
		5	2	7		3	0		
The Southern Scale [Lanx	Virgo	1	5	2	0	2	1	B	2

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Australis]		0	6	7		5	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Those above the southern scale [Quæ supra lancem austral.]	Virgo	1	7	2	1	5	1	B	5
		0		7		4	0		
Those above the northern scale [Quæ supra lancem borealé]	Virgo	1	4	3	8	1	0	B	4
		1		0		7			
The first from the southern scale, toward the east [Prima à lance austral. ad ortum]	Virgo	1	5	0	1	1	1	B	5
		3	2			3	0		
The second from the same [Secunda ab eadem]	Virgo	1	4	3	2	5	4	B	6
		7	4	0		7	0		
The third toward the east [Tertia ad ortum]	Virgo	2	5	2	4	2	1	B	3
		0	8	9		7	0		
Below this one toward the east [Infra hanc ad ortum]	Virgo	2	1	5	4	3	1	B	4
		3	3	7			0		
Below the same toward the west [Infra eandem ad occasum]	Virgo	2	5	3	2	2	1	B	4
		0	2	0		0	0		
Below the northern scale, toward the east [Infra lancem borealem ad ortum]	Virgo	1	1	0	8	5	3	B	4
		7	0				0		
Of the unformed stars, the two below the Southern Scale [Informis duarum infra lacem Austrinam]	Virgo	2	3	2	0	2	0	B	4
		3	5	7					
The lower of the same [Earundem inferior]	Virgo	2	2	5	0	6	1	B	4
		8	8	7			0		
Preceding the three followers [Præcedens trium]	Virgo	2	4	3	3	3	1	B	4
		5	1	0		2	2		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
sequentium]									
The middle [Media]	Virgo	2	1	2	6	9	1	B	4
		6	3	6			5		
The Eastern upper one [Superior Orientalis]	Virgo	2	6	5	9	1	5	A	4
		7		0		9	0		
The following [Sequens]	Virgo	2	4	3	10	5	5	A	5
		8	4	0		7	0		

(Right column of page 111)

(Continuation of LIBRA, 2. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the left arm below the northern scale [In sinistro brachio sub lance bor.]	Virgo	2	4	0	7	3	3	A	3
		8	4			8	0		
The following [Sequens]	Virgo	1	4	0	1	4	2	A	3
		6	1			9	5		

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Below the southern claw, northern [Infra Chelá austral. borealis]	Virgo	2	2	3	8	4	5	A	4
		4	7	0		2	0		
Below the same, southern [Infra eandem australis]	Virgo	2	5	5	10	2	4	A	4
		4	9	0		0	8		

SCORPIUS.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The Heart of the Scorpion, Antares [Scorpij Cor, Antares]	Scorpius	5	3	2	4	2	3	A	1
			5	7		6	0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The northern one in the forehead [Borealis in fronte]	Virgo	2	5	5	1	6	5	B	2
		8	6	7			5		
The middle of the forehead [Media frontis]	Virgo	2	2	7	1	5	4	A	3
		8	0			2	0		
The southern one in the forehead [Australis in fronte]	Virgo	2	4	4	5	2	4	A	3
		8	5	7		0	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the foot, toward the south below the southern forehead [In pede ad austru sub australi frontis]	Virgo	2	4	3	8	2	0	A	4
		9		0		6			
The most northern of the forehead [Borealissima frontis]	Scorpius	0	2	3	1	4	0	B	4
			4	0		4			
The little one in the bright triangle of the forehead [Parva in $\triangle$ cù lucida frótis]	Virgo	2	2	0	0	1	0	B	5
		9	8			6			
...or rather [vel melius]	Virgo	2	2	0	0	1	0	B	5
		9	3			6			
Preceding, toward the heart, on the North [Præcedens cordi ad Boreá]	Scorpius	3	3	0	3	5	0	A	4
			2			3			
Following after the heart [Sequens post Cor]	Scorpius	7	1	0	5	4	0	A	4
			4			8			
Preceding, in the lower feet [Præcedens in inferioribus pedibus]	Scorpius	2	7	3	6	3	3	A	5
				0		5	0		

Ex Keplero de nova Stella [From Kepler, on the new star]:

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Below the sole of the foot of the serpent-bearer [Sub vola pedis serpentarii]	Scorpius	4	1	0	1	4	0	A	4
			8			8			
Which is above the heart of the Scorpion [Quæ supra cor Scorpij]	Scorpius	5	3	0	3	0	0	A	5
			3						
Above the [star] preceding the Heart [Supra præcedentem Cordi]	Scorpius	3	2	0	2	4	0	A	5
			2			8			
Behind it, in the body, the hinder one [Infra eá in corpore poster.]	Scorpius	3	4	0	6	5	0	A	4
			2			8			
In the first vertebra [In primo spondylo]	Scorpius	9	2	0	10	5	0	A	3
			5			8			
In the second vertebra [In secundo spondylo]	Scorpius	1	5	9	14	5	0	A	3
			1			0			
In the sting of the tail [In aculeo caudæ]	Scorpius	1	5	0	13	5	0	A	3
			9	0		2			

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the third vertebra, from Clavius [In 3 spondylo ex Clavio]	Scorpius	1	4	0	18	2	0	A	3
			2	1		0			
Following in the fourth vertebra [Sequens in 4 spondylo]	Scorpius	1	4	0	19	4	0	A	3
			5	1		9			
After it, in the fifth vertebra [Post eum in 5 spondylo]	Scorpius	2	3	0	19	9	0	A	3
			0	1					
Further, in the sixth vertebra [Vltior in 6 spondylo]	Scorpius	2	5	0	16	5	0	A	3
			2	1		9			
Those in the seventh vertebra [Quæ in 7 spondylo]	Scorpius	2	2	0	15	2	0	A	3
			1	1		9			

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Preceding the sting [Præcedens oculum]	Scorpius	1	2	0	13	5	0	A	4
		9	1			9			
Of the unformed stars, following the sting [Informis sequens aculeum]	Scorpius	2	3	0	13	3	0	A	ne b.
		3	1			9			
Of the two above the preceding sting [Duarum supra aculeum præced.]	Scorpius	1	5	0	6	2	0	A	5
		7	1			9			
Following them [Sequens earum]	Scorpius	2	5	0	1	2	0	A	5
		1	1			9			
Otherwise [Aliter]	Scorpius	2	5	0	4	2	0	A	5
		1	1			9			

SAGITTARIUS.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The bright star of the head [Lucida Capitis]	Capricorn	9	2	2	1	4	1	B	4
			2	7		5	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the point of the arrow [In cuspidē sagittæ]	Scorpius	2	5	0	6	5	4	A	4
		6	6			4	0		
...or per Kepler [vel Kepl.]	Scorpius	2	5	0	6	5	0	A	4
		6	6			4			
...or per Ptolemy [vel Ptolem.]	Scorpius	2	1	0	6	5	4	A	4
		7	6			0	0		
In the left handle of the hand [In manubrio sinistræ man.]	Capricorn	0	1	0	6	5	5	A	4
			7			0	0		
...or per Ptolemy [vel Ptolem.]	—	0	1	0	6	5	—	A	4
			6			0			

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the northern part of the arc, the more southern [In parte borea arcus australior]	Capricorn	2	1	3	2	5	2	A	4
			3	0		9	0		
In the same, the more northern [In eodem borealior]	Scorpius	2	7	3	2	2	1	B	4
			9	0		8	0		
In the left shoulder [In humero sinistro]	Capricorn	8	1	0	3	3	2	A	4
			7			0	0		
Preceding this one in the javelin [Antecedens hanc in iaculo]	Capricorn	6	6	0	3	4	2	A	5
						9	0		
The middle one in the head [Media in capite]	Capricorn	1	1	0	0	5	4	B	4
			0	4		9	0		
The last of three in the head [Vltima trium in capite]	Capricorn	1	9	0	1	3	3	B	4
			2			1	8		
The first in the contact [Prima in contactu]	Capricorn	1	1	0	3	7	1	B	6
			4	0			0		
The middle one in the northern contact [In boreo contactu media]	Capricorn	1	2	3	4	1	4	B	4
			5	0		7	0		
The following, and upper [Sequens, & superior]	Capricorn	1	3	0	6	1	1	B	5
			5	7		0	0		
The more eastern one [Hac orientalior]	Capricorn	2	3	3	5	8	4	B	6
			0	4			0		
The last eastern one in the contact [Orientalis vltima in cōtactu]	Capricorn	2	1	3	5	1	3	B	6
			4	8		2	9		
The dark one in the lower contact [Obscura in contactu inferiori]	Capricorn	2	5	0	1	2	3	B	6
			0	0		5	8		
The dark one in the right elbow [Obscura in dextro cubito]	Capricorn	1	5	0	3	7	1	A	6
			7	2			0		

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the southern part of the arc [In australi parte arcus]	Capricorn	0	3	0	11	1	0	A	3
			6				0		
In the double nebulous eye [In oculo nebulosa duplex]	Capricorn	7	4	0	0	2	0	B	ne
			6				5		b.
In the right shoulder [In humero dextro]	Capricorn	1	6	0	2	1	0	A	5
			5				0		
In the shoulder-blades [In scapulis]	Capricorn	1	3	0	2	5	0	A	5
			2	6			0		

(Left column — continuation of SAGITTARIUS, 3. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the shoulder, the third of the trapezium [In armo tertia trapezij]	Capricorn	1	5	0	4	4	0	A	4
			0	6			0		
Below the armpit, the fourth of the trapezium [Sub Axilla quarta trapezij]	Capricorn	9	2	0	6	4	0	A	3
			6				0		
In the left hough, the prior one [In suffragine sinistra priori]	Capricorn	1	1	0	23	2	0	A	2
			0	6			0		
In the knee of the same leg [In genu eiusdem cruris]	Capricorn	9	3	0	18	2	0	A	2
			6				0		
In the prior right hough [In priori dextra suffragine]	Scorpius	2	1	0	13	2	0	A	3
			9	6			0		
In the left shoulder-blade [In scapula sinistra]	Capricorn	1	5	0	13	5	0	A	3
			9	6			0		
In the hinder right knee [In posteriori dextro genu]	Capricorn	1	1	0	20	3	0	A	3
			9	6			0		
In the first drawing-out of the tail [In educatione caudæ prima]	Capricorn	2	2	0	5	1	0	A	5
			0	6			0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Following it, in the Crupper [Sequens eam in Terebello]	Capricorn	2	2	0	5	1	0	A	5
		1	6			0			
In the same place, preceding, of the southern side [Ibidem præced. austrini lateris]	Capricorn	2	1	0	6	1	0	A	5
		1	1			0			
In the same place, the following [Ibidem sequens]	Capricorn	2	6	0	6	5	0	A	5
		2				0			

CAPRICORNUS.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The preceding horn, or upper [Cornu præcedens, seu superius]	Capricorn	2	4	2	7	3	1	B	3
		9	4	7			1		
The following horn, lower [Cornu sequens inferius]	Capricorn	2	5	2	4	4	1	B	3
		9	7	7		2	0		
The bright star preceding in the tail [Caudæ præcedens lucida]	Aquarius	1	4	2	2	2	5	A	3
		7	0	7		4	0		
The bright star following in the tail [Caudæ sequens lucida]	Aquarius	1	2	2	2	2	5	A	3
		9	6	7		7	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B / A	Mag.
The middle of three in the preceding horn [Media trium in cornu præced.]	Aquarius	0	1	0	7	3	1	B	6
	s		7				0		
The southern of the same [Australis	Capricorn	2	5	0	6	5	9	B	3
	n		9	7		4			

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B / A	Mag.
earundem]									
The nebulous one above the preceding horn [Nebulosa supra cornu præced.]	Capricor n	2	3	0	7	1	1	B	neb.
		8	4			7	0		
The Western nebulous one at the base of the triangle in the forehead [Nebulosa Occidentalis basis trianguli in fronte]	Aquariu s	0	2	0	0	4	4	B	neb.
			3			9	0		
The Eastern nebulous one [Nebulosa orientalis]	Aquariu s	1	7	0	0	2	1	B	nel. [recte: neb.]
						9	0		
The topmost of the same triangle [Suprema eiusdem triáguli]	Aquariu s	1	3	0	1	2	8	B	6
						1			
The nebulous one in the preceding face [Nebulosa in fróte præced.]	Capricor n	2	3	0	0	2	1	B	nel. [recte: neb.]
		8	9			5	0		
In the neck, the northern of two [In cervice duarum borea]	Aquariu s	4	1	0	3	2	1	B	6
			5			6	0		
In the same place, the southern [Ibidem australis]	Aquariu s	3	3	0	0	1	0	B	6
			2			6			
Preceding, in the right knee, dark [Præced. in genu dext. obsc.]	Aquariu s	3	1	0	6	5	0	A	6
			3			8			
Following, in the left knee [Sequens in genu sinistro]	Aquariu s	3	5	0	9	1	0	A	6
			4						
In the left shoulder [In	Aquariu	7	3	0	8	7	0	A	6

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B / A	Mag.
sinistro armo]	s	9							
The lowest one in the belly [Infima in ventre]	Aquariu s	1 5 2 0	3 6 0		5 0 5			A	5
The northern following, near to those [in the belly] below the channel [Sequens borea contiguarú sub alveo]	Aquariu s	1 2 3 6	0 6 0		2 0 8			A	6
The more eastern of three in the belly [Trium in ventre orientalior]	Aquariu s	1 4 0 9	0 4 0		2 0 4			A	6
The lowest of them [Infima earum]	Aquariu s	8 5 7	0 4 0		2 0 6			A	6
The most northern of three [Septentrionalis trium]	Aquariu s	8 4 4	0 3 0		0 0 0			A	5
Of the two in the front of the back [Duorum in dorso anteriori]	Aquariu s	9 4 7	0 0 0		2 0 8			A	5
Following them in the back [Sequens earum in dorso]	Aquariu s	1 3 3 3	0 1 0		1 3 5 0			A	5
Preceding the two at the Flanks [Antecedens duarú ad Ilia]	Aquariu s	1 5 5 1	0 4 0		4 0 7			A	4
Following the same [Sequens earundem]	Aquariu s	1 3 7 2	0 4 0		4 0 8			A	5
Preceding, in the upper tail [Anteced. in cauda super.]	Aquariu s	1 4 9 0	0 2 0		2 1 3 0			B	5
In the upper tail, southern [In superiori]	Aquariu s	2 5 1 3	0 0 0		1 3 3 0			A	5

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B / A	Mag.
cauda austral.]									
Preceding this one toward the North [Præcedens hanc ad Boreá]	Aquariu s	2	4	0	0	9	0	A	5
The northern one at the extreme tail [Borea in extremo caudæ]	Aquariu s	2	2	0	4	1	1	B	6
		1	0			8	0		

AQUARIUS.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The bright star of the right shoulder [Humeri dextri lucida]	Aquarius	2	3	5	10	4	1	B	3
		8	1	7		2	5		
The bright star of the left shoulder [Humeri sinistri lucida]	Aquarius	1	1	2	8	4	1	B	3
		9	3	7		2	5		
The lower one of the left hand [Manus sinistræ inferior]	Aquarius	1	1	2	4	5	1	B	5
		2	3	7		0	5		
In the effusion of [the water toward] Fomalhaut [In effusione Fomahant]	Aquarius	2	3	4	20	5	4	A	1
		9	6	3		9	0		

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the head [In capite]	Aquarius	2	4	0	15	2	1	B	6
		3	9			3	5		
In the right shoulder, southern [In humero dextro austral.]	Aquarius	2	5	3	9	1	4	B	5
		7	8	0		1	5		

De hac vide in fine signi [On this one, see at the end of the sign].

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the back below the armpit [In dorso sub axilla]	Aquarius	2	0	2	6	0	4	B	5
		0		9			4		
The middle one in the left hand [Media in manu sinistra]	Aquarius	8	5	0	8	1	1	B	5
		1				9	6		
Preceding, the brighter one of the hand [Antecedés lucidior manus]	Aquarius	7	3	3	8	1	1	B	4
		4		0		0	5		
In the right elbow [In cubito dextro]	Pisces	2	3	2	8	1	4	B	3
		2		8		7	5		
In the right hand, more northern [In dextra manu borealiore]	Pisces	4	2	0	10	3	1	B	5
		7				1	6		
The preceding of the remaining two, southern [Reliquarum duarum austr. præced.]	Pisces	4	4	3	8	5	4	B	4
		5		0		2	6		
Following them [Sequens earum]	Pisces	6	1	2	8	1	1	B	4
		5		9		0	5		
Preceding, in the right Cotyle [hip-socket] [Præcedés in Cotyla dextra]	Aquarius	2	7	2	2	4	1	B	4
		9		8		6	4		
Following in the same [Sequens in eadem]	Aquarius	2	5	3	2	2	4	B	6
		9	3	0		9	5		
In the right thigh [In femore dextro]	Pisces	1	1	2	1	9	4	A	5
		5		9			6		
Those toward the Buttocks [Quæ ad Clunes]	Aquarius	2	3	3	1	5	4	A	4
		4	5	0		9	5		

(Right column of page 112 — continuation of AQUARIUS, 2. Classis)

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Scheat, in the right shin [Scheat in dextra tibia]	Pisces	4	4	2	8	9	4	A	3
			4	8			5		
The northern one of the shin, at the knee [Borea tibiæ ad genu]	Pisces	4	2	3	5	3	4	A	5
			7	0		6	6		
In the left hip [In coxa sinistra]	Pisces	1	2	2	5	3	4	A	6
				9		9	4		
In the left knee, more southern [In sinistro genu australior]	Aquarius	2	1	0	10	4	1	A	5
		8	8			8	5		
In the same, more northern [In eodem borealior]	Pisces	1	1	3	9	5	1	A	6
			2	0		7	5		
The first, from the hand, in the effusion of the water [Prima à manu in effusione aquæ]	Pisces	5	1	2	4	8	4	B	4
			4	9			5		
Following it, southern [Succedens australis]	Pisces	7	2	3	0	1	1	A	4
			6	0		9	5		
Following in the first bend of the water [Sequens in primo flexu aquæ]	Pisces	1	2	2	1	2	4	A	6
		0	2	8		3	6		
Which accompanies it [Quæ illam comitatur]	Pisces	1	0	3	0	5	4	A	5
		3		0		9	5		
In the other southern bend [In altero flexu australi]	Pisces	1	1	2	2	4	4	A	5
		2	3	9		8	6		
Preceding, more northern, of the followers [Præcedés borealior sequétium]	Pisces	1	5	3	3	5	1	A	5
		2		0		8	5		
The more southern follower [Sequens australior]	Pisces	1	3	2	4	1	1	A	5
		2	3	9		0	4		
Declining near this toward the south [Prope hanc declinans ad austr.]	Pisces	1	3	0	4	4	4	A	5
		2	7			3	5		
After this, the preceding of	Pisces	1	2	3	10	5	4	A	5

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
the contiguous ones [Post hanc contiguarum præced.]		5	9	0		8	6		
Following the same [Earundem sequens]	Pisces	1	0	2	11	3	4	A	5
		6		9		2	5		
In the third bend, three of the northern water [In 3 flexu aquæ borea triú]	Pisces	1	2	3	14	2	4	A	5
		4	5	0		8	7		
The middle of them [Media earum]	Pisces	1	8	2	15	1	1	A	6
		5		8		6	5		
The southern follower of them [Sequens earum australis]	Pisces	1	6	3	16	2	4	A	6
		6		0		2	5		
The northern of three followers [Trium sequétium borealis]	Pisces	9	1	0	14	4	4	A	6
			7			4	6		
The middle of them [Media earum]	Pisces	9	4	0	15	2	4	A	5
			3			9	5		
The southern of the same [Australis earundem]	Pisces	1	1	3	16	3	4	A	6
		1	2	0		0	6		
In the last bend, the upper of three [In vltimo flexu trium superior]	Pisces	5	4	2	14	2	1	A	5
			7	9		5	5		
The middle of them [Media earum]	Pisces	5	2	3	15	3	4	A	5
			4	0		9	7		
The lowest of them, near Fomalhaut [Infima earú ppe Fomahát]	Pisces	4	3	2	15	5	4	A	5
			9	8		2	5		

3. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the right Buttock [In dextro Clune]	Aquarius	2	2	3	4	9	4	A	6
		5		0			6		
Of the unformed stars, the	Pisces	1	3	2	15	3	4	A	4

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
preceding, after the bend of the water [Informium præced. post aquæ flexum]		9	2	9		9	5		
The northern of the followers [Sequentium borealis]	Pisces	2	3	3	14	3	4	A	4
		3	7	0		9	6		
The southern of them [Australis earum]	Pisces	2	4	3	18	1	4	A	4
		1	2	0		9	1		

[Margin: Adverte Keplerum, & Longomontanum posuisse humeri dextri longitudinem in $\approx$ gr. 27. 49' $\frac{1}{2}$. vel gr. 27. 48'. Anno 1600. cum Tycho posuerit gr. 27. 9' $\frac{1}{2}$. quare excesserunt errore 40'. minutum.] *[Margin, translated: Note that Kepler and Longomontanus put the longitude of the right shoulder at Aquarius 27° 49'½, or 27° 48', for the year 1600, whereas Tycho put it at 27° 9'½ — so they exceeded [the true value] by an error of 40 minutes.]*

PISCES.

1. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
The back of the head of the Southern Fish [Piscis australis occiput]	Pisces	1	1	5	7	1	0	B	4
		7	2	9		7			
The bright star in the knot of the thread [Lucida in nexu lini]	Aries	2	9	5	9	4	0	B	3
		5		9					

2. Classis.

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the mouth of the southern Fish [In ore Piscis austrini]	Pisces	1	2	3	9	4	3	B	5
		4	4	0			0		
The northern one in the back of the head [Borealis in occipite]	Pisces	1	5	0	8	5	0	B	6
		8	3			5			

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
Preceding the two in the back [Præcedens duarú in dorso]	Pisces	2	4	3	9	3	3	B	5
		1		0			0		
Following in the back [Sequens in dorso]	Pisces	2	1	0	7	1	0	B	5
		3	9			4			
Preceding in the belly [Præcedens in alvo]	Pisces	1	4	2	4	2	3	B	5
		8	3	9		7	0		
Following in the belly [Sequens in alvo]	Pisces	2	2	3	3	2	2	B	5
		2	2	0		5	8		
In the tail [In cauda]	Pisces	2	2	2	6	2	0	B	5
		8	4	9		4			
Above this, toward the east [Supra hanc ad ortum]	Pisces	2	4	2	7	2	3	B	6
		9	9	8		7	0		
Following [Sequens]	Aries	3	5	3	5	2	3	B	6
		1	0			8	0		
In the southern thread, the brighter, preceding the three [In lino australi lucidior trium præcedens]	Aries	9	5	2	2	1	3	B	4
		8	9			1	0		
The middle of the same [Earundem media]	Aries	1	3	2	1	6	0	B	4
		3	0	8					
Following [Sequens]	Aries	1	4	3	0	5	0	B	4
		5	1	0		8			
In the northern bend of the thread [In flexu lini borea]	Aries	1	4	2	1	3	3	A	6
		3	7	8		0	0		
In the same place, the following southern [Ibidem sequens australis]	Aries	1	8	3	4	1	0	A	6
		5		0		9			
After the bend, preceding the three [Post flexum trium præcedens]	Aries	1	5	2	3	2	3	A	5
		8	5	8			0		
The middle of them [Media earum]	Aries	2	1	0	4	4	0	A	5
		1	8			0			
The last follower [Sequens vltima]	Aries	2	2	0	7	5	3	A	5
		3	0			5	0		

Name of the star	Long. Sign	G	'	"	Lat. G	'	"	B/ A	Ma g.
In the northern thread, preceding from the knot [In lino borea à nexu præcedens]	Aries	2	3	2	1	3	0	B	5
		3	4	9		8			
After this, three southern [Post hanc trium australis]	Aries	2	3	3	1	5	0	B	5
		2	8	0		2			

Catalogue of the Fixed Stars for the Year 1700

(TAB. 98. Each page carries two side-by-side table panels; reading order is the left panel top-to-bottom, then the right panel top-to-bottom. The columns are: **Names of the Fixed Stars** [Nomina Fixarum] | **Longitude** [Longitudo: Sign · Degrees · Minutes · Seconds] | **Boreal Latitude** [Latitudo B.: Degrees · Minutes · Seconds] | **Magnitude** [Magnitudo]. In the latitude column, **B** = boreal/northern, **A** = austral/southern.)

Pars Prima — concluded (Pisces, with the Northern Triangle informes)

The following rows conclude the Pisces section of Pars Prima (the zodiac).

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The middle one in the boreal knot	♈	2	3	3		5	2	3	B	4
		2	8	0			1	0		
The northern one, and the last of the cord	♈	2	5	0		9	2	2	B	5
		2	9				4	8		
The northern one in the mouth of the boreal Fish	♈	2	3	3		2	0	3	B	6
		4	7	0		2		0		
The southern one in the same place	♈	2	1	0		2	4	2	B	5
		4	2			0	3	8		
The northern one of the triangle of the head	♈	2	4	0		2	5	3	B	6
		0	5			0	5	0		
The southern one of the said triangle	♈	1	2	0		1	2	3	B	6
		9	9			9	4	0		
The middle one, and	♈	1	2	0		2	2	2	B	6

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
preceding the triangle		8	6			0	4	9		
On the southern spine, near the left elbow of Andromeda	Υ	1	1	0		1	2	3	B	5
The middle one after it	Υ	9	9			3	1	0		
		1	2	0		1	2	0	B	6
		9	5			2	2			
The lowest of them	Υ	1	3	3		1	2	3	B	6
		9	1	0		1	1	0		
The northern of the two in the belly	Υ	2	4	2		1	2	2	B	5
		4	0	9		7	6	9		
The one more toward the south	Υ	2	2	0		1	3	2	B	5
		2	1			5	0	8		
The following middle one of the three on the southern spine	Υ	2	2	3		1	2	0	B	5
		9	2	0		2	8			
The one following, northward in the belly, toward the north	Υ	2	3	2		1	3	3	B	6
		5	3	8		8	1	0		
On the back of the head of the boreal fish	Υ	2	3	3		2	3	2	B	6
		3		0		3		9		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Of the informes in the square below the Fish, the preceding one on the first boreal side	⋈	1	3	3		1	3	3	A	4
		9	2	0		5	9	0		
The following one	⋈	2	3	2		2	2	3	A	4
		4	2	9			4	0		
The preceding one of the southern side	⋈	2	3	3		5	3	2	A	4
		3	7	0			4	9		
The following one	⋈	2	5	2		5	2	3	A	4
		4	2	8			9	0		
The preceding one of those following this square	Υ	2	3	3		4	3	2	A	5
			7	0			5	9		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The posterior one	Υ	7	3	2		4	2	3	A	5
			3	9			3	0		

PARS SECUNDA — Astra Borealia extra Zodiacum

(The northern constellations outside the zodiac.)

URSA MINOR — The Lesser Bear

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The last of the tail, now the Pole star [Polaris]	Π	2	2	4		6	5	5	B	2
			4	6			5	9		0
The bright one of the shoulder, formerly the Pole star in the time of Eudoxus	Ϡ	8	4	7		7	4	4	B	2
			5				2	8		0

Or, the upper one of the two preceding in the square.

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The next-to-last of the tail	Π	2	6	0		6	4	3	B	4
			7				9	6		0
The one at the root of the tail	Ϡ	4	5	0		7	4	0	B	4
			4				3	6		
The upper one of the two in the following square	Ϡ	2	5	0		7	5	0	B	4
			2	9			4	6		
The lower one of them	Ϡ	2	2	0		7	3	3	B	5
			6	2			7	4		0
The lower one of those preceding, in the square	Ϡ	1	1	0		7	1	3	B	3
			6	1			5	9		0
The informis at the head of the more southern Bear	Ϡ	4	2	0		7	2	0	B	6
			4				1	0		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one above this	♄	2	5	0		7	1	0	B	6
		8	0			0	5			
The first of the informes, in a straight line with the Pole	♄	1	4	0		3	4	0	B	6
		8	7			5	7			
The second	♄	1	5	0		3	1	0	B	6
		8	8			7	7			
The third, obscure	♄	1	1	0		4	1	0	B	6
		9	7			0	0			
The fourth	♄	1	3	0		4	5	1	B	6
		9	3			2	3	0		
The first of the informes near the Pole star	♄	2	8	0		5	5	0	B	6
		3				7	2			
The second	♄	2	2	0		7	3	0	B	6
		3	5			0	9			
The third	♄	2	1	0		6	0	0	B	6
		6				9				
The fourth	♄	1	3	0		6	1	0	B	6
		6	7			8				
The fifth	♄	8	5	0		6	4	0	B	6
		2				7	0			
The sixth	♄	1	2	0		6	1	0	B	6
		1	7			7	9			
The one nearest the Pole	♄	2	0	0		6	5	0	B	6
		8				3	2			

URSA MAIOR — The Greater Bear

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the shoulder, Dubhe [α Ursae Maioris]	♈	1	5	2		4	4	1	B	2
		0	9	7		9	0	0		
The bright one of the side,	♈	1	7	5		4	5	4	B	2

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
below Dubhe		5		7		5		0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the posterior haunch	♏	2	1	1		4	8	4	B	2
		6	0	2		7		0		
The bright one of the back, toward the tail	♏	2	4	5		5	3	1	B	2
		6	9	7		1	7	0		
The root of the tail, or the first one	♏	4	3	2		5	1	4	B	2
			6	7		4	7	5		
The middle one of the tail	♏	1	2	5		5	2	1	B	2
		1	1	3		6	1	0		
The last one of the tail	♏	2	3	7		5	2	1	B	2
		2	7			4	4	0		
The one following it on the neck	♏	2	3	0		4	3	1	B	4
						2	6	8		
The one following below this	♏	5	3	3		3	1	4	B	4
				0		8	5	5		
The one on the left fore-foot, anterior	♏	1	5	3		3	3	4	B	3
			7	0		4	4	6		
On the right foot, the more northern one	♏	2	2	0		2	1	4	B	3
		7	1			9	5	8		
The southern one in the same place	♏	2	3	0		2	3	2	B	3
		8	5			8	8	0		
Below the right knee	♏	2	3	0		3	3	1	B	5
		8	2			3	0	9		
On the right knee itself	♏	2	5	0		3	6	1	B	5
		8	1			6		5		
The upper one of the left hind-foot, posterior	♏	1	2	3		2	5	4	B	4
		5	1	0		9	1	5		
The one following, and more southern	♏	1	3	3		2	4	1	B	4
		6	0	0		8	5	6		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one preceding it, posterior	♌	2	5	0		3	1	1	B	4
		3	8			5	4	5		
The one following, on the right foot, posterior	♍	2	1	0		2	1	1	B	4
			5			6	4	8		
The one following, and more southern	♍	3	1	0		2	5	2	B	4
						4	4	0		
The informis between the tails of the Bear and of Leo	♍	1	8	3		4	6	2	B	2
		9		0		0		0		
On the back	♌	2	3	0		4	3	1	B	4
		9	5			1	0	5		
On the left hind-foot, posterior	♌	2	2	3		3	1	2	B	5
		2	7	0		3		0		
The informis between the Bear and the head of Leo	♌	7	4	0		1	5	1	B	3
			2			7	5	8		
The one above this, toward the rising	♌	9	3	0		2	4	2	B	4
			5			0	2	0		
The one preceding it	♌	6	2	1		2	5	1	B	4
			5	0		0		6		
The one preceding the two before these	♌	3	2	0		2	5	1	B	4
			2			0	1	8		
The one preceding them	♌	1	7	0		2	4	2	B	4
						3	1	0		
Between the foot and the head of Leo	♌	1	3	0		2	5	1	B	4
		5	7			1	3	9		
The northern one	♌	2	2	0		2	4	1	B	4
		0	0			5		7		
The southern one	♌	2	3	0		2	5	2	B	3
		1	2			4	0	0		
The one at the base of the right triangle	♌	2	4	0		2	2	1	B	3
		4	7			1	8	9		
(continuing)	♌	2	3	0		2	4	2	B	3
		7	4			0	4	0		
The northern one in the said	♌	2	4	0		2	5	1	B	4

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
base		6	4			4	8	5		
The one between the legs of the Bear	♏	1	4	0		4	3	1	B	5
		3	1			0	0	8		
The informis between the tail and the body	♏	2	5	0		5	8	1	B	6
		2	4			8		0		
The second	♏	2	3	0		4	1	6	B	6
		5	0			7	4			
The third	♏	2	1	0		4	3	1	B	6
		1	4			7	0	2		
The one between the Bear and the head of Leo	♏	2	4	0		4	5	1	B	6
		4	2			6	0	5		
The second	♏	5	3	0		4	5	1	B	6
			3			7	5	6		
The third	♏	7	2	0		4	4	1	B	6
			5			8	0	4		
The fourth	♏	7	5	0		4	4	1	B	6
			5			9	2	8		
The fifth	♏	7	4	0		4	4	1	B	6
			4			9	2	5		
The sixth	♏	2	3	0		4	0	1	B	6
		0	0			9		8		
The seventh	♏	1	2	0		4	2	1	B	6
		9	6			9	7	2		
The eighth	♏	2	7	0		4	1	1	B	6
		7				8	1	5		
The ninth	♏	1	2	0		5	2	1	B	6
		7	7			2	5	4		
The little one touching the haunch	♏	3	6	0		3	4	1	B	6
						5	0	5		

DRACO — The Dragon

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one, following, in the head	♌	2	4	7		7	2	1	B	3
		3	6			5		0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one in the tongue	♍	2	1	3		7	1	0	B	4
		0	8	0		6	6			
The one in the mouth	♌	5	3	3		7	1	3	B	4
			6	0		8	4	0		
The one preceding, in the head	♌	7	4	3		7	2	0	B	3
			1	0		5	0			
The one at the cheek	♌	2	2	0		8	2	3	B	4
		0	5			0	0	0		
The first of three in the bend of the neck	♍	1	2	0		8	5	0	B	5
		8	6			1	2			
The southern one in the same place	♍	2	5	0		7	5	0	B	5
		5	3			7	6			
The middle one of them	♍	2	5	3		7	5	3	B	5
		1	5	0		9	0	0		
The one following, toward the rising	♍	1	5	0		8	5	0	B	4
		0	1			0	2			
Near the second bend	♍	2	5	0		8	5	0	B	4
		9	5			1	0			
The northern one of the square of the second bend	♍	1	4	3		8	4	0	B	3
		3	8	0		2	8			
The northern one of the following side	♍	1	4	0		7	8	3	B	4
		6	5			8		0		
The southern one of the same side	♍	2	9	0		7	2	0	B	3
		9				9	4			
The one following the right triangle, preceding	♍	1	4	0		8	4	0	B	4
		6	0			3				
The one following this,	♍	2	2	3		8	3	0	B	4

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
toward the south		1		0		0	7			
The one above this	Υ	2	6	0		8	5	0	B	4
		8				0	3			
In the rest of the triangle, following	ϙ	7	5	3		8	3	3	B	4
			6	0		3		0		
The southern one of the same	ϙ	2	5	0		8	2	3	B	4
			0			3	7	0		
The northern one preceding the Triangle	Π	6	5	0		8	4	0	B	4
			3			4	7			
In the bend of the third node	♍	1	6	3		8	3	3	B	3
				0		1		0		
The one nearest the Pole of the Zodiac	♌	7	4	0		8	5	0	B	4
			8			6	2			
The one that follows the 24th	♍	2	4	0		8	1	0	B	5
			9	3		3	7			
The one succeeding this	♍	2	4	0		8	4	0	B	5
			9	4		1	0			
The one nearer the Pole	♍	2	1	3		8	4	0	B	5
			8	3		4	5			
The one preceding the next- to-last, from the end of the bend	♌	9	1	0		7	3	0	B	3
			7			8	1			
Before the next-to-last, the bend preceding	♌	1	5	3		7	1	3	B	5
			3	0		4	0	0		
The next-to-last, at the bend	♌	0	4	0		7	3	0	B	6
			4			1				
The bend following, the second	♍	0	3	0		6	1	0	B	5
			9			5	7			
The bend next following	♍	3	3	3		6	3	0	B	2
			2	0		5	5			
The next-to-last of the tail	♌	1	4	0		6	3	0	B	3
			1	8		1	2			
The last one of the tail	♌	5	5	3		5	6	0	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
			9	0		7				
The informis between the 11th and the arm of Cepheus	Υ	2	2	0		7	3	3	B	5
			6			7	0	0		

CEPHEUS

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The girdle of Cepheus	♄	1	3	3		7	8	0	B	4
			6	0		1				

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the shoulder	Υ	8	3	3		6	5	0	B	4
			6	0		8	6			
On the left shoulder	Υ	2	1	0		6	3	2	B	3
			9	7		2	6	5		
The one following, in the tiara toward the north	Υ	9	5	3		6	4	3	B	4
			2	0		1		0		
The southern one	Υ	9	1	0		6	0	2	B	4
			9			0		0		
The one toward the rising	Υ	1	2	3		5	4	0	B	4
			5	0		8	7			
In the bend of the arm, more southern	Υ	1	4	3		7	5	2	B	4
			3	0		1	0	5		
In the same place, more northern	Υ	0	1	3		7	1	5	B	4
			7	0		4		0		
The one on the shoulders	Υ	2	9	2		6	4	2	B	5
			0	8		5	3	5		
On the right foot	♄	2	5	3		7	2	3	B	4
			8	6		5	8	0		
On the left foot	♄	2	4	3		6	2	2	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		5	6	0		4	9	5		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The informis near the tiara	Υ	5	5	3		6	2	3	B	5
			3	0			4	0		

BOOTES, seu ARCTOPHYLAX — Boötes, or the Bear-keeper

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Arcturus, in the fringe	♌	2	4	2		3	0	4	A	1
			0	7			1	0		
On the left shoulder	♌	1	3	2		4	5	3	B	3
			4	0			9	1	0	

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the left hand, preceding	♍	2	3	3		5	5	3	B	4
			5	4			8	1	0	
The second	♍	2	5	0		5	4	3	B	4
			6	8			8	9	0	
The third	♍	2	2	3		6	3	4	B	4
			8	4			0	0		
In the left forearm	♌	2	4	0		5	3	2	B	4
				3			4	8	9	
In the head	♌	2	8	3		5	1	0	B	3
			0	0			4	4		
On the right shoulder, above the Crown	♌	2	5	3		4	5	3	B	4
			8	4			8	9	0	
In the haunch below the right	♌	2	5	3		4	3	2	B	4

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
arm		3	4	0		0	8	8		
The lower of the two on the back	♌	1	4	0		4	9	3	B	4
		9	1			2		2		
The upper one of them	♌	1	4	3		4	3	0	B	4
		8	2	0		2	4			
On the right leg	♌	2	5	3		2	5	3	B	3
		8	1	0		7	5	3		
The upper one of the leg	♌	1	7	0		2	7	3	B	3
		5				8		0		
The middle one of the leg	♌	1	5	0		2	3	2	B	4
		3	0			6	1	9		
The lowest one of the leg	♌	1	2	0		2	1	3	B	4
		5	0			5	2	2		
Near the knee, the lowest of three informes	♌	2	3	0		3	2	0	B	4
		7	8			0	6			
The middle one	♌	2	3	0		3	2	2	B	4
		8	6			1	0	9		
The upper one	♌	2	1	0		3	5	3	B	4
		9	7			3	0	0		
The one preceding, of the four of the right hand	♌	2	3	0		4	1	0	B	5
		9	6			0	3			
The one following, southern	♍	1	5	0		4	3	0	B	5
						0	0			
And the northern one	♌	2	1	0		4	1	3	B	5
		9	8			2	4	0		

CORONA BOREA — The Northern Crown

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the Crown	♍	8	1	2		4	2	2	B	2
			2	7		4	5	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one preceding the bright one	♏	5	1	0		4	8	0	B	4
						6				
The one above this	♏	4	3	3		4	2	0	B	5
			4	0		8	5			
The one following, toward the north	♏	9	2	0		5	2	0	B	6
			6			0	1			
The one following the bright one	♏	1	3	3		4	3	0	B	4
			0	8		4	3			
The one next following	♏	1	4	0		4	5	0	B	4
			2	9		4	2			
The one this one accompanies	♏	1	5	0		4	9	3	B	4
			4	6		6		0		
The last of all	♏	1	2	0		4	2	0	B	6
			4	6		8	4			

HERCULES, seu ENGONASI — Hercules, or the Kneeler

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The head of Hercules	♐	1	5	7		3	2	1	B	3
			1	8		7	2	5		
The right shoulder	♏	2	5	3		4	4	1	B	3
			6	4		2	7	5		
The left shoulder	♐	1	3	7		4	4	1	B	3
			0	7		7	6	5		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The next-to-last of the right arm	♏	2	2	1		4	5	0	B	3
			5	0		0				

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The lowest one in the right arm	♍	2	3	4		3	1	1	B	4
		1	2	0		7	8	5		
In the left arm	♌	1	4	9		4	2	1	B	4
		5	8			9	2	4		
The one preceding, in the spoils of the Lion	♌	2	2	1		5	1	0	B	4
		1		2		1	6			
The one following, in the triangle of the spoils	♌	2	4	1		5	1	2	B	4
		8	5	0		2	8	0		
At the base of the triangle, toward the north	♌	2	4	8		5	4	1	B	4
		8	5			3	5	6		
The middle one in the spoils	♌	2	4	1		5	4	2	B	4
		5		0		2	6	0		
In the left haunch	♍	2	2	1		5	1	0	B	3
		7	8	2		3	0			
The more eastern one in the left thigh	♌	4	1	4		5	2	1	B	3
			1	0		3	0	8		
The one preceding the three adjacent ones of the thigh	♌	7	4	4		5	3	1	B	4
			7	0		9	7	5		
The middle one of them	♌	8	4	1		6	1	0	B	4
			5	2		0	1			
The one following	♌	1	1	4		6	1	0	B	4
		1	3	0		0	3			
In the left knee	♌	2	2	1		6	4	1	B	3
		7	2	0		0	6	7		
The first of the three on the left calf, toward the head of the Dragon	♌	1	4	9		6	2	2	B	3
		5	3			9	1	0		
The one preceding the three on the left foot	♌	8	3	4		7	1	1	B	6
			1	0		1	9	7		
The middle one of them	♌	1	3	1		7	1	0	B	6
		2	3	0		1	3			
The last, nebulous	♌	1	2	8		7	4	1	B	ne
		9	6			1		8		b.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the upper right thigh	♏	2	3	4		6	2	0	B	4
		4	4	0		0	2			
The more northern one in the same	♏	1	1	3		6	1	2	B	4
		9	5	9		3	3	0		
In the right knee	♏	1	9	4		6	5	1	B	4
		0		0		5	4	5		
In the upper part of the calf	♏	7	2	1		6	5	1	B	4
			3	2		3	0	4		
In the calf	♏	4	9	1		6	2	1	B	4
				0		4	2	5		
The one preceding, in the right calf	♏	1	5	1		6	2	1	B	4
		7	8	7		2	8	7		
On the shin of the right foot	♏	3	5	3		6	1	0	B	4
			4	8		0	5			
The last on the right foot	♏	2	3	8		5	1	0	B	4
		8	2			7	5			

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the left haunch, preceding	♏	2	4	1		5	5	1	B	5
			6	0		5	4	5		
The one following in the same	♏	3	5	8		5	1	1	B	5
			6			8	4	6		
The informis of the right arm, southern	♏	2	1	1		5	2	1	B	5
		6	5	0		7	9	7		

LYRA, seu VULTUR VOLANS — The Lyre, or the Flying Vulture

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the Lyre [Vega]	♌	1	6	2		6	4	0	B	1
		1		7		1	7			

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Above the bright one, toward the north	♊	1	3	3		6	2	3	B	5
		4	7	0		2	6	0		
Below the bright one, toward the south-east	♊	1	4	2		6	2	3	B	5
		3	9	8		0	5	1		
At the springing of the horns	♊	1	3	0		5	2	2	B	4
		7	4			9	5	9		
The northern of the two adjacent ones, toward the north	♊	2	5	0		6	4	3	B	5
		5	6			0	5	0		
The southern of the same two	♊	2	2	3		5	4	2	B	5
		6	5	0		9	0	8		
The northern one in the yoke, preceding	♊	1	4	0		5	4	3	B	3
		4	0			6		0		
The little one below this	♊	1	2	0		5	1	2	B	6
		4	7			5	5	9		
The northern one in the yoke of those following	♊	1	3	3		5	5	3	B	3
		7	4	0		5		0		
The little one below this	♊	1	4	2		5	3	0	B	6
		7	3	9		4	1			
Nearly in the middle of the body	♊	2	1	3		5	5	3	B	5
		2	5	0		8		0		

CYGNUS — The Swan

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The beak of the Swan	♊	2	5	3		4	3	0	B	3
		7		1		4				
The bright one of the breast, the ancient one	♊	2	4	4		5	1	2	B	3
		0	6	0		7	0	0		
The tail of the Swan	♊	1	1	1		5	5	2	B	2

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
			5	2		9	7	0		
The elbow of the upper wing	♊	1	1	4		6	2	5	B	3
			2	4		4	8	0		
The elbow of the lower wing	♊	2	3	1		4	2	0	B	3
			3	1		9	7			

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one in the head	♊	0	4	0		5	4	0	B	5
			6			0	3			
In the middle of the neck	♊	8	5	0		5	2	0	B	4
			9			4	0			
Of the three in the upper wing, the southern one	♊	1	4	0		6	4	0	B	4
			4	3		9	3			
The next-to-last of the upper wing	♊	1	1	3		7	3	0	B	4
			4	0		1	2			
The last of the upper wing	♊	1	5	3		7	5	3	B	4
			0	8		3	1	0		
In the middle of the lower wing	♊	2	4	0		5	4	3	B	4
			5	0		1	2	0		
The extreme one of the lower wing	♊	2	5	0		4	4	0	B	3
			9			3	5			
The one preceding, in the lower foot	♋	1	5	0		5	0	0	B	4
			4			5				
The one following, in the lower knee	♋	6	4	3		5	3	1	B	4
			3	0		6	7	0		
The adjacent one in the upper foot, preceding, and southern	♊	2	1	0		6	3	2	B	4
			4	2		3	8			
The upper one of them, boreal	♊	2	5	3		6	1	3	B	4
			5	6		4	8	0		
The lower of the informes, following the right wing	♋	4	2	3		5	3	0	B	4
			5	0		0	4			

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The upper one of the same	♄	6	1	3		5	3	0	B	4
			5	0		1	2			
Below the wing, toward the foot of Pegasus	♄	5	5	0		3	4	3	B	3
			5			8	0			
The one preceding the two toward the Lyre	♊	2	1	0		6	1	2	B	4
			1	9		6	6			
The one following, more northern	♊	2	1	3		6	5	0	B	4
			6	1		8	3			
The little one near the hollow of the wing	♊	1	5	0		6	4	2	B	4
			4	3		9	0			
Toward the lower wing	♊	1	3	0		5	1	0	B	6
			9	7		3	3			
Toward the upper wing	♊	1	4	0		6	4	0	B	6
			4	0		9	3			
* Nova in the breast of the Swan — it was in the Year 1600; with us in the Year 1659, in November	♊	1	1	0		5	3	0	B	3
			6	5		5	0			
(the same Nova, second reading)	♊	1	3	1		5	2	1	B	3
			6	1		5	4	0		
In the right knee, nebulous	♄	4	2	0		6	2	0	B	ne
			2			3	1			b.

CASSIOPEIA

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the Throne	♑	0	5	4		5	1	0	B	3
			5	7		1	7			
The Schedar of the breast [Schedar, α Cassiopeiae]	♑	3	3	2		4	3	5	B	3
			9	7		6	6	0		
The Flexure	♑	9	4	2		4	4	5	B	3
			9	7		8	7	0		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the knee	♊	1	4	5		4	2	5	B	3
		3	2	7		6	5	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one in the head	♊	0	5	0		4	4	0	B	4
			7			4	2			
In the girdle	♊	6	0	0		4	6	3	B	4
						7		0		
In the leg	♊	2	3	3		4	3	2	B	3
		0	5	0		7	0	9		
The extreme one of the foot	♊	2	1	0		4	5	3	B	4
		8				8	5	1		
In the left arm	♊	7	3	3		4	8	0	B	4
			6	0		3				
In the left elbow	♊	6	3	0		4	2	3	B	5
			8			3	9	0		
In the right elbow	♊	2	1	0		4	2	0	B	6
		6				9	6			
At the springing of the seat	♊	8	2	0		5	1	0	B	4
			8			1	6			
The extreme one of the Throne	♊	2	5	0		5	9	2	B	6
		6	6			1		8		
At the extremity of the seat	♊	2	5	0		5	4	3	B	5
		6	4			2	0	0		
In nearly a straight line with the 11th and 17th	♊	2	5	0		5	4	2	B	6
		0	0			2	9	9		
The extreme one of the footstool	♊	2	4	0		5	1	3	B	6
		3	3			6	4	0		
The middle one of the footstool, or, from Longomontanus	♊	2	4	0		5	2	3	B	6
		3	5			4	8	1		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
(the same, from Longomontanus)	Υ	2	5	0		5	2	3	B	6
		3	4			4	8	1		
In the footstool, toward the sole of the foot	ϣ	2	2	0		5	1	0	B	6
		3	0			2	0			
The one that follows the knee	ϣ	2	1	3		4	5	0	B	6
		4	9	0		4	9			
The one that precedes the knee	ϣ	1	2	0		4	6	0	B	6
		1	2			5				
The whorl of the navel	ϣ	8	1	0		4	3	0	B	6
		4				7	3			
The little one near the locks	ϣ	0	3	0		4	3	3	B	6
		2				5	9	0		
The one following, boreal, in the rod	ϣ	0	5	0		4	1	2	B	6
		4				1	6	8		
The one preceding them	Υ	2	1	0		4	2	0	B	6
		9	9			1	7			
The next-to-last of the rod	Υ	2	1	0		3	1	0	B	6
		8	8			9	7			
The last of the rod	Υ	2	1	3		3	1	2	B	6
		8	6	0		8	0	9		
The preceding one of the three below the footstool, toward the north	Π	3	8	0		5	1	2	B	6
						3	7	8		
The northern one	Π	7	3	0		5	3	2	B	6
		4				3	3	9		
The southern one of them	Π	1	3	0		5	5	3	B	6
		3				2		0		
Above these, toward the Pole	Π	8	7	0		5	9	2	B	6
						9		8		
The first between Auriga and Cassiopeia	Π	1	3	0		3	5	3	B	6
		8	9			5	1	0		
The second	Π	2	4	0		3	4	2	B	6
		8	1			5	9	8		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The third	♄	3	5	0		3	5	3	B	6
			5			4	0	0		
The fourth	♄	4	2	0		3	2	2	B	6
			2			0	3	8		
The first of the three toward the north	♄	2	7	0		4	1	3	B	6
						4	1	0		
The second	♄	2	1	0		4	3	2	B	6
			9			5	3	8		
The third	♄	2	3	0		4	3	2	B	6
			7	7		5	3	9		
Those more toward the north, and the first toward the Bear	♄	1	3	0		5	4	3	B	6
			2			4	4	0		
The second	♄	2	7	0		5	1	2	B	6
			9			6	6	8		
The third	♄	5	3	0		5	5	3	B	6
			5			6	6	0		
The fourth	♄	1	2	0		5	1	2	B	6
			0			9	9	8		
The fifth	♄	9	1	0		6	4	3	B	6
			6			0	8	0		
The sixth	♄	1	3	0		6	5	2	B	6
			1	6		2		8		
The seventh	♄	1	5	0		6	4	3	B	6
			0	9		2	7	0		
The eighth	♄	2	2	0		6	1	2	B	6
			2	0		3	8	9		
New star, in the Year 1572 it was [SN 1572 / Tycho's star]	♄	6	5	0		5	4	0	B	6
			4			3	5			

PERSEUS

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright side of Perseus	♊	2	3	5		3	5	4	B	2
		7	9	5		0		0		
The common base, with the boreal horn of Taurus	♊	1	2	4		5	2	3	B	2
		8	2	7			0	0		
The head of Medusa	♊	2	5	5		2	2	4	B	3
		2		7		2	2	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The folded one at the extremity of the right hand	♊	1	5	0		3	1	1	B	6
		9	9			9		0		
In the right elbow	♊	2	3	0		3	2	1	B	4
		4	7			7	9	2		
In the right shoulder	♊	2	5	3		3	3	4	B	3
		5	4	0		4	0	0		
In the left shoulder	♊	2	3	3		3	3	8	B	4
		0	2	0		1	5			
In the crown of the head	♊	2	1	0		3	2	4	B	5
		3	8			4	6	0		
The one on the back	♊	2	1	0		3	3	0	B	5
		5				0	7			
Below the bright one of the side	♊	2	3	3		2	5	3	B	5
		8	2	0		7	9	8		
The little one following this	♊	2	4	3		2	5	4	B	5
		9	1	0		7	5	0		
In the bend of the side	♊	0	5	0		2	1	3	B	3
		3				7	4	9		
In the left elbow	♊	2	3	0		2	4	0	B	4
		3	4			6				
The one below the head of Medusa	♊	2	5	0		2	5	3	B	4
		1	9			0	4	8		
The one preceding this	♊	2	4	0		2	3	4	B	4

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		0	6			0	3	0		
The one preceding, toward the north, in the head of Medusa	♊	1	4	0		2	3	4	B	4
		9	8			1	5	0		
In the right knee	♊	7	4	3		2	2	1	B	5
			1	0		8	3	0		
The one that precedes the right knee	♊	5	3	3		2	5	4	B	4
			9	0		8	0	0		
The one preceding the knee	♊	5	3	0		2	1	3	B	5
			3			6	1	8		
In the right knee	♊	6	4	0		2	3	4	B	6
			2			6	9	0		
Below the right knee	♊	7	2	0		2	3	3	B	6
			8			4	5	9		
In the sole of the right foot	♊	9	2	0		1	5	4	B	5
			9			8	6	0		
In the left thigh	♊	2	3	0		2	6	3	B	4
			9			2		8		
In the left knee	♊	1	3	0		1	4	3	B	3
			6			9		9		
In the left calf	♊	0	5	3		1	5	0	B	5
			1	0		4	4			
In the left heel	♊	2	5	0		1	8	4	B	6
			6	1		2		0		
The one following, of the left foot	♊	2	4	0		1	1	0	B	3
			9			1	8			
The informis above the head	♊	2	1	0		4	2	3	B	5
			8	3		2	6	8		
In the upper part of the right thigh	♊	4	0	0		2	3	4	B	5
						9	1	0		
The informis preceding the head of Medusa	♊	1	4	0		2	5	4	B	4
			7	2		0	3	0		
In a straight line with the	♊	3	4	0		4	1	3	B	6

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Pole, and with the bright one of the side		6				5	0	9		
The second of them	II	5	4	0		4	7	4	B	6
			0			3		0		
(the same, from the other Catalogue of Kepler)	II	5	3	0		4	7	4	B	6
			0			8		0		
The third of them	II	6	9	0		4	2	3	B	6
						9	7	8		
The fourth of them	II	7	5	0		5	3	4	B	6
			3			3	7	0		
(the same, from the other Catalogue of Kepler)	II	7	4	0		5	3	4	B	6
			3			3	7	0		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The informis, from the left knee toward the rising	II	3	3	0		1	5	4	B	5
			8			7	0	0		

Catalogue of the Fixed Stars for the Year 1700

(TAB. 98, continued. Each page carries two side-by-side table panels; reading order is the left panel top-to-bottom, then the right panel top-to-bottom. The columns are: **Names of the Fixed Stars** [Nomina Fixarum] | **Longitude** [Longitudo: Sign · Degrees · Minutes · Seconds] | **Latitude** [Latitudo: Degrees · Minutes · Seconds] | **Magnitude** [Magnitudo]. The latitude column heading on each panel reads **B.** for boreal/northern latitude or **A.** for austral/southern latitude.)

AURIGA, HENIOCHUS ERICHTONIUS — The Charioteer

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Capella, or the She-Goat	II	1	4	2		2	5	4	B	1

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
[Hircus]		7	0			2	1	5		
The bright one of the right shoulder	II	2	1	2		2	2	4	B	2
		7	2			1	5	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The preceding and upper one of the head	II	2	2	0		3	1	1	B	6
		5				2	6	5		
The following, and lower one	II	2	3	0		3	5	1	B	4
		5	8			0	1	4		
On the right arm	II	2	5	0		1	4	1	B	4
		5	2			3	5	6		
From another catalogue, the Longomontanian	II	2	2	0		1	4	1	B	4
		5	2			3	5	6		
On the left elbow	II	1	3	0		2	5	1	B	4
		4	5			0	3	5		
The preceding of the Kids [Haedi]	II	1	2	3		1	1	0	B	4
		4	9	0		8	0			
The following of the Kids	II	1	1	3		1	1	0	B	4
		5	3	0		8	3			
On the upper foot	II	1	2	3		1	2	1	B	4
		2	8	0		0	3	5		
Above, near the bright one of the right shoulder	II	2	4	3		2	2	1	B	5
		5	9	0		7	8	3		
On the more northern loins	II	1	1	3		1	3	0	B	6
		8	6	0		8	6			
On the more southern loins	II	1	3	0		1	0	1	B	5
		7	0			7		5		
Below this, toward the west	II	1	2	0		1	2	0	B	5
		6	2			5	3			
The following one	II	1	3	0		1	5	1	B	6
		8	3			4		5		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
At the buttocks	II	1	2	0		1	4	1	B	5
		3	4			5		4		
The preceding of the two on the right arm	II	2	3	3		1	4	0	B	5
		3	6	0		5	4			
The following of them	II	2	4	0		1	4	1	B	5
		3	8			5	4	3		
<i>From the other catalogue of Kepler</i>	II	2	8	0		1	4	1	B	5
		4				5	4	3		
Below this, on the right shin	II	2	5	0		1	5	1	B	6
		3	9			3	0	5		
On the left lower-leg	II	1	1	3		1	1	1	B	5
		8	3	0		1	6	4		
On the right foot	II	1	5	0		8	5	1	B	5
		9	8				2	6		
The preceding, near Erichthonius	II	1	2	3		1	5	1	B	5
		1	8	0		4	2	3		
The southern following one	II	1	5	0		1	3	1	B	5
		1	5			4		5		
The boreal informis between the Charioteer and the feet of Gemini	II	2	1	0		6	5	1	B	4
		9	6					4		
The second one	II	2	2	0		4	7	1	B	4
		4	8					5		
Below it, toward the rising	II	2	2	0		2	2	1	B	4
		5	8				7	3		
The preceding of these	II	2	2	3		2	2	1	B	4
		1	0	0			9	5		
The last of them all	II	2	2	0		1	7	1	B	4
		3	4					6		

[The following rows complete the lower classes of the Ophiuchus/Serpentarius region drawn from Kepler's Nova Stella; they continue at the head of the right panel.]

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The following of three	♏	2	2	0		2	9	1	B	4
		7	5			6		8		
The preceding, on the right foot	♏	1	2	0		2	1	2	B	3
		5	8				5	0		
The following one	♏	1	9	0		1	3	1	B	4
		7					1	9		
The third	♏	1	5	0		0	1	2	B	4
		7	0				9	0		
Another following one	♏	1	3	0		0	2	1	B	5
		8	9				8	9		
The one that touches the heel	♏	1	5	0		0	5	2	B	5
		9					7	0		
On the right shin	♏	1	1	0		7	9	1	B	5
		8	7					8		
The informis outside the shin	♏	2	1	0		4	1	2	B	6
		3	2				9	0		
The following of two in the hand	♏	1	3	0		2	3	1	B	5
			4				3	8		
On the hip of Ophiuchus	♏	1	2	0		1	1	1	B	5
		6	7			0	7	9		
The southern following one	♏	2	2	0		8	4	2	B	4
		0	9					0		
On the right hand	♏	2	3	0		1	3	1	B	5
		1	1			0	9	8		
The boreal one	♏	2	3	0		1	5	2	B	5
		0	2			5		0		

The remaining of the 2. Class, from Kepler's account of the New Star in Serpentarius:

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Of three, the one ahead of the foot, in a straight line, preceding, boreal	♑	2	9	0		9	2	2	B	5
		7				6	0			
The middle one	♑	2	1	0		6	4	1	B	5
		6	4			1	9			
The lowest one	♑	2	3	0		3	4	2	B	5
		5	2			4	0			
Preceding the anterior knee	♊	2	3	0		1	3	1	B	6
		0				3	3	9		
The upper of two between the feet	♊	8	1	0		1	4	2	B	6
		8				1	9	0		
The lower one	♊	7	1	0		4	3	1	B	6
		6				7	9			
On the anterior boreal shin	♊	4	1	0		5	4	2	B	4
		4				1	0			
The middle of them	♊	3	3	0		3	1	1	B	4
		4				0	9			
The southernmost of them	♊	3	1	0		1	3	2	B	4
		2				7	0			
On the heel of the anterior foot	♊	5	3	0		0	2	1	B	4
		1				5	8			
On the following thigh	♊	1	6	0		1	2	2	B	5
		7				7	7	0		
On the following elbow	♊	2	2	0		1	5	1	B	4
		0	9			4	6	9		
On the lower-leg of the following foot	♊	1	9	0		1	5	2	B	4
		7				6	1			
On the toe of the foot	♊	1	3	0		3	3	4	A	4
		5	4			7	0			
On the back of the foot	♊	1	1	0		1	2	4	A	5
		6	4			7	0			
The bright one in the sole	♊	1	1	0		1	4	3	A	3
		7	4			3	9			

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the hollow of the foot	♊	1	1	0		0	5	4	A	4
		8	4				9	0		
At the heel, or ankle	♊	1	3	0		0	5	3	A	4
		9	2				7	9		
The one following this foot	♊	2	3	0		1	2	2	B	4
		1	1				1	0		
The informis between the shoulder of Ophiuchus and of Hercules	♍	2	5	0		3	5	1	B	4
		7	4			4	9	9		
At the shoulder of Ophiuchus, in the boreal Rhombus	♊	2	3	0		2	5	2	B	4
		6	4			7	9	0		
The preceding of the middle ones	♊	2	2	0		2	3	1	B	4
		6	4			6	9	8		
The following one	♊	2	1	0		2	2	2	B	4
		8	7			6	7	0		
The lowest one	♊	2	7	0		2	4	1	B	4
		7				4	4	9		
Above the informes, solitary	♊	2	1	0		3	4	2	B	4
		9	7			2	4	0		
<i>The New Star in Serpentarius, which appeared in the year 1604</i>	♊	1	4	0		1	5	0	B	★
		7	0				6			

OPHIUCHUS, or SERPENTARIUS — The Serpent-Bearer

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The Head of Ophiuchus	♊	8	1	7		3	5	1	B	3
			7				5	6	5	
The more boreal of the left hand	♍	2	1	3		1	1	2	B	3
		8	1	7		7	8	0		
On the right knee	♊	1	5	7		7	1	2	B	3
		3	1				7	0		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
On the left knee	♌	5	6	7		1	2	2	B	3
						1	9	0		
On the right shoulder	♌	2	1	7		2	0	2	B	3
		1	2			8		0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The following on the right shoulder	♌	2	3	0		2	1	2	B	3
		2	2			6	0	0		
The preceding on the left shoulder	♌	6	2	3		3	3	0	B	4
		6	0			2	5			
The following on the left shoulder	♌	7	4	0		3	5	2	B	4
		3				1	5	0		
On the left elbow	♌	1	3	0		2	3	0	B	4
		0				3	9			
On the more austral left hand	♍	2	2	0		1	3	0	B	3
		9	4			6	0			
On the right forearm	♌	2	0	0		1	1	1	B	4
		1				5	8	9		
<i>In the other catalogue of Kepler</i>	♌	2	3	0		1	1	1	B	4
		0	0			5	8	9		
The austral preceding one in the right hand	♌	2	4	3		1	4	1	B	4
		5	0	0		3	6	8		
The more boreal following one, in the same place	♌	2	4	3		1	1	2	B	5
		6	1	0		5	9	0		
On the right knee	♌	1	5	0		7	1	2	B	3
		3	1			7	1			
<i>But, by Kepler's correction</i>	♌	1	4	3		7	1	2	B	3
		3	7	0		7	1			
On the left knee	♌	5	6	0		1	2	2	B	3
						1	9	0		
On the right lower-leg	♌	1	5	0		2	1	2	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		5	0			1	1			
The fifth informis, in the Milky Way	♏	2	5	0		3	2	0	B	4
		7	8			3				
Above the bright one of the Serpent's neck	♏	1	1	0		2	3	0	B	4
		8	5			6	6			
Behind the hips of Ophiuchus	♏	1	1	0		1	2	1	B	4
		6	6			0	0	9		
The more austral of the following ones	♏	2	2	0		8	3	1	B	3
		0	4					8		
The more boreal of them	♏	2	1	0		1	3	2	B	4
		1	5			0	4	0		
The one above this	♏	2	1	0		1	1	1	B	4
		0	2			5	7	9		
Between the left hand and the knee	♏	2	2	0		1	1	2	B	5
			4			3	8	0		
The informis near the boreal shoulder	♏	2	5	0		2	5	2	B	4
		5	7			7	4	1		
The middle of them	♏	2	5	0		2	2	1	B	4
		6				6	2	8		
The austral of three	♏	2	1	0		2	4	2	B	4
		6	0			4	9	0		

SERPENS OPHIUCHI — The Serpent of Ophiuchus

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the Serpent's neck	♏	1	5	4		2	3	5	B	2
		7	0	7		5	3	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
In the mouth	♏	1	4	3		3	5	2	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		5	5	0		9		0		
The preceding, in the mouth	♏	1	5	0		3	1	0	B	5
		2	6			8	1			
At the temples	♏	1	2	3		3	2	0	B	3
		8	7	0		5	4			
At the drawing-out of the neck	♏	1	4	3		3	2	2	B	3
		5	2	0		4	6	0		
At the left eye	♏	1	3	0		3	2	2	B	4
		6	1			7	7	5		
At the nostrils	♏	1	5	0		4	3	0	B	4
		7	3			2	6			
The second on the neck, below the head	♏	1	7	3		2	5	0	B	3
		4		0		8	7			
The more austral of three behind the bright one	♏	2	7	3		2	4	2	B	3
		0		0		4		0		
At the second bend	♏	2	4	3		1	2	1	B	4
		1	7	0		6	5	8		
Before the next-to-last of the tail	♏	2	5	3		1	5	0	B	3
		5	5	0		9	6			
<i>From the other catalogue</i>	♏	2	5	3		1	3	0	B	3
		5	5	0		9	6			
The next-to-last of the tail	♏	1	3	3		2	3	2	B	3
			3	0		0	6	0		
The last one	♏	1	3	0		2	5	0	B	3
		1	1			6	8			

The remaining, from Kepler on the New Star:

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one above the double, and the eighth according to Ptolemy	♏	1	5	0		2	3	0	B	4
		7	4			6	5			
On the crest	♏	1	3	0		3	1	0	B	5

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		9	0			7	4			
At the apex of the coil, an Isosceles	♈	1	2	0		1	2	0	B	4
		6	1			0	4			
The base, preceding, the 14th of Ptolemy	♈	2	4	0		8	3	0	B	4
		0	4							
The following, the 15th according to Ptolemy	♈	2	3	0		1	2	0	B	4
		1	0			0	2			

SERPENS OPHIUCHI — continued

(The left panel of this page resumes the Serpent of Ophiuchus, completing the 2nd class.)

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Above the tail, the upper of two	♏	1	1	0		2	3	0	B	6
			0			6	7			
The lower one	♏	3	0	0		2	2	0	B	6
						3	4			
Below the tail	♏	4	2	0		1	4	0	B	4
			1			5	8			
The lowest of three at the end of the tail	♏	3	2	0		2	2	0	B	6
			1			1	8			
The middle one	♏	5	2	0		2	4	0	B	6
			7			2	1			
The last one	♏	8	2	0		2	5	0	B	6
			1			4	1			
Next below the last one	♏	1	4	0		2	1	0	B	6
		1	3			5				

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one following the hand of Ophiuchus	♏	1	6	0		1	5	0	B	5
						5	9			

SAGITTA, or TELUM — The Arrow

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The upper, and eastern one	♊	2	5	1		2	1	1	B	4
			5	0		9	2	0		
The one preceding it	♊	2	1	1		3	5	4	B	5
		9	8	2		8	7	0		
The small one above this	♊	2	5	0		3	3	1	B	6
		9	4			9	0	0		
The upper, adjoining at the Notch [Glyphis]	♊	2	5	4		3	5	1	B	4
		6	3	0		8	2	3		
The lower of them	♊	2	2	1		3	1	1	B	4
		7		3		8	7	0		
The informis above the Arrow, the lower one	♊	1	3	1		4	4	1	B	4
			6	0		1	2	2		
The upper of the informes	♊	2	5	1		4	1	1	B	4
			9	2		4		0		
The third, in the right-angle of the informes	♊	2	2	1		4	2	1	B	4
		5	0	0		6		3		

AQUILA, or VULTUR VOLANS — The Eagle, or Flying Vulture

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one on the shoulder-blades [Altair]	♊	2	3	1		2	2	4	B	2
		7	2	7		9	0	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one in the Head	♊	1	5	4		2	7	4	B	6
			1	0		7		0		
On the neck	♊	2	1	1		2	4	4	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		8	6	0		6	8	0		
The small one above the Bright one	♊	2	5	1		3	5	4	B	6
		6	6	2		0	3	0		
On the left shoulder	♊	2	4	1		3	1	1	B	3
		6	9	3		1	7	0		
The following small one	♊	2	3	4		3	5	1	B	5
		7	1	2		1	8	2		
The upper, and preceding of the lower wing	♊	2	3	4		2	4	4	B	4
		2	9	3		8	5	0		
The lower, and following, in the wing	♊	2	3	1		2	3	1	B	5
		3	7	4		6	4	0		
The tail of the Vulture	♊	1	3	4		3	1	4	B	3
		5	8	2		6	5	0		
The informis nearest the tail	♊	1	7	1		3	3	1	B	3
		4		0		7	9	0		
The middle of the informes above the tail	♊	1	3	1		4	3	4	B	4
		0	5	2		3	1	0		
The one following this	♊	1	4	4		4	4	1	B	4
		0	0	2		1		0		

ANTINOUS

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
On the left hand	♊	0	4	4		1	4	0	B	3
			4	0		8	7			
On the right side	♊	2	4	4		2	1	0	B	3
		1	0	1		0	4			
On the knee	♊	2	4	1		1	2	0	B	3
		0	0	2		4	7			
On the right arm	♊	1	2	1		2	5	0	B	3
		9	4	3		4	5			
On the chest	♊	2	1	1		2	3	0	B	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		6	3	2		1	7			
On the right foot	♊	1	9	1		1	4	0	B	3
		3		5		7	0			
The informis preceding this	♊	1	5	1		1	5	0	B	4
		1	2	2		6	6			

DELPHINUS — The Dolphin

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the tail	♊	9	5	1		2	7	0	B	3
			5	2		9				
The one following the tail	♊	1	1	1		2	5	3	B	6
		1	1	3		8	1	0		
The one below the tail	♊	1	5	1		2	3	0	B	6
		1		2		7	3			
In the Rhomboid, the more austral of the preceding side	♊	1	1	1		3	5	3	B	3
		2	9	0		1	6	0		
The more boreal of the same side	♊	1	1	4		3	4	0	B	3
		3	3	0		3				
The more austral of the following side	♊	1	5	4		3	5	0	B	3
		4	9	2		1	9			
The one on the Head	♊	1	1	1		3	4	0	B	3
		5	5	2		2	6			
Four in the preceding side, the closely adjoining preceding one	♊	1	4	1		3	7	3	B	5
		1	0	0		2		0		
The lowest of the two preceding ones, in the Rhomboid	♊	1	4	1		3	4	3	B	6
		0	1	2		0	0	0		
The following of the same	♊	1	5	1		3	4	0	B	6
		2		3		0	0			

EQUULEUS, or EQUI SECTIO — The Foal, or Section of the Horse

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The preceding of the Head	♊	1	5	4		2	1	2	B	4
		8	5	0		0	1	0		
The following of the Head	♊	2	1	4		2	5	0	B	4
		1	7	2		1				
The preceding of the mouth	♊	1	1	1		2	1	0	B	4
		9	7	2		5	5			
The following of the mouth	♊	2	1	4		2	5	0	B	4
		0	7	0		4	1			

PEGASUS EQUUS ALATUS — Pegasus, the Winged Horse

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The mouth of Pegasus	♊	2	4	7		2	6	2	B	3
		7	5			2		0		
Scheat, on the leg	♋	2	1	7		3	8	2	B	2
		5	4			1		0		
The first of the wing, <i>Markab</i>	♋	1	1	3		1	2	5	B	2
		9	9	7		9	4	0		
The extremity of the wing, <i>Algenib</i>	♋	5	0	7		1	3	2	B	2
						2	7			
The navel of Pegasus — see the head of Andromeda	♋									

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The Head of Pegasus	♋	2	3	3		2	6	2	B	4
			8	0		2		0		
Toward the south, on the	♋	1	8	3		1	4	0	B	5

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
head				0		5	2			
The lower following one in the mane	✕	1	2	0		1	2	2	B	6
		4	3			4	9	0		
The upper preceding one in the mane	✕	1	7	0		1	4	2	B	6
		4				5	2	0		
The bright one of the neck	✕	1	2	3		1	4	0	B	3
		2		0		7	0			
The following on the neck	✕	1	4	0		1	2	0	B	5
		3	8			8	8			
The left shin	✕	4	4	0		3	4	2	B	4
		6				6	1	0		
The left knee	✕	1	1	0		3	1	0	B	4
		0	3			4	8			
The right shin	✕	1	2	0		4	5	2	B	4
		5	6			0	9	0		
The preceding of two on the chest	✕	1	5	3		2	4	0	B	4
		8	2	0		8	8			
The following of them	✕	2	1	3		2	2	2	B	4
		0	6	0		9	3	0		
The right knee	✕	2	3	3		3	6	2	B	3
		1	3	0		5		0		
On the same knee, toward the south	✕	2	4	0		3	2	1	B	5
		0	8			4	3	8		
The preceding of two in the wing	✕	2	5	0		2	3	0	B	6
		6	6			5	4			
The following in the wing, and southern	✕	2	2	0		2	4	1	B	6
		8	9			4	9	9		
On the neck	✕	7	5	0		2	5	0	B	4
		1				0	0			
Below the mouth, above the foot	≈	2	1	0		3	2	0	B	4
		6	4			3	0			
The upper one of this	✕	0	1	0		3	1	0	B	4
		0				6	0			

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The first following one	✠	1	3	0		2	1	0	B	4
		6	8			3	5			
<i>From the other catalogue of Kepler, perhaps</i>	⌘	2	3	0		2	1	0	B	4
		6	8			3	5			

ANDROMEDA

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The Head of Andromeda	♈	1	9	3		2	4	1	B	2
		0				5	2	0		
The more austral one of the Girdle	♈	2	1	0		2	5	3	B	2
		6	1			5	8	0		
The bright one in the austral foot	♉	1	1	4		2	4	1	B	2
		0		4		7	7	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The lowest of the right shoulder-blade	♈	1	2	3		2	6	4	B	5
		8	8	0		7		0		
The lower of the left shoulder	♈	1	4	0		2	3	3	B	4
		6	7			3		9		
Of three on the right arm, the austral one	♈	1	2	0		3	3	1	B	5
		6	0			1	3	5		
The boreal of them	♈	1	7	3		3	2	4	B	4
		7		0		3	0	0		
The middle of them	♈	1	2	0		3	1	3	B	5
		7	9			2	4	8		
The more austral, on the upper hand	♈	1	5	0		4	5	3	B	5
		1	0			0	6	9		
The more boreal in the same place	♈	1	8	0		4	4	3	B	4
		3				1	4	0		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The obscure one in the same place	Υ	1	4	0		4	8	2	B	5
		5	5			2		5		
The highest in the boreal hand	Υ	1	9	0		4	4	4	B	4
		4				3	9	2		
The preceding on the left arm	Υ	1	3	0		1	4	2	B	4
		6	1			7	8	0		
On the left elbow	Υ	1	1	3		1	5	2	B	5
		8	5	0		5	8	5		
The middle one in the girdle	Υ	2	2	5		3	3	0	B	4
		9	7	0		0	4			
The boreal one in the girdle	Υ	2	5	2		3	3	1	B	4
		4	7	0		2	1	0		
The extremity of the upper foot	ϝ	1	2	3		3	5	0	B	5
		0	8	0		6	0			
The brighter in the right foot	ϝ	8	1	0		3	2	0	B	4
		4				5	2			
The highest in the left lower-leg	ϝ	6	2	0		2	5	3	B	5
		8				8	9	0		
The lower one in the same place	ϝ	4	4	0		2	5	0	B	5
		5				7	5			
At the right knee	ϝ	2	1	0		2	2	2	B	5
		8				6	0	5		
At the extreme link of the chain	⋈	2	2	0		5	1	3	B	4
		5	2			7	9	0		
The brighter in the left shoulder-blade	Υ	1	4	3		2	2	3	B	3
		7	1	0		4	0	0		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The boreal of the two in the chain	ϝ	5	2	0		3	4	3	B	5
			2			4	0	0		
The austral one in the same	ϝ	6	5	0		3	4	2	B	5

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
place		2				2	0	5		
The informis preceding, the	Υ	4	2	0		4	0	3	B	3
three on the right hand		2				4		0		

TRIANGULUS DELTOTON — The Triangle

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
At the apex of the Triangle	Ϡ	2	4	0		1	4	5	B	4
		1				6	9	0		
At the base, toward the north	Ϡ	8	1	3		2	3	2	B	4
		1	0			0	3	0		
The middle one	Ϡ	9	2	0		1	2	2	B	5
		1				9	9	5		
The more austral at the base	Ϡ	9	2	0		1	5	2	B	4
		0				8	7	4		

COMA BERENICES — The Hair of Berenice

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
At the point of the first, and boreal Triangle	♍	1	4	0		2	2	2	B	3
		9	1			8	4	0		
<i>Or otherwise, from Kepler</i>	♍	2	3	0		2	3	2	B	3
		9	9			8	0	0		
The upper one of this, toward the south	♍	2	6	0		2	2	0	B	4
		0				7	2			
The lower one in the same place	♍	2	1	0		2	1	1	B	4
		0	0			7	8	2		
The following of two adjoining ones	♍	2	4	0		2	5	1	B	4
		0	3			7		5		
Preceding the two adjoining	♍	1	4	0		2	4	1	B	4

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
ones, toward the south		9	9			5	9	3		
Another adjoining one, toward the rising	♏	2	1	3		2	5	2	B	4
		0	2	0		6		0		
All preceding, toward the south	♏	1	2	0		2	2	2	B	4
		9	4			3	8	5		
The highest of three adjoining following ones	♏	2	3	0		2	1	2	B	4
		2	4			5	4	2		
The other, and preceding one	♏	2	1	0		2	5	2	B	4
		2	5			4	4	0		
The lowest, and following one	♏	2	1	0		2	5	5	B	4
		4	6			3	8	0		
<i>The other Codex of Kepler</i>	♏	2	1	0		2	5	5	B	4
		3	6			3	8	0		
The last one, in the extension of the Hair	♏	0	2	3		3	4	2	B	4
			2	0		2	4	0		
The one that precedes this	♏	2	1	3		3	4	2	B	4
		9	3	0		1	0	3		
Between these, and the first at the point	♏	2	4	0		3	1	2	B	4
		5	1			0	4	2		
At the austral point of the small Triangle	♏	2	3	0		2	3	2	B	5
		9	9			8	0	0		

PARS TERTIA — Astra Australia

(Part Three — The Southern Stars. From here the latitude column on each panel is headed **Latit. A.** — austral/southern latitude.)

CETE — Cetus, the Whale

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The bright one of the jaw	♏	1	7	3		1	3	5	A	2
		0		2		2	6	0		
The bright one of the boreal	♏	1	4	1		2	1	2	A	3

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
belly		7	8	5		0	7	0		
The boreal of the tail	✕	2	4	4		9	5	1	A	3
		6	6	7			8	0		
The austral of the tail	✕	2	1	4		2	4	4	A	2
		8	9	7		0	3	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The one in the snout	♊	1	5	0		7	4	5	A	4
		0	2				9	0		
The middle of the mouth	♊	5	1	3		1	2	2	A	3
			4	0		2		0		
Preceding three at the jaw	♊	3	2	0		1	3	4	A	3
			3			4	1	9		
Below the eye	♊	3	1	0		5	5	5	A	4
			5				1	0		
Above the eye	♊	7	2	0		5	3	4	A	4
			2				5	8		
On the back of the head	♊	2	5	3		4	1	5	A	4
		9	0	0			8	1		
On the chest, in a [square □] toward the north	♊	2	3	0		2	1	3	A	4
		5	1			5	6	0		
The lower of two, preceding, toward the south	♊	2	5	3		2	3	2	A	4
		5	4	0		8	9	9		
The following, on the austral chest	♊	2	3	2		2	1	0	A	4
		9	3	9		8	6			
The preceding, and boreal one	♊	2	9	3		2	5	2	A	3
		9		1		5	7	9		
The middle one in the belly	♊	1	4	0		2	0	3	A	4
		3	7			5		0		
The lowest one in the belly	♊	1	1	0		3	3	2	A	4
		5	2			1		8		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
On the eastern back	Υ	1	4	3		1	4	0	A	3
		2		0		5	6			
On the western back	Υ	7	3	3		1	5	2	A	3
			3	0		6	4	9		
The informis following the jaw	ϣ	1	7	0		1	2	5	A	5
		4				4	9	0		
Preceding the boreal of the belly	Υ	1	2	4		2	5	0	A	5
		6	7	5		1	3			
In a straight line with the 3rd and 5th of the Head	ϣ	8	1	3		9	1	2	A	4
			0	0			2	0		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
Of the tail [square □], the following one on the boreal side	Υ	4	8	3		1	8	0	A	5
				0		2				
The austral one of them	Υ	3	8	2		1	8	0	A	5
				5		4				
The one preceding the boreal side	Υ	1	5	0		1	2	3	A	5
			3			3	9	0		
The austral one of the same	Υ	1	2	0		1	3	3	A	5
			2			4	9	0		

ORION

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The highest of the Head	Π	1	3	3		1	2	4	A	4
		9	5	0		3	5	0		
The right shoulder, following	Π	2	3	3		1	6	1	A	2
		4	6	5		6		5		
The left shoulder, preceding	Π	1	4	4		1	5	3	A	2

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		6	6	7		6	2	0		
The left foot, the bright one, Rigel	II	1	3	5		3	1	1	A	1
		2	6	7		1	0	0		

(The right panel of this page continues Orion from this point — the Belt [Baltheus], the Sword [Ensis], and the lower limbs.)

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The highest of the Belt	II	1	9	2		2	3	4	A	2
		8		7		3	6	0		
The middle one	II	1	1	4		2	3	1	A	2
		9	3	2		4	4	0		
The lowest one	II	2	2	2		2	2	1	A	2
		0	3			5	1	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The more western of the Head	II	1	3	3		1	5	4	A	5
		9	5	0		3	3	0		
The third of the Head, eastern	II	1	5	3		1	4	2	A	5
		9	7	0		4		0		
The following one of the left shoulder	II	1	1	0		1	2	4	A	5
		8	0			7	1	0		
The one on the right arm	II	2	2	3		1	5	4	A	4
		6	8	0		4	0	0		
On the right forearm [Ulna]	II	2	5	0		1	3	1	A	6
		9	5			1	0	0		
On the more austral right hand	II	2	4	1		9	1	1	A	4
		8	8	0			5	5		
Preceding, on the right	II	2	4	3		8	4	1	A	4
		7	5	0			4	8		
Nearest the highest, on the	II	2	4	2		7	2	4	A	6

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
right		8	6	9		0	0			
The last in the hand	II	2	3	0		7	1	1	A	6
		9	3			9	6			
Preceding the two in the Club [Colorobus]	II	2	3	3		3	1	4	A	5
		4	3	0		2	6			
The following of them	II	2	4	0		3	2	1	A	5
		6	6			1	5			
Preceding, on the back	II	1	5	3		2	8	2	A	5
		6	8	9		0	0			
The most boreal among the 9 of the Shield [Clypeus]	II	9	1	2		8	1	2	A	4
		6	0			6	9			
The second of them	II	1	1	1		9	6	3	A	4
		0	1	9			0			
The third	II	9	3	2		1	5	2	A	6
		3	0			1	8			
The fourth	II	9	2	4		1	2	0	A	4
		3	8			2	5			
The fifth	II	8	1	1		1	3	0	A	4
		2	9			3				
The sixth	II	7	4	2		1	2	3	A	4
		6	0			5	6	0		
The seventh	II	7	5	2		1	4	2	A	4
		6	2			6	9	8		
The eighth	II	8	2	2		2	1	3	A	4
		1	0			0	0			
The last	II	9	2	1		2	5	0	A	4
		0	9			0	5			
The one on the hilt of the sword	II	1	5	3		2	3	1	A	3
		5	7	0		5	7	0		
The highest of three in the sword	II	1	4	0		2	1	1	A	3
		8	8			8	0	0		
The middle of the sword	II	1	4	3		2	4	3	A	3
		8	4	0		8	5	9		

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
The lowest of the sword	II	1	4	3		2	1	3	A	4
		8	7	0		9	7	9		
Preceding, below the sword	II	1	4	0		3	3	0	A	4
		7	3			0	7			
Following, below the sword	II	1	4	0		3	3	2	A	5
		9	6			0	7	8		
On the left heel	II	1	3	3		2	5	0	A	4
		3	5	0		9	2			
On the calf of the left foot	II	1	2	0		3	5	1	A	5
		5	2			0	9	0		
On the right knee	II	2	9	3		3	7	0	A	3
		2		0		3				
Preceding the last of the Belt	II	1	5	0		2	0	0	A	4
		9	9			6				
Preceding, near this, on the back	II	1	5	0		1	3	2	A	6
		5	4			9	9	0		
The following above the hilt of the sword	II	1	5	0		2	6	3	A	6
		6				4		0		
Preceding them	II	1	1	0		2	3	3	A	5
		5	9			3	2	8		
On the left side, above this	II	1	2	0		2	2	3	A	5
		6	0			1	2	1		
Preceding, below the shield, and on the arm	II	1	2	0		2	7	2	A	4
		3	1			0		9		
Preceding, on the left side	II	2	8	0		2	5	3	A	5
		1				1	7	0		
Following in the same place	II	2	4	3		2	3	2	A	5
		3	8	0		1	8	9		
The informis after this	II	2	3	0		2	5	3	A	5
		5	3			2	6	0		
The upper of three on the left hand	II	1	5	3		1	4	2	A	6
		4	9	0		1	4	8		
The middle of them	II	1	5	3		1	7	3	A	6

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
		2	6	0		3		0		
The lowest of them	♈	1	2	0		1	2	2	A	6
		2	3			4	3	9		
Of ten informes above, preceding Orion	♈	0	7	0		2	3	3	A	4
						9	0	0		
The following of them	♈	4	6	0		2	4	2	A	4
						9	8	9		
The one above this	♈	3	4	0		2	3	3	A	5
		5				8		0		
Preceding, the third, in a straight line	♈	2	3	0		1	4	2	A	4
		1				8	6	8		
The middle one	♈	4	2	0		1	5	0	A	4
		1				5	6			
The boreal one	♈	6	1	0		1	1	3	A	5
		3				3	4	0		
Below the straight line, toward the south	♈	4	2	0		1	2	2	A	5
		1				8	3	9		
Above this, toward the rising	♈	7	5	0		1	5	3	A	5
		9				4	8	0		
Preceding the two above the Dog	♈	8	3	3		2	3	2	A	4
		7	0			0	2	8		
The following of them	♈	1	2	0		2	4	2	A	4
		5	3			2	6	9		
Below the right shoulder, toward the setting	♈	2	2	0		1	1	2	A	5
		0	1			9	7	0		
The obscure one on the back, following	♈	1	4	3		1	3	2	A	6
		9		0		9	6	0		
The preceding one	♈	1	1	3		1	5	2	A	6
		8	0	0		9	2	0		

ERIDANUS, NILUS FLUVIUS — Eridanus, the River Nile

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat .	°	'	"	B/ A	Ma g.
At the left foot of Orion, at the beginning of the river	II	1	6	0		3	3	0	A	4
		1				1	4			
Above the foot of Orion, in the river	II	1	8	0		2	5	0	A	3
		1				7	3			
The following of two others	II	9	5	3		2	5	1	A	5
				0		9	1	0		
The preceding one	II	6	5	3		2	5	0	A	5
			4	0		7	1			
The following of two upper ones	II	5	9	3		2	3	3	A	4
				0		5	3	0		
The preceding of them	II	2	3	0		2	1	0	A	4
			9			5	1			

Catalogue of the Fixed Stars for the Year 1700

(TAB. 98, continued — *Pars Tertia*, the southern constellations [*Astra Australia*]. Each page carries two side-by-side table panels; reading order is the left panel top-to-bottom, then the right panel top-to-bottom. The columns are: **Names of the Fixed Stars** [*Nomina Fixarum*] | **Longitude** [*Longitudo*: Sign · Degrees · Minutes · Seconds] | **Latitude** [*Latitudo*, here **A.** for austral/southern latitude: Degrees · Minutes · Seconds] | **Magnitude** [*Magnitudo*]. Throughout this stretch the latitude is austral, so the B/A column reads **A.** in every row.)

Page 119 — left panel

(Continuing *ERIDANUS*, the River — the 2nd certitude class, begun on the preceding page.)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The following one of four, after the gap	♊	1	4	0	33	1	0	A	3
		9	2			3			
The one that precedes this	♊	1	6	3	31	8	4	A	4
		6		0			0		
The third to the north,	♊	1	3	0	28	4	1	A	3

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
preceding		6	1			6	0		
Preceding all four	♍	1	9	0	27	4	5	A	3
		4				6	0		
The first of those next to Cetus	♍	4	3	0	24	3	5	A	3
		4				3	0		
Between this one and the third	♍	7	0	0	23	5	2	A	4
						8	0		
The third, which follows	♍	9	4	0	25	5	5	A	3
		0				8	0		
The preceding, lower one	♍	2	1	0	30	2	4	A	5
		5	3			4	9		
Above this one	♍	2	1	0	27	3	5	A	4
		5	7			1	0		
The following one	♍	2	2	0	28	9	2	A	4
		6	2				0		
The upper eastern one	♍	2	1	0	25	2	4	A	5
		9	0				3		
The preceding of the two between the River and Taurus	♍	1	4	3	18	2	5	A	4
		7	9	0		6	0		
The following, southern one	♍	2	3	0	22	4	5	A	4
		1	1			4	0		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B / A	Mag.
The last of three	♍	2	4	0	25	5	0	A	4
		8	4			0			
The middle one, Ptolemy's 8th	♍	2	0	0	26	5	0	A	4
		8				0			
Out of the four, the one that precedes	♍	2	5	0	23	1	0	A	4
		4				0			

Name of the fixed star	Long. Sign	° ' "	Lat. °	' "	B / A	Mag.
At the bend of the River, toward the breast of Cetus	♈	2 3 0 7 4	32	1 0 0	A	4
The following one	♈	2 1 0 8 4	34	5 0 0	A	4
The first of the three following	♏	1 1 0 4	38	3 0 0	A	4
The middle one	♏	6 1 0 4	38	0 0	A	4
The last one	♏	9 5 0 4	38	5 0 0	A	4
In the □ [quadrilateral], the preceding of the boreal side	♏	1 4 0 3 4	41	1 0 0	A	4
In the same, the austral one	♏	1 5 0 3 4	42	2 0 0	A	5
The preceding of the following side	♏	1 3 0 4 4	43	0 0	A	4
The last of these four	♏	1 4 0 7	43	1 0 0	A	4
Toward the rising, the boreal of the two conjoined ones	♈	2 3 0 6 4	50	2 0 0	A	4
More toward the south	♈	2 2 0 7 4	51	4 0 0	A	4
At the turn of the two posterior ones	♏	2 3 0 0 4	53	4 0 0	A	4
The preceding one	♏	1 1 0 8 4	53	0 0	A	4
In the last interval, out of three, the hindmost	♏	1 1 0 0 4	52	5 0 0	A	4

Name of the fixed star	Long. Sign	° ' "	Lat. ° ' "	B / A	Mag.
The middle one	♊	7 1 0 4	53 2 0 0	A	4
The first of three	♊	4 1 0 4	51 5 0 0	A	4
At the end of the River	♊	2 3 0 2 4	53 3 0 0	A	1
Scaliger wrote to Tycho [Brahe] that this one is placed by the sailors in Pisces, which Bayer [Johann Bayer] depicts	♊ [X]	9 4 0 5	59 3 0 0	A	— [no magnitude given]

LEPVS — The Hare

1. Class.

Name of the fixed star	Long. Sign	° ' "	Lat. ° ' "	B / A	Mag.
On the left shoulder, or the thigh	♊	1 2 7 5 9	43 5 5 5 0	A	3

2. Class.

Name of the fixed star	Long. Sign	° ' "	Lat. ° ' "	B / A	Mag.
The upper one of the preceding ear	♊	1 3 3 1 7 0	34 3 2 2 0	A	5
The lower one of the same ear	♊	1 4 3 1 3 0	35 5 2 2 2	A	5
The upper one of the following ear	♊	1 5 0 3 0	35 1 2 6 5	A	6
The lower one of the following ear	♊	1 3 0 3 7	36 1 2 2 4	A	5
The one on the head	♊	1 1 0	39 2 2	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
		1	2				1		
At the tip of the front feet	♐	7	4	3	44	5	2	A	4
			8	0			8	3	
On the back, in the middle of the body	♐	1	1	3	41	4	0	A	3
			7	2					
The more austral of the two on the hind feet	♐	2	4	3	45	4	0	A	3
			0	4			8		
The more boreal of the same	♐	2	5	0	44	1	2	A	3
			2	9			6	0	
The preceding one on the back	♐	2	4	3	38	1	2	A	4
			1	9			4	2	
The following one on the back	♐	2	5	3	37	3	0	A	4
			4	0			9		
The last one on the tail	♐	2	4	0	38	2	2	A	4
			7	5			4	0	

CANIS MAIOR — The Greater Dog

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The most brilliant, in the mouth: Sirius	♄	2	4	4	39	3	5	A	1
			0	7			2		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the forehead, toward the right ear	♄	1	2	5	34	5	0	A	4
			0	9			2		
In the middle of the forehead	♄	1	5	2	36	4	0	A	5
			2	5			5		
Under the left ear	♄	1	3	2	38	4	2	A	3
			5	4			0		
On the neck	♄	1	3	2	39	3	0	A	4

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
		3	1	0		2			
On the right shoulder of the front feet	♌	8	0	5	42	1	0	A	5
				0		5			

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(CANIS MAIOR continued — the body of the Greater Dog.)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the tip of the front paw	♌	3	1	5	41	2	2	A	2
			0	0		0	0		
On the back	♌	1	5	5	46	1	2	A	5
		6	8	0		1	0		
In the middle of the breast	♌	1	4	5	46	4	2	A	5
		4		0		1	0		
On the belly	♌	1	2	2	48	3	5	A	3
		9	3	0		1	0		
Between the hind thighs	♌	1	4	5	51	2	2	A	3
		6	9	0		6	0		
The lower one on the right front foot	♌	2	3	2	51	4	2	A	3
			5	0		8	0		
The one on the tail	♌	2	3	5	51	2	2	A	3
		5	9	0		6	0		

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The other one on the breast	♌	1	5	1	42	2	0	A	5
		2	8	9		2			
On the southern knee	♌	8	2	2	42	1	—	A	5
			8	0		2			
On the left knee, preceding of the two	♌	1	2	1	46	1	—	A	5
		6	8	8		2			
The following one of these	♌	8	3	2	45	3	—	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
			8	0		2			
On the hock of the right leg	♄	1	2	1	54	5	—	A	4
			5	8	9	2			

(Stars not belonging to a figure [informes], around the Dog:)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
To the north, toward the crown of the Dog	♄	1	5	2	25	2	—	A	4
			1	8	0				
Under the feet, after four, in a straight line, austral	♄	2	2	1	61	1	—	A	4
			8	8		2			
The one more toward the north	♄	3	4	2	58	3	—	A	4
			8	0		2			
Still more boreal	♄	5	2	1	56	4	—	A	4
			8	9		2			
The remaining, the most boreal, of four	♄	6	3	2	55	4	—	A	4
			8	0		2			
The third, toward the west, in a straight line, preceding	♄ [II]	1	2	1	55	1	—	A	4
			9	8	8	2			
The middle one of these	♄	2	5	2	57	2	—	A	4
			2	8	0	2			
The last of three	♄	2	5	1	59	3	—	A	6
			4	8	9	2			
Following these	♄	2	2	1	59	2	—	A	2
			1	8	8	2			
The preceding of these	♄	1	2	2	57	2	—	A	2
			8	8	0	2			
The rest, more austral	♄	1	3	1	59	3	—	A	4
			4	8	9	2			

CANIS MINOR — The Lesser Dog

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
Procyon, on the thigh	♄	2	4	2	15	5	1	A	2
		1	0	7		7	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the neck, or the collar	♄	1	1	5	13	3	4	A	3
		8		0		3	0		
Above the bright one of the neck	♄	2	4	5	12	5	1	A	6
		1	0	0		1	0		
An informis [unfigured star] above this	♄	1	4	5	9	4	1	A	6
		8	4	0		6	0		
The following one, toward the tail of Cancer	♄	2	1	5	10	1	4	A	5
		2	9	0		9	0		

ARGO NAVIS — The Ship Argo

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the very top of the stern	♏	7	1	0	43	1	3	A	3
			8			8	0		
The topmost of the shield	♏	2	0	0	44	5	3	A	3
						8	0		
The preceding one of the shield	♄	2	2	3	47	2	3	A	3
		9	4	0		8			
On the sail	♏	5	3	0	32	7	—	A	4
			1						
An informis, toward the south	♏	5	5	3	38	3	0	A	4
			1	0		1			
The lower of three on the mast	♏	1	5	5	32	5	0	A	6
		3	0	0		6			
Above this	♏	1	1	4	30	1	0	A	4
		4	5	9		8			

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
Higher than this very one	♏	1	2	5	24	2	3	A	4
		1	5	0		9	0		
The preceding of two on the yardarm	♏	0	5	2	21	3	3	A	4
			0	8		9	0		
The following of these	♏	5	4	5	22	2	3	A	3
			4	7		9	0		
An informis between the sail and the Milky Way [lacteam]	♏	2	8	2	30	3	0	A	3
		5		7		0			

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The preceding of the two ends	♏	3	2	2	42	1	—	A	5
			4	7		0			
The one more toward the south	♏	1	4	2	45	4	—	A	4
			4	8		0			
Preceding these two	♏	2	2	2	45	1	—	A	4
		8	4	8		0			
The preceding of three under the shield	♏	2	2	3	49	1	—	A	4
		8	4	0		0			
The following one	♏	2	2	2	49	3	—	A	4
			4	7		0			
The middle of three	♏	1	3	3	49	0	—	A	4
			4	0					
At the end of the rudder-bar [temo]	♏	7	4	2	49	3	—	A	4
				7		0			
On the keel of the stern, the boreal of two	♏	2	4	2	52	4	—	A	4
		3		8		0			
The austral of them	♏	2	4	2	58	2	—	A	3
		7		9		0			
On the seat of the stern, boreal	♏	3	1	2	55	2	—	A	5
			4	7		0			
In the same place, the	♏	5	1	2	58	3	—	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
preceding of three			4	8		0			
The middle one	♌	6	1	2	57	0	—	A	4
			4	9					
The following one	♌	9	2	3	57	3	—	A	4
			4	0		0			
The bright following one, beyond [transtra, the rowers' benches]	♌	1	4	2	58	3	—	A	2
			4	8		0			
The obscure one preceding under this	♌	1	4	2	59	5	—	A	5
			1	7		0			
The following one	♌	1	5	2	59	1	—	A	5
			5	4		0			
The one above the Bright one, preceding	♌	1	5	3	56	3	—	A	5
			5	4		0			
The following one	♌	1	4	2	57	3	—	A	5
			7	8		0			

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(*ARGO NAVIS continued — 3rd class.*)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the station of the boreal mast, of three	♌	2	1	2	51	3	0	A	4
			8	4		0			
The middle one	♌	2	4	3	55	3	—	A	4
			8	4		0			
The austral of three	♌	2	3	2	57	0	—	A	4
			6	4					
Under these, the boreal of the joined ones	♍	1	4	2	59	5	—	A	4
			4	7		0			
The more austral of these	♍	1	3	2	61	0	—	A	4
			4	8					
In the middle of the mast, the austral	♌	2	3	2	51	3	—	A	4
			2	4		0			

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The more boreal of these	♌	2	4	2	49	0	—	A	3
		1	4	8					
At the top of the sail	♌	2	2	2	43	1	—	A	4
		0	4	7		0			
<i>Another reading</i> [Alia lectio]	♌	2	2	2	53	1	—	A	4
		0	4	7		0			
The following one	♌	2	2	2	43	3	—	A	2
		1	4	8		0			
Under the third, the following one of the shield	♌	1	3	3	51	3	—	A	2
		7	4	0		0			
<i>Otherwise</i> [Aliter]	♌	1	3	3	54	3	—	A	2
		6	4	0		0			
At the section of the deck [instrati]	♌	9	5	2	51	1	—	A	2
			4	9		5			
Among the oars in the keel [Carina]	♌	1	4	2	63	0	—	A	4
		4		8					
The following obscure one	♌	1	2	2	64	3	—	A	6
		1	4	7		0			
The bright following one at the station	♌	2	2	2	63	5	—	A	2
		2	4	8		0			
Shining below the keel	♍	0	5	2	69	4	—	A	2
			4	7		0			
The preceding of three following this	♍	7	3	2	65	4	—	A	4
			4	8		0			
The middle of these	♍	1	4	2	65	5	—	A	3
		3	4	8		0			
The following one	♍	1	2	3	67	2	—	A	2
		8	4	0		0			
<i>From another reading</i> [Ex alia lectione]	♍	1	2	3	65	5	—	A	2
		8	4	0		0			
The preceding of the two following, toward the deck- section	♍	2	2	3	62	5	—	A	3
		3	4	0		0			

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The following of these	♈	0	2	2	62	1	—	A	3
			4	7		5			
<i>From another reading</i>	♈	0	2	2	65	1	—	A	3
			4	7		5			
On the rudder-bar, the boreal one, preceding	♊	2	2	3	65	5	—	A	4
		6	4	0		0			
<i>From another reading</i>	♊	2	2	3	65	5	—	A	4
		4	4	0		0			
The one that follows	♋	1	3	2	65	4	—	A	3
		2	4	8		0			
<i>From another reading</i>	♋	1	3	2	65	4	—	A	3
		8	4	8		0			
On the rudder-bar: Canopus	♋	9	2	2	75	0	—	A	1
		4	7						
<i>From another reading</i>	♋	9	2	2	69	0	—	A	1
		4	7						
The rest following this	♋	2	2	3	71	4	—	A	3
		1	4	0		5			
<i>From another reading</i>	♋	2	2	3	61	4	—	A	3
		1	4	0		5			

HYDRA, seu HYDRVS — The Water-Serpent (Hydra)

1. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The Heart of Hydra [Cor Hydrae]	♋	2	6	3	22	2	5	A	1
		3		7		3	0		

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The preceding one on the head	♋	7	1	3	14	3	5	A	4
			1	0		6	0		

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
Above the first, toward the north	♌	8	8	0	14	1 6	2 0	A	4
The more boreal one on the back of the head	♌	8	1 0	0	11	8	0	A	4
The third preceding, toward the south	♌	8	4 4	3 0	11	3 6	0	A	5
The most eastern of the head	♌	1	2 0	3 0	11	1	0	A	4
The preceding one on the neck	♌	1	1 3	3 0	11	5	2 0	A	6
The following one at the drawing-out of the neck	♌	1	3 6	3 0	13	5	0	A	5
The middle of the neck	♌	2	3 1	3 0	15	0	0	A	4
The boreal of three at the bend of the neck	♌	2	2 3	0 6	14	1 7	2 0	A	4
The austral one at the joint [nexu]	♌	2	1 1	3 5	16	4 6	0	A	5
The one that next follows the Heart	♌	2	3 8	3 0	26	3 3	3 0	A	4
Following close upon this	♍	1	3 0	0	26	1 2	0	A	5
The preceding of the adjacent ones	♍	4	1 0	0	23	1 3	0	A	5
The following of these	♍	5	1 5	0	21	5 1	0	A	4
The fifth from the Heart	♍	1	5 0	3 0	24	3 8	0	A	4
In a straight line with this and the next	♍	1	3 4	3 0	23	3 1	0	A	5
The one preceding, next to the Crater [Cup]	♍	1	1 6	0 3	21	4 8	3 0	A	4
An informis, nearest to the	♌	6	7	3	12	2	0	A	4

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
head				0		7			
The boreal one under the base of the Crater	♏	2	2	3	25	3	0	A	4
		4	3	0		6			
The austral one under the same base	♏	2	1	0	30	1	0	A	4
		5	1			7			
Under the tail of the Crow [Corvus]	♏	2	4	0	13	4	0	A	3
		2	6			3			
A little one preceding this	♏	2	4	0	14	3	0	A	6
		0	6			7			
An informis before the head of Hydra	♏	0	6	0	10	1	0	A	3
						9			

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The boreal of two on the eye	♏	5	4	0	13	4	0	A	4
			4			0			
The austral of them, in the gap [hiatu]	♏	8	2	0	14	1	0	A	4
			2			5			
From the south, the boreal of the two adjacent ones	♏	2	2	0	19	4	0	A	6
		2				5			
The preceding one in the triangle [triquetro]	♏	5	2	0	31	2	0	A	4
						0			
The middle of them	♏	7	2	0	33	1	0	A	4
			2			0			
The following of them	♏	9	2	0	31	2	0	A	4
						0			
At the very end of the tail	♏	7	2	0	17	4	0	A	4
			2			0			

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(Two stars completing the preceding section — at the head of Hydra; then CRATER.)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the head, toward the south	♌	5	2	0	23	1	0	A	3
			2			5			
<i>Otherwise</i> [Aliter]					13	5	0	A	3
Following the neck	♍	3	5	0	16	0	0	A	3
			2						
<i>Otherwise</i> [Aliter]					26	0	0	A	3

CRATER — The Cup

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the base of the Crater	♍	1	3	0	22	4	0	A	4
		9	3			1			
The following of two in the middle	♍	2	5	0	19	3	0	A	4
		5				9			
The preceding of them	♍	2	3	3	17	2	0	A	4
		2	2	0		5			
The preceding of two above the Crater	♍	2	4	2	13	1	0	A	4
		1	9	4		0			
The following of them	♍	2	2	0	11	1	0	A	4
		4	4			7			
The preceding of two lower ones	♍	2	5	0	18	1	0	A	4
		9	2			0			
The following of them	♌	1	5	0	16	2	0	A	4
		5							
In the middle of the Crater	♍	2	1	0	14	9	0	A	5
		6	7						

CORVVS — The Crow

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The one toward the eye	♌	7	3	0	19	3	0	A	4
			0			9			
The preceding of the two upper ones in the □ [quadrilateral]	♌	6	3	0	14	2	0	A	3
			5			5			
The following of them	♌	9	1	0	12	7	0	A	3
			7						
The following of the lower ones in the □	♌	1	1	0	17	5	0	A	3
			3	1		9			
On the beak	♌	8	0	0	21	4	0	A	4
						6			
On the neck	♌	9	3	0	18	1	0	A	5
			6			4			
On the left wing, above the bright one	♌	9	4	3	11	2	0	A	5
			3	0		8			

CENTAVRVS CHIRON — The Centaur (Chiron)

2. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the head, the most austral	♐	2	4	0	21	4	0	A	5
			9			9			
The one more toward the north	♐	2	2	0	19	8	0	A	5
			1						
The preceding of the two intermediate ones	♐	1	3	0	20	5	0	A	5
			4			1			
The following of four	♐	2	2	0	20	1	0	A	5
			5			2			

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the left shoulder,	♑	2	3	0	25	4	0	A	3

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
preceding		8	2			0			
On the right shoulder	♏	8	2	0	22	4	0	A	3
						0			
On the left fore-shoulder [armo]	♏	1	3	0	27	4	0	A	4
			2			0			
On the shield, the preceding boreal one	♏	1	3	0	22	3	0	A	4
		0	2			0			
The austral one of them	♏	1	3	0	23	5	0	A	4
		1	2			0			
At the top of the shield	♏	1	2	0	18	3	0	A	4
		4	2			0			
On the shield, toward the south	♏	1	5	0	21	1	0	A	4
		4	2			0			
On the right side, the preceding of three	♏	5	4	0	28	3	0	A	4
			2			0			
The middle one	♏	6	2	0	29	3	0	A	4
			2			0			
The following one	♏	7	3	0	28	1	0	A	4
			2			0			
On the right arm	♏	8	5	0	26	4	0	A	4
			2			0			
On the right elbow	♏	1	1	0	25	3	0	A	3
		5	2			0			
At the end of the right hand	♏	1	5	0	24	2	0	A	4
		9	2			0			
The bright one at the drawing-out of the human body	♏	1	2	0	33	4	0	A	3
		0	2			0			
The following of two boreal ones	♏	1	2	0	31	1	0	A	5
		0				0			
The preceding one	♏	9	1	0	33	1	0	A	5
			2			0			
At the drawing-out of the	♏	4	3	0	35	0	0	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
back			2						
Preceding this, on the back of the horse	♏	1	2	0	37	5	0	A	5
			2			5			
On the loins, the following of three	♏	2	1	0	40	1	0	A	3
		8	2			0			
The middle one	♏	2	2	0	43	1	0	A	4
		7	2			0			
The preceding of three	♏	2	2	0	44	1	0	A	5
		5				0			

[Otherwise (Aliter):]

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the right thigh, preceding	♏	2	2	0	46	2	0	A	3
		5				0			
The following one in the same place	♏	2	5	0	46	5	0	A	4
		5	2			0			
On the breast under the horse's wing	♏	1	4	0	42	5	0	A	4
		0	2			0			
Under the belly, the preceding of two	♏	8	4	0	43	1	0	A	2
		2				0			
The following of them	♏	1	2	0	44	0	0	A	3
		0							
On the hock of the right foot	♏	2	2	0	51	2	0	A	2
		2				0			
On the heel of the same	♏	7	4	0	51	5	0	A	2
		2				0			
On the hollow of the left foot	♏	2	4	0	55	1	0	A	4
		8	2			5			
Under the muscle of the same	♏	3	3	0	55	3	0	A	2
		2				0			

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(CENTAVRVS continued.)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the top of the right front foot	♐	0	4	0	41	2	0	A	1
			2			0			
On the left knee	♐	1	3	0	45	3	0	A	2
		6	2			0			
Under the right hind foot	♐	7	2	0	49	2	0	A	4
						0			

LVPVS, seu BESTIA CENTAVRI — The Wolf, or the Centaur's Beast

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B / A	M ag.
At the top of the hind foot	♐	2	2	0	25	0	0	A	3
		0	2						
On the hock of the same foot	♐	1	1	0	29	2	0	A	3
		8	2			0			
On the fore-shoulder, preceding	♐	2	2	0	21	3	0	A	4
		3	2			0			
On the fore-shoulder, following	♐	2	3	0	21	2	0	A	4
		6	2			0			
In the middle of the body	♐	2	2	0	25	3	0	A	4
		5	2			0			
On the belly, under the flanks [Ilibus]	♐	2	3	0	27	2	0	A	5
		2	2			0			
On the thigh	♐	2	1	0	29	2	0	A	5
		3	2			0			
At the drawing-out of the boreal thigh	♐	2	2	0	28	5	0	A	5
		7				0			
The austral one of them	♐	2	2	0	30	3	0	A	5
		6				0			

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B / A	M ag.
On the upper loin	♏	2	2	0	33	3	0	A	5
		8				0			
At the end of the tail, the austral of three	♏	1	2	0	31	4	0	A	5
		4	2			0			
The middle one	♏	1	1	0	30	5	0	A	4
		7	2			0			
The boreal of them	♏	1	2	0	29	4	0	A	4
		5	2			0			
On the jugular [iugulo], the austral	♏ [♏♏?]	1	1	0	17	2	0	A	4
		2				0			
The boreal one in the same place	♏	1	4	0	15	4	0	A	4
		2				0			
On the maw [rictu], preceding	♏	2	2	0	13	4	0	A	4
		8				0			
The following one	♏	2	2	0	12	1	0	A	4
		9				0			
On the front foot, the more austral	♏	1	3	0	12	1	0	A	4
		9	2			0			
The more boreal of them	♏	1	5	0	10	2	0	A	4
		8	2			0			

THVRIBVLVM, seu ARA — The Censer, or the Altar

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the base, the boreal of two	♏	2	1	0	23	0	0	A	5
		0	2						
The austral one	♏	2	4	0	26	0	0	A	4
		5	2						
On the middle little altar [arula]	♏	1	5	0	26	4	0	A	4
		8	2			5			
On the little hearth [foculo],	♏	1	2	0	30	4	0	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
the boreal of three		3				0			
<i>Otherwise</i> [Aliter]					13	4	0	A	5
						0			
Of the rest, the austral one	♌	1	4	0	34	3	0	A	4
		7	2			0			
The boreal one	♌	1	3	0	33	3	0	A	4
		7	2			0			
At the top of the flame	♌	1	2	0	34	3	0	A	4
[flammae]		3	2			0			
<i>Otherwise</i> [Aliter]					31	3	0	A	4
						0			

CORONA AVSTRALIS — The Southern Crown

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
At the southern rim, on the	♐	1	4	0	21	5	0	A	4
outside, preceding			2			0			
<i>Otherwise</i> [Aliter]					24	5	0	A	4
						0			
Following this one in the	♐	4	1	0	21	2	0	A	5
Crown			2			0			
Succeeding this	♐	5	4	0	23	2	0	A	5
			2			0			
Following close upon this	♐	7	2	0	20	2	0	A	4
			2			0			
After this, before the knee of	♐	8	4	0	18	5	0	A	5
Sagittarius			2			0			
The one from there most	♐	9	3	0	17	3	0	A	4
boreal, on the bright knee			2			0			
The one more boreal	♐	8	5	0	16	2	0	A	4
			2			0			
Still more boreal	♐	9	2	0	15	3	0	A	5

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
						0			
On the boreal rim, the following of two	♐	7	4	0	15	4	0	A	6
			2			0			
The preceding of them	♐	7	1	0	15	1	0	A	6
			2			0			
Beyond an interval, preceding these	♐	4	2	0	15	0	0	A	5
			2						
The one that goes before this	♐	2	1	0	16	1	0	A	5
			2			0			
The rest, toward the south	♐	1	4	0	18	5	0	A	5
			2			0			

PISCIS NOTIVS — The Southern Fish

3. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
On the rim of the head, preceding	♓	2	1	0	20	3	0	A	4
			3	2		5			
The middle one	♓	2	4	0	22	3	0	A	4
			6	2		0			
The following one	♓	2	5	0	22	4	0	A	4
			7	2		5			
At the gill [branchiam]	♓	2	5	0	16	3	0	A	4
			6	2		0			
On the austral spine and the back	♓	1	4	0	19	5	0	A	5
			7	2		0			
On the belly, the following of two	♓	2	4	0	15	3	0	A	5
			3	2		0			

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(A southern constellation continuing in ♓ Aquarius — the Bayer figure preceding GRVS; these complete the stars associated with the region before the Crane.)

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
Preceding in the same place	♊	2	2	0	15	0	0	A	4
		1	2						
On the boreal spine, following	♊	1	4	0	15	1	0	A	4
		7	2			5			
The middle one there	♊	1	2	0	16	4	0	A	4
		4	2			5			
Preceding in the same place	♊	1	3	0	18	2	0	A	4
		3	2			5			
At the very end of the tail	♊	1	4	0	22	3	0	A	4
		2	2			0			
Preceding the Fish of those preceding	♊	0	3	0	22	4	0	A	3
			2			0			
The middle of them	♊	3	4	0	22	3	0	A	3
			2			0			
Following them	♊	6	3	0	21	3	0	A	3
			2			0			
Going before this	♊	4	3	0	21	1	0	A	5
			2			0			
The more austral of the remaining two	♊	6	2	0	17	2	0	A	4
			2			0			
The more boreal of them	♊	6	2	0	15	1	0	A	3
			2			0			

GRVS — The Crane

4. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The bright one of the head [Lucida Capitis]	♊	1	1	0	22	5	0	A	2
		3	6			0			
In the middle of the neck	♊	1	1	0	24	5	0	A	4
		3	7			6			
At the drawing-out of the neck, more eastern	♊	1	4	0	28	5	0	A	6
		4	7			7			

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The more western one	♊	1	5	0	28	4	0	A	6
		5	8			0			
On the back, more eastern	♊	1	2	0	31	5	0	A	6
		6	3			2			
There, the more western one	♊	1	3	0	31	3	0	A	6
		7	8			5			
On the right wing, more boreal	♊	2	3	0	34	2	0	A	5
		4	7			3			
There, the more austral one	♊	2	8	0	36	1	0	A	4
		4				5			
On the left wing	♊	1	5	0	32	5	0	A	2
		1	9			7			
At the drawing-out of the tail	♊	1	1	0	34	3	0	A	5
		8	7			6			
On the tail, more boreal	♊	1	4	0	39	2	0	A	4
		6	9			0			
On the tail, more eastern	♊	1	4	0	41	3	0	A	5
		4	5			6			
On the tail, more western	♊	1	9	0	41	2	0	A	4
		9				7			

PHOENIX — The Phoenix

4. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B / A	Mag.
The bright one on the neck [Lucida in Collo]	♋	1	3	0	40	1	0	A	2
		0	5			0			
A little one adjacent	♋	1	1	0	41	3	0	A	5
		0	3			0			
On the bend [ancone] of the right wing	♋	4	3	0	41	4	0	A	4
		8				0			
On the right wing, the	♊	2	4	0	39	4	0	A	5

Name of the fixed star	Long. Sign	° ' "	Lat. ° ' "	B / A	Mag.
third, more austral		9 8		5	
The middle of them	✕	0 3 0 8	35	5 0 0	A 5
The more boreal of them	✕	1 5 0 8	32	0 0	A 5
On the left wing, at the very end	✕	2 8 0 4	47	3 0 0	A 3
At the drawing-out of the same	✕	1 2 0 0 8	44	1 0 0	A 4
Toward the right foot, the eastern of three	✕	6 5 0 3	45	1 0 0	A neb. [nebulous]
The more western one	✕	8 2 0 3	45	4 0 0	A neb. [nebulous]
The more austral one	✕	7 3 0	46	0 0	A 4
In the hollow under the left wing, austral	✕	1 1 0 9 5	53	0 0	A 3
There, the more boreal	✕	1 4 0 4 8	48	2 0 5	A 3
In the hollow under the right wing, upper	✕	3 5 0 8	53	0 0	A 4
The lower one of them	✕	8 1 0 8	54	4 0 0	A 4

INDVS — The Indian

4. Class.

Name of the fixed star	Long. Sign	° ' "	Lat. ° ' "	B/ A	Ma g.
On the head	♐	2 0 0 9	32	3 0 0	A 4
On the left armpit	♊	1 1 0 3	36	5 0 5	A 4
On the left hand, arrow 1	♊	4 3 0	37	0 0	A 4

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
				0					
The second	♊	6	2	0	38	3	0	A	4
			8			5			
The third	♊	5	4	0	40	0	0	A	4
			5						
At the top of the arrow of the right hand	♐	2	4	0	27	5	0	A	5
			4	0		5			
At the bottom	♐	1	0	0	32	3	0	A	5
			5			5			
On the right armpit, more western	♐	2	1	0	33	4	0	A	6
			4	6		5			
The following one	♐	2	0	0	33	5	0	A	6
			5			3			
The more eastern one	♐	2	4	0	33	4	0	A	6
			3	8		0			
On the breast	♐	2	5	0	36	0	0	A	5
			4	8					
On the belly	♐	2	3	0	39	1	0	A	4
			2	8		5			

PAVO — The Peacock

4. Class.

Name of the fixed star	Long. Sign	°	'	"	Lat. °	'	"	B/ A	Ma g.
The bright one on the head	♐	1	9	0	36	0	0	A	2
			8						
On the upper neck	♐	1	2	0	40	4	0	A	6
			8	3		0			

(The catalogue continues onto the following page — PAVO and the remaining southern figures are not yet complete; there is no FINIS or colophon on this page.)

Catalogue of the Fixed Stars for the Year 1700 (TAB. 98, continued — Pars Tertia: southern constellations, conclusion)

The catalogue continues with the remaining southern (austral) constellations. Each table gives the star's name, its ecliptic longitude (Sign, degrees, minutes), its southern ecliptic latitude (degrees, minutes), and its magnitude. The certitude class (4. *Classis*) is printed beneath each constellation rubric. *neb.* marks a nebulous object.

Pavo (the Peacock), continued

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
The middle one there [Media ibi]	♎	19	38	41	20	6
The lower one in the same place [Inferior ibidem]	♎	17	23	41	45	6
In the breast [In pectore]	♎	21	53	48	30	3
At the root of the right wing [In radice alae dextrae]	♎	16	38	46	32	3
A small one adjacent to it [Parua huic adiacens]	♎	15	13	47	0	neb.
In the middle of the wing, or the back [In media ala, seu dorso]	♎	11	48	45	20	3
A nebulous one adjacent [Nebulosa adiacens]	♎	9	53	46	5	neb.
At the start of the tail, the first [In educatione caudae prima]	♎	3	18	45	40	5
The second [Secunda]	♎	1	45	44	0	5
The third [Tertia]	♎	1	51	43	0	5
The fourth [Quarta]	♎	2	8	39	35	5
The fifth [Quinta]	♏	29	38	41	30	5
The sixth [Sexta]	♏	29	3	40	30	5

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
The seventh [Septima]	♄	28	13	39	20	5
The eighth [Octaua]	♄	24	53	41	20	5
The ninth and last [Nona, & vltima]	♄	19	58	42	20	4
In the right foot, austral [In dextro pede australis]	♄	9	33	50	0	4
In the same, boreal [In eodem borealis]	♄	12	28	49	20	6
In the left foot [In sinistro pede]	♄	19	23	50	25	6
At the end of the tail [In extrema cauda]	♄	2	28	48	27	6
In the same [In eadem]	♄	28	15	51	40	5

Apus, or Avis Indica (the Bird of Paradise) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
Unformed, or in the head [Informis, aut in capite]	♄	18	33	44	40	5
In the neck [In collo]	♄	18	13	48	6	5
At the start of the boreal tail [In educatione caudae boreal.]	♄	17	35	54	20	5
The middle one there [Ibidem media]	♄	13	15	55	0	5
The austral one there [Ibidem austrina]	♄	16	10	55	45	5
In the tail, toward the triangle of the two upper ones [In cauda versus △ duarū superior]	♄	8	48	51	30	6
The lower one there	♄	8	3	52	0	6

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
[Ibidem inferior]						
In the middle of the tail, the 3rd more boreal [In media cauda 3. borealior]	♄	10	11	57	10	5
The middle one [Media]	♄	9	0	57	57	6
The more austral one [Australior]	♄	9	38	59	20	4
In the same, toward Chamaeleon [In eadem versus Chamaeleonem]	♄	13	40	61	25	4

Apis, or Musca (the Fly) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
In the head [In Capite]	♄	16	58	54	0	4
In the right wing [In ala dextra]	♄	16	53	56	25	4
In the left wing [In ala sinistra]	♄	23	13	56	5	4
In the tail [In cauda]	♄	20	57	57	30	4

Chamaeleon — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
In the forefeet [In prioribus pedibus]	♄	1	27	62	40	5
At the neck [Ad collum]	♄	26	8	63	20	5
On the back [In dorso]	♄	24	53	67	0	5
In the hind feet [In posterioribus pedibus]	♄	1	21	67	25	5
At the start of the tail, more eastward [In educatione caudae]	♄	0	28	70	38	5

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
orientalior]						
The more western one [Occidentalior]	♄	2	58	75	35	5
In the middle of the tail, the upper [In media cauda superior]	♄	28	8	73	0	5
The lower [Inferior]	♄	26	13	73	15	5
At the end of the tail, the upper [In extrema cauda superior]	♄	23	30	74	26	5
The lower [Inferior]	♄	24	28	75	12	5

Triangulum Australe (the Southern Triangle) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
The following one at the base, toward the neck of Apus [Sequens basis versus collū Apodis]	♄	14	20	46	20	3
The upper one at the cusp, toward Lupus [Superior in cuspide versus Lupum]	♄	5	30	41	0	3
A small one adjacent to it [Parua huic adiacens]	♄	8	40	44	40	5
The base, preceding, toward the tail of Apus [Basis praecedēs versus caudam Apodis]	♄	4	20	48	30	3
A small one above this [Parua supra hanc]	♄	5	0	44	15	3

Piscis Volans, or Passer (the Flying Fish) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
In the head [In Capite]	♌	19	53	72	26	5
In the middle of the body [In medio corpore]	♌	24	29	77	12	6
In the tail [In cauda]	♍	7	12	82	5	5
In the left wing, upper [In ala sinistra superior]	♌	13	34	75	20	6
The lower one there [Ibi inferior]	♌	20	7	82	14	6
In the right wing, upper [In ala dextra superior]	♍	6	13	76	21	6
The lower one there [Ibi inferior]	♍	11	53	79	28	6

Dorado, or Xiphias (the Swordfish) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
In the head [In Capite]	♌	26	45	86	53	4
In the gills [In branchijs]	♍	1	23	87	0	5
In the belly [In ventre]	♏	0	53	88	12	5
Above the back [Supra dorsum]	♏	25	3	84	46	4
At the very end of the tail [In extrema cauda]	♏	10	38	76	15	4
The center of the larger cloud [Nubeculae maioris centrum]	♍	1	3	84	0	neb.
Adjacent to it [Huic adiacens]	♎	18	3	82	31	5

Toucan, that is, Anser Americanus (the American Goose) — 4th class

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
At the tip of the beak [In rostrum extremo]	≈	5	18	45	55	3
In the head [In capite]	≈	16	15	48	15	3
At the bend of the left wing [In ancone alae sinistrae]	≈	15	23	54	15	4
The lower one there [Ibi inferior]	≈	14	18	55	45	5
In the middle of the wing [In media ala]	≈	16	9	58	20	3
On the back [In dorso]	≈	22	23	57	50	3
In the tail [In cauda]	≈	22	48	61	30	4
On the frond of a branch, or the nutmeg [In rami folio, seu nuce myristica]	≈	2	33	49	55	4

Hydrus (the Lesser Water-Snake)

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
In the head [In Capite]	✕	5	23	64	5	3
In the upper neck [In collo superior]	✕	11	53	71	40	4
The lower of the three of the neck [Colli trium inferior]	✕	13	18	70	25	4
In the first turn of the neck [Conuersionis colli prima]	✕	1	18	71	12	4
The second [Secunda]	≈	18	18	70	30	5
The third [Tertia]	≈	26	3	67	50	5
The fourth [Quarta]	≈	21	33	64	0	5

Star name	Si gn	Long. °	Long. '	Lat. (S) °	Lat. '	Magnit ude
The fifth [Quinta]	♊	7	4	65	0	5
The sixth [Sexta]	♊	26	29	64	55	4
The seventh [Septima]	♊	19	15	60	0	5
In the first turn of the tail, austral [In caudae cōuers. 1. Austral.]	♊	15	38	58	10	5
Boreal [Boreal.]	♊	13	48	56	0	5
In the 2nd, the antepenultimate of the tail's bend [In 2. caudae flexu antepenult.]	♊	13	13	62	40	5
The penultimate [Penultima]	♊	8	53	64	30	5
The last [Vltima]	♊	5	38	64	0	5
The center of the smaller cloud [Nubeculae minoris centrum]	♊	6	3	67	0	neb.
Between this and the larger, unformed [Inter hanc, & maiorem informis]	♊	8	48	72	20	6
The austral one [Austrina]	♊	5	48	78	30	4
Which is above the 8th and 9th of Hydrus [Quae supra 8. & 9. Hydri]	♊	4	40	61	20	5
Below the upper neck [Infra collum superior]	♋	17	10	75	30	4
The lower one there [Ibi inferior]	♋	1	19	80	0	6

Summary tally of the catalogue

There are, then, 12 zodiacal constellations, 23 boreal, and 27 austral — 62 in all.

Group	Magnitude	Count
Among the zodiacal stars there are stars of the first magnitude	first	6
	second	9
Among the boreal stars there are stars of the first magnitude	first	3
	second	22
Among the austral stars there are stars of the first magnitude	first	5
	second	28
Therefore all the stars of the first magnitude are	first	14
The second, however	second	59

TABLE 99. The Right Ascension and Declination of One Hundred Fixed Stars, for the completed Year of Christ 1700

Columns: star name; **Right Ascension** for the year 1700 (degrees, minutes, seconds); **Declination** for the year 1700 (degrees, minutes, seconds), with B = boreal/northern and A = austral/southern; **Difference of Ascension over 100 years** (degrees, minutes); **Difference of Declination over 100 years** (minutes), with the trailing A/S marking whether the declination is increasing toward the north (A = *augescens/borealis*) or south (S).

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl ."	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
Head of Andromeda [Andromedae Caput]	3 5 8	14	8	27	27	26	B 1	17	34	A
Girdle of Andromeda [Andromedae Cingulum]	1 3	11	20	34	2	40	1	23	33	A
Southern foot of Andromeda [Andromedae]	2 6	21	51	40	52	30	1	29	30	A

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
pes Australis]										
Fomalhaut of Aquarius [Aquarij Fomahant]	3 4 0	11	0	31	8	10	A 1	25	31	S
Right shoulder of Aquarius [Aquarij humerus dexter]	3 2 7	36	55	1	43	44	1	20	29	S
Left shoulder of Aquarius [Aquarij humerus sinister]	3 1 8	55	54	6	48	46	1	21	26	S
Left hand of Aquarius [Aquarij manus sinistra]	3 0 7	45	54	10	33	44	1	16	19	S
The bright star of Aquila [Aquilae lucida]	2 9 4	2	47	8	6	32	B 1	17	13	A
1st in the Horn of Aries [Arietis 1. in Cornu]	2 4	17	2	17	48	24	B 1	23	31	A
2nd in the Horn of Aries [Arietis 2. in Cornu]	2 4	30	3	19	19	24	1	22	31	A
The bright star of Aries	2 7	35	58	22	1	30	1	25	30	A

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
[Arietis Lucida]										
Capella of Auriga [Aurigae Capella]	7 3	35	56	45	40	0	1	49	10	A
Right shoulder of Auriga [Aurigae humerus dexter]	8 4	29	42	44	51	30	1	58	4 ½	A
Arcturus of Boötes [Bootis Arcturus]	2 1 0	33	2	20	48	2	B 1	11	29 ½	S
Left shoulder of Boötes [Bootis humerus sinister]	2 1 5	2	33	39	35	12	1	2	27	S
The Beehive of Cancer [Cancri praesepe]	1 2 5	46	2	20	43	4	B 1	28	19	S
The Northern Ass of Cancer [Cancri Asellus Boreus]	1 2 6	26	0	22	3	0	1	30	20	S
The Southern Ass of Cancer [Cancri Asellus Austral.]	1 2 6	54	3	19	15	0	1	27	20	S
Canis Maior, Sirius [Canis Maior, Sirius]	9 7	57	6	16	18	6	A 1	7	4	A
Canicula,	1	54	33	5	59	12	B 1	20	12	S

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
Procyon [Canicula, Procyon]	1 0									
Preceding horn of Capricorn [Capricorni cornu praeced.]	3 0 0	24	34	13	22	6	A 1	25	16	S
Lower horn of Capricorn [Capricorni cornu inferius]	3 0 1	7	29	15	38	2	1	27	17	S
Preceding tail of Capricorn [Capricorni cauda praeced.]	3 2 0	56	29	17	54	21	1	26	26	S
Following tail of Capricorn [Capricorni cauda sequens]	3 2 2	43	30	17	22	22	1	25	27	S
The bright star of the Throne of Cassiopeia [Cassiopeae lucida Cathedrae]	3 5 8	14	33	57	32	16	B 1	15	34	A
Schedar of Cassiopeia [Cassiopeae Schedir]	5	56	0	54	55	16	1	22	34	A
The bend of	9	45	58	59	7	36	1	27	34	A

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
Cassiopeia [Cassiopeae flexura]										
The knee of Cassiopeia [Cassiopeae genu]	1 6	36	0	58	40	22	1	35	33	A
The girdle of Cepheus [Cephei cingulum]	3 2 1	6	20	69	17	10	0	22	26	A
The bright star of Cetus' jaw [Ceti mandibulae lucida]	4 1	38	7	2	53	50	B 1	15	25	A
The northern part of Cetus' belly [Ceti ventris borea]	2 4	12	0	11	44	50	A 1	15	31	S
The southern tail of Cetus [Ceti cauda Australis]	7	5	8	19	35	44	1	18	34	S
The northern tail of Cetus [Ceti cauda Borealis]	1	4	12	10	24	50	1	17	34	S
The bright star of the Northern Crown [Coronae borealis]	2 3 0	39	0	27	45	20	B 1	5	21	S

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
lucida]										
The beak of Cygnus [Cygni rostrum]	2 8 9	39	48	27	22	40	1	1	11	A
The ancient star of Cygnus' breast [Cygni pectoris antiqua]	3 0 2	55	52	39	20	5	0	53 ½	18	A
The tail of Cygnus [Cygni cauda]	3 0 7	47	17	44	14	52	0	51 ½	10 ¾	A
The upper wing of Cygnus [Cygni ala superior]	2 9 3	56	2	44	26	21	0	48	14	A
The lower wing of Cygnus [Cygni ala inferior]	3 0 8	29	10	32	51	24	0	0	21	A
The bright star of Draco [Draconis lucida]	2 6 7	25	20	51	35	2	0	35	2	S
Head of Castor of Gemini [Geminorum Castoris caput]	1 0 8	50	46	32	30	26	B 1	44	11	S
Head of Pollux [Pollucis caput]	1 1 1	43	36	28	43	2	1	34	12	S
The bright foot of Gemini [Geminorum	9 5	3	32	16	37	32	1	28	2	S

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
pes lucidus]										
Head of Hercules [Herculis caput]	2 5 5	21	37	14	46	48	B 1	8	8	S
Right shoulder of Hercules [Herculis humer. dexter]	2 4 4	19	35	22	11	40	1	5	15	S
Left shoulder of Hercules [Herculis humer. sinist.]	2 5 5	31	33	25	15	48	0	52	8	S
The Heart of Hydra [Hydrae cor]	1 3 8	12	22	7	21	30	A 1	15	25	A
The Heart of the Lion [Leonis cor]	1 4 8	4	15	13	25	16	B 1	22 ½	28 ½	S
The tail of the Lion [Leonis cauda]	1 7 5	25	34	16	14	4	1	19	34	S
The bright star of the Lion's mane [Leonis Lucida iubae]	1 5 0	48	47	21	21	0	1	21	29	S
The bright star of the Lion's loins [Leonis Lucida lumborum]	1 6 4	32	20	22	7	44	1	27	34	S
The topmost of the Lion's neck [Leonis	1 4 9	58	52	24	53	54	1	28	29	S

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl ."	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
suprema ceruicis]										
The lowest of the Lion's neck [Leonis infima ceruicis]	1 4 7	47	52	18	13	33	1	28	28	S
The thigh of Lepus [Leporis femur]	7 8	51	30	20	59	0	A 1	5	7	S
The northern Scale of Libra [Librae lanx borealis]	2 2 5	15	26	8	14	46	1	21 ½	24	A

Remainder of TABLE 99. The Right Ascension, etc.

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl ."	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
The southern Scale of Libra [Librae lanx australis]	2 1 8	38	12	14	45	18	1	25	27	A
The bright star of Lyra [Lyrae lucida]	2 7 6	39	32	38	32	16	B 0	50	4	A
Head of Ophiuchus [Ophiuchi caput]	2 6 0	15	38	12	49	22	B 1	11	7	S
Left hand of Ophiuchus [Ophiuchi manus sinistra]	2 3 9	47	37	2	52	52	A 1	23	18	A

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
Right knee of Ophiuchus [Ophiuchi genu dextra]	2 5 2	39	40	9	53	30	0	50	10	A
Left knee of Ophiuchus [Ophiuchi genu sinistra]	2 4 5	11	37	15	16	30	1	23	15	A
Right shoulder of Ophiuchus [Ophiuchi humerus dextra]	2 6 2	8	38	4	44	40	B 1	13	5	S
The topmost of Orion's head [Orionis capitis suprema]	7 9	41	10	9	34	38	B 1	22	7	A
Right shoulder of Orion [Orionis humerus dexter]	8 4	43	4	7	18	20	1	22	8	A
Left shoulder of Orion [Orionis humerus sinister]	7 7	16	40	6	3	2	1	19	8	A
Rigel, the foot of Orion [Orionis pes Rigel]	7 5	2	50	8	33	42	A 1	15 ½	9 ½	S
The 1st of Orion's belt	7 9	19	48	0	32	50	1	17	7	S

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl ."	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
[Orionis 1. balthei]										
The 2nd of the belt [2. balthei]	8 0	12	54	1	25	46	1	17	6	S
The 3rd of the belt [3. balthei]	8 1	18	25	2	8	20	1	16	5	S
The mouth of Pegasus [Pegasi os]	3 2 2	27	36	8	32	14	B 1	18	26	A
The leg of Pegasus, Scheat [Pegasi crus scheat]	3 4 2	20	36	26	28	38	1	12	32	A
Markab of Pegasus [Pegasi Markab]	3 4 2	28	10	13	35	58	1	15	32	A
Algenib of Pegasus [Pegasi Algenib]	3 5 9	27	25	13	32	56	1	16	34	A
The bright flank of Perseus [Persei lucidum latus]	4 5	32	18	48	44	54	1	28	12	A
The head of Medusa of Perseus [Persei Medusae caput]	4 2	12	42	39	46	30	1	37	25	A
The occiput of Piscis Australis [Piscis australis]	3 4 5	24	5	1	40	2	1	17	33	A

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
occiput]										
The knot of the cord of the Fishes [Piscium lini nexus]	2 6	38	5	1	19	0	1	18	30	A
The bright star of Sagittarius' head [Sagittarij lucida Capitis]	2 8 3	1	5	21	22	48	A 1	31	22	S
Antares, the Heart of Scorpius [Scorpij cor, Antares]	2 4 2	47	28	25	39	54	1	32	16	A
The northern brow of Scorpius [Scorpij frons borealis]	2 3 6	58	15	18	53	36	1	28	19	A
The middle of the brow [Frontis media]	2 3 6	4	34	21	41	40	1	30	20	A
The southern brow [Frons australis]	2 3 5	18	0	25	9	54	1	37 ½	21	A
The bright star of Serpens' neck [Serpentis lucida colli]	2 3 2	24	0	7	24	36	B 1	15	21	S
Aldebaran, or	6	41	35	15	52	10	B 1	26 ½	15	A

Star name	R A °	R A '	R A "	Dec l. °	Decl . '	Decl ." "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
the southern eye of Taurus [Tauri Aldeb. seu oculus austr.]	4									
The northern horn of Taurus [Tauri cornu boreum]	7 6	51	18	28	19	2	1	37	8	A
The southern horn of Taurus [Tauri cornu australe]	7 9	55	20	20	55	58	1	23	16	A
The northern eye of Taurus [Tauri boreus oculus]	6 2	43	36	18	30	28	1	24	17	A
The lowest of the Hyades of Taurus [Tauri infima Hyadum]	6 0	39	35	14	55	38	1	25	17	A
The bright star of the Pleiades of Taurus [Tauri Pleiadum Lucida]	5 2	27	35	23	9	24	1	29	21	A
Spica of Virgo [Virginis Spica]	1 9 7	22	55	9	33	30	A 1	19 ½	32 ½	A
The girdle of Virgo [Virginis cingulum]	1 9 0	10	22	5	2	54	B 1	18	34	A

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
Vindemiatrix of Virgo [Virginis Vindemiatrix]	1 9 1	52	20	12	34	58	1	17	33	A
Dubhe of Ursa Maior [Vrsae maioris Dubhe]	1 6 1	17	5	63	22	2	B 1	41	32	S
The bright star of the flank [Lateris lucida]	1 6 0	52	20	57	59	2	1	37	32	S
The bright star of the hind haunch [Posterioris coxae lucida]	1 7 4	23	34	55	23	42	1	23	34	S
The bright star near the tail of the back [Tergoris prope caudā lucida]	1 8 0	8	2	58	41	42	1	9	33	S
1st of the tail of Ursa Maior [Vrsae mai. 1. Caudae]	1 9 0	7	56	57	36	58	1	3	32	S
2nd of the Tail [2. Caudae]	1 9 7	55	2	56	30	52	1	2	31	S
3rd, at the very end of the Tail [3. in extremo Caudae]	2 0 3	53	50	50	50	56	1	2	31	S

Star name	R A °	R A '	R A "	Dec l. °	Decl '	Decl "	B / Diff. A Asc. °	Diff. Asc. '	Diff. Decl. '	A / S
The last star of the tail of Ursa Minor, now the Pole Star [Vrsae minoris ultima caudae nunc Polaris]	9	52	10	87	42	51	3	10	34 1/8	A
The bright star of the shoulder of Ursa Minor, formerly the Cynosure [Vrsae minoris lucida humeri, olim Cynosura]	2 2 2	39 2 2	20	75	37	30	1	15	2 1/2	A

Its right ascension is decreasing. [Huius Ascensio Recta decrescit.]

TABULA 100. Motion of the Fixed Stars in Longitude — to be added to, or subtracted from, the Longitude for the Year 1700 of Christ, so that their positions may be had before or after.

[TABULA 100. The Motion of the Fixed Stars in Longitude, to be added to the Longitude for the Year 1700 of Christ, or subtracted, so that their positions may be had after or before.]

The table is in two stacked blocks. The left block runs from year 1 to year 60 and gives the accumulated motion as three sexagesimal sub-columns (I, II, III — i.e. minutes, seconds, thirds — the whole-degree column being 0 throughout this range). The right block continues from year 61 to year 100, then by decadal/larger steps (200, 300, ... 7000, 8000, 9000, 10000, 20000, 25579), and adds a degrees column (Gr.) ahead of the three sub-columns. The right block's argument column is here labelled Anni and the value columns Gr. I II III.

Anni	I	II	III
1	0	50	40
2	1	41	20
3	2	32	0
4	3	22	40
5	4	13	20
6	5	4	0
7	5	54	40
8	6	45	20
9	7	36	0
10	8	26	40
11	9	17	20
12	10	8	0
13	10	58	40
14	11	49	20
15	12	40	0
16	13	30	40
17	14	21	20
18	15	12	0
19	16	2	40
20	16	53	20
21	17	44	0
22	18	34	40
23	19	25	20
24	20	16	0
25	21	6	40
26	21	57	20
27	22	48	0
28	23	38	40
29	24	29	20
30	25	20	0
31	26	10	40

Anni	I	II	III
32	27	1	20
33	27	52	0
34	28	42	40
35	29	33	20
36	30	24	0
37	31	14	40
38	32	5	20
39	32	56	0
40	33	46	40
41	34	37	20
42	35	28	0
43	36	18	40
44	37	9	20
45	38	0	0
46	38	50	40
47	39	41	20
48	40	32	0
49	41	22	40
50	42	13	20
51	43	4	0
52	43	54	40
53	44	45	20
54	45	36	0
55	46	26	40
56	47	17	20
57	48	8	0
58	48	58	40
59	49	49	20
60	50	40	0

Anni	Gr.	I	II	III
61	0	51	30	40
62	0	52	21	20
63	0	53	12	0
64	0	54	2	40
65	0	54	53	20
66	0	55	44	0
67	0	56	34	40
68	0	57	25	20
69	0	58	16	0
70	0	59	6	40
71	0	59	57	20
72	1	0	48	0
73	1	1	38	40
74	1	2	29	20
75	1	3	20	0
76	1	4	10	40
77	1	5	1	20
78	1	5	52	0
79	1	6	42	40
80	1	7	33	20
81	1	8	24	0
82	1	9	14	40
83	1	10	5	20
84	1	10	56	0
85	1	11	46	40
86	1	12	37	20
87	1	13	28	0
88	1	14	18	40
89	1	15	9	20
90	1	16	0	0
91	1	16	50	40

Anni	Gr.	I	II	III
92	1	17	41	20
93	1	18	32	0
94	1	19	22	40
95	1	20	13	20
96	1	21	4	0
97	1	21	54	40
98	1	22	45	20
99	1	23	36	0
100	1	24	26	40
200	2	48	53	20
300	4	13	20	0
400	5	37	46	40
500	7	2	13	20
600	8	26	40	0
700	9	51	6	40
800	11	15	33	20
900	12	40	0	0
1000	14	4	26	40
2000	28	8	53	20
3000	42	13	20	0
4000	56	17	46	40
5000	70	22	13	20
6000	84	26	40	0
7000	98	31	6	40
8000	112	35	33	20
9000	126	46	0	0
10000	140	44	26	40
20000	281	28	13	20
25579	360	0	0	0

[Footer of table: *Anni 61* — i.e. the second block of the table begins at year 61.]

TAB. 101. Foreign and Mostly Arabic Names of the Stars, with Their Interpretation.

[TAB. 101. Containing the names of the stars, foreign and for the most part Arabic, together with their interpretation. In which, reader, do not be surprised if you see different names assigned to the same star — this is on account of the diversity of the dialects, or perhaps of corrupted manuscripts.]

The following is an alphabetical glossary of star-names (chiefly of Arabic, but also Hebrew, Greek, Chaldaean, Egyptian, and "Nubian" origin) with their Latin identifications. Each headword is given in *italic* in the source; the identification follows. Abbreviations: *arab.* = Arabic, *Hebr.* = Hebrew, *Chald.* = Chaldaean, *Gr.* / *Græc.* = Greek, *Græcolat.* = Greek-Latin, *Ptolem.* = Ptolemy's, *Nubianis* = of the Nubians (i.e. the Nubian astrologers).

A

- **Abrachaleus** — Castor, or his head.
- **Acharnar, Acharnaar, or Acharnarim** — arab., the bright star at the end of Eridanus.
- **Achluschemali** — arab., the Northern Crown [Corona Borealis].
- **Adared** — arab., Mercury.
- **Aderaimin, or Alderamin** — arab., the star above the right shoulder of Cepheus.
- **Adigege, or Adegige** — arab., Cygnus, as it were "smelling like a rose."
- **Adhil** — the star at the bottom of Andromeda's robe.
- **Adrendefa** — arab., Virgo.
- **Aegipan, Aegoceros** — Greek-Latin, Capricorn.
- **Afeichius** — Serpentarius [Ophiuchus], or corruptly from the Greek-Latin *Ophiuchus*?
- **Akrab** — Hebrew; **Aakrab** arab., **Acrobo** Chaldaean — Scorpius.
- **Alacrab, or rather Aakrab** arab., or **Hacrab** — Scorpius.

- **Alamak**, or **Almaak** arab. (not **Alhames**) — the star at the southern foot of Andromeda.
- **Alascha** — the one preceding [the two] in the sting of Scorpius.
- **Alasid**, or **Alezet**, or **Asid**, or **Ellesed** — arab., Leo.
- **Alazet**, in Azophi [al-Şūfi] — the tail of Leo.
- **Alazel**, or **Alaazel**, or **Hazimet Alazel**, and **Hermeti Alhaiseth** — Spica Virginis [Spica].
- **Alathod**, or **Alhaiot** — Capella.
- **Albegala** — Lyra.
- **Albezze**, or **Albizze** — Centaurus.
- **Albireo** — arab., the one in the beak of Cygnus.
- **Alcantarus** — arab., Capricorn.
- **Alcor** — arab., the "Horseman," the little star above the second star of the tail of Ursa Major.
- **Aldebaran** — the southern eye of Taurus, that is, the dominant star [of the Hyades].
- **Alderamin**, or **Aderaimin** — arab., the one above the left shoulder of Cepheus.
- **Algebar**, or **Algebra** — arab., Orion; see *Elgeuze*.
- **Algedi** — arab., Capricorn.
- **Algenib** — arab., the bright star at the end of Pegasus's wing, or in the side of Perseus.
- **Algethi**, or **Algiethi** — arab., Hercules.
- **Algeuze**, or rather **Elgiautze** — arab., the head of Castor.
- **Algol** — arab., the Head of Medusa, or Medusa herself.
- **Algomeiza** — arab., Procyon, Canis Minor.
- **Algorab** — arab., Corvus.

- **Alhabor** — arab., the splendid one in the mouth of Canis Major.
- **Alhague** — arab. (not **Alangue**) — Serpentarius [Ophiuchus].
- **Alhaiot** — arab., **Alhaiset Hermeti** — Spica Virginis.
- **Alhance** — arab., or **Alabance** — Sagitta.
- **Albes**, arab., or **Alkes**, the one at the base of Crater, in common with Hydra.
- **Aliath** — the first in the tail of Ursa Major.
- **Aliemini** — of the Alphonsine [tables], Canis Major.
- **Alkalurops** — the one on the Colorobus [club] of Boötes.
- **Alkameluz** — arab., Arcturus.
- **Almucedie** — arab., Vindemiatrix.
- **Almuredin** — arab., Vindemiatrix.
- **Almegrameth** — arab., the Censer [Thuribulum].
- **Alohore** — Lyra.
- **Aloue Cap.** — Medusa's.
- **Alphard** — arab., the Heart of Hydra [Cor Hydrae], at the bend.
- **Alpheichius** — arab., Serpentarius.
- **Alphas** — arab., Pegasus.
- **Alpheta**, or **Alphena** — among the Syro-Chaldaeans, the bright star of the Northern Crown, as it were "the open pupil [of the eye]."
- **Alramech**, or **Aramech** — arab., Arcturus.
- **Alruccabah** arab., or **Ruccabah** — the Pole Star [Polaris], at the very end of the tail of Ursa Minor.
- **Alsartan**, **Asartan**, or rather **Elsartan** — arab., Cancer.
- **Alzimon** — of the Nubians, Spica Virginis.
- **Amaza** — Greek-Latin, ἄμαξα — the Lesser Wain, Ursa Minor.

- **Angetenar**, or **Achenetenar** — these are 9 stars in the third bend of Eridanus.
- **Archelar** — Chald., the head of Castor.
- **Antares** — Ptolemy's "Heart of Scorpius" [Cor Scorpii], ἀντάρης in Hesychius.
- **Apullum** — corruptly for *Apollo*, that is Castor.
- **Arie** — Chaldaean, **Arieh** Hebrew — Leo.
- **Arieded** — the bright star in the tail of Cygnus.
- **Aris** — Chaldaean, Mars; and in Greek ἄρης.
- **Asange** — Lyra.
- **Asartan** — arab., Cancer.
- **Aschere**, or **Aschemie** — Canis Minor.
- **Asida** — arab., Lupus.
- **Asmeat** — arab., Centaurus.
- **Astacus** — Greek, Cancer.
- **Astaroth** — Chaldaean, Venus.
- **Asua** — Hydra.
- **Asugia** — Orion.
- **Ataxr**, or **Alcair** — the bright one in the head of Aquila, arab.
- **Atargatis** — Virgo.
- **Athaur** — arab., Taurus.
- **Athalpis** — Greek, ἀθαλπής [?] — Capricorn.
- **Athorae** — Ptolem. 1, Quadripl. ch. 9 — the Pleiades.
- **Athoriae**, or **Altorich**, in Hali Haben Ragel [ʿAlī ibn Abī al-Rijāl] — these are the Pleiades.
- **Atin**, or **Eltaur** — the eye of Taurus.

- **Auellar**, or **Auellan** — Pollux.
- **Azelphage** — arab., the two stars at the very end of the tail of Cygnus.
- **Azmech** — arab., Spica Virginis.
- **Azubene** — arab., the Claw [Chela] between [the signs of] Cancer and Scorpius; and from this it signifies Libra, hanging from this Claw.

B

- **Baculus Iacob** — Orion's belt [Orionis baltheus].
- **Basiliscus**, βασιλίσκος — Regulus, the Heart of Leo [Cor Leonis].
- **Baten Kaitos** — arab., the northern star in the belly of Cetus.
- **Beemin** — arab., these are 7 stars in the fourth bend of Eridanus.
- **Bellatrix** — the star in the right shoulder of Orion.
- **Benat Elnaasch** — arab., the daughters of the bier [filiae feretri]; the Pleiades.
- **Benenatu**, or rather **Benenasch** — arab., the last in the tail of Ursa Major.
- **Betelgeuze**, or **Bectelgeuze** — arab., the bright one in the left shoulder of Orion; and it signifies "the home of the Giant."
- **Bridemif** — Persian, Lupus.
- **Brinek** — Lyra, that is, Lyra's bright one [Lyra lucida].
- **Buthean** — in German, *Burrio*; in English, "the hen warming her chicks" — so they call the Pleiades, just as the Italians call them *la Gallinella*.

C

- **Callisto** — Ursa Major.
- **Cammarus** — Cancer.
- **Caucas** — Cepheus.
- **Canopus**, or **Canobus** — the bright star on the rudder of the Argo [Argonauta].
- **Carnabon** — Serpentarius.
- **Caseia**, or **Caia** — the first in the northern part of Hercules's club.
- **Caun** — Chaldaean, Saturn.
- **Ceginus** — Cepheus, and the one in the left shoulder of Boötes.
- **Cerna** — anything-whatever [quibusdam], Cassiopeia.
- **Chammah** — Hebraic, the Sun.
- **Cheichius**, or **Chegius** — to some, Cepheus; to others, Boötes.

- **Chelub**, or **Chelenb** — of the Alphonsine [tables], Perseus.
- **Chem**, or rather **Genib** — arab., the bright one in the side of Perseus.
- **Chesil** — Hebraic, Arcturus, or Orion; from the verb *Cacal*, which signifies "various" and "inconstant."
- **Chateb** — Hebraic, Mercury, that is, "Scribe" [Scriba].
- **Chima**, or **Kima** in Hebrew — the Pleiades, and the Hyades — indeed to others Arcturus, namely the "storm-bringing stars" [sidera procellosa].
- **Chrysomallus** — Greek, the Ram of the Golden Fleece [Aries velleris aurei].
- **Cixtoris** — 2.b., the lesser one in the tail of Ursa Minor.
- **Cochau** — Chaldaean, **Cochab** Hebraic, Mercury, that is, "the bright star" [stella fulgens].
- **Colorrhobus**, κολόρροβος — the hollow staff, or club of Boötes.
- **Currus volitans** — to Catullus the offspring of the Argo [Catullo Natus Argo].
- **Cynosura** — Ursa Minor.

D

- **Dagim** — Hebr., Pisces, or **Dagiotho**.
- **Dat Elkarsi** — arab., the Throne of Cassiopeia [Sedes Cassiopeae].
- **Daulo** — Chald., Aquarius.
- **Delli** — Hebr., *Situla* (the Bucket) for Aquarius.
- **Deneb**, or **Denneb** — arab., the Tail [Cauda].
- **Deneb Adigege** — the bright one in the tail of Cygnus.
- **Deneb Ellassid** — arab., or **Deneb Alasid** — the tail of Leo.
- **Deneb Algedi**, or **Elgeudi** — the one preceding in the tail of Capricorn.
- **Deneb Elaakrab** — arab., the tail of Scorpius.
- **Deneb Kaitos** — arab., the more southern one in the tail of Cetus.
- **Didymi**, δίδυμοι — Gemini.
- **Dioscouri**, δίοσκουροι — Gemini.
- **Dubhe**, or **Dubbeh** — arab., the bright one in the shoulder of Ursa Major.
- **Dubhe Elezguar** — arab., the bright one in the shoulder of Ursa Minor.
- **Dubherukabah** — Ursa Minor.

E

- **Edeleu** — arab., Aquarius.
- **Eladari** — arab., or **Eleadari** — Virgo.

- **Eleazelet** — fused by the Nubians as the Astrologers' [reading], or Spica Virginis, corruptly **Alzimon**.
- **Elezguar** — Cynosura, Ursa Minor.
- **Elaeguatri** — Cygnus, as it were "the rose of a cock-comb" [galli rosa].
- **Elgebar** — arab., Orion, the Giant [Gigas].
- **Elgeudi** — arab., Capricorn.
- **Elgenib** — fulgent [shining] in the side of Perseus, arab.
- **Elgeuze** — arab., Gemini.
- **Elgeziale** — arab., Hercules.
- **Elhakeae** — arab., the Heads of the Twins [Capita Geminorum].
- **Elhamel** — Aries.
- **Elharneb** — arab., Lepus.
- **Elhauc** — arab., Hydra.
- **Elhautz** — arab., Pisces.
- **Elhenaat** — arab., the Head of Pollux [Caput Pollucis].
- **Elkanfu**, or **Elkufu**, or **Elkaut** — arab., Aquarius.
- **Elkaitus** — arab., Cetus.
- **Eikamer** — arab., Luna (the Moon).
- **Elkis**, or **Elnarad** — arab., Crater.
- **Elkleil Eigenubi** — arab., Corona Australis [Southern Crown].
- **Elkleil Schemali** — arab., Corona Borealis [Northern Crown].
- **Elmac Alcheras** — arab., Equus Minor [the Lesser Horse].
- **Elsefed** — arab., Leo.
- **Elmarig** — arab., Mars.
- **Elmesteri** — arab., Jupiter.
- **Elnatra** — arab., the Manger of Cancer [Aselli Cancr].
- **Elsartan** — arab., Cancer.
- **Elschemis** — arab., Sol (the Sun).
- **Eltsamach** — arab., Spica Virginis.
- **Elzabareh** — arab., Venus.
- **Emro** — Chald., Aries.
- **Engonasi** — Greek, "Ingeniculus" [the Kneeler], Hercules.
- **Ensf**, or **Enf Alphas** — the star at the nose of Pegasus [in rictu Pegasi].
- **Erigone** — Virgo.
- **Ezra** — Cynosura, Ursa Minor.

F

- **Famauth**, or **Phomalhaut**, or **Phomauth**, corruptly **Phomaant** — arab., the Mouth of the Fish [Os piscis], or the splendid star in the outpouring [stream] of Aquarius.

G

- **Gadio** — Chald., Capricorn.
- **Garactes**, or **Abrachaleus** — Chald., the Head of Pollux [Caput Pollucis].
- **Gedi** — Chald., Capricorn.
- **Gienz** — arab., with the joint [article], **Elgeuzi**, Gemini.
- **Grumium** — barbarous [name], that which is at the jaw of Draco [genam Draconis].
- **Grus**, or **Ciconia** — to the Moors [Mauris], Serpentarius.
- **Guad** — to the Moors, Eridanus, or the Nile.

H

- **Haakrab**, or **Aaakrab**, and with the article **Elaakrab** — arab., Scorpius.
- **Hammel** — arab., Aries.
- **Harneb**, and with the article **Elharneb** — arab., Lepus.
- **Haut**, and with the article **Elhaut**, or **Elhautine** — arab., Pisces.
- **Haut Elgenubi** — arab., Piscis Australis [the Southern Fish].
- **Haut Elschemali** — arab., Piscis Borealis [the Northern Fish].
- **Helice** — Greek, Ursa Major.
- **Heniochus** — Greek, Auriga.
- **Hermannibis** — to the Egyptians, the God of speech, that is, Mercury.
- **Hermes** — Greek, ἑρμῆς, Mercury.
- **Hermidone**, ἑρμηδόνη — in Vitruvius l. [book] [?], [?].
- **Hermippus** — in Pliny, Delphinus.
- **Hesperus**, ἔσπερος — the evening Venus [Venus vespertina].

- **Hexastron** — Greek, ἑξάστρον, "the six-star constellation," the Pleiades; which, as Ovid sings, "they say are seven, although there are nevertheless six," because the seventh is scarcely seen [quae, vt canit Ovidius, septem dici, sex tamen esse solent, quia septima aegrè conspicitur].
- **Hierezim** — arab., "smelling like a rose," or "a lily"; thus they call the star of Cygnus [Cygni astrum].
- **Hydrochous** — Greek, Aquarius.
- **Hydridurus** — Greek, "turning the urn of water," namely Aquarius.

I

- **Ingeniculus** — "kneeling on the knee" [in genua procumbens], Hercules.
- **Ingum** — to Cicero, Libra.
- **Ingula** — to Plautus and Varro, Orion.
- **Ingulae** — the Asses in Cancer [Aselli in Cancro].

K

- **Kalb** — arab., the Heart [Cor].
- **Kalbelaakrab** — arab., the Heart of Scorpius [Cor Scorpii].
- **Kalbellesed**, arab. of the Ferzani [people of Fezzan] and Moroccans, and of the Nubians, the Heart of Leo [Cor Leonis], corruptly in the Alphonsine [tables] **Kalbelasfad**.
- **Kalbelalphard**, and reduced [shortened] to **Alphard** alone, arab., the Heart of Hydra [Cor Hydrae].
- **Kaitos**, and with the article **Elkaiton** — arab., Cetus.
- **Kaus**, and with the article **Elkaus** — arab., Sagittarius.
- **Kertko** — Chald., Sagittarius.
- **Kescheth** — Hebr., Sagittarius.
- **Ketpholtsumman** — the Head of Pollux [Caput Pollucis].
- **Kochab** — arab., the bright one in the shoulder of Ursa Minor.
- **Kolanza** — Arcturus, arab.

L

- **Laelaps** — Canis Major.
- **Lebanah**, or **Ianeah** — to the Hebrews the Moon, so called from its whiteness [ab albore].

- **Lesath**, or rather **Lessaa Elaakrab** — arab., the star in the sting of Scorpius [in aculeo Scorpil]; and it signifies "the Bite of Scorpius" [ipsum Morsum Scorpil].

M

- **Maadim** — Hebr., Mars, inasmuch as of a blood-red colour [sanguinei coloris].
- **Maasym** — arab., the star at the right elbow of Hercules [in dextro cubito Herculis].
- **Maforte** — barbarous [name], Auriga.
- **Markab** — arab., curtus [shortened], but to them it is the first in the wing, or shoulder-joint of Pegasus [in ala, vel armo Pegasi].
- **Malphelcane** — that is, the garland of the pupil [sertum pupillae], to the Chaldaeans, namely Corona Borea [Northern Crown].
- **Marra**, or **Merga** — arab., the star in the sickle of Boötes [in falce Bootis].
- **Marat Musalseleth** — arab., the Chained Woman [Mulier Catenata], that is Andromeda.
- **Marfic** — that is "the reclining-place" [reclinatorium], arab., the star in the left hand of Hercules [in sinistra Herculis manu].
- **Mafathre** — Chald., Libra.
- **Meeleph**, or **Melleff** — arab., the nebulous one in the breast of Cancer [in pectore Cancr].
- **Meloch** — to the Egyptians, Mars, inasmuch as the God of destruction to them [Deus destructionis ipsis].
- **Menkar Elkaiton** — arab., the star at the nostrils of Cetus [in naribus Ceti].
- **Mesangu** — Chald., Lyra.
- **Mesartim** — Hebr., the two stars in the horn of Aries [in cornu Arietis].
- **Mexar** — arab., the star in the right thigh of Boötes [in dextro femore Bootis].
- **Micar**, or **Mizar**, "the middle," to the Arabs signifies the star, in that it is the middle in the tail of Ursa Major, just as the one which is in the belt of Andromeda [in cingulo Andromedae].
- **Miluius** — to Ovid otherwise, Cygnus.
- **Mizan** — arab., Libra.
- **Miznaim** — Hebr., Libra.
- **Moschleb** — in the sting of Scorpius [in aculeo Scorpil].

- **Munir** — pupilla [the pupil], arab., the bright one of the Crown [Lucida Coronae].
- **Mufator** — to Cicero, Sagitta.
- **Muscida** — to the barbarians, it is a small star at the nostrils, or muzzle, of Pegasus [in naribus siue Pegasi], or **Muscida Pegasi**, or of Ursa Major, and it is called **Muscida Vrsae**.
- **Muthlatum**, or **Mutlat** — arab., Triangulum.
- **Myrtilus** — Auriga.

N

- **Naasch Laazar** — to the Christian Arabs it signifies the bier of Lazarus [Pheretrum Lazari]; thus they call the seven stars of Ursa Major, and the three in the tail **Benat Naasch**, that is, the daughters of the bier [filias pheretri].
- **Nahar** — arab., the Nile, or Eridanus.
- **Nebolassid** — arab., and **Nebolassid** to the Nubian astrologers, the Tail of Leo [Cauda Leonis].
- **Nembus** — arab., the star in the sickle of Perseus [in falce Persei].
- **Nepa** — to Varro, Cancer.
- **Nobia** — Chaldaean, Mercury.
- **Noctiurus**, νυκτοῦρος — "guardian of the night," namely Saturn, in Plutarch *On the Face [of the Moon]* [De Facie Lunae].
- **Nogah** — Hebraic, Venus, inasmuch as "the gleaming light" [lux rutilans].
- **Nonacrine** — in Latin, Ursa Major.

O

- **Oftipes** — Cancer.
- **Ophiuchus**, ὀφιοῦχος — Serpentarius.
- **Orfercalem** — to the Turks, Sagitta.
- **Orphas** — Cetus.

P

- **Palilicium** — in Latin, the Southern Eye of Taurus [Oculus Australis Tauri].
- **Pesceho** — Chald., the Nebula of Cancer [Nebulosa Cancri].
- **Pcochos**, and **Asephcom** — Luna [the Moon] to the Egyptians, inasmuch as the Mistress of the Sea [Maris domina].
- **Phaenon**, φαίνων, 1. the apparent Saturn [apparens Saturnus].

- **Phaëthon** — Jupiter, by the Greeks for its splendour [á splendore].
- **Pharmaz** — Crater.
- **Phicarus** — Cepheus.
- **Phomant**, or **Phomault**, or **Phomelhaut** — the Mouth of the Fish [Os piscis], arab., and it is in the outpouring [stream] of Aquarius [in effusione Aquarij].
- **Phoenus** — to the Egyptians, Jupiter, inasmuch as God of life to them [Deus vitae].
- **Phosphorus**, φόσφορος — the morning Venus [Venus matutina].
- **Piorion**, πιώριον — to the Egyptians, the Station of Horus [Statio Hori], that is, the Eye of Taurus [oculus Tauri].
- **Potirir** — to the Egyptians, the Sun, that is, to them God the Saint [Deus Sanctus].
- **Procyon**, πρόκυνον — to Cicero **Antecanis**, or **Praecanis**, Canis Minor.
- **Propus**, πρόπους — the star at the very top of the left foot of Pollux [in summo pedis sinistri Pollucis].
- **Pyrois**, πυρόεις — Mars, the fiery [star] [Mars igneus].

R

- **Ras** — Arabic, the Head [Caput].
- **Ras Algethi** — arab., the Head of Hercules [Caput Herculis].
- **Ras Algol** — arab., the Head of Medusa [Caput Medusae].
- **Ras Algeuze**, or **Ras Elgautze** — arab., the Head of Castor [Caput Castoris].
- **Ras Alhague** — arab., the Head of Serpentarius [Caput Serpentarij].
- **Rastalben** — arab., the bright star of the Head of Draco [Lucida Capitis Draconis].
- **Rephan** — to the Egyptians, Saturn, inasmuch as God of time to them [Deus temporis].
- **Rigel**, or **Rigel Elgebar** — arab., the bright one in the left foot of Orion [in sinistro pede Orionis].
- **Ruha** — to the Hebrews, Auriga.
- **Rota Ixionis** — Corona Australis [the Southern Crown].
- **Ruccabah** — the Pole Star [Stella Polaris], at the very end of the tail of Ursa Minor [in extremo caudae Vrsae minoris].

S

- **Sagmarius** — Pegasus.

- **Sameh** — Pisces.
- **Sartai** — Hebr., Aries, that is, the Horned [Cornua].
- **Sartam** — Hebr. and Arab., **Elsartam** — Cancer.
- **Sartono** — Chaldaean, Cancer.
- **Sceara** — Canis Major, or Sirius.
- **Schaham** — arab., Sagitta.
- **Schabtai** — Hebraic, Saturn.
- **Schasro** — Chaldaean, the Moon [Luna].

TAB. 101 — *Nomenclatura Stellarum* (continued and concluded)

The alphabetical glossary of foreign star-names with their interpretations continues from the catchword "Scheat-". Each headword is given in *italic*, followed by the language of origin and the Latin identification. The page is set in two columns.

Letter S (continued)

- *Scheat*, Arabic. The leg or shin [*crus, vel tibia*], and it is both the star in the leg of Pegasus — and so it is called *Scheat Pegasi* — and the one in the left [arm] of Aquarius, where it is called *Scheat Aquarii*. Among the Arabs the former is *Scheat Alpheras*, the latter is *Scheat Edeleu*. [The right-column fragments confirm: "in Crure Pegasi ... sinistra Aquarii ... prior Scheat Alpheras, posterior est Scheat Edeleu."]
- *Scheder*, or rather *Seder*, Arabic. A star in the breast of Cassiopeia.
- *Scheer Eliemini*, among the Persians, Canis Maior [the Greater Dog].
- *Schemasch*, among the Hebrews, the Sun, from "heat" [*à calore*].
- *Schemso*, among the Chaldaeans, the Sun.
- *Simon*, or *Smon*, among the barbarians, the Dolphin.
- *Soail Iemani*, among the Persians, Canopus.
- *Stilbon*, in Greek στίλβων [Greek: stilbōn, "the gleaming one"], Mercury, from its shimmering light [*à vibrando lumine*].
- *Sucula*, in Varro, the Hyades.
- *Succoth Benoth*, Hebrew. "The daughters of the tabernacle" [*Tabernaculi filiae*], that is, the Pleiades.
- *Suhel*, Canopus.
- *Sumbalet Eleadari*, Arabic. Spica Virginis [the Ear of grain of Virgo].

- *Suroth*, among the Egyptians, "the mistress of love" [*amoris domina*], namely Venus.
- *Syndesmos*, σύνδεσμος [Greek: syndesmos, "binding, knot"], in Aratus the Knot of the Linen Thread of the Fishes [*Nodus Lini Piscium*].

Letter T

- *Tammech*, among the Chaldaeans, Gemini [the Twins].
- *Tauro*, Chaldaean. Taurus [the Bull].
- *Tauss*, among the Chaldaeans, Jupiter.
- *Ternouelles*, among the Persians, Hercules.
- *Theemin*, Arabic. The seven stars in the fourth bend of Eridanus [*septem stellae in 4. flexura Eridani*].
- *Theomin*, among the Hebrews, Gemini.
- *Triones*, the seven stars of Ursa Maior [the Greater Bear].

[The right column continues with letters U/V, Y, Z:]

- *Tur*, Arabic. Taurus.
- *Tzedek*, among the Hebrews, Jupiter, on account of [its] equity [*ob aequitatem*].
- *Tzegel*, among the Arabs, Saturn.

Letter V

- *Vardi*, among the people of Fez, the Nile, or Eridanus.
- *Vazneganubi*, Arabic. Lanx Austrina [the southern Scale of Libra].
- *Vazneschemali*, Arabic. Lanx Borealis [the northern Scale of Libra].
- *Vespertilio*, in Sophocles, the Heart of the Scorpion [*Cor Scorpii*].
- *Vesper*, *Vesperugo*, in Varro, the evening Venus [*Venus vespertina*].
- *Vigiles*, in Italian *le gauerdiole*, or *guardiane* [the guardians], the lesser stars in the tail of Ursa Minor [the Lesser Bear].
- *Virgilia*, or *Vergilia*, the Pleiades.
- *Vmbilicus Pegasi*, the Head of Andromeda [*Caput Andromedae*].
- *Vuega*, or *Vagieh*, Arabic. The Lucida of Lyra [*Lyrae lucida*].
- *Vultur cadens*, Lyra [the falling Vulture].
- *Vultur volans*, Aquila [the flying Vulture].

Letter Y

- *Yed*, Arabic. The more northern star in the right [hand] of Serpentarius [Ophiuchus].

Letter Z

- *Zeus*, in Greek Ζεύς [Greek: Zeus], Jupiter.
- *Zubenelgenubi*, Arabic. Lanx Australis [the southern Scale], or *Vazneganubi*.
- *Zubeneschemali*, or *Vazneschemali*, Lanx Borealis [the northern Scale].

FINIS.

[This concludes the *Nomenclatura Stellarum* (TAB. 101), the *Tabulae Novalmagesticae*, and Tomus II of the work.]

ERRATA ... CORRIGE (Errata)

Two facing errata lists are printed at the foot of the page: one *In Prolegomenis* (for the Prolegomena), one *In Tabulis* (for the Tables). For each, the columns give where the error occurs and the correction. The convention is: the printed (erroneous) reading on the left under *ERRATA*, the corrected reading on the right under *CORRIGE*.

ERRATA ... In Prolegomenis ... CORRIGE. (Errata in the Prolegomena)

Pag.	Col.	Lin.	Printed (Errata)	Read (Corrige)
II	1	29	sphæricam	sphæram
II	2	21	sub firmamento	supra firmamentum
IV	2	13	percurret	percurreret
IV	2	42	Spicæ	Spica
IV	2	45	Attrogradi	Antrogradi
V	2	47	Comas	Comes
VI	1	11	qui &	qui ea
VII	1	65	mediæ distantiae	medias distantias
VIII	1	43	Videri	Viden
IX	2	45	retentosq;	retentaque
39	1	6	Labouera	Lalouera
69	2	50	Sideris	Sidereï
70	2	70	melius	meliores

Pag.	Col.	Lin.	Printed (Errata)	Read (Corrige)
78	1	76	eius	eiusque

Place-name corrections in the Prolegomena (second part of the same *In Prolegomenis* list)

A second list under the same *In Prolegomenis* heading normalizes the spelling of place-names. Each line gives the page, the form as printed, and the corrected (*italic*) modern form.

Pag.	Printed	Corrected
9	Alba Iulia Transilvani	Alba Iulia Transilvaniæ
10	Cliuia	<i>Cliues</i> (Cleves)
10	Dauentia	<i>Deuenter</i> (Deventer)
10	Fauentia	<i>Faënza</i> [followed by coordinates: 0 1 56, adj. 44 33 15]
10	Hildesemium Saxonîæ	<i>Hildesem</i> (Hildesheim)
11	Iuliacum Giuliech	& <i>Giuliers</i> (Jülich)
11	Lemouices	<i>Lemoges</i>
11	Leouardia Frisiæ	<i>Leuuayden</i> (Leeuwarden)
11	Lipsia Misniæ	<i>Lipsi</i> , & <i>Leipsig</i> (Leipzig)
11	Maiorica	<i>Mallorca</i>
11	Massico	<i>Mascon</i> (Mâcon)
11	Mussipons, seu Mosæpons	<i>Portamuson</i> (Pont-à-Mousson)
12	Oenipontum	[coordinates: 47 10 0]
12	Promontorium Sairum	—
12	Rhemiorum	<i>Rems</i> (Reims)
12	Sabalæ Galliæ	<i>Sable</i> (Sablé)
13	Santonas	<i>Santogne</i> (Saintonge)
13	Triuer	<i>Trier</i>
13	Tuder	<i>Todi</i>
13	Valentiane	—

ERRATA ... In Tabulis ... CORRIGE. (Errata in the Tables)

The facing right-hand list, headed *In Tabulis*, gives the same kind of place-name corrections for the tables. The entries largely repeat the Prolegomena place-names with their corrected forms.

Pag.	Printed	Corrected
9	Alba Iulia Transilvani	Alba Iulia Transilvaniæ
10	Cliuia	<i>Cleues</i> (Cleves)
10	Dauentria	<i>Deuenter</i> (Deventer)
10	[coordinate correction]	44 23 15
10	Hildesemium Saxonîæ	<i>Hildeseim</i> (Hildesheim)
11	Iuliacum Giuliech	& <i>Giuliers</i> (Jülich)
11	Lemouices	<i>Limoges</i>
11	Leouardia Frisiæ	<i>Leuuarden</i> (Leeuwarden)
11	Lipsia Misniæ	<i>Lipsia</i> , & <i>Lipsig</i> (Leipzig)
11	Maiorica	<i>Mallorca</i>
11	Matisco	<i>Mascon</i> (Mâcon)
11	Mussipons, seu Mosæpons	<i>Pontamuson</i> (Pont-à-Mousson)
12	Oenipontum	[coordinate: 47 15 0]
12	Promontorium Sacrum	—
12	Rhemi: orum	<i>Rems</i> (Reims)
12	Sabulæ Galliæ	<i>Sable</i> (Sablé)
12	Santones	<i>Santogne</i> (Saintonge)
13	Treuiri	<i>Trier</i>
13	Tuder	<i>Todi</i>
—	Valentianæ	—

[The two following leaves are blank endpapers / the back board of the binding; no text.]

[Back board of the binding — exterior of the rear cover (mottled tan-brown calf/leather, no lettering, no binder's mark, no label).]