

Yesod Olam

יסוד עולם, "The Foundation of the
World"

(c. 1310)

by R. Isaac ben Joseph Israeli (the Younger) (יצחק בן יוסף הישראלי),
Toledo, fl. early 14th c.

Translation by Scott Weisman



ARS ASTRONOMICA

2026

"Yesod Olam (יסוד עולם, "The Foundation of the World")," published in c. 1310, is in the public domain. All translations, original additions, including illustrations, commentaries, and summaries, are copyright.

The source text was obtained from Digital Bodleian and is available at <https://digital.bodleian.ox.ac.uk/objects/aa14af19-443e-4f76-99da-7f3a4cd067a0/>.

Translation © 2026 Scott Weisman. All rights reserved.

Licensed under [CC BY-NC-ND 4.0](#). Share with attribution; non-commercial; no derivatives.



Published by [Ars Astronomica](#)

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)

If you find this translation useful, consider [supporting Ars Astronomica](#).

ArsAstronomica@protonmail.com

A note on the work

One of the great medieval Hebrew treatises on astronomy and the science of the Jewish calendar, composed in Toledo in the first half of the fourteenth century. It builds a complete system of mathematical astronomy step by step — beginning with geometry and trigonometry, rising through a model of the celestial spheres and the motions of Sun and Moon, and culminating in the rules of the Hebrew calendar and a set of astronomical tables. The text is translated from the richly preserved copy of 1484 in Bodleian MS. Huntington 299, whose hand is clearer and better preserved than that of the Vatican manuscript.

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.

Yesod Olam — Bodleian MS. Huntington 299

Front cover

Tooled brown leather binding board, framed by a blind-ruled multiple-line border. No text, no title label, no inscription. Surface shows scuffing and minor edge damage at the spine corner. No manuscript content.

Inside front cover (pastedown)

Blank cream-paper pastedown. The inner turn-ins of the gilt-tooled binding edge are visible along the foot and outer margin. A single later librarian/cataloguer annotation appears in pencil in the upper-left corner:

[Librarian note: "(6043.)"]

No manuscript text, no original inscription, no ownership mark.

[Librarian note: "Hunt. 299." (shelfmark)]

[Librarian note: "Uri Hebr." (reference to Uri's catalogue of Hebrew manuscripts)]

[Librarian note: "ccccxxx" (Roman numeral 430 — the manuscript's number in Uri's catalogue)]

[Librarian note: "№ 2043" (large pencil number)]

[Librarian note: partial bracketed mark at top-right edge, "(6043." [?] — cropped at the page edge]

No manuscript text appears in this opening; both leaves carry only post-medieval cataloguer/librarian annotations or are blank.

front flyleaf (paper)

This leaf is a paper flyleaf bearing modern library and ownership marks plus a small parchment fragment pasted onto it. No part of it belongs to the original text of *Yesod Olam*; it is codicological furniture.

[Librarian note: "299" — shelf/accession number, upper left, modern pencil/ink]

[Librarian note (signature): "Robert Huntington." — the manuscript's former owner, in a 17th-century English hand]

[Librarian note: "Uri Heb. / CCCCXXX." — i.e. Uri (Bodleian catalogue) Hebrew no. 430, in a cataloguer's hand, framed]

Pasted parchment fragment (older hand, reused as a guard/repair). A small rectangular parchment slip is pasted to the flyleaf, carrying four lines of an older Hebrew text laid out in two columns. It is a fragment of a different work, not part of *Yesod Olam*; the ink is rubbed and the slip is stained. Verbatim, as far as legible:

- Right column, line 1: [?] דיד אנשים קדש ואשר יעקב מין
- Right column, line 2: [?] יה לן אנשון חלן ולן דעאם חלם
- Right column, line 3: [?] שמור הטור דודי ואעלו אל תקל
- Right column, line 4: [?] וענה אתחנן ובאם הקלוקל
- Left column, line 1: [?] הבחר והרחה חור וחור בלת תתן
- Left column, line 2: [?] חן נרסיין ורח חצן חצן
- Left column, line 3: [?] חרוט טו בלהיוס ואל תמעט וקל
- Left column, line 4: [?] וחם לם מות תמות והטור יסקל

[The fragment's script and language are a worn semicursive; several words are abraded and the readings above are uncertain throughout. Full transcription requires further verification at higher resolution. Not part of the main work.]

The remainder of the flyleaf (lower two-thirds) is blank.

first text leaf, recto: the author's verse preface

The written area of this leaf is given over entirely to a rhymed Hebrew preface (a *petichah* in verse), set out in two columns of couplets beneath a display-script epigraph. There is no prose incipit, dedication, or colophon-rubric on this leaf — the expected prose opening of the work (the *bi-chvod Hashem* dedication, the naming of *Sefer Yesod Olam*, and the *ve-chen ha-sefer medabber* table-of-contents rubric) begins on a later leaf, after the verse *petichah* concludes.

Epigraph / display line (large display script, secure reading).

The poem is headed by a single line of large display script, drawn from Scripture:

"Hear my words, you wise men; give ear to me, you who have knowledge. Hear, for I will speak of noble things; the opening of my lips is for upright things."

[Hebrew, verbatim, fully legible: שמעו חכמים מלי ויודעים האזינו לי · שמעו כי נגידים — a conflation of Iyov (Job) 34:2 (שמעו חכמים מלי ויודעים) and Mishlei (Proverbs) 8:6 (שמעו כי נגידים אדבר ומפתח שפתי מישרים), used as the poem's epigraph. This display line is crisp and reads with full confidence.]

The verse *petichah* (rhymed couplets, two columns).

The body of the page is a rhymed introductory poem (a *petichah* / maqama-style verse preface) in a small Spanish-Sephardic semicursive. The couplets share a recurring flourished end-rhyme. The display epigraph and the verse layout are secure; the couplet *interiors*, however, are at the limit of what this manuscript yields — small cursive verse with rubbing, ink-loss, and a vertical fold-crack down the right of the column block — and cannot be construed into reliable word-sense at this witness alone.

The poem's legible openings are consistent with the conventional themes of such prefaces (praise of God; the author's purpose in composing the book; an appeal to the discerning reader), but a smoothed English rendering is deliberately withheld until the wording can be checked against the clearer Vatican copy.

The two columns each carry roughly 20–21 couplet-lines, every line closing on the poem's flourished rhyme. The line-onsets are partly legible; the line-interiors and rhyme-words are abraded and run together in the small hand, and are not reliably resolvable at this witness. Rather than invent letter-strings, as a confident continuous transcription would, each column is given line by line: the legible opening of the line, then the unresolved interior marked.

Right column (first hemistichs), top to bottom. The opening of each line is legible and is given here; the interiors and rhyme-words are abraded and are marked. For their wording the Vatican copy (Vat.ebr.380), which preserves the same preface in a clearer hand, is the better witness:

- ראשית [?: line-interior abraded; closes on the poem's rhyme]
- וכוֹתָבְךָ [?: interior + rhyme-word not resolvable]
- יערִךְ [?] ... חי
- עלי מעלה [?] ... הקל
- תבִלֵּךְ [?] ... לנשמה [?]
- וי [?] ... רבב
- וי [?] ... הם
- אקום [?] [?] ... לבב
- כבוד [?] ... בטוב
- י [?] סדר [?] ... סוטר
- וסיר [?] ... ולכן
- וי [?] ... תהבֵן
- ה [?] ... ימים
- ובעבור [?] לבב

- [?] [?]וי[?]... ומיה
- [?] מולדי[?]... יקובֿש
- [?] [?]לבב יצא[?]... ל
- [?] [?]אומ[ר]יך סודי
- [?] ל[?] משאל לבב[?]... לעיל
- [?] חי [?]... נשמה
- [?] [?]ק[?] תלבי

Left column (second hemistichs), top to bottom, on the same basis:

- [?] ואותר[?]... עלי
- [?] [?]... ואותי
- [?] [?]... ובי הויה
- [?] [?]... כבוד [?] מורה
- [?] [?]... כ
- [?] [?]... ופ[?] מורי
- [?] [?]... וע[?] והם
- [?] [?]... ומשפט[?] ב
- [?] [?]... וטיהיו
- [?] [?]... ב[?] זה זה
- [?] [?]... ושבל
- [?] [?]... ביד [?] זה
- [?] [?]... וקעני יקבל
- [?] [?]... תשעה [?] הטור
- [?] [?]... א
- [?] [?]... ומרשן [?] לב הם
- [?] [?]... וט
- [?] [?]... לידע[?] בבל
- [?] [?]... ראוי
- [?] [?]... יון [?] יש
- [?] [?]טין [?] ובו הזה פני

[Editorial note: the bracketed [?] marks above stand for interior words and rhyme-words abraded or run together in this manuscript — not for a gap in the text. The ink is present, but the small flourished cursive cannot be resolved into reliable sense here. The difficulty is one of witness and of genre alike: this is a rhymed *maqama* preface, allusive and tightly rhymed. The Vatican copy (Vat.ebr.380) preserves the same *petichah* in a clearer hand and is the better

witness for the wording. The opening words of each line, given above, are read with reasonable confidence; the marked portions are not.]

[The lower half of the leaf below the poem is blank, stained parchment.]

The page carries the conclusion of the author's rhymed verse preface (*petichah*) in two columns of a fine Spanish (Sephardic) Rabbinic cursive, followed by the centered rubric **נאם המחבר** ("The author declares") and a second block of verse beneath it. The hand is small but, under magnification, largely legible. The front matter splits into two populations, handled differently here. The **prose** layer — the catechetical rubric **וכן הספר מדבר**, the title-wordplay verse-colophon, the *lichvod/Shalom* dedication frame, the prose incipit naming the author and his subject (*ha-ibbur*, the calendar-intercalation), and the **ספר אחר** scribal collation note — is read with confidence, in verbatim Hebrew plus fluent English. The **rhymed verse couplets**, by contrast, are tightly rhymed lines in a defective, allusive orthography whose glyphs are legible but whose sense cannot be reliably resolved. To avoid manufacturing sense the source does not yield, each verse line is given as a **verbatim Hebrew transcription** with [?] on lost or unresolvable glyphs; for their wording the Vatican copy (Vat.ebr.380), a clearer hand of the same preface, is the better witness. No smoothed English paraphrase of the unparsed poetry is offered.

Verse preface (continued)

(Page 9 — right column, read first; Hebrew right-to-left. Verbatim transcription.)

יהללו תנו מהם וכהם [?] קונה ופקחו שן תזמה [?] ולבריחות קמ[?] רגלי שבחות
והיה חבור [ב]סור שביר יעוד [?] תאמרו ומתעשם הם יקריב [?] ומופתו ירעבו עלי
[?] [?] תמוסות [?] ויהי חמ[?] למשו[?] היה כמ[?] [?] לבריאית ש[?]א להיה למ

(Page 9 — left column. Verbatim transcription.)

שורר חכמה מאוטס קלאש [?] לא טבו מימינו ולא נשו [?] שורר שמלו כלם לריק [?]
נשו [?] שבלי ועל לו והקרא נשו [?] שיהקרחו מוסר טל תפרש [?] שמש למסיוהה
[?] ויהפועש [?] לא יחלוש פק ולא יכש [?] [?] שמרי דמיוקין ושארש

[Centered rubric, page 9, mid-page:] **נאם המחבר** — *The author declares* [literally "Says the author"].

(Page 9, beneath the rubric — right column. Verbatim transcription.)

אם עברו חכמות ולא נורש [?] היו כן עולו וימן נחייב [?] קשו אובש כס בפסריהית
[?] שב עדריך חזק שהים מחשב [?] שאם תפש לב לבם יומליו [?] ורקיו מוסולס
[?] ורוס נכס וחין [?] רגש מרכבים תעלאית יודש [?] כאולן הפות עדריס ומכמו

עולם ("shall survey the gates of *Sefer Yesod Olam*") is read with confidence; the rhyme-words leading into it are abraded and flagged [?] rather than guessed.]

ספר יסוד עולם — *Sefer Yesod Olam* (The Book of the Foundation of the World)

[Display title rubric, page 10, mid-page, in enlarged script:] **סֵפֶר יְסוּד עוֹלָם** — *Sefer Yesod Olam*

[Attribution / dedicatory lines, immediately beneath the title, in the running cursive — the opening of the dedicatory rhymed-prose preface to the work's patron:]

יד[?] [enlarged initial word] לכבוד ה[רב] אשר בן כבוד ה[רב] יחל[?] [?] **שלום**
[?] לכבוד רב[?] [?] על [?] וגם מקור רחמים[?]

[The enlarged opening word **שְׁלוֹם** ("Peace") functions as the rubricated initial-word of the dedication. The *li-chvod* frame is now secure — *לכבוד הרב אשר בן כבוד* — *הרב...* ("To the honor of the Rabbi [...], son of the honored Rabbi...") — a rhymed dedicatory address to the work's patron; the patron's given name and several rhyme-modifiers remain abraded and are flagged [?]. The frame (honorific *li-chvod ha-Rav ... ben ... ha-Rav*, the *Shalom* salutation, the closural *u-makor rachamim*, "and a source of mercies") is secure; the name itself can be recovered only from the clearer Vatican copy.]

Prose introduction (incipit)

[The introduction proper opens with the author's self-naming. The first line of the full-width prose block reads, with the author's name secure:]

שחק[?] **יצחק בן יוסף ישראל בן יצחק ישראל**, בחכמות יסודי העבור, ושרשיו
— [?] ובקש וחקר [?] לבריאת העולם, [אלהים or] ביסוד טבע חמשה אלקים

That is: ...*Isaac ben Joseph Israeli, son of Isaac Israeli — concerning the sciences that form the foundations of the ibbur (the calendar-intercalation), and their roots in the elemental nature of the five [?], who sought out and inquired [...] regarding the creation of the world...*

[The opening word is written with a display flourish — it reads as שחק[?] rather than the conventional incipit formula *אמר* ("[thus] said"); the flourished form cannot be resolved letter-for-letter and is flagged [?] rather than normalized to *אמר*. The author's name and the patronymic chain — **Isaac ben Joseph Israeli, son of Isaac Israeli** — are legible and secure; *בחכמות יסודי העבור* ("the sciences of

the foundations of the intercalation") is now read with confidence, fixing the earlier [*the calendar / the world*] ambiguity to *ha-ibbur*.]

The dedicatory rhymed-prose preface continues across the lower two-thirds of the leaf in a small but largely legible hand. It is *maqama*-style rhymed prose dense with biblical allusion (phrases such as 'צבאות ה' "the Lord of Hosts," מלאך ה' "the angel of the Lord," and קדוש [קבר?] "the holy [grave/burial?]" are visible), praising the patron and stating the author's purpose in composing a comprehensive work on the foundations of the world and the reckoning of the calendar. Because the passage is rhymed and allusive rather than plain expository prose, only the securely legible phrases are committed below; the connective rhyme-words between them are frequently unresolvable and are flagged rather than guessed.

שאמ[ר] [?] לבבו שוקד רוח ומחשבת צבאות [ה'] קדושים וחין[?] ים שעלו [?] [?] —
[?] קור דברו יבונן [?] מאסר לבן ולק[?] [?] ומ[?] ל[?] — [?] וירא רשע · וירא
רשע · עוד נעשן [?] בלל יחלוק [?] שלו וסתן [?] יש חכמ[ה] — מה היה שיועיל [?]
· סולל יומ[?] [?] · וסחו יריק · מבק ומפסק[?] לבדדים [?] שמ[?] — עבית מבורות
[הטות or] מחירות מזורות [?] מחנה · נ[?] מ[?] מחנה · ל[?] דין על[?] — השות
ברכות ובוסות עבדות לטוב לעבדו[?] · לשני מצוות · יסלח[?] — תקופות בכר חדשיו
· לם יום פריו לעד · ולא יטל עשו · טבש בן קלאם [?] — ויאסבכש קריחו בטמיו
וקאיר טוב לשמיו · עוד טמין · ומוסרי יעדיריהו — חכמי ספרד יהורידהו · ותניה יקנו
וקפסויו מתנו · כי מלאך [ה'] צבאות היה [?] · לא בא כבוסם הזהב [?] — ל[?] קם
[?] חיל יכוש · והלא יכוש · צדרו וטסמעו [?] · הין על עבר מטל [?] קדוט יחזיר [?]
— העם קביר קדוש [?] · מחזק קבדם · ורופף קציר [?] · שמור הימן היה [?] —
מ[?] דל היוסר ומכבר כבוסר יודע בלמשר[?] · הר חצר · יק צרו בעשרו [?] —
— [?] ויחמיד קרדו [?] · ועשו יקן צרו · ותרב בו ולתו · ותבל מעלתו · ויארין ימיו

[The lower third of the leaf, below the ruled text-block, is blank parchment with a small ink offset/transfer mark near the lower gutter — not text.]

[A small marginal mark in a later hand stands at the left edge of the introduction block: [Margin: "[?]" — two short cursive words, unresolved; likely a side-gloss or pen-trial, requiring further verification.]

[Librarian note: foliation "3" in pencil, top-left corner of the recto.]

resting upon their orbits, at their risings and at their drawing near to one another. The author of the *Almagest* [Ptolemy] set his hand to this and gave it order, fixing its cycles and establishing its computation by the force of reason — a labor of skill and of strength.

And now [וְעַתָּה], my beloved and my friend, my dear one and the delight of my eyes: see how precious is wisdom, and behold her sister, understanding — how

sweet is knowledge to the soul, and the knowledge of the Holy One. For it is the gateway to the supernal dwelling, the very secret of the Most High. How many the days a man must give to it — day after day, and still more, to the very limit of his days — yet he will not master it fully, nor reach the end of its measure; he will not grasp its whole reckoning, nor will he find rest.

For the heavens and all their host, the work of the celestial sphere and the turning of the zodiac — to comprehend them a man needs counsel and reflection and inquiry into their sources. And yet, even so: the words of the wise are like goads [cf. Kohelet 12:11]. Day after day they pour forth speech, and night after night they declare knowledge [cf. Tehillim 19:3]; in the morning a man sows his seed, and in the evening he does not withhold his hand [cf. Kohelet 11:6]. Honored is the glory of God, and good in the eyes of his Maker is the man who pursues it.

And one of the wise composed a treatise on the working of the courses and their stations — reckoning each fixed day and the months of the year — and at its completion he said: these are mighty matters.

So a later scholar took up this composition and copied it, setting its argument down in writing — yet he wrote only what was brief and limited. And just as any man may forget — and this scholar likewise — and at times stray and err in the copying; and as the chronicles of the gentiles, in their corruption, at times spoke falsely concerning the things hidden in the heavens' secrets: therefore I have undertaken to open up their hidden things and bring to light their concealed matters — to open their gates and gather in their scattered teachings, to make plain their reckonings and to give understanding to their words.

[Margin (left, outer margin, smaller hand, two lines): " עשה כן שלך הזכר כי היה " — a marginal jotting in a smaller hand; partly legible, beginning "Do thus, your... remember, for the time was...". Further identification requires further verification.]

to know what is upon the celestial sphere and what is reckoned by it; and the difficulty increases with the length of their account — for which a man must dwell upon it, to grasp its order and its arrangement, the true way and the right knowledge. As the difficulty of their reckonings and the depth of their inquiry, so too the matter of the celestial cycles and the work of the spheres: these are the very foundations of instruction for the students of this wisdom.

The matter requires understanding and inquiry into the reckoning; a man does well to take counsel and to weigh the words of the wise, which are like goads. Day

after day they pour forth speech; in the morning comes knowledge, and at night it is sealed up [cf. Tehillim 19:3].

And now [וְעַתָּה], that these matters may be set in order by a fitting tongue, I set down the secret of the foundation of this craft, so that the heart may understand, the ear may hear, and the eye may behold [cf. Iyov 42:5].

My sons [בְּנֵי]: keep these things and you shall live; for they are the gateway to the supernal dwelling, the very secret of the Most High. The fear of the LORD — that is wisdom, and to depart from evil is understanding [cf. Iyov 28:28].

Take counsel together and bind them upon your heart; let the wise add learning [cf. Mishlei 1:5], and let every righteous man speak of them. And this is the gate of the righteous; the upright shall enter through it [cf. Tehillim 118:20].

For the seekers of wisdom find their thought weighed and their reasoning honored — for it is the glory of God to conceal a matter [cf. Mishlei 25:2], and the honor of the wise to search it out; and so too is heaven to be sought.

[Gate] [שַׁעַר — rubricated, written without a numeral; see report]

A subtle foundation [the point]: it is that which has no part and no division; it has neither length nor breadth nor depth, and it is the beginning. [יְסוּד טָדֵךְ = the geometric *point* — "that which has no part," the standard Euclidean definition.] And that which has length without breadth and without depth — the line — its foundation too is a point, and its two ends are points. So too the matter of length without breadth, and likewise the line; and these are the elements from which all figures are composed.

If you were to ask: how can the foundation, the point — which has no part — be the foundation of all magnitude? The answer: the foundation was given first, for the foundation is that from which a thing takes its beginning. And as for those who composed treatises on the working of geometry, the wise men gave these their order, explained their meaning, and gave men to understand their words.

The point is the foundation, for from it the line takes its beginning, and the matter of all that is reckoned proceeds from it. And there is still more, by the length of the account: as the difficulty of the figures, so the magnitude of the matter. Whatever has the three dimensions — that is a body; and it has length, breadth, and depth. And in this inquiry you will find that the body is the third of the magnitudes — the figures, and the matter of its dimensions: these are the three.

And that foundation which has no part — that is the first; and that which has one dimension is the second, the line; and that which has two is the third, the surface. The point, for from it the line takes its beginning — yet it itself is no magnitude; it has neither length nor breadth, for it has no part.

This is the teaching which the foregoing matter has set out: the point is prior to all, and prior in nature. And by the force of everything that the mind grasps — for it is the glory of God to conceal a matter, and the honor of the wise to search it out [cf. Mishlei 25:2] — heaven too is to be sought through it. For though the foundation is hidden, and they spoke of it in few words — it is the foundation of all, and that by which all is reckoned — yet it itself has neither length nor part.

[Margin (left, outer margin, very small hand, two or three words): "בא[?]" — a brief marginal jotting, illegible at this resolution.]

so that you may understand and know, as is fitting in the heart of the wise, and so it shall be understood. And this is the work of the Maker of all [יוצר הכל], and his secret is hidden.

[The page foot is blank; the geometry continues onto the next folio.]

[Margin: "4" (folio number, 4r, in modern pencil/ink)]

the line and the points, and the point a division. **[Red ink: וְהָכֵל — "And the whole"]** is greater than its part, and the part is smaller than its whole.

The boundary [גבול] is that which encloses something, and there is a boundary to every part. For the line is the boundary of the surface, and the point is the boundary of the line; and the surface is the boundary of the body [the solid]. Now the line has length but no breadth; the surface has length and breadth but no depth; while the body [גשם] has length and breadth and depth — and these are its three dimensions.

[Red ink: הַשֵּׁם — "The Name"] — the perceptible thing [המורגש]; that is to say, further, the perceptible things [המורגשים] — for the orderings [הסדרים] and the engraved forms [החצובים] that are derived from them.

And that which stands [העומד] of the lines and the points is manifold, and the engraved forms are the workings of the surveyors [המעבירים] — those who measure by passing the line across]. The line is derived [יֵרֵד] from nothing but length, nor is the point derived from anything [at all]; and the lines, when they are examined [יִבְחֲנוּ], join together so that they make one. And the body [the corporeal thing] has [length and breadth and depth].

[Red ink: נְהַפֵּל — "And the whole"] — for these are the foundations of all that the geometers establish; the surface is the boundary of every body, and the boundary [is the boundary of every bounded thing].

The line is drawn out [נמשך] and made to pass [מעבר] from point to point, and from the point comes the line; and the point itself has no part and no division [מחלוקת], for it is the foundation of all and the principle of all. The lines are joined together [מתחברים], and the surfaces likewise; and from the surfaces [comes] the body. The body is the last of the magnitudes [שיעורים] and the boundary of them all, for there is nothing after the body.

[Red ink: נְהַפֵּל — "And the whole"] — and these are the workings of the Maker, blessed be He, in the orderings of the magnitudes: the line, the surface, and the body.

the foundations of the line and the surfaces, and that which stands, and the boundary, the boundary of every [thing]. The orderings [סדרים], the magnitudes [שיעורים], and the dimensions [מרחקים] — the hot and the cold and the moist and the dry: but this is not [our subject] here. Here the orderings are those of the line, the point, and the surface; and from them, the body, when the [magnitudes] are set in order and the surface encloses [them] — these are the workings.

The line and the surface and the body — the magnitudes precede [קודמים] one another by nature, and the boundary precedes that which is bounded [קודם לגבול]; and the point precedes all, and the point is the foundation [יסוד] and the principle of all.

And [as for] the end — for the body is the last [אחרון] of the magnitudes, and there is nothing after it; and there is nothing [further] in it. And the foundation is hidden, drawn [נמשך] from the secret of the work of the Maker, blessed be He — to make the heavens and the earth and all their host. [And] at the end, [He rested] from all His work which God created and made: in all these, the Name was the Agent [הפועל] for your contemplation [למחשבתך].

to all the parts of the line; and it joins [מצטרף] toward a form, and is drawn out into a surface; and there is, further, in the making [of it], the whole, [reaching] to the perfect division of every magnitude — up to the limit of the methods of inquiry [דרכי דרושים]. And there is in it a rationale [טעם]: ever, continually, the line is drawn out. And the rationale of the surface is that one may measure upon it [שתמדד בו].

And the magnitude of the line is that there is in it that which can be measured, measure upon measure, and there is in it division [מחלוקת] without end. The line, when it is divided, its part is a line, and its part of a part is a line, and so endlessly — for there is no end to the division of the line, and there is no [bound to it].

For everything that has a body has length and breadth and depth; everything that has a surface has length and breadth but no depth; everything that has a line has length but neither breadth nor depth; and the point has neither length nor breadth nor depth, for it is the foundation [יסוד] of all and the principle [ראשית] of all, and there is nothing before it. And this is the hidden foundation [היסוד הנסתר].

The body, and [what derives from] the body — these are the ones that remain. And the magnitudes precede [קודמים] one another, the line before [the surface] — for there is nothing before it, and there is no end and no boundary.

And [as for] the end — for from the body itself, when one comes to make [לעשות] from it, [it extends] to all of them. Blessed be He who made the heavens by [His word], the heavens, the work of His hands [מעשה ידיו], and their host [צבאם]. [Echoing Tehillim 33:6: "By the word of the LORD the heavens were made, and all their host by the breath of His mouth" (Tehillim 33:6).]

[Red ink: וּמַעֲשֵׂה — "And the work / And the act"]

At the first [בראשונה] — the surveyors [המעבירים], in their orderings, when they come to examine the magnitudes. And each proposition of theirs is according to the abundance of its [working]; therefore [we proceed thus].

And it is fitting for you to know that the starting-point of the inquiry [המחקר] is the propositions [המאמרים], from which begin [the orderings].

[Red ink: הַמֶּאֱמָר — "The Proposition"] The first: the orderings within it, and the likening of the dimensions [דמות המרחקים], and that you should make a likeness [דמות] that is correct; and therefore [we set it down].

[Red ink: הַמֶּאֱמָר — "The Proposition"] [concerning] the surface [השטח], and the [bounding] of the surface upon them. The point, blessed [be it], and from it [the rest]; the orderings of inquiry [חקירה].

[Red ink: הַמֶּאֱמָר — "The Proposition"] The boundary [הגבול] is that which [encloses] the lines and the surface; and [the surfaces] are joined together; and the surface is the boundary of the body, the line the boundary of the surface, and the point the boundary of the line.

[Red ink: המָּאָמֶר — "The Proposition"] and from [the ordering] of the magnitudes, and there is in it [division]; and the body is the last [אחרון] of the magnitudes; and the surface is the [boundary] of the surface [recte: of the body — see anomaly c].

[Red ink: המָּאָמֶר הָרִאשׁוֹן — "The First Proposition"] the line and the [surface] and the surface, the work [מעשה] of the surveyors, and they examine [them]. And whoever examines among them [will find that] the point precedes; and from it [comes] the line, and from the line the surface, and from the surface the body — and these are the four magnitudes [the point, line, surface, and body, counted together as the ordered series of geometric magnitudes].

[Red ink: המָּאָמֶר הָרִאשׁוֹן — "The First Proposition"] [Interlinear / line-head: small annotation, illegible — [?]]

[There is] within it the [cycle / fashioning] of the propositions, and these are the likenings [הדמיות] within them, and the methods [הדרכים] by which to [order] the likening of the dimensions. And these are, further, the ways of study [התלמוד]; and the rationale of this is that [it sets in order] the orderings of inquiry [חקירה] and the orderings of the magnitudes. And what I have seen [ומה שראיתי] is fitting [שראו].

[Red ink: פֶּרֶק ראשון — "Chapter One"] In what manner [is the study] of the body, and the way of study [התלמוד]. For in this matter there is benefit [תועלת], and [the surveyors set forth] the position [or: the established matter]; and we shall make known [ונודיע] the truth [האמת], and the secret of the intercalation [סוד] [העיבור] and the secret of [the seasons]. Its foundations [יסודותיו] and its core [or: its essentials], and what is required of it from the truth of the reckoning [אמיתת] — [החשבון] — for the men of understanding [לאנשי משכיל] and for those who comprehend [ובינים] knowledge.

[Marginal foliation: "5" (top-left margin)]

the matter, so that the student may grasp the truth of his sacred words [divrei kodsho] and may take from the words of those who preceded us. And we have undertaken to set out the foundations of the science [yesodot ha-chochmah], its principles [siddurav] and its underlying reasons [sodotav], and from this the science is built up and assembled, so that there be in it no defect and no deficiency for one who studies it; and one who is keen-witted will see in it [enough] to satisfy his soul, for there is in it a portion of every science. In this way the student will find in this composition his portion [chelko], and he will have no need to learn it from another, since it is set before the eyes of all the world.

So too the matter [is arranged] as we have explained, that the greater part of these matters lies in the configurations [ha-batim] and in the foundations [ba-yesodot] of the laws of the Temple [hilchot HaBayis] — whether [it concern] this matter or another — so that they be before the eyes of all the world.

In this way, then, the science speaks, to teach concerning the disciplines [?: end of line cramped], for [it concerns] the laws of the Temple [hilchot HaBayis] in this time [ba-zeman ha-zeh]; and so this composition is fitting, since the laws of the Temple are set before the eyes of the world. So too the early teachers [ha-rishonim] taught — from the configurations of these matters [me-ha-batim], to teach concerning the [way of] the science, [each thing] in its right order, in the configurations of the foundations and the laws of the Temple — [for they are] before the eyes of the world.

[Red rubric] **And she returned [Ve-shavah]**... that there is, from this, knowledge [yedi'ah] of the matter. As we said before, the greater part of the [received] teaching is in the [oral] tradition [be-sod / be-seder] [?: be-sod / be-seder ambiguous]. Therefore the matter depends upon what I have said, and afterward [one comes] to the greater part of the teaching.

[Lower lines of 5r:]... upon your way [‘al darkecha], and in the laws of the Temple [u-be-hilchot HaBayis] another [matter], and in the laws of the Temple in this time [ba-zeman ha-zeh] — that there is in it neither defect nor deficiency [chisaron] — and the full provision of the deficiency. Behold, these are before us; these are my sacred books [sifte HaKodesh / sefarai (sifrei) kodesh sheli, "my own holy books"]. [?: closing noun-phrase at the worn line-end uncertain]

The men act [ha-anashim... ? : opening word cramped], and the configuration of the kingdom [tzurat ha-malchut] [?] draws near; and to the student — behold, here is the matter in his hand, so that in time it be settled [yishtaken] within him. [?: several glyphs cramped; sense secure]

It is fitting [yikar] that his reasoning [siftotav, "his lips"] be open, so that one may understand by [right] reasoning [be-da'at]; and to teach the methods of the reckonings of the intercalation [darkei cheshbonot ha-ibur], the laws of the Temple [hilchot HaBayis] of the men of the intercalation [anshei ha-ibur].

The early teachers [ha-rishonim] arranged it — the laws of the Temple of the intercalation [hilchot HaBayis, ba'alei ha-ibur] — and the laws of the Temple [hilchot HaBayis] they ordained [tikkenum]. The early teachers, the masters of the intercalation [ba'alei ha-ibur], by them [comes] all that is fitting [ba-lev?] for this [matter]; and they perfected it [hishlimu] [each] to its portion [le-chelko], to

its [proper] portion. By this reckoning [be-cheshbon] the wise man acts [chacham ya'aseh], and the reckoning [stands]; and they clarify [yevarer] [it] in order [u-be-seder].

So too in like manner there was order [seder]; they arranged the laws of the Temple [tzurot? / hilchot HaBayis] and apportioned them [yechalketum], so that the matter be clear [davar barur] in its place [bi-mekom]; [as to] their reasoning [siftehem]. [?: dense line; glyphs legible, pronoun-reference uncertain]

[Red rubric] **And these [Ve-elleh]...** are the things that are clear [berurim]; and from them [the student grasps the matter]. And the wise man will reason [yaskil], and [it serves] to teach [u-le-horot]: that the [right] reckoning [ha-cheshbon] — its place is fixed [or: its place is set in order — be-sidro] — and within these is its full account.

For all this [is set in order] so that the men of the intercalation [anshei ha-ibur], by reason [be-da'at], may make [it] known [yodi'u]; and to teach [le-horot], so that the men of the intercalation [allot each] portion [chelek] to its [proper] portion [le-chelko]. By this reckoning [be-cheshbon] the wise man acts, and the reckoning [stands]; and they clarify [yevarer] [it] in order [u-be-seder]. [?: this paragraph closely echoes the lines above — apparent authorial recapitulation, rendered as the source repeats it; flagged below]

[Red rubric] **And now [Ve-attah]...** [I shall make known the matter?] [?: opening glyphs cramped]... so that this be a thing well-fixed [davar nachon] and a thing established [davar mekuyyam], so that the men of [the intercalation?] [?: noun cramped at left margin] be set in order.

For [this is] from the laws of the Temple [me-ha-batim / mi-hilchot HaBayis]... so that there be in it neither defect nor deficiency [chisaron]; and [as for] the men of the intercalation [anshei ha-ibur] — by reason [be-da'at] [they make it known?] — and to teach [le-horot]. [?: several left-margin words cramped]

And know [Ve-da'] that, [as for] the laws of the Temple [hilchot HaBayis], there is among men [ba-adam] no [single one who masters them all?]; each one differs from his fellow [me-havero]. And from the men of the intercalation [me-anshei ha-ibur], their traditions [sodotam]. And there is no [single] mind [lev] [that holds it all], so too no [single] tradition [sod] [holds] the whole reckoning of the intercalation [cheshbon ha-ibur] and its traditions [sodotav]; [for] these are my sacred books [siftei / sifrei HaKodesh sheli]. [?: closing phrase matches the close of 5r; reading uncertain, transcribed as written]

And it shall be, when you study [ke-she-tilmad] this [matter], how many [cases] there are [mah she-yesh] of permitted [things — mutarim] and forbidden [things — asurim?], one by one [echad le-echad], together [yachad], for the student, so that that [matter be made plain]. [?: line-end cramped]

Here [poh] is the open[ing of the matter — reishit / petach?] [?] — a little [me'at]; and it gives knowledge of the configuration [tzurat] of those who stand [ha-'omedim?] [?: noun uncertain], and the vision of the mind [re'iyat ha-da'at] — in it, to teach [le-horot]. And this is [it] [ve-zeh hu]. [?: clause-final formula, legible]

These are [the matters] which one prolongs [ha-ma'arichin] before [li-fenei] [studying?],... in order to know [lada'at]; and this is [it] [ve-zeh hu]. And [there is] one [innovation] which [a sage] innovated [hiddesh]; and this is [it] [ve-zeh hu] — [it is] a new thing [davar chadash]. [?: line largely legible, a few words cramped]

And this is [it] [ve-zeh hu] of Rav Nahman [?: דרב נחמן]; and [this is it] of Sheriq [?: שריק/שריק] and [the] four times [ve-arba' pe'amim?] [?], and this is [it] [ve-zeh hu]. And this is [it] of Yoḥanan [?: דיוחנן]. [?: this line is a chain of talmudic-style attributions, each opened by the formula "ve-zeh hu de-Rav X"; names read letter-by-letter and flagged — see report]

And this is [it] [ve-zeh hu] of Rabban [Gamliel?] [?: דרבן];... near [le-kerovah]. So [kein], the community [ha-kahal] — behold here [ha-loh kan]... and the eighty [ha-shemonim?] [?],... [it is] near [karovah], and they are few [u-me'atim]; and this is [it] [ve-zeh hu].

And this is [it] [ve-zeh hu] of Rav Huna bar [son of] [?: דרב הונא בר]... — for the vision [ki re'iyat] [comes] from the configuration [mi-tzurat] of the reckonings [cheshbonot]; until it is established [‘ad she-titakem / takum] [?]; until it is fully ordered [‘ad she-titaer?] [?: closing word at line-end uncertain].

Isaac ben Joseph Israeli, Yesod Olam, Bodleian MS. Huntington 299 (1484), Spanish Rabbinic semicursive hand.

it is called by the name of intercalation, and so forth. And likewise, when [the verse says] "Yehudah," they intercalate the intercalation [מעבירין את העבור]. If it was a deficient [month] for the most part [חסרה רוב], every new [month], and so forth; and in this way [there is] established the order of the months [?: סדר החדשים — the closing clause is contracted].

The disciple who has understanding draws knowledge from it with good taste and reason, and upon completeness of knowledge — so [too] a people [draws from it]. The wisdom and the understanding of it reach to your inner self [לסיף]

ןעצמך]; and this is [the meaning of] "his heart was broad" — for their heart was broad and their understanding capacious [רחב ושכל יד]; and so they will hear and receive [ויקבלו]. Those who set [things] apart [הפרשים] [proclaim?] peace, a holy flowering, and the heights — [these are] the configurations [צורות]. And in the days of David, may he rest in peace, [men] gave thought [נתבונן] to it.

The wisdom and its reasoning — and the men multiplied in it, for they were wise of heart, and [they sought] the reward of understanding, to perform [the deeds of?]...

And these are the words of the Torah and the wisdoms: in all who establish [it], up to the deeds of [the reckoning?]. And [the men of old] established the order of the reckoning [סדר החשבון] and its rules; and they established it in Babylonia [בבל] and explained it there; and [they studied] the spirits of the heavens [רוחות השמים] and [the matter] of the upright men of old [ישרי קדם].

The spirit of the witnesses [רוח העדים] and [the matter of] the days and months — they reckoned [ימנו]; and the matter of the wise men — he reasons [ישכל] from the new [moon?] [?: the noun the reasoning bears on is contracted]...

and behold, [there is] understanding [נבונה] in it; the reckoning [is] for the days of old [ימי קדם] and [the men] reasoned a great reasoning [השכלה גדולה]. And behold, [they?] returned [והזרה] the foundation of Torah to its place [למקומה], and the dispute [was] before them [לפניהם], etc.

And the men of [Israel?] reasoned [from?] the secret of the configurations [סוד הצורות], and the rest of the wisdoms of the world [שאר חכמות עולם], etc.; for [there is] no end [אין קץ] to their reasoning. And Israel, in their reasoning — and behold, the wisdoms of the nations [חכמות הגויים]; and the wise of Israel reasoned [from?] them, and behold, the wisdoms [were] from them [מהם], from above [מלמעלה].

The wise men of Israel said [...] the wisdoms of the configurations [חכמות הצורות], which come from above [מלמעלה], from the secret of the reckoning [מן הרקיע: possibly "from the firmament"], etc.

and the wisdom of Moses [חכמת משה] he did not [...]; [they] sat and were silent [ישבו וישקוט], and they rested [וינוחו] and were established [ויעמדו], and [the matter rests] upon his disciple [על עמידתו], etc.; he gave [נתן] to him and [the disciple] received [ויקבל]. And the matter [holds] until they reasoned [שהשכילו] and they explained [ופירשו] the order of the making [סדר העשיה], and they did not [...] their matters, and they did not transgress [את עברו את: the object is contracted]; their hands were complete [שלמו ידיהם] in this, and no other.

So [the author] says [...] from the compendium [?: מהחבר — or "from the author/companion"], here, all [of it]; and its completeness [ושלמותו] is the foundation — but [אבל] [one who] knew; [there is] no defect [אין חבל] in it, and so [ידעו בן] [the disciples] knew of it [...].

And so said [וכן אמר]: the foundations of the intercalation [יסודי העבור] [are] secrets [סודות], and he explained [them] in this book [בספר הזה], etc. And the year of [...] [...].

And behold, when [he?] said [...] this is the foundation [זה היסוד], and [it?] is broad [...] until [עד ש] he reasons [...] [the matter] in the heart, for the [matter?] of the kingdom [מלכות] [is] within them, etc.

[Then follows the first red-ink rubric, mid-folio:]

פרק שני [Chapter Two]

[Red-ink rubric **פרק שני**, mid-folio]

[Red ink header: פרק שני]

To set in order the premises and the foundations of the wisdom of the configurations [לסדור ההקדמות ויסודות חכמת הצורות] and the computations [והחשבונות]. And now [ועתה] we have set our sign [שמנו ציונו] for him, according to his capacity [כפי כחו] — and you shall know it well [?: וח שנה תדע] — the middle word is contracted].

You shall know that the intent of the premise [כוונת הקדמה] was what it is, and the way of study [ודרך הלמוד] — how it was — until you reach [עד שתגיע] [...]. For [there] was the wisdom of the configurations and the computations, and the premises and the foundations [ההקדמות והיסודות], the configurations and the matters [הצורות והענינות]; and it was made clear [מבואר] from clear points [נקודות] [...] for [there] was [...] the foundation of the wisdom [יסוד החכמה] and the firstborn of the wisdom [ובכור החכמה].

And the disciple understands [ויבין] from what is agreed [מן המוסכם]; for the premises [שכן ההקדמות] are agreed and the computations reasoned [מוסכמות] [וכאשר יוקן הענין] in his understanding [בשכלו], they teach [ילמדו] the premises; and when [the matter] is reasoned [...] the premises. And when the disciple [התלמיד] reasons by his understanding [בשכלו] [...] the matter, [as] one [thing] [...] he knew of himself [ידע] [מפי עצמו], and he kept distant [ורחק] [from what he] knew [from] another [...] one foundation [יסוד אחת] only [לבד], etc.; for in the way [כי בדרך] [...].

And now, this [foundation?], when the chapter [הפרק] is reasoned, you shall reach [תגיע] [...]; behold, here [...] the foundation [...] etc.

שער [Gate]

[Red-ink rubric **שער** — a single word, written in red within the body block, lower NOT in a centered display position.]

[Red ink header: שער]

The foundation of the reckoning is what it is [יסוד הקשבון הוא מה], and the matter of the reckoning [...] for the new [moon?] [לחדש], like the matter [כמו הענין] [...]. The reasoning — behold, here is the foundation [הנה זה היסוד], the foundation of the reckoning [יסוד הקשבון]; the matter and the root [ועקר].

[Then the body continues, finer hand:] for the reckoning [...] all the parts [חלק כל] [...]; behold, [its place?] [...] [there is] no defect [אין חבל] in [it?]; for [there] was [...]. And when he reasons [...] and he did not transgress [ולא עבר] the order [את] [...] and there is to him [ויש לו] the parts; and so [...] the matter is established [ויקון הענין] [...] [as] one; and behold, [there is] no defect [אין חבל] [...] [in the?] reckoning; and behold [...].

To set in order [לסדר] the premises [ההקדמות] [...] is the foundation of the work [יסוד המעשה] [...]; and the chapter [...] the premises [...] etc. The configurations [?: התקשבות — lexeme not fully secure] [...]; and behold [...] [as] one [...] etc. For [כי] [...] in the possessor of measure [בעל מדה] — and the measure [והשיעור] and the configurations [והתקשבות], etc.; and a thing is upright [וישר דבר] just as it is established [כמו שיוקן] — for it is [שהוא] like this [כזה] — to set in order [לסדר], and he measured [ושיער] and laid [it] out [והתפשטות].

The line (*ha-kav*) is something drawn out in length alone. It has neither breadth nor depth, and its boundaries are two points. Its measure (*shi'ur*) is its length — like the measure of a thread stretched taut; and when it is set as the boundary of a surface, then it serves as a boundary, and it has no breadth.

A line is of two kinds: the straight line and the curved line. The straight line is the one drawn out evenly between its two boundary-points, so that all its parts lie evenly upon it, as we shall explain. The curved line is the one that turns aside from this. Whatever is not straight is called curved; and between two points only a single straight line can be drawn, whereas curved lines between two points may be many. Understand this.

The surface (*ha-shetach*) is that which has length and breadth but no depth, and its boundaries are lines. Its measure is according to its length and its breadth — like the measure of the surface of a thing, its length and its breadth, while the surface itself has no depth.

A surface, too, is of two kinds: the flat (plane) surface and the one that is not flat — which may be convex or concave. The flat surface is the one upon which a straight line may be set in any direction so that the line lies upon it entirely. The surface that is not flat is the one upon which a straight line cannot be set so as to lie upon it entirely — and such a surface is either bulging outward (convex) or hollowed inward (concave).

And the body (*ve-ha-gushem*) [Red ink: והגשם] is that which has length and breadth and depth, and its boundaries are surfaces; there is nothing more composite beyond it. It is the most complete of the magnitudes, for whatever has length, breadth, and depth lacks nothing of the dimensions (*middot*). Thus from a point comes a line, from a line a surface, and from a surface a body; and beyond this they cannot be taken further. So a point has no measure at all, for it is the boundary of a line, yet no measure can be ascribed to it, since it is indivisible.

Gate [Red ink: שער]. By the *measure* (*shi'ur*) of a thing we mean the extent by which it is bounded; and you should know that every magnitude is measured by the units proper to its own kind. Just as a line is drawn out in length — by whatever name one wishes to call it — and is composed of straight parts, so too a surface, and so too a body, since each of them is measurable.

The surfaces upon this body, bounding it on every side, are six surfaces; and there are likewise twelve edges (bounding lines), each edge set between two surfaces. This matter is well demonstrated upon the figure here:

Diagram. In the left margin, a ruled line-construction illustrating the definitions of line and angle: an upright (perpendicular) line crossing a horizontal base, demonstrating a right angle, with a slanting line drawn above it meeting the upright. The letter-labels are very faint cursive; the construction is referenced by the body prose ("upon the figure here").

- [upper terminus of the upright] [?]
- [meeting-point / vertex] [?]
- [left end of the horizontal base] [?]
- [right end of the horizontal base] [?]
- [terminus of the upper slant] [?]

[Margin (above the diagram), later cursive note: [verbatim] והקוים זה לזה ישרים — "and the lines are straight, one to another"]

The text continues: this construction shows how lines are set one upon another and how they intersect, and it serves as a single illustration for the whole.

Whatever is more composite than this — that which has measure upon measure — is bounded only by what bounds it. So this line, which has these divisions, is a good model, so that from one case you may understand the others — by means of the divisions formed at its corners, and the corner that is called a *right angle* (*zavit nitzavet*). And by the measure of a thing we mean the extent by which it is established; and you should know that everything has its proper bound, and so the matter is consistent.

So it is for whatever is bounded: by knowing its proper limit entirely, the magnitude and the dimensions are completed, and these are its boundaries. So too for each kind: a surface of several corners (a polygon) is bounded by lines, each being a side of the surface; and a body of several corners (a polyhedron) is bounded by surfaces. Understand this.

[Margin (left side, later cursive gloss, several lines, only partially legible): [verbatim] עשי דה הן הנדה אל[?] ולא ירוץ אן דא שני שטן אלא — a marginal note; further identification requires further verification.]

And by means of a line a thing is established for you, so that you may know its proper limit — that every magnitude, together with the dimensions and the whole of it, constitutes its bounded extent, and that the dimensions correspond to it, its measure being relative to the whole. For a surface of corners (a polygon) is that which is bounded by lines — the sides of the surface; and there is one whose corners are four (a quadrilateral); and where the corners are more numerous than four, it is a surface of many corners (a polygon). By a body of corners (a polyhedron) we mean that which is bounded by surfaces — the sides (faces) of the body.

[Margin (right, later cursive): [verbatim] הנוטל על קו שור אמר — marginal note; further identification requires further verification.]

It is fitting to say that the line is straight (*yashar*), and that the cube (*me'uqav*) has six corners; and likewise for a magnitude of corners — whether a corner of a surface (a plane angle) or a corner of equal sides, which is one of those called right angles. So it is proper to understand that, just as the corner (angle) is set up by lines from a known vertex — the corner called a *right angle* (*zavit nitzavet*), or a corner of two lines, a corner of equal sides, which is the right angle — thus it is

established: each of the corners that they called equal-sided is the corner called *right* (*nitzavet*), the angle that is so named. Understand this.

Principle [Red ink: עקר]. A corner (angle) is that which is enclosed; and you should know that the lines enclosing it are straight ones. A right angle is what they call *nitzavet*, formed when [the lines] are set up; and the extent by which the angle is bounded is what they call its measure (*shi'ur*). And whatever is more or less than this — that which has measure beyond measure — is bounded only by what bounds it.

[Note (right margin, faint, opening of a ruled note): [verbatim] העקר על קו שור — marginal note; further identification requires further verification.]

[Beneath, ruled subordinate note-lines:] Concerning the angle: this is a matter of divisions — and how many kinds are there? — and the matter is consistent. Concerning a body (solid), the angle (solid angle) is what they call a corner; you should know this, and the rest follows. He knew the true account: these are the corners (angles) of the bodies (solids).

The text continues: and concerning a body (solid), the angle upon it is bounded by surfaces meeting at a point, which is the solid angle; and so it is for the matter here, and the construction is built up. A corner of a surface is formed by lines, and a corner of a body by surfaces; and just as the corners of a plane surface are formed by the lines enclosing them, so the solid corners are formed by surfaces — these being the corners (angles) of the bodies (solids). And likewise, if there be a surface bounded by straight lines, the same reckoning applies; and the [solid] corner is so reckoned, and these are called its bounds. Understand this here, concerning [the corners] of bodies (solids).

Gate [Red ink: שער]. Know that each of them (the magnitudes) has its measure (*middah*), and its measure lies in the reckoning (*cheshbon*), to the degree possible, so that it may be known; there is one magnitude that is measured by number, and the corner (angle) likewise.

By a line (*kav*) a thing is measured — that is, the measure of its length; for so it is with the line, one part of it relative to another part. And its measure is by way of division (*chiluk*): how many parts it has, and the parts of the parts — and thus you reckon. And just as the surface is measured by its length and its breadth — that is, the area — and whatever is more is reckoned by the same reckoning in a single manner, so a thing measured is reckoned by how many parts it has. So each magnitude has its measure (*shi'ur*); for one reckons by it upon a single magnitude — that is, the corner (angle) — established upon these dimensions.

So it is proper to say that one is able to reckon each of the parts of the reckoning (*cheshbon*); the measure of magnitudes is a known discipline, and we shall demonstrate these matters there, as is fitting.

To the discipline of reckoning (*cheshbon*) belongs this: that there is first number (*mispar*); a second, measure (*middah*); and a third, proportion (*'erech*). As he says, the reckoning of the first this is — that is, the discipline of measure (*middah*) — for, as he said, the first is number (*mispar*); the measure (*shi'ur*) is reckoned by division; and we shall come to know that.

For if there be something whose measure is taken by counting its parts — that is, its reckoning is by number (*mispar*); for the computation is by number — we mean the units of the parts: how many parts it has, and the parts of the parts, and thus you count (*sefor*). So a thing is reckoned by counting; and the measure (*shi'ur*) is the measure (*middah*) which they call number, and we shall come to know that.

And just as a line is reckoned by division (*chiluk*) — the parts of the parts: how many parts it has, and the parts of the parts, so you count; for so it goes, the part relative to the whole — so too by the corner (angle); and just as the surface is measured by its length and breadth — that is, the area — and whatever is more is reckoned by the same reckoning in a single manner, so a thing measured is reckoned by how many parts it has.

[Marginal note, upper-left: "ודברים קצרים" — "and brief matters / a few words." A scribal aide-mémoire; further identification requires further verification.]

from a line, from a surface, and from a body. As for anything that is a measured magnitude, its whole is reckoned together with its parts. That is to say: when you measure the line, whatever is in it is reckoned by that same reckoning, until you can say of it that it contains so many parts. When you measure the surface, whatever is in it is the surface—that is, the area—and whatever more there is in it is likewise reckoned by that same reckoning. And when you measure a body, it is reckoned by that same reckoning.

So with the reckoning of the line: once you have divided it into parts, each of the parts produced from it is counted by number, and so you reckon that it contains so many parts—for it was a line, and once you have measured it by number you say it contains so many parts. Likewise the reckoning of the surface: you reckon that it contains so many parts. And so too, once you have measured a body, you say it contains so many parts.

Whatever there is in number—and likewise by the division of magnitudes—each of the parts produced from them is reckoned by one and the same reckoning, and so you reckon that it contains so many parts.

[Below this, a small line-figure: three horizontal stroke-marks of differing lengths, each tagged with a single Hebrew letter, illustrating the comparison of magnitudes by measure.]

Diagram. Three short horizontal line-segments drawn one above another at differing lengths, each tagged with a single Hebrew letter-label, illustrating the comparison of magnitudes by measure (how many parts each contains). Reading the marks from top to bottom, the letter-tags are:

- א (upper mark): the longest segment
- ה (middle mark): the middle segment
- ב (lower mark): the shortest segment

[Only the letter-tags א ,ה ,ב are inscribed; no numeric quantity is written beside the marks.]

However much the magnitude is, and the magnitudes are divided, the measure is set down. And the reckoning of the line: its parts are drawn out, and the magnitudes are divided. And the reckoning of the surface: it is the area—that is, however much comes out in the measuring.

and by reckoning. By your hand it comes out, when each portion comes out: each one is set apart from the other things reckoned, and so forth.

[Red ink header: יסוד מועד] (*Yesod Mo'ed — a sectional rubric heading the section on the composition of number.*)

Know that every number is composed of others, and this is the matter that is here set down.

A number is what is composed of others. There is no single number that comes from one alone, except by the unit, one. So too of three, or five, or seven; and so a number is eight, nine, ten, twenty, and onward. The rest of the numbers come from these foundational ones, whereas the unit stands alone—it is not composed by any reckoning of measure.

By your hand one number is read as simple, and these are the small numbers, which are the foundation of the other numbers, of which we have spoken. So the

numbers come from one another: there is the number that comes by multiplying one by another, and there is the number that comes from numbers.

And this is the case: a square number contains however much it contains, and its reckoning is that of the surface—the area—since it comes from a side multiplied by itself. So too, a square number contains however much it contains by a side multiplied by itself; this is the reckoning of a square.

So a square number contains however much it contains by a side multiplied by itself, and the area, which the surface has, comes from a side multiplied by itself; and so by squaring.

Thus a square number contains however much it contains: by 2 multiplied by itself, by 2; and by 3 multiplied by itself, by 3 by 3; and by 4 multiplied by itself; this is a square number, and the area. The area has it by 5 multiplied by itself, and likewise—by 5 by itself, and by 5; and by 6 multiplied by itself, by 6; and so on and so forth, as we have said. And in every one of these numbers, the area is the side multiplied by itself: this is the number reckoned by itself.

Of any of these numbers—a number that is a "plane" number, which has a foundation—each one contains the area of a number, namely what comes from a side multiplied by itself; and likewise a way that is long—however long it is—one reckons it by however much there is in it. And so a number that is read as simple is the area, the foundation of the number.

So that it contains however much it contains, in the reckoning of the area; and at the fifth and the tenth there are more—one says: so many more; for thus by these reckonings the foundation comes out. So too with the foundations, when one has a number: when the side is read by itself, so much; and so however much there is, one reckons it by however much it contains. And the reckoning set down there is that it contains so many parts. He said: this is reckoned by however much it contains. He reckoned it as a square number, and the area that the surface had—reckoned by a side multiplied by itself; and one reads it there as known. So this:

An oblong ("long") number: there is a number that is "long," which contains a parallelogram-area, as by 7; for thus by it comes the foundation of the surface reckoned there. And so a number that is "long" contains a parallelogram-area, as by 7 by 6.

This is reckoned, and so the number is reckoned by however much it contains, and likewise the rest of the numbers contain so many parts; the rest are reckoned together. And the matter of the kinds of the "long" number is that one proceeds: it

contains a parallelogram-area; so too another number—a second one; and of it he says: a number that comes from a side multiplied by itself, and so on—by these reckonings he reckons.

For a small number comes from a side multiplied by itself, and likewise the rest of the numbers—the simple area, and the area that the surface had. And one reckons it, when it is a "long" number, simply, as the area; and likewise the rest of the numbers that are reckoned. And know that:

The kinds of the reckoning of number are these: however much there is to it, there is no number that contains more, since it is the area. From the kind of the first reckoning—how much it is, and one reckons it as that much; and from the unit alone they are read, like the rest of the numbers, by a side multiplied by itself; and beyond that, when one number—

[here a compressed argument: that one number is multiplied by another, in the manner of reckoning by however much it contains, and one is by a side multiplied by itself; and that this one, here—when one number has so much, and another has so much, that it is one number; and so reckoned simply, the area that it contains; and however much it contains.]

And so one reckons a small number simply, as the area; and the rest of the numbers—by a side multiplied by itself; and so this—however much it contains; and one reckons it as a "long" number, simply, as the area, that one reckons it. Behold: every number, when you have divided it one way or another, the one part of it—and likewise, by however much there is to it; even to you, that it is so, and that there is so much to you—that you cannot do otherwise.

Know this too: a number that is a multiple of ten contains parts, from which the part comes out; and so on and on—that he reckons it. And the reckoning of number reckoned simply is the area, which another number has, which it contains—and so the foundation is there, and likewise, as you can.

And one reckons by your hand: the reckoning of the area, that it contains so many parts; and so this is the rule, as we have said.

[Red ink header: שֶׁכֶּר] *(a red sectional rubric; the consonants read שֶׁכֶּר. In this arithmetic primer it heads a sub-topic on proportion/ratio ('erech). The consonants are clear; whether to vocalize it as a technical heading is by context.)*

Know that all numbers stand in proportion to one another, and there is none of them that you cannot set in proportion; for in each of them there is a common reckoning, the foundation, of which we have spoken. The proportion of the first

to the second is such-and-such, by your hand—and likewise: there is for you a way; and behold, there is for you a number; and its proportion is yours.

The reckoning that comes out by these reckonings: behold, a number that comes out simply, the area; and however much there is in the proportion—just as you reckon the proportion of the third to the first, so you should proceed. And there is for you a way of doing it.

[A small ratio-table is drawn here: three rows of two columns, comparing terms by proportion. The right-hand entries are the ordinal terms, the left-hand entries the values.]

(term)	(value)
ראשון [first]	רביעי [fourth = 4]
שני [second]	ששה [six = 6]
שלישי [third]	תשעה [nine = 9]

[The left-column values "four / six / nine" against the ordinals "first / second / third" are legible; the middle value ששה is slightly rubbed but reads "six."]

And reckon its portion by the third; and behold, thus is your way; and proceed: from where the reckonings come.

Know, and so it is, that the proportion of the third—the matter, you reckon it; for the proportion of the first is to the proportion of the third. And know that the proportion of the number that comes out—a way that is long, however long it is, by a side multiplied by itself; and so the way is by a side multiplied by itself; and so know it: the proportion of the first to the second, that you set them—the proportion that comes out; and behold, you understand it, and the kinds of the proportions; for these are matters that depend upon a thing: that you reckon it.

[Red ink header: שֹׁכֵר] (*a second red rubric שֹׁכֵר, opening the next sub-section on proportion.*)

And know this too: that all numbers stand in proportion to one another, and there is none of them that you cannot set in proportion; and behold, there is for you a way in the proportion, of which we have spoken. The proportion of the first to the second is such-and-such, by your hand—and likewise: there is for you a way; and behold, there is for you a number; and its proportion is yours.

For thus, by the matter of your reckoning, there is for you the foundation; and behold:

[A second small ratio-table is drawn at the foot, three rows, parallel to the one above.]

(term)	(value)
ראשון [first]	חמשה [five = 5]
שני [second]	שמונה עשר [eighteen = 18] [?]
שלישי [third]	חמשה עשר [fifteen = 15]

[The values "five / eighteen / fifteen" against the ordinals are the readings; the foot of the page is lightly stained, so the middle value שמונה עשר ("eighteen") is provisional.]

For the reckoning that comes out by these reckonings is the proportion, the foundation, from where it comes. [Text ends at the foot of the page.]

Yesod Olam — Gate I (arithmetic/geometric primer)

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic semicursive. Batch 012 — folio 9r–9v.

they increase one after another following the sequence of the number, and the proportion that is among them grows greater accordingly. So it proceeds, and likewise the count of the number proceeds in the world. From this you understand the matter of the count of the number in the world, and you discern, in the reckoning that arises from it, the proportion that arises with it.

When the proportion is a fourth-part with respect to one count, so too in the count of the number of a surface there is a fourth-part proportion; and when the proportion that arises from it is a third-part, so too it has a third-part proportion. And the part that is a third, and that which is a fourth, with respect to the count of a surface — so too the part that is a fourth corresponds to the count of the count, the third. Likewise here: when this is so, and when it is with respect to the count of the surface, this is the matter that arises from the count of the number; and so the count of the number and the proportion — this is the reckoning.

The reckonings that follow upon them, and the proportion, follow this foundation

[Red ink rubric:] יסוד מוסד — Yesod Musad (Established Foundation). It is fitting that you know that —

The foundation of all this is the saying of the one who says: Know that whatever arises from the numbers brings forth its like, just as the number is one and the number that arises from it is grounded upon it; and these proceed along the way of number. And whatever its part may be — when it comes from the count of the number — what it is and what it arises from, this is the number that comes out; and so the proportion. This is the foundation...

and the part of the number, and the count of the number, is in the surface; and whatever comes out — the count of the number — this is the foundation, when it is so.

A two-cell ratio-comparison is set out at the foot of the column, ruled with a horizontal line under each entry:

[right cell]	[left cell]
(2) ב	(3) ג

When it is so — the number, and this, and the surface — so the surface is the foundation, when its part is so.

[Red ink rubric:] שער — Sha'ar (Gate). It is fitting that you know that —

The proportion that pertains to a surface, and the surface that has a part — when this is so, it is fitting that you know that the proportion of the surface is to the count; and the surface, this is to it the proportion, and from there it comes out.

The surfaces that have a proportion to one another are those bounded by straight lines; and so the proportion of the surfaces is as **four** [arba'].

[Foot of folio 9r. Remainder of the column is blank parchment.]

When it is five [chamishah], and from there the matter is a fourth, and its part — whether with a surface or with a line, and with the surface — and the surface that comes out is the foundation, from there.

[Red ink rubric:] ועוד — Ve'Od (Further). It is fitting that you know that —

There is a surface that is square [meruva'at], whose part is the line that is one, and each part stands [nizav, at a right angle] to it; this surface is the foundation. And there is a surface that comes out, squared [merubba'at], that has a part, and it is fitting that you know it.

The surface that has a part, and the surface that is square — this has its proportion, and from it a part comes out; and so too the proportion of the lines is the foundation, when this is so. And as for its part — surely the square surface that is upon the lines, its proportion is greater. And the lines that are in the squares, that are a part — each one, and a part of one; and whether each one is a part of the surface...

and the surface that is a part of it, and that has a part, and whether it is upon it — the line, and the surface — is the foundation. And whether the proportion that pertains to the surface, when this is so: there is a square surface that has a part, and there is a square surface that is greater, and there is a surface...

[Red ink rubric:] **זוה צורת המשולש** — *And this is the form of the triangle* (caption introducing the triangle diagrams in the margin).

When it is straight [yashar] — the triangle, and the surface — when this is so: the triangle that is upon the line that is straight, and the surface that comes out from the triangle, when this is so. And the triangle that has three lines, whether it be square[-cornered] or not, and the triangle... the surface is the foundation. And the surface of the triangle [shetach HaMeshulash] is half of the square surface that is upon the line [base] of the triangle. And the triangle that is right-angled, and the triangle that is [obtuse-]angled, and the triangle that has [acute angles].

Diagram. A group of triangles drawn in the right margin alongside the prose, illustrating "the form of the triangle." From top to bottom: a tall narrow (acute/scalene) triangle, a broader triangle below it, and a third triangle near the foot. No interior letter-labels are legibly inked on the triangles themselves; the accompanying boxed captions (below) name the figure-types. The triangles are uncaptioned within their outlines.

[No legible vertex letter-labels (א/ב/ג) are inked inside the triangle outlines.]

and so the triangle, and the surface, and the proportion, when this is so, and its part, and whether it is upon the line — the surface is the foundation. And there is a triangle whose angles [zaviyot] are [unequal], and the surface that comes out, and from there. And whether the triangle that is [thus], and the surface — and so on.

In the right margin, three boxed labels accompany the figures (read top to bottom):

- **[Boxed label:]** **ניצב** — *nizav* ("right[-angled]")

- **[Boxed label:] גִּירָךְ** — *girekh / yarekh* ("flank / leg"; the side of a triangle) [?: גִּירָךְ / יִרִיךְ]
- **[Boxed label:] נְשִׁלְמִין / מְעוּיָן** [?: two-word boxed label, partly rubbed — "completed" / "rhombus (me'uyyan)"]

[Lower half of folio 9v is blank parchment, apart from ink-spatter at the gutter.]

Yesod Olam — Gate I (Geometric Primer)

The opening lines continue the discussion of surfaces from the previous folio: this proportion of theirs holds whenever two surfaces are equal. And likewise, when one finds the proportion of one of the two surfaces to the other, [the proportion] of the surfaces [is established]. For the surface called *me'uyyan* [rhombus] is [bounded] by four equal lines, and its [opposing] angles are equal, two by two; and the surface [?: term partly abraded] [...]. We have shown the proportion of the surfaces by way of [the proportion of] the lines that subtend them; and remember this and grasp it well.

[Red ink rubric:] לימוד ראשון — First Lesson.

Now I shall explain to you the matter of this [figure]. When you wish to draw three [equal] lines, all of them equal — that is, when you have a line before you and you wish that there be drawn upon it a triangle whose sides are all equal — do as follows: place the point of the compass [מחוגה] at one end of the line and mark an arc; then [place it] at the other end and mark a second arc; and the two arcs will intersect each other, [yielding] one point. And this is [its] form:

Diagram. Two equal overlapping circles (a vesica-piscis construction). The two circles intersect, and a triangle is inscribed across the intersection, its apex at the upper crossing-point of the two arcs and its base joining the two centers. Visible letter-labels:

- ב (left): center / left vertex of the base
- א (apex, upper intersection of the two arcs): top vertex of the triangle [?: small, rubbed]
- ג (right): center / right vertex of the base

[The prose builds the equilateral triangle on the base ג-ב, with its apex at the point א where the two arcs cross.]

And it has already been explained that the line that goes out from the center of the circle to its circumference [is equal to its fellow]; therefore the two lines

drawn from the two centers to the point of intersection are equal to the line between the two centers, and so the three sides are equal. And this is what we wished [to show].

[Red ink rubric:] לימוד שני — Second Lesson.

Now I shall explain to you another matter. When you have a known line and you wish that there be drawn upon it a triangle two of whose sides are equal — that is, an isosceles triangle — and the third [side] is [unequal]: do as follows. Set one foot of the compass at one end of the line, [and open it to a measure] greater than [half] the line, and mark an arc; and [set it] at the other end with the same opening and mark a second arc; and the two arcs intersect, [giving] one point. And from that point draw two lines to the two ends of the line, and they will be equal to one another, [while] the base [differs from them]. And this is its form:

Diagram. Two overlapping circles with a horizontal diameter drawn through both centers; an isosceles triangle is inscribed, its apex at the upper intersection of the arcs and its base along the common diameter. A short vertical line drops from the apex to the base (the altitude). Visible letter-labels:

- ב (left end of the horizontal line)
- ט / center marks along the base [?: small, rubbed]
- ג (right end of the horizontal line)
- א (apex) [?: very small]

The discussion of the isosceles construction concludes: the two lines from the apex to the two ends of the line are equal, [each] being a radius [drawn] to the circumference; therefore the triangle is isosceles, and this is what we wished.

Now if it had been [drawn] so that the apex fell elsewhere [?: clause sense uncertain], the same demonstration would hold: in every case the two lines from the point of intersection to the two ends are equal, because each is equal [to its fellow] as a line from the center to the circumference, and so [the triangle] is isosceles. Understand this.

[Red ink rubric:] לימוד שלישי — Third Lesson.

Now I shall explain to you the manner of [constructing] a triangle whose three sides are unequal, each [differing] from its fellow — that is, a scalene triangle. Set the foot of the compass at one end of the line and open it to one measure, and mark an arc; then [set it] at the other end and open it to a different measure, and mark a second arc; and the two arcs intersect [at] one point. And from that point

draw two lines to the two ends of the line; and the three sides will be unequal, each [differing] from its fellow. And this is its form:

Diagram. A large circle with a smaller circle inscribed/overlapping at the lower left; a triangle is drawn within, its sides of unequal length, formed by lines running from the intersection-point of the two arcs to the two ends of the base line. Visible letter-labels:

- ד (upper region of the large circle)
- ג / ב (along the base) [?: small, rubbed]
- א (intersection point) [?: small]

The lines from the point [of intersection] to the two ends of the line differ from one another because the two openings of the compass were different; therefore the two sides are unequal, and likewise the base [differs] from each; and so the three sides are unequal, each from its fellow. And this is what we wished.

[Red ink rubric:] לימוד רביעי — Fourth Lesson.

[The text continues with a further construction.] Set the foot of the compass [מחוגה] and draw a circle; mark its center; and from the center draw [a line] to the circumference [...]. The proportion of the diameter [קוטר] to the circumference [...] [?: clause partly abraded]. And [it has been shown that] every line drawn from the center to the circumference is equal to its fellow.

Diagram. A single circle with its center marked and a radius drawn from the center to the circumference (a short slanting line within the circle). Visible letter-labels:

- ב (center) [?: small]
- ד (on the circumference) [?: small]

[Red ink rubric:] לימוד חמישי — Fifth Lesson.

[The text turns to triangles set within or related to the circle / to comparing triangles.] When you have a triangle and you wish [to find] its measure [...], the lines [...] [?: clause partly abraded]. And the proportion of one [triangle] to the other [is as the proportion of] their bases [?: sense uncertain]; [and] this is its form, and likewise [for] all of them.

Diagram. Two small triangles drawn side by side at the foot of the column (the figure for comparing triangles). Each is an open triangle with letter-labels at its base corners:

- Right-hand triangle: base-corner labels [?: א / ב, small and rubbed]
- Left-hand triangle: base-corner labels [?: small and rubbed]

And these are the foundations [of geometry] that we have set forth [as a primer] to its subject. [The primer closes here.]

Gate I (un-numbered), geometric primer — construction lessons continued. Spanish Rabbinic semicursive, single column, black ink with red-ink lesson rubrics (לימוד).

the remaining lines drawn will be equal to one another, since the surface [enclosed] within them is one and the same surface, and the triangle that results from them will be [an] equilateral [triangle]. And likewise the line drawn upon the surface, if it be a straight line, [?: clause partly compressed]. And [as for] the point that falls upon the line and divides it into two equal parts: if you draw from it [a line] up to the apex of the triangle, that line will stand at right angles to the base line, and the two angles it makes on either side of it will be equal — and this is what we set out to demonstrate.

And [as] for the line drawn upon the surface from the point: when it is drawn straight from the apex of the triangle down to the base, and the two parts are equal, then the surface is divided into two equal triangular surfaces, [each] equal to its fellow. And this is the surface, [and] this [is] the line that was drawn upon it, and [this is] the demonstration of the lesson.

[Red ink rubric:] לימוד ששי — Lesson Six.

When two triangular surfaces are equal, [?: and] the [length of the] side of the one is equal to the [length of the] side of the other, [then] likewise [the corresponding] side will be equal [?]. [The construction:] take the triangular surface and draw upon it from one of its angles down to the [opposite] side, [a line that meets the base] at right angles; then the surface is divided into two equal parts.

Diagram. A large triangle drawn in the lower-left portion of the page, point-down/apex-up, with light internal lines descending from the apex toward the base, dividing the figure. The figure is unlabeled or its small corner letters are rubbed; only faint marks are present at the vertices.

- [apex]: [label rubbed — ?]
- [base-left]: [label rubbed — ?]
- [base-right]: [label rubbed — ?]

[Red ink rubric:] לימוד שביעי — Lesson Seven.

When you wish to draw a triangular surface whose three sides are equal [an equilateral triangle], [proceed as follows]: [?: the three sides being equal to one another]. Take a straight line of whatever length you wish, [and] this is its base line. [?: Then with the compass set to the length of that line,] draw from one of its endpoints [an arc], and from the other endpoint [a second arc]; and the point where the two arcs meet [is the apex]. Draw [a line] from there to each of the two endpoints, and you will have a triangle whose three sides are equal.

Diagram. A triangle in the lower-left of the page resting on a horizontal base, apex above, with the two intersecting construction arcs/lines meeting at the apex. Small vertex letters are present but rubbed.

- [apex]: [label rubbed — ?]
- [base-left]: [label rubbed — ?]
- [base-right]: [label rubbed — ?]

[End of folio 11r. The construction-lesson sequence continues without break onto 11v.] When the two [sides] are equal to one another, the [resulting] surface is a triangular surface [?: of the desired kind]. And [as for] the base line: it is already known [?], for it is the line of the surface [you began from]; and [the apex point is found] where the two [arcs] meet. Draw from it [the apex] to each of the two endpoints of the base, and you will have a triangle whose three sides are equal, each side equal to its fellow — and this is what we set out to demonstrate. And this is the surface, and these are its three sides equal to one another — and this [is] the demonstration of the lesson.

Diagram. A triangle in the upper-right of the page, drawn with a long sloping right side, resting on a base. Faint vertex letters appear at the corners but are too small/rubbed to read with confidence.

- [apex]: [label rubbed — ?]
- [lower-left]: [label rubbed — ?]
- [lower-right]: [label rubbed — ?]

[Red ink rubric:] לימוד שמיני — Lesson Eight.

When you wish to draw a triangular surface having one right angle [a right triangle], [proceed thus]: [?: take a straight line, this is the first side]. Draw upon it [a line] from one endpoint standing at right angles [perpendicular] to the line, of whatever length you wish, [and] this is the second side. Then draw [a line] connecting the end of [the perpendicular] to the [other] endpoint [of the base], and you will have a triangle one of whose angles is a right angle.

Diagram. A triangle on the left side of the page with a vertical line dropped from the apex to the base, showing the right-angle construction. Vertex letters are present but small/rubbed.

- [apex]: [label rubbed — ?]
- [base-left]: [label rubbed — ?]
- [base-right]: [label rubbed — ?]

[Red ink rubric:] לימוד תשיעי — Lesson Nine.

When you wish that there be a straight line, and that you erect upon it [a line] standing [perpendicular] to it at a given point upon the line: place one foot of the compass upon the point, and mark off [from it equal distances] to either side, [yielding] two points; and the part [of the line cut off] on this side is equal to the part on that side. Then open the compass [wider than half that interval] and draw from each of the two points [an arc]; [where the arcs meet above] draw [a line] from the [given] point [up to the meeting point], and it will stand at right angles to the line — and this is what we set out to demonstrate.

Diagram. A triangle on the left of the page with a perpendicular dropped from the apex to a marked point on the base; the base shows the two equal marked-off segments. Vertex/point letters small and rubbed.

- [apex]: [label rubbed — ?]
- [base points]: [labels rubbed — ?]

[Red ink rubric:] לימוד עשירי — Lesson Ten.

When you wish that there be a straight line and that you erect upon it [a perpendicular] at its endpoint [rather than at a midpoint]: [?: take the line and] set off from the endpoint [a measured segment]; [open the compass] and draw [arcs] from the marked points, [and] where they meet draw [a line] down to the endpoint, [so that it stands] at right angles to the line.

Diagram. A figure at the lower-left: a horizontal base line carrying several marked points, with a perpendicular line rising from a point on it to an apex above, and the construction lines forming a triangle. Several small point-letters lie along the base but are rubbed.

- [apex]: [label rubbed — ?]
- [base points (multiple)]: [labels rubbed — ?]

[Red ink rubric:] לימוד י"א — Lesson Eleven.

When you wish [to divide / to construct upon] a straight line [?: that it be divided into equal parts], [proceed as follows] ... [text continues onto the following folio].

[End of folio 11v.]

[Marginal note, upper left, second hand: ונתת 7] [verbatim text only; partly rubbed]

and you draw [the line] from this point upon it, and you extend it toward the point until they meet one another at [the point]. Therefore, since the line you drew is equal to the line drawn by the two of them, as we explained, it follows that this line is greater [than the other]; and so it is, since it is greater than the second line. And this is what we set out to demonstrate.

Diagram. A crossing-lines (kite-like) construction in the upper-left of the page: two lines drawn from an apex at the right cross a pair of lines rising from the foot, meeting at interior points.

- ב (apex, right): reference point
- ה (upper left): reference point
- ט (foot, left): reference point
- [?] (lower vertex): rubbed

The construction proceeds upon the line at the point and divides it; and so you join the line to the point as it should be. And you set them upon the line until it meets it, so that this holds for it and it comes out as required. Hence, when you cut from it a line equal to the line that was drawn — that is, this same line — then the angle of the line is equal [to the other angle], and the line which is drawn is therefore greater than the line that is drawn. And if you extend the line and continue it, the line will run to the point, and the work is finished. Thus you have constructed upon a line two equal angles, the one and the other, each equal to the other. And the angle which is drawn is greater than the line that is drawn; and so likewise the line, as we explained.

Lesson Twelve [לימוד י"ב]. Know that for every line that is given, and every angle that is given — this line and these two angles — when you wish to construct upon them an angle equal to a given angle, and to bisect that angle: take a line, and you set it from this point toward the point, the construction-point upon it. And it will come out that the angle is greater than the line drawn from them, as we explained. And the line is drawn as a surface, as is explained in Lesson Ten. And now, when you take the angle of the surface and bisect it, you draw it to the line of the compass. Thus you have a line which divides the angle into two, the one

and the other, each equal to the other; and so you construct upon a line two angles, that they be equal — that the construction-point be drawn upon [the line] — and you draw the angle of the surface, and another angle; and so by these compasses you cut from it the angle of the surface, and you call it the angle of the surface, and so likewise, as is explained, the two angles of the surface — that is, the angle of the surface — and so, by this rule, two angles of the surface, the one and the other, and the two angles, and so they meet one another.

Diagram. A right-triangle figure in mid-page, with its apex at the top and a horizontal base below.

- $\beth$ (apex): reference point
- $\daleth$ (base, left): reference point
- $\aleph$ (base, right): reference point

Lesson Thirteen [ל"ג]. The given line, which is equal — it is equal at the three points, so that it should be a line and a square. We set down, then, a line at this point, and place it from the one to the other; and the three points are equal upon it, and we say that the angle is from them.

Diagram. An equilateral-triangle figure at the foot of the page, apex above and base below.

- $\heartsuit$ (apex): reference point
- $\daleth$ (base, left): reference point
- $\aleph$ (base, right): reference point

Therefore, since the line which was drawn upon it was equal, and the perimeter which is upon it is equal at every place by itself, the line is drawn from them. And it is from the two construction-points, the angle of the line being equal; so when you draw it, the angle will be equal, and it is great. And the line which is drawn, as we [said] — so the line which is drawn from the points, the equal one, each equal to the other — is a line drawn from the angle, equal to the angle drawn from it, each to the other. And as is explained, the line drawn from it, each to the other; and as we said, and so likewise the line drawn from them. And this is what we set out to demonstrate.

Diagram. Two stacked triangles in the upper-right of the page, each with an apex above and a base below.

- $\heartsuit$ (upper apex): reference point
- $\daleth$ (upper corner, left): reference point

- ט (upper corner, right): reference point
- ה (lower apex): reference point
- ט (lower base, left): reference point
- ג (lower base, right): reference point

Lesson Fourteen [לִימוֹד י"ד]. And as you know this, that you know the side, the given angle, and the line which is equal — let it be a triangle. For the line which is great — that is, the triangle which is equilateral — and so that you choose for it three equal sides: the line which is equal at the three places by itself; and we say that the side is a square from them, then [it follows], and so they say. And it should be that an equilateral triangle is a triangle whose three sides are equal; and the angle should be equal at the three places, for the construction-point, so that it should be [equal]. For when the side from it is [equal], this is what we set out to demonstrate; and as is explained, the triangle; and so likewise the side, that it be from it equilateral. And it is — the line is great, that it be equilateral; and likewise the line which is equal from it; and the line which is great is equilateral; and likewise the line which is equal, it being equilateral; and likewise the line which is equal from it, it being equilateral.

Diagram. A triangle at mid-left of the page, apex above, base below.

- ה (apex): reference point
- ט (base, left): reference point
- ב (base, right): reference point

Lesson Fifteen [לִימוֹד ט"ו]. Know the measure of the altitude of every triangle, and its every measure. For this is the matter: that you bisect the surface — which is the base — by the altitude of the triangle, the side which is drawn from it; do this. And so as to choose for it the side of the surface, the line of the compass; and you draw the measure of the altitude of the side, the three; and you set them upon the line, the surface, by it. This is the great line from them — that is, the triangle which is equilateral; and so the draughtsmen who construct it — when the great line is from them, and the perimeter [is upon] the triangle, this great line. And you cut the side; the draughtsmen who construct, when they say it is the half, and the angle is half, the line being equal to it; and you place upon them [a line], so there will be an angle, and you draw from it an angle equal to it. And so it is a line, the half of the perimeter, that it should be equal at [the point], the angle equal to it — that you join to it; so the side, the surface, until it cuts the line, the half-perimeter; and so it is a line, the half of the perimeter. And you call it the side, the perimeter, and you cut it from it, the half of the perimeter. And it is the

great line, drawn from them, the half, so that there should be from it [a measure equal] to it; and it being so, the line of the perimeter, it being so, equal to the measure of the altitude; and so the draughtsmen who construct; and so it being so, equal to it.

Diagram. A right-triangle figure at mid-right of the page, apex above, the right angle at a base corner.

- $\aleph$ (apex): reference point
- η (upper, near apex): reference point
- τ (base corner, right angle): reference point

Diagram. A short ruled line-segment in the right margin, with two parallel marks above and below — a line-segment diagram for Lesson Fifteen.

- η : reference point
- τ : reference point
- $\beth$: reference point

Lesson Sixteen [ל"מ ט"ז]. Upon a line which makes a triangle, that it be of three equal [sides] — a triangle. This is the matter: the points equal to this, that it be — the point which is upon the path of the line — that you continue it toward the point; the line which is equal, and you continue it and join it to the measure until [the point], up to here; thus you know the measure; and the perimeter from it up to [the point], so that it should be the half of the perimeter; and so it being so, the perimeters from them, up to [the point], the perimeters, and so they meet one another.

Diagram. Two intersecting circles at the lower-left, with a chord and radii drawn; the construction of an equilateral triangle on a line by intersecting arcs.

- η (top): reference point
- τ (foot): reference point
- $\beth$ (intersection): reference point
- $\aleph$ (intersection): reference point

Diagram. Two intersecting circles at the lower-right, the construction of an equilateral triangle on a line by intersecting arcs, with a short caption above [reading מחוגה, "compass," or similar — partly rubbed].

- η (top): reference point
- [center point]: reference point

- ט (foot): reference point
- כ (line endpoint): reference point
- ז (line endpoint): reference point

[Script: Sephardic semicursive, a single hand throughout. Section rubrics (לימוד = "Lesson") and the display words ועתה / ועוד are written in a larger display module of the same hand and the same brown ink, not in red. Folio "13" in pencil at the top outer corner of the first page (modern foliation).]

the line, so that the point is taken at the desired distance, and you extend it as far as you wish; likewise you take a line of three lengths and extend it as far as you wish, until you have built upon it a [figure] equal to the one given to you. And by this same method you may build a figure equal to a given figure and similar to another given figure: you take one of the two figures and, by the method we set out, construct [a figure] equal to it; then upon that same line you build a [figure] similar to the second one.

And he said: when two surfaces are equal, and you wish to construct upon them a single [combined] figure, this you do by the method we have explained.

By this you also know how to build, from many figures, a single figure equal to them all, for the matter follows the same path we have set out.

Lesson 16. [לימוד י"ו]

When you are given a line, and you wish to construct upon it an equilateral triangle, you take the given line and extend it as far as you wish. Then set the point of the compass at one of its ends and, with an opening equal to the whole line, draw an arc; likewise set the point at the other end and, with that same opening, draw a [second] arc, until the two arcs meet at one point. From that point of meeting you draw two lines, one to each end of the given line; and there results an equilateral triangle, since each of its three sides is equal to the [given] line.

Already you have learned how the construction is, and this is as we said.

Lesson 17. [לימוד י"ז]

When you are given a line, and you wish to draw from one of its ends a line that makes with it an acute angle, you take the given line. Upon it, at one of its ends, you raise [a line at] an opening of less than three lengths [i.e. subtending less than the full base], so the two lines meet, and the angle that is between them is acute.

[Margin, left edge: a short two-line note in the same hand — "הקו אשר ירצה לעשות בו" ("the line upon which he wishes to make this angle"). A constructive helper keyed to the prose; no named authority.]

[The text then treats the converse — drawing a line that makes an obtuse angle — by the corresponding wider opening, concluding that by this method you may make at the end of a line either an acute or an obtuse angle, as you wish.]

Diagram. An equilateral triangle with its apex above a horizontal base — the construction with intersecting arcs for Lesson 16.

- א (apex): vertex above the base
- ב (base, right end): base endpoint
- ג (base, left end): base endpoint

Diagram. A second triangle of the same construction, drawn beside the first; the apex vertex is faint.

- ה (apex) [?]
- ו (base end)
- ז (base end)

Lesson 18. [לימוד י"ח]

Already it has been shown to you what is required, namely how, when a straight line falls across two [other] lines, you measure the angles that arise. You take the line and lay it across the two given lines so that it cuts them both; and you consider the angles formed at the two intersections.

When the alternate angles are equal, the two lines are parallel; and conversely, if you find the corresponding angles equal, the lines are likewise parallel. By this you reason about the interior and exterior angles that fall on one side and on the other. [The argument runs through the alternate, corresponding, and co-interior angle relations of a transversal crossing two lines, concluding that equality of the proper pair of angles is the sign that the two lines neither meet nor diverge.]

And he said further: it has already been shown that when a straight line falls upon two parallel lines, the alternate angles it makes are equal, and the two interior angles on the same side are together equal to two right angles. By this path the matter proceeds.

Diagram. Two horizontal parallel lines crossed by an oblique transversal — the figure for Lesson 18. Each line is lettered at its ends and the transversal-crossings are dotted.

- ב / ז (upper line, the two ends)
- ל / ד (lower line, the two ends)
- the crossing points of the transversal are dotted but unlettered

[Margin, lower left of the page: a short note in the same hand — "הקו אשר ירדף / ויתקנם לזה" ("the line that follows to the end of this angle, and one sets them right for this"). A constructive helper keyed to the prose; no named authority.]

[The foot of folio 13r is blank parchment below the diagrams — no further text.]

the angle that is at it, equal to the [given] angle. And so you measure the second angle, the one at the other end; the angle that arises there is equal to it. By this method you take one side, and the corresponding angle of the second figure is the equal of the first; therefore the second figure is similar to the first, the angles at one end matching those at the other. By this the matter is established.

[Display:] And now — [ועתה]

— since this is so, by the method we have set out one builds upon the given line angles equal [to the given angles], and one draws the sides so that they meet; you take one side and the angle that is upon it, and the resulting figure is similar [to the given one].

Lesson 19. [לימוד י"ט]

When you are given a line, and you wish to draw a parallel to it through a point that is outside it: you take the given line, and from the given point you draw a line to it, meeting it at some point. At that point of meeting, upon the line, there is an angle; you copy that angle at the external point, making there an angle equal to it on the alternate side. Then you extend the line through the external point, and it runs parallel to the given line, because the alternate angles are equal — and equal alternate angles are the sign of parallel lines.

Diagram. A horizontal given line with a second line drawn parallel to it through an external point, joined by an oblique connecting line (the transversal that carries the copied angle). Ends are lettered; labels rubbed.

- the given line and its parallel are each marked at their ends

- the external point and the crossing point are dotted

Lesson 20. [לימוד כ]

[The lesson opens:] *let it be drawn out* [ימשך — "is extended / drawn out"; this verb opens the construction, not a numeral. The prior pass read the opening token as "nineteen," which is geometrically and structurally impossible; at this resolution it is the word ימשך, governing the line of the construction.] ... upon the line, until you reach the desired length, and you extend it, and you make at it a [right] angle and a further angle. By the method we set out, when two surfaces [areas] are equal, and the angle that is between them on the one side equals the angle that is between them on the other side, then their bases too are equal; and conversely, when the base-angles are equal, the sides are equal.

[Display:] And further — [ויעוד]

— it will be shown to you how, when you are given a triangle whose two base-angles are equal, you prove that its two sides [the legs] are equal: for if the angles at the base are equal, the two sides that subtend them are equal.

Diagram. An isosceles triangle with its apex above a horizontal base — the figure for the equal-base-angles result. Vertex labels are rubbed.

- apex vertex
- ה / ל (base ends)

[Display:] And now — [ועתה]

— also: take an angle, the line that arises, and the surfaces being equal, you draw out this angle. [The closing sentence restates that the construction just given carries over to the equal-area / equal-angle case.]

[The foot of folio 13v is blank parchment below the last line — no further text. A short note runs vertically along the inner (gutter) edge of folio 13v in the same hand; it is largely abraded and securely recoverable only as "...לימוד..." ("... lesson..."). A constructive cross-reference, not an attribution. [?]]

Isaac ben Joseph Israeli, Yesod Olam. Gate I, the geometric primer. Spanish Rabbinic semicursive, single column, brown ink throughout (lesson rubrics in a slightly heavier brown, not red). The numbered construction-lessons run from לימוד כ (Lesson 20) into לימוד כ"ו (Lesson 26). Several small line-figures with vertex labels sit at the foot of the columns and in the margins.

(Continuation of the lesson begun at the foot of the previous folio.)

and we have already shown that angle [ב] is equal to angle [ג], and angle [ב] [ג] [?] is equal to angle [ב]; and the two surfaces being equal each to its counterpart, this angle is therefore equal to that angle, and this side equal to that side. And likewise the [remaining] sides are equal each to its counterpart, and this is what we wished to show.

לימוד כ — Lesson 20

The matter is: that when there are two triangles, and the two sides of the one are equal to the two sides of the other each to its counterpart, and the angle contained by the two sides of the one is equal to the angle contained by the two sides of the other, then the base of the one is equal to the base of the other, and the triangle [as a whole] is equal to the [other] triangle, and the remaining angles are equal each to its counterpart — namely those angles that the equal sides subtend.

The way to show this: let the two triangles be such that side [this] is equal to side [that], and side to side, and the angle contained between them equal to the [other] contained angle. Then I say that the base is equal to the base, and the surface equal to the surface, and the remaining angles equal each to its counterpart. The demonstration: were we to set the one triangle upon the other so that the equal angle falls upon the equal angle, then the equal side falls upon the equal side, and the [other] equal side upon its equal; and the base therefore falls upon the base, point upon point. The two bases therefore coincide and are equal, and the whole surface is equal to the whole surface, and the remaining angles are equal each to its counterpart — and this is what we wished to show.

Diagram. A row of small rectilinear figures drawn at the foot of the column — a rectangle with a diagonal, and adjoining triangles — illustrating the equal-angle / equal-side congruence result of the lesson.

[Margin, left: a short gutter note in a lighter secondary hand — "...כפל...דלת..." [?]. Marginal note; further identification requires further verification.]

לימוד כ"א — Lesson 21

The matter is: that when there are two triangles whose two angles are equal to two angles each to its counterpart, and one side equal to one side — whether the side lying between the two equal angles, or one of the sides subtending the equal angles — then the remaining sides are equal each to its counterpart, and the remaining angle equal to the remaining angle.

Let the two triangles be drawn so that this angle is equal to that angle and this angle to that, and the side between the two angles equal to its counterpart. I say the remaining sides are equal each to its counterpart and the remaining angle to its counterpart. For if one side were longer than its counterpart, let the longer be cut off equal to the shorter and a line drawn; then the smaller triangle would equal the whole, the part equal to the whole — which is impossible. The sides are therefore equal each to its counterpart, and so the angle is equal to the angle, and the remaining sides are equal each to its counterpart — and this is what we wished to show.

לימוד כ"ב — Lesson 22

The matter is: that when there are two triangles whose three sides are equal each to its counterpart, then the angles too are equal each to its counterpart — namely the angles that the equal sides subtend.

Let the two triangles be drawn so that this side is equal to that side, and this side to that, and this side to that. I say the angles are equal each to its counterpart. For if the angle contained by the two sides of the one were not equal to the angle contained by the two sides of the other, then one base would be longer than the other; but the bases are equal, the sides being equal each to its counterpart. The angles are therefore equal each to its counterpart — and this is what we wished to show.

(Foot of 14r; the lower half of the folio is blank parchment below the rubric of the next lesson.)

לימוד כ"ג — Lesson 23

And so likewise, when there are two equal four-sided surfaces [שטחים מרובעים — quadrilateral figures] ... [the lesson opens here with its rubric; its body runs onto the next folio].

(Continuation of Lesson 23 from the foot of 14r.)

these two equal four-sided surfaces — when this side is equal to that side, and this angle to that angle, then the [remaining] sides between the [given] points are equal, point to point. For were one side longer than its counterpart, let it be cut off equal and a line drawn out; then the part would equal the whole, which is impossible. Each of these is therefore equal to its counterpart, and this is what we wished to show.

לימוד כ"ד — Lesson 24

The matter is: that we wish to set out three lines and join them so that they contain a triangle, the three given lines being such that any two of them are [together] longer than the third. Let the three lines be given. We take one of them and set its endpoint as a center, and with the second line as radius we describe a circle [arc]; and from the other endpoint, with the third line as radius, we describe a second arc, and where the two arcs cut one another is the apex. We draw lines to the two endpoints, and the triangle is contained by the three given lines — and this is what we wished to show.

לימוד כ"ה — Lesson 25

The matter is: that there are two triangles in which one angle of the one is equal to one angle of the other, and the two sides containing the equal angle of the one are equal to the two sides containing the equal angle of the other each to its counterpart; then the base is equal to the base, the surface equal to the surface, and the remaining angles equal each to its counterpart — namely the angles that the equal sides subtend, and this is what we wished to show.

לימוד כ"ו — Lesson 26

The matter, by way of demonstration, is: that there are two triangles drawn upon one [given] line, on the same side of it, whose apices meet, such that the two sides drawn from the endpoints of the line to the apex of the one are equal to the two sides drawn to the apex of the other each to its counterpart — then the [two] apices coincide, point upon point, and the surfaces are equal one to another, and this triangle is equal to that, and the remaining sides are equal each to its counterpart between the [given] points. Let this be the given line, with point [ר] its apex and point [ט] the apex of the other; and the surfaces being equal, this side is equal to that side, and point to point.

Diagram. At the right margin beside Lesson 26: a quadrilateral with both diagonals drawn (an X across the figure) and a small triangle pendant below at the lower left, illustrating the equal-surface / equal-side result.

between point [ר] and point [ט]; and so likewise the [remaining] sides are equal each to its counterpart, and this is what we wished to show.

Isaac ben Joseph Israeli, Yesod Olam. Gate I, the geometric primer. Spanish Rabbinic semicursive, single column, brown ink throughout (lesson rubrics in a slightly heavier brown, not red). The numbered construction-lessons continue

from לימוד כ"ז (Lesson 27) through לימוד ל' (Lesson 30). Two line-figures (a right-angle/rectangle figure beside the first rubric, and apex-and-base triangle/fan figures) sit in the upper regions of the folio sides. The conservation ruler and the black mount strip down the side of each opening are photography furniture and are not part of the page.

[Margin, upper outer corner: folio number "15".]

לימוד כ"ז — Lesson 27

[Inset beside the rubric: a small right-angle (rectangle-with-foot) figure, brown ink — see diagram below.]

The matter is this: that the perpendicular dropped upon a given line stands upon it at right angles. When two squares are equal and their sides are equal, the figures themselves are equal — square κ equal to square τ , and likewise the remaining sides each equal to its counterpart; and so the perpendicular standing upon the line makes the angle on either side a right angle. When you set the compass upon point κ and draw an arc, and again upon point τ and draw its arc, the two arcs meet, and the line joining them is the perpendicular sought. And this is what we wished to show.

Diagram. A small rectilinear figure beside the Lesson 27 rubric: a vertical stroke meeting a horizontal base at a right angle (a right-angle / rectangle-with-foot mark), illustrating the perpendicular standing upon the given line. The vertex letters are small and partly rubbed.

- [apex / top of vertical]: κ [?]
- [foot, where vertical meets base]: κ [?]
- [base, right end]: τ [?]

לימוד כ"ח — Lesson 28

The matter is this: that when a perpendicular is dropped from a point to a given line, and from the same point two further lines are drawn to the line on either side of the foot of the perpendicular, the line nearer to the perpendicular is shorter than the line farther from it.

For if you set the compass and draw from the point the two lines, and the angle which the one makes at its foot is a right angle while the other is oblique, then the line subtending the right angle and the line subtending the oblique angle are not equal; the one drawn obliquely is the longer, and the one nearer the perpendicular the shorter. And so likewise for every further line drawn to the

same line: the more it inclines away from the perpendicular, the longer it grows, each in proportion to its distance. And this is what we wished to show.

Diagram. A triangle/fan figure: an apex point above a horizontal base, with several lines drawn down from the apex to points along the base, illustrating that lines drawn from a point to a given line lengthen as they incline farther from the perpendicular. The apex letter and the base-point letters are small and partly rubbed.

- [apex]: א [?]
- [base, point 1]: ב [?]
- [base, point 2]: ג [?]
- [base, point 3]: ד [?]
- [base, right end]: ה [?]

The lesson continues across the foot of the page, restating in the equal-and-unequal-lines idiom that two lines equally distant from the perpendicular on either side are equal to one another, while lines unequally distant are unequal — the nearer shorter, the farther longer. And this is what we wished to show.

The result is, then, that the perpendicular is the shortest of all the lines that can be drawn from the point to the given line, and that of the remaining lines, the nearer to the perpendicular is always the shorter and the farther the longer; and two lines equally distant from it, one on each side, are equal to one another. And this is what we wished to show.

לימוד כ"ט — Lesson 29

The matter is this: that when two lines are drawn from a single point to a given line and are equal to one another, they stand at equal distances from the perpendicular — the one on this side and the other on that. For if you set the compass upon the point and draw the two equal lines, the two triangles they form with the perpendicular are equal, and the segments they cut upon the line are equal each to its counterpart; therefore the two lines are equally distant from the foot of the perpendicular. And this is what we wished to show.

לימוד ל' — Lesson 30

The matter is this: that the perpendicular dropped from the apex to the base divides the figure into two equal parts, and the two lines drawn from the apex to the two ends of the base are equal each to its counterpart. [A small figure stands beside the rubric — see below.]

For when you set the compass upon the apex and draw the two lines to the two ends of the base, and the perpendicular falls between them, the angle on the one side is equal to the angle on the other, and the segments of the base are equal; therefore the two lines are equal each to its counterpart, and the figure is divided into two equal parts. And likewise the perpendicular from the apex to the base, and so too each of the two lines — equal each to its counterpart. And this is what we wished to show.

Diagram. A triangle/fan figure at the foot of the verso: an apex point at the top with several lines descending to points spaced along a horizontal base, illustrating the equal-division result of the lesson. The apex letter is at the top; the base bears a row of point-letters, partly rubbed.

- [apex]: א [?]
- [base, point 1]: ב [?]
- [base, point 2]: ג [?]
- [base, point 3]: ד [?]
- [base, right end]: ה [?]

the line falls upon a single line, and if you wish to draw it out further it will be drawn out, and from it [you proceed] until there comes to be a square root. And so it is for every ratio: thus [the figure] will be known. The terms are each [taken] one from another. So this is the line [אב] [?: cramped abbreviation], and similarly [the line] ב"ג [BG], and so likewise every line. And from this you understand that what we have set forth above as a foundation [?: לימוד] is fitting.

Take the line א"ב [AB] equal to the line ג"ד [GD] [?: glyph-cluster lightly rubbed], and likewise [take the line] ה"ז [HZ]; and the ratio of this [line] to that, and likewise the ratio of these [lines], they being equal, the one to the other. Rather, each one is equal to the others; so they are equal. And the ratio that the line ב"ג [BG] [bears], whatever that ratio is — therefore what the line bears [?: phrase rubbed] is a known ratio. [Margin, left: a brief annotation in the same hand — verbatim: "ערכים על צלעי... מן... זה זה לזה שום עלילה..." — a constructive helper recording that the ratios upon the sides [bear no] relation, this to that — further identification requires further verification.]

By means of a line one falls upon a line [Euclid: a perpendicular construction], and a line upon a line, and they are joined; and there comes about a known [figure]. And there fall four lines, two and two, and a line upon a line, and a line upon a line; this is how it comes about. [Margin, left: brief annotation, verbatim:

"ועתה מצרך שאתי הוף... על ב' של נ"... כן הוא משונה אם שוה זהל..." — constructive helper, partly rubbed; further identification requires further verification.]

And from it [you take] a line — and so it is — and from this there comes about a square [מרובע] equal to a square [?: phrase compressed]. And likewise the ratio of the line to the line is as the line to the line; and this is what they have established as four terms, and they fall, two and two, and a line and a line — and from this there comes about a known thing. [Margin, left: verbatim "... שט תמשול אבא אדבא " — a marginal note in the same hand; the leading word abraded; further identification requires further verification.]

And now: behold, these are placed as four terms, and they fall, two and two; and there come about two squares [Euclid VI.16/17, on proportion and rectangles]. And from it [there results] a known [equality]. And so it is for them, the lines, when they are [proportional]: and so the ratio of a line to a line is as the ratio of a line to a line — that is, as their [mutual] ratio; and so this comes about. The rectangle [מרובע] of one [pair] is as the rectangle of the others, the line by the line; and the rectangle of [the others] is as that, [from] every line by a line. Behold, this has been demonstrated by way of the rectangles that are [formed].

And likewise the lines that are placed thus — the first one — and the rectangle that is changed in the proportion [?: sense uncertain — possibly "the figure that is altered"]; and the proportion is changed: the length [is taken] toward the breadth — by way of [the figure that fits], a small change to it. And the small toward the length, that is, [the figure] of the lengths — and the rectangle from them, the one by the other, so that the length is [as] the breadth of the rectangle. So if there be a length here, the line ל"ב [or perhaps a ratio-marker] [bears] toward this; and likewise the breadth toward this — that is, [their] ratios are toward this, this and that — [are as] one ratio. So if [the figure] be of length thus, the line — namely, that the length comes to be like the breadth, just as the length [stands] toward the breadth. And so likewise, if there be a length thus, the line — that is, the rectangle [from] the lengths, this being the breadth; and so likewise the breadth thus, the line; and this is the rule [הדין] in every case like this.

Lesson 32 [לימוד ל"ב] — the matter of every line that is drawn out [?: לכל משולש]: that the line that bears toward the others is a known [ratio]. [Heading is in display position, brown ink, with a line-space before; running of the lesson continues.]

Thus: if you draw out a line [Euclid: extend a line], and there comes about a point upon the line received [מקבל] upon the line of the triangle [המשולש] — likewise,

what is set forth [?: סמסך] toward the line ל"ד [LD] [bears] toward the line, [namely] the rectangle toward the triangle, the line ב"ג [BG], the line — and there comes about a known ratio [?: זה חוזק]. This is the rule of the triangle [?: צלע ש].

The line [bears] toward a single line, [as] toward the line, [and] toward the line ו"ק [QV] [bears] toward the line ד"ח [HD], and the line ל"ב [LB] comes to be toward the line ו"ק [QV] thus. The line ו"ק [QV], that is [?: cluster rubbed]. And if you wish to draw out the matter further, by way of the truth — [the figure] is drawn out further; clear [it] is, the line, that there comes to be [a relation], this and that — and there will be [?: cluster lightly abraded].

A triangle equal [equilateral?] to a triangle, the line as the line — that is, what is set forth — when the triangle is like this. The matter is in the lesson; that is, of the triangle, that this [is the case], that [?: יג זוי] —

Diagram. A triangle drawn in brown ink in the upper-middle of the page, with internal cevian lines crossing within it (forming the figure for a proportion / similar-triangles demonstration). The apex is at the upper left; the base runs along the bottom. Two or three internal lines run from the apex region and the base vertices, intersecting inside the triangle, consistent with the prose construction of a line cut in a given ratio.

- ה (apex, upper-left vertex): label legible
- (lower-left base vertex): label rubbed [?]
- (lower-right base vertex): a mark resembling a numeral/letter at the right end of the base [?]
- (interior intersection point): no legible label

[Note: more than two diagram labels are illegible/rubbed The surrounding prose names points but the in-figure ink is faint at this resolution.]

it is — and there are points, and what comes about thus; behold, then [the figure] comes about thus, the triangle ד"ח [HD] this; that is, the triangle of the line — by way of the [proportion?] thus: a triangle as the line, the line ל"ב [LB] toward this thus. As the ratio of the line ו"ק [QV] thus, [the line] ל"ב [LB] [bears] toward this thus, [Euclid: the line], that there comes about this, and there will be by way of [the line] toward it; and this is what is received [מקבל] toward it. [Margin, left: brief constructive helper in the same hand, verbatim "...קם..."] — recording the proportional ratio upon the triangle's side; further identification requires further verification.]

And now, if you ask, this line toward the matter [is to be] said: this [figure] comes to be by way of [the line] toward the others, the line ל"ד [LD]: that is, what its proportion is — by way of the line toward [the line] ק"ו [QV]; and so the matter of the line. **And to him [be praise]** ו"ס = a closing flourish] — and the verse [?: [ועכיב].

[A struck-through line follows here — the scribe has cancelled it: verbatim, partly legible: "...קו כולו אצלוקו זה לב כולו אצלוקו זה ממנו..." — a cancelled sentence repeating the ratio-statement, deleted by a horizontal stroke. Not transcribed as live text.]

the line wholly toward the line, this — and so it comes about, the side, the line, this — and the line ל"ד [LD] wholly toward the line, this; and likewise the line wholly toward the line as the line thus, wholly. The line wholly toward the line [bears] thus. And you have already seen — and already we have set forth at the beginning of the chapter [פרק] the principal foundations of the figures [?: [המקפריס העשפ].

And now [ועתה], if you should ask concerning the figure of the form of these [figures] [?: [בצורה הזאת תהיה], that the breadth and the length, the dimensions [מדות] [?: [מעוית] of the triangle, this — it is good [tov] for writing the dimension [מדה] this, [namely] the great dimension of the triangle, this; and it is a dimension [מדה] thus, [the figure] is good in the calculation. So it is changed in [the dimensions / proportions]; and what is the great dimension toward [the figure]? It is, by way of the small change to it; thus the line ל"ד [LD] is good there; for from it [you take] a measure [מקבל]. And so it is, and behold, this is the dimension [מדה] [?: [זויתך], that is, the small one — there comes about a triangle as the line; that is, the rectangle, this is the breadth — toward writing [?: [לחביתה]. And likewise the breadth thus, the line. And all of them, [whether] triangles or more — or the dimension that is more, this; in the dimensions [מדות] of one — what dimension by what [other], in the matter that the proportion makes [?: [שעושים].

Upon the triangle [המשולש]: how, and how — that they are equal — and so it is, equal, this and that [?: [cramped]. So the [figure] is changed; for behold, the matter is upon it. Behold, now we have said that there are triangles equal [?: [דומים — similar], this toward that, [and] there are [triangles] equal, and equal toward [the other]; that is, by way of [the lesson]. And there are [triangles] similar [דומים] to them, that they are equal, this toward that, and likewise [equal] toward this; and from the matter [it follows] that the [figure] is good. From them [you take] a measure [מקבל]: one toward the other, this similar [דומה] toward the other; that is, [the figure] is good in the calculation, the other one. And there comes about a

measure [?: עֵד] [in] what [way] the triangles are equal, this toward that, with what [is] like it; this toward it. And so when this [is] thus, behold, the matter is in the dimensions [תַּמּוּנוֹת — read כתמיות, "in the forms"], that they are equal [?: שְׁעוּבָלִים] toward [it] thus — [this is] the fourth principle [?: אַרְבַּעָה כְּלָשִׁי].

Lesson 33 [לִימוּד ל"ג] — the knowledge of all the triangles [or: figures] that are similar, this toward that, and they are of one figure [?: שַׁחַת אַחַת]: the dimensions of this [figure] are good for writing it, so that [you obtain] the dimension thus, the [figure], that they [be] similar [?]. The ascent [or: result, עוֹלָה] — and it [the figure] is that of [the side] that is the third [הַשְּׁלִישִׁי], that they are more, [namely] the sides of the angles [?: יִתְרֵי הַזְּווִיִּת], the right-angles [תְּהִקְשׁוּת]; and the ratios of them are values [סְ עֵרְכִים]; thus, then, this — and this is clear.

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic semicursive, brown ink. Single column.

[continuation of Lesson 33] for in every matter in which there is a proportion, when the whole is to the whole as the part is to the part, then the remainder will be to the remainder as the whole is to the whole. And likewise the proportion of line AB to line GD [ג"ד to א"ב] is as the proportion of line AG to line BD [ג"א to ב"ד], equal to it. Hence the proportion of the one to the other is as the proportion of this to that, equal to it, in their division.

The proportion of line AB to line GD is as the proportion of line GD to a third line, when this is to that as that is to the third; and the proportion of the first to the third is the proportion compounded of the proportion of the first to the second and of the second to the third.

So too, if there be three quantities in continuous proportion — the proportion of the first to the second as the second to the third — then the proportion of the first to the third is as the square of the proportion of the first to the second [the duplicate ratio]. For the first to the third is compounded of the first-to-second taken twice.

And when there are four quantities in continuous proportion, the proportion of the first to the fourth is as the cube of the proportion of the first to the second [the triplicate ratio], because it is compounded of three equal proportions. This is the matter of "the proportion that is doubled and trebled," of which the masters of geometry speak.

Diagram. A triangle in the left margin, lightly drawn. Its three vertices bear point-letters corresponding to the points named in the surrounding proportion-text; the labels are faint.

- (apex): $\aleph$ [?]
- (base, right): $\beth$ [?]
- (base, left): $\aleph$ [?]

לימוד ל"ד — Lesson 34.

In every triangle whose interior is divided by a line drawn parallel to one of its sides, that line cuts the other two sides proportionally: the proportion of the segment of side AB above the line to the segment below it is as the proportion of the segment of side GD above to the segment below. [The point-pairs are read $\beth\aleph$ and $\tau\aleph$ from the prose; the inner segment-letters at the dividing line's endpoints are abraded — [?].]

And conversely: if a line cuts two sides of a triangle proportionally — the upper part to the lower part on the one side as the upper part to the lower part on the other — then that line is parallel to the third side, the base. And this is what we wished to demonstrate.

Likewise, when two triangles share one angle and the sides containing that angle are proportional, the triangles are similar, and their remaining angles are equal each to its counterpart; for the proportion of side to side is as the proportion of side to side, and the included angle is common to both. So the third side of the one is to the third side of the other as the corresponding sides, and the whole proportion is preserved.

Diagram. Lower in the left margin: a triangle drawn above a rhombus (lozenge). The triangle illustrates the similar-triangles construction; the rhombus illustrates the equilateral proportional figure. Vertex letters are faint and rubbed.

- (triangle, apex): τ [?]
- (triangle, base corners): two further letters, abraded [?]
- (rhombus): the four corner-letters are rubbed [?]

And when you wish to know whether two figures are similar, examine their angles and the proportion of their sides: if the angles are equal each to its counterpart and the sides about the equal angles are proportional, the figures are similar, however many sides they have. So it is in the triangle ABG [$\aleph\aleph\aleph$] and so

it is in the rhombus; the proportion of side to side is one proportion throughout. And this completes the matter.

Diagram. A triangle with apex at top and two corners at the base. A caption is written beneath the figure: אהג.

- א (apex)
- ה (base, left)
- ג (base, right)

Diagram. A rhombus (lozenge) beside the triangle, drawn as two triangles sharing a base, with a vertex at top, bottom, left, and right.

- ז (top vertex)
- ב (left vertex)
- ד (right vertex)
- ה (bottom vertex)

and the proportion of the side would be as the proportion of the side, equal to it. So it is in the one triangle and so it is in the other; and likewise in the rhombus...

The proportion of side AD [ד"א] to side GD [ד"ג] is as the proportion of side AB [ב"א] to a third; for they share the angle, and the sides about the angle are proportional. So line BD [ד"ב] is the mean proportional that falls between line AD [ד"א] and line GD [ד"ג]. And this is one single matter.

So too in every equilateral figure, when one side is to another as that is to a third, the figure is similar to its fellow, and its area is to the area as the square of the proportion of side to side. And this is what the masters of geometry have established.

לימוד ל"ה — Lesson 35.

We wish now to draw within a given circle a triangle equiangular to a given triangle [Euclid, Elements IV.2]. Take the circle whose centre is the point [?], and draw within it the triangle whose vertices fall upon the circumference, such that each angle of the inscribed triangle equals the corresponding angle of the given triangle. The proportion of arc to arc and of chord to chord follows from the equality of the angles standing upon them.

Diagram. A circle with a triangle inscribed in it, in the left margin. A line is drawn from the centre and a small right-angle mark sits within. Two ink dots lie inside the circle.

- (the inscribed triangle's three vertices touch the circumference; their point-letters are faint) [?]
- (centre, marked) [?]

A computation line follows: the chord (יתר) that subtends the arc, measured in parts (חלקים) and degrees (מעלות). The legible values give the chord as [32] ל"ב parts against an arc reckoned in degrees, with a second value of כ"ב [22 — [numeral: ?] for whether the gershayim falls כ"ב vs. 'כ"ב]; the remaining fine sexagesimal figures of this line are abraded at the gutter and are left [numeral: ?].

לימוד ל"ו — Lesson 36.

We wish to draw within a given circle a regular quadrilateral [Euclid, Elements IV.6 — to inscribe a square in a circle]. Draw within the circle two diameters cutting one another at right angles at the centre; join the four points at which they meet the circumference, and the figure they enclose is the required equilateral, equiangular quadrilateral. Each of its sides subtends a quarter of the circle, and the four sides are equal because the four arcs are equal, and the four angles are equal because each stands upon a semicircle.

Diagram. A circle with its centre marked and an inscribed triangle, in the lower left margin. Two radii run from the centre to two of the vertices, and a chord/perpendicular descends from the centre toward the foot; a small right-angle mark sits at the bottom.

- ה (centre)
- ז (vertex, upper left)
- ט (vertex, right)
- ב (vertex, foot / bottom of circle)

The closing computation line gives the chord (יתר) subtending the arc and its measure in parts and degrees: it names a diameter/chord relation with the value [52] נ"ב legible at the line's end, while the remaining figures are rubbed at the lower edge — [numeral: ?].

[Margin: "18" — folio number, top left, modern hand]

and so this ratio is the one compounded of the ratios that we mentioned. So too in the case of the third quantity: when the first is to the second as the second is to the third, then this third is to the first in a ratio compounded of the ratio of the first to the second taken twice. And likewise in the case of the fourth: when the first is to the second as the second is to the third, and as the third is to the fourth,

then this fourth is to the first in a ratio compounded of the ratio of the first to the second taken three times.

[Lesson] [35] ה"ל.

It is already established for us in the figure that we have set out, that the three angles of every triangle are equal to two right angles. From this it follows necessarily that any two angles of a triangle, taken together, are smaller than two right angles, for the remaining third angle must always have some measure. And likewise, the exterior angle that arises when one side is extended is equal to the two opposite interior angles together.

Diagram. A circle drawn with the compass, with a single straight chord/radius descending from the upper circumference toward the centre and meeting the lower arc. The drawing is light and the interior labels are abraded.

- [Point letters within the figure are too faint to read with confidence — [?].]

[Body resumes:] When a straight line stands upon a straight line and makes the two adjacent angles equal, then each of them is a right angle; and if it does not make them equal, then their sum is still equal to two right angles. Therefore, when the line stands upon the line and the two angles upon it are equal, it is perpendicular. The meaning of a perpendicular line is that it stands upon the line and the two angles that are upon it on either side are equal, this being a right angle.

And when there is a triangle whose angle at the apex is a right angle, and you draw from the right angle a perpendicular to the base, then the perpendicular divides the triangle, and the part cut off is in proportion as the whole is to the part.

the line, taken twice, is as the whole line is to the part, and likewise the part to the remaining part. So this is the matter of the perpendicular and its proportional division.

[Lesson] [36] ו"ל.

When a triangle is inscribed within a circle, and its three angles touch the circumference of the circle, and the centre of the circle is within the triangle, then the construction proceeds as follows. The line drawn from the centre to each of the three vertices is equal to the others, for all are radii of one circle. And when the triangle is equilateral, the three lines from the centre divide it into three equal parts, and each angle at the centre is one-third of four right angles.

Diagram. A circle drawn with the compass, with a triangle inscribed; lines run from a marked centre point to the vertices, and a chord/perpendicular descends to the lower arc. The figure is lightly drawn and partly abraded.

- א (apex): faintly visible at the upper vertex
- [Remaining centre and vertex labels are too faint to read with confidence — [?].]

the angle of this triangle, and the part cut off is the angle, and the line of the angle divides it. And likewise the part that is at the centre. So this is the matter of the triangle inscribed within the circle.

[Lesson] [37] ר"ז.

A known quantity is reckoned according to its known measure, and its parts likewise. The whole circle is divided into 360 [ד"סו] degrees, and each degree into sixty minutes, and each minute into sixty seconds.

[Margin / interlinear note, lower right: a short gloss in the same hand, partly abraded — verbatim text not securely legible; [?]. Further identification requires further verification.]

and so every arc has its chord, and the chord that subtends the arc is computed. When the arc is known, its chord is known; and when you wish to know the chord, you take half the arc. The chord of 60 degrees is equal to the radius, for it subtends an arc that is one-sixth of the circle, and its central angle is one-third of two right angles.

Diagram. A circle drawn with the compass, with several straight chords drawn across it from points on the upper-left circumference, crossing toward the right side and forming an inscribed figure of chords. A single interior label is faintly visible near the centre.

- ב (interior, near centre): faintly visible
- [Remaining interior point letters are too faint to read with confidence — [?].]

[Lesson] [38] נ"ז.

When you wish to find the measure of the chord that subtends a given arc, and the arc together with its chord are inscribed in the circle, you take the given arc, and from it the chord follows. And when two chords are drawn equal, the two

arcs they subtend are equal; and when the arcs are equal, the chords subtending them are equal. So this is the matter of the chord and the arc that subtends it.

When two chords within a circle cut one another, the rectangle contained by the two segments of the one is equal to the rectangle contained by the two segments of the other. And when a point is taken outside the circle, and from it two lines are drawn — one cutting the circle and one touching it — then the rectangle contained by the whole secant and its outer segment is equal to the square upon the tangent line.

Diagram. Two adjacent circles, each drawn with the compass. Each has chords inscribed meeting at interior points, with two small filled dots marking points within the left circle. Lines run from circumference points across each circle.

- [Interior point letters are faint and not securely legible — [?].]

Diagram. A small circle, lower right, drawn with the compass, with a single interior line/radius and a faint central mark. A short gloss in the same hand stands just above it.

- λ (upper): faintly visible
- [Remaining centre/base labels faint — [?].]

[Margin, lower right of p. 42, above the small circle: a short gloss in the same hand — verbatim text not securely legible; [?]. Further identification requires further verification.]

continuing the chord construction: when the chord is drawn within the circle and its arc is known, then its measure is known according to the parts of the circle. And likewise, when the arc is a known fraction of the circle, its chord is known.

[Lesson] [39] ٥"٧.

When there is a circle and a known arc, and you wish its measure, then the construction follows as in the foregoing. And when the angle inscribed in the semicircle is taken, it is a right angle. So this is the matter of the chord, the arc, and their measure in parts and in degrees.

[Margin: folio numeral "19" at the upper outer corner, in a later hand.]

it is a chord drawn from it, and it subtends an arc equal to it. So too it is said: that an angle whose base is upon a known [given] arc — its measure in parts and in degrees is known. And the reason for this is upon the path of the proof we already gave, and it is understood from what precedes. And when the angle of

this triangle is divided in half, [the chord] cuts off from it an arc equal to its own [arc]. And so too, in the angle that stands at the centre [of the circle], [the two arcs] are equal — each to its fellow.

Diagram. A circle with several straight lines drawn across its interior from points on the circumference, forming inscribed angles and intersecting chords. The interior point-labels are abraded and not securely legible.

- [Labels rubbed — interior point-letters not securely legible: [?]]

And the reason that this angle is double the angle whose base is upon the [same] arc, [is] from what we already explained; for the angle that is at the centre is double the angle [standing] at the circumference, [both] when its base is one and the same arc. By this it has been demonstrated to you that, just as we said, the two angles, which are upon two [equal] arcs — these arcs are equal, each to its fellow. And so it is.

וְעַתָּה [And further]: Let the line [drawn] from the centre of the circle reach as far as [the point] upon which the angle stands, and there be drawn [the lines completing the construction], as we have explained.

for it is upon a given [known] arc, and its measure in parts is known; and likewise the chord that subtends it [is known], by what we have explained concerning the chords and the arcs. And there is no difference between them save in this. And the proof of this is according to what we set down before, [namely] that every angle whose base is upon a semicircle is a right angle. And by this the matter is established for you.

[A short ruled segment / construction line is drawn in the margin here; no legible label.]

הנה [rubricated marker — "Now / Behold"]: When the diameter of the circle is drawn, and it divides the circle into two halves, every angle that stands upon [one of] these halves — its measure is a right angle, neither more nor less. And this is upon the path we have explained.

Diagram. A semicircle (a half-circle resting on its diameter), with a line drawn from one end of the diameter up to a point on the arc and back down to the other end, forming an inscribed angle in the semicircle (the right-angle construction, Euclid III.31). Point-labels are not securely legible.

- [Labels rubbed — point-letters at the diameter's ends and at the apex not securely legible: [?]]

the half of the circle, [the angle] standing within it, and the angle whose base is upon the [same] arc. And it is fitting that we make clear the half-circle which is upon the arc, [namely] its measure. And [as for] the chord and the arc and the angle that stands upon them, the relation between them is understood and reconciled — each with its fellow. So from this be it understood: that every angle whose base is upon the half-circle is a right angle; and when it stands upon less than a half-circle [the angle is greater], and when upon more than a half-circle [the angle is smaller]. We have now drawn it near to you in its proof and in its measure, and this is what we wanted [Q.E.D.].

לימוד מ [Lesson 40 — rubricated heading]: If there be a circle, and within it a known [given] arc, and there be drawn within it a chord subtending it, and there stand upon it an angle — [I say] that...

[Margin (right, later/secondary hand): "וזה יותר אם נעשין קו אל גב סהם" — "and this is more [exact] if we make a line to the back of the arrow [sagitta]"; a side-computation helper, not an attribution.]

Diagram. A circle with a short horizontal stroke near its top (a chord cutting off a small upper arc) and a point marked at the centre. The single visible interior label appears to be a centre-mark; other labels are not securely legible.

- [Centre point marked; interior labels not securely legible: [?]]

I shall make known its [the arc's] measure in parts. We make of the [given] arc a chord [meytar], and we draw from its two ends two lines to the centre, and there is formed a triangle whose vertex is at the centre. And the angle at the centre is known in its measure, for it is upon a known arc; and the two [base] angles are equal, since the two sides [the radii] are equal. And [each of] them is half of what remains [after the central angle is subtracted from two right angles]. And when the angle is known, the chord that subtends it is known; and when the chord is known, the arc that it subtends is known — each from its fellow. This is the way of [reckoning] the chord, the arc, and the angle, and their measure in parts and in degrees.

לימוד מא [Lesson 41 — rubricated heading]: If there be drawn a line and upon it a perpendicular, and there stand upon it an angle... [the heading's continuation runs directly into the body].

for the line [drawn] from the point upon the circumference to the centre is equal to the line [drawn] from the centre to the [other] point upon the circumference; for both of them go out from the centre, and every [line] that goes out from the

centre to the circumference is equal to its fellow. And by this the matter is reconciled. And when you draw from the centre a perpendicular to the chord, it divides the chord into two equal halves, and it divides the arc [too] into two equal halves; and the angle [at the centre] is likewise divided into two equal halves. And so the half of the chord, and the half of the arc, and the half of the angle, [stand together] — each corresponding to its fellow. And this is what we wanted [Q.E.D.].

Diagram. A semicircle resting on its diameter, with a line drawn from a point on the arc down to the diameter (a perpendicular dropped from the apex to the base, with a chord), illustrating the bisection construction of Lesson 41. Point-labels are not securely legible.

- [Labels rubbed — point-letters not securely legible: {?}]

לימוד מ [Lesson 42 — rubricated heading]: If there be two equal arcs in a circle, [I say] that the chords subtending them are equal. And we have already explained this; and now [we say]: that this [chord] is in this [arc] as that [chord] is in that [arc].

and when they are drawn, [the two chords] — let this one be known, for [the demonstration runs] in this manner. And this [point] is the centre, and there stand upon them two known angles, [for they are] upon two equal arcs; and the two [chords] are equal — each to its fellow. So [in] equal arcs, the chords [drawn] within them are equal, each to its fellow; and the perpendiculars [drawn] to them from the centre are likewise equal, each to its fellow. By this the angle is reconciled, so that it be upon a single arc, [and] there be [drawn] upon it an angle — and they are equal, each to its fellow. So [the relation between] the chord, the arc, the perpendicular, and the angle is reckoned, and they are [understood] — each from its fellow; for the matter [of them all] is one [and the same] measure: of the chord, of the arc.

the right angle that exists. And know that the angle that subtends the greater arc is the larger angle, while the angle that subtends the lesser arc is the smaller angle; and so likewise it is with the chord, for the chord that subtends the greater arc is the larger chord, and the chord that subtends the lesser arc is the smaller chord. And so likewise with the perpendiculars and the chords, for the perpendicular that is drawn from the centre to the larger chord is the smaller perpendicular, and the one drawn to the smaller chord is the larger perpendicular. So when you know one of these four things — the angle, the arc,

the chord, and the perpendicular — you can know its fellow from it; for the matter of all four is one, [each] reckoned from the chord of the arc.

In order to understand this measure, they divided the whole circle into three hundred and sixty equal parts, and they called each part a degree (*ma'alah*) [מעלה]; and each one of these degrees they divided into sixty equal parts, and they called each part a minute (*chelek*) [חלק = "part," sexagesimal minute]; and each one of these minutes they likewise divided into sixty equal parts, and they called each one a second (*sheniyah*) [שניה], because it is the second division. And [each second] they divided again into sixty, and they called each part a third (*shelishit*) [שלישית], for it is the third division; and so they continued [dividing] in like manner as far as they wished. So the degree is sixty minutes, and the minute is sixty seconds, and the second is sixty thirds, and so for the rest of them.

So each one of these [divisions] is reckoned from its degree (*ma'alato*), and the whole circle is reckoned by these parts; and you reckon the chord of each arc by the [sexagesimal] parts and the seconds, until you arrive at the precise measure (*ha-shi'ur ha-mduyak*). And by this method the chord of each [arc] is computed, so that you may obtain the chord of any arc you wish by these [tabulated] parts. The measure of the chord is computed, and the whole is reckoned, until you arrive at the precise [value]. And just as you reckon the chord of the arc by these parts, so do you reckon the arc by [its] chord, and the angle by the arc; and likewise the rest of them, each from its fellow. And the chord is the foundation of them all, for from it all are derived. Q.E.D.

that there be a still greater [value], and you will know that the measure of the degree (*ma'alah*) is one [unit] in this manner. And further: the circle is divided into parts, by which the position of each [point] is reckoned, in the manner we have set down — that the parts are equal, this part being equal to that part. And they called all the parts "degrees" (*ma'alot*); and so too [they divided] into sixty, and they called each one a minute, equal to [the others]; and they called the rest [of the divisions] by their names, as we explained — sixty for the minute, and again sixty for the second, equal [each to each], and they called [them] thus. And likewise [they reckoned] the perpendicular and the chord, that were drawn within the circle, [each] reckoned by these parts and seconds; for [the chord] is the foundation, and from it the rest are derived. So when you have the chord [you have] all of them, for the perpendicular is the chord of [half the arc], and the angle is reckoned [from it], and likewise the arc; so the whole proceeds by one reckoning.

And know that the reckoning [proceeds] by minutes (*chalakim*) and by seconds, and the measure is reckoned by the [tabulated] parts; and the precise reckoning is by the degree, [each] degree being one [unit], and the precise [value] is obtained from the parts and the seconds. And likewise the rest [of the divisions] follow in their order, [each] reckoned [from] its fellow; and the whole is one measure.

Diagram. A single circle drawn in brown ink in the middle-left of the text column. Within the circle a horizontal chord (a diameter-like line) is drawn across the upper portion, with a shorter line meeting it — the construction illustrating the chord, the arc it subtends, and the perpendicular dropped to it from the centre, matching the surrounding chord-reckoning exposition. The point-labels are abraded and faint at this resolution; they cannot be read letter by letter.

- [Labels illegible — abraded; ~2–3 lettered points expected from the construction, but none resolves on the scan.] [?]

[: figure labels illegible.]

for it [the chord] is [reckoned] by [the parts of] its degree, and the whole circle [is reckoned] by them. And by these the position (*matzav*) of each [point] is reckoned, in the manner we explained, until you arrive at the precise [measure]. And the chord that is drawn within [the circle], its measure is one, and [from it] the perpendicular and the rest are reckoned, [each] from its fellow.

[Rubric — *Shoresh* / "Principle":] *And now (ve-atah) [ועתה] — written larger, opening a new sub-section]* I shall set forth for you the [reckoning] of the chords, that you may know [how] to compute the chord of every arc. And know that the chord [of an arc] together with [the chord of] its supplement — when [the arc] is a part of the circle — [is reckoned thus]; for every chord [of an arc] and the chord of [its] complement [together] complete [the construction], so that the chord of the [given] arc and the chord of [the remaining] arc are both known. And so the chord of every arc is known, and the chord of the [remaining] part of the semicircle is known as well. Q.E.D.

the arc is known, the chord that subsists within it is known, and that chord is reckoned upon the parts, up to a quarter of the circle. You take the chord that you obtain, and you reckon every chord that you obtain in this way. And so likewise the chord that you obtain: the chord you obtain is the chord of the arc.

And know that the whole table (*ha-luah*) [הלוח] which the Sages set down — its tabulated values correspond to the arcs. They intended thereby the number of parts, and they recorded in it the chord of each arc, so that you may reckon from it.

[Rubric — sub-section heading, set off at the foot of the column, written slightly larger:] **Gate** (*Sha'ar*) [שער]

And here there shall be set down: you take the chord of the arc, and the chord of the supplement of the arc; and every chord is reckoned upon the tabulated parts. The table was reckoned upon a circle whose diameter is divided into a hundred and twenty parts [numeral: 120: the "120 parts" basis is named here but the exact glyphs of the number are rubbed], and the semidiameter is the line drawn from the centre.

Diagram. A small semicircle drawn in brown ink at the lower-left of the text column. The diameter forms the base (a horizontal line) with the arc above it; within the semicircle a chord is drawn and a perpendicular is dropped to it, illustrating the relation of arc, chord, semidiameter, and perpendicular treated in the surrounding text. The point-labels are very faint and do not resolve letter by letter at this resolution.

- [Labels abraded/illegible — two or three lettered points expected from the construction (base endpoints and apex), but none resolves on the scan.] [?]

[: figure labels illegible.]

And so, for the chord of the arc and the chord of its supplement, each is reckoned upon the tabulated parts and the seconds, until you arrive at the precise measure. And the matter of them all is one. So you reckon the chord of every arc.

You may thus know the chord and set it down; and behold, it is so much, and you would know it from the arc. And as for the chord of the supplement — that is, the remainder up to a hundred and eighty degrees [180 = 90] — and so the chord is reckoned, each from its fellow.

[Marginal note, left margin of folio 21r, later/secondary hand, short:] [Margin: "the length of the chord, etc." — *orekh ha-meytar wkhu'* — a brief gloss keying the body's "length of the chord."]

It would be so much, once you knew it; and you set it down, and behold it is so much — and you would know it from the given arc. And if the chord of the supplement were sought, and behold it is so much, you take the supplement of

the arc; and so the chord is reckoned, whether the chord of a quarter of the circle or the chord of the whole semicircle. For this is the basis: the chord of the arc and the chord of its supplement; and the matter is one — that you reckon the chord upon the tabulated parts and the seconds, until you arrive at the precise measure.

And the chord that is drawn within the circle is reckoned by these parts, upon the parts of the semidiameter [חצי הקוטר — half the diameter] and upon the seconds, until you arrive at the precise value. And so likewise the perpendicular that is dropped to the chord; for the perpendicular is the chord of half the arc, and from it the rest are reckoned. And the matter of them all is one: that you reckon the chord, and from it the perpendicular, and the arc, and the angle; for the whole proceeds by a single reckoning, each reckoned from its fellow.

[Marginal note, left margin of folio 21v, short, later hand:] [Margin: "the length of the chord, etc." — *orekh ha-meytar wkhu'* — brief gloss.]

[Rubric — *And now (ve-atah)*, opening a new sub-section, written slightly larger mid-column:] **And now** (*ve-atah*) [ועתה]

I shall set it forth for you: you set down the arc and its degrees, and you take its chord from the table. And behold, it is so many parts; and you reckon it upon the tabulated parts. And if you wished the chord of its supplement — that is, the remainder up to a hundred and eighty degrees [$180 = 900$] — you take the supplement, which is so many degrees, and its chord is so much. So the chord of the arc and the chord of its supplement are both known; and from the two of them you reckon, until you arrive at the precise value.

So many parts, and a hundred and two [$102 = 510$]; and this is what we explained — that the chord of every arc is reckoned upon the tabulated parts, the seconds, and the thirds, until you arrive at the precise measure. And the matter is one for them all: the chord, and the perpendicular, and the arc, and the angle — each reckoned from its fellow.

And in this manner the reckoning proceeds: and the half of the chord, and from it the perpendicular, each from its fellow. And this matter is the foundation. And now that you understand it, the position of each point [המצב — turning toward a further topic] follows by this reckoning; for it is a true reckoning, whether in this cycle [סדור] [?: closing technical noun faint] or that — so it shall be.

[Margin: "22" — folio number, upper right]

that you compute everything by its place, and from the sum of this comes what you require.

[Display rubric, centred, in the line: **שַׁעַר** [Gate] — un-numbered]

And another of the surface-figures [הצורות השטחיות]: what was required was that they need no other for their operation [פעולתם]. Now consider well. We have already said and repeated several times that there are surface-figures without limit [שטחיות עד אין מספר] that have one common figure; and there is a figure that several of them share [שמעלל], yet differing in operation. So there are many figures whose surfaces [שטחים] are straight [ישרים]; and there is among them one whose figure has many surfaces, and yet there is none other like it.

This figure [תמונה אחת], though it be one figure, has many surfaces that are straight [ישרים]; and there is none other like it. And were it not so [ולו בכך], its figure would be a thing [שום שְׁעוֹק: — sense of the predicate uncertain]; and it would not stand so [ולא כן].

This figure [תמונה אחת] — and you see [ונחנן] how all its sides [צדדין] stand alike; this is the figure, and it has, as we know from it, a certain common proximity [קורבה אחת] of contact [מגע] for all its lines. That is, the straight lines [הקוים הישרים] running from a single point [נקודה] all the way to its outermost extremity [תכליתה] are all equal [שוים]; it is one figure, and the figure is straight [?: parse of the closing clause uncertain].

[Display rubric, centred: **כדור** [Sphere]]

And the point [הנקודה] that is at its centre [שטחה] — that is the centre [המרכז], and from it the straight lines [הקוים הישרים] are equal in measure [משפט]. From its plane [שטח] to its sides [צדדין] and to the centre, [the lines] are equal [שוים], so [the centre] is its [precise] constriction [צמצומו], and its mark [סמנו] is known. And we know that everything whose sides are equal [שוה צד] to you is the sphere [הכדור].

The sphere is a solid body [גוף מושם] that has surfaces [שטחיות], and it is one figure [תבנית]; so that they say [שיאמרו] there are two for it [להיות שנים], yet it is not so. And the more finely [יותר] one reckons it, the more its surfaces are equal parts [חלקים] upon one centre [על מרכז אחד]. And there is a hollow sphere [כדור חלול] that has within it, in its precise interior [תכליתיות], a surface [שטחיות]; so these surfaces are in relation to one another [מקבלות זו]; and so it is for one sphere [כדור]; and what is in its thickness [בעוביה — recte: בעוביה] is round, like a hollow sphere.

And the second figure [התבנית השנית] is the thick one [העבה], in its entirety [בכללות]; and what is within it is the firmament [רקיע] of the heavens [השמים]. The more finely one reckons it, the more — from outside [מבחוץ] and inside — its

surface and its interior are surfaces lying between its surfaces. So for it there is one thick body [גוף עבה], and its precise extent [תכליתו] reaches to its surface. And we know that what is within is a hollow sphere [כדור חלול], and it can be computed, from its surface inward, as hollow spheres [כדורים חלולים — text: "scribed/marked"] upon one and the same centre [מרכז אחד מסויים]. And from this — as you go [ולהיות] toward the centre — they are hollow spheres, each one [כל אחד מהם] scribed, and the more so toward the centre.

[Display rubric, centred: **ועתה** [And now] — worked-reckoning lead-in]

So they are joined together [ויתחברו] by these many surfaces [בהמון השטחיות], the straight ones [הישרים]: the bodies [הגופים] in the reckoning [במחשבה], in the manner [כדרך] of the sphere, reckoned from the whole of the sphere and from all of it [מכלל הכדור ומכל].

reaching to its precise extent [תכליתו], the half [החצי]; you see how each one of them is reckoned far [רחוק] in the reckoning [במחשבה] upon the centre [מרכז] of the sphere, and that it is straight [ישרה]. Upon a surface [שטח] one reckons until it be so; so that there are scribed surface-figures [חקוקות] whose protrusion [בליטה] is reckoned, and their number is not bounded [ושמספרם]; the figure being like the number of the straight elements [הישרים הסטוקים]; and after they have crossed through it [שעברו בו], from each one of them, it is a part [חלק] of the sphere [הכדור]. In the reckoning [במחשבה], reckon its two pieces [שתי חתיכות], for each one [כל אחד], from the surfaces [מהשטחים] whose part [חלק] is upon [על] the centre of the sphere; that is its part [חלק], its half [אותו לחצי], as the Sages put it [בלשון חכמים]; and there is firmness [חוזק] upon it; and likewise scribed figures [חקוקות] at the same level [שעלה — recte: שוה, "equal"], so that the lines [הקוים] whose centre [שמרכזם] is the centre of the sphere — so it is for each one of them; by your inquiry [כשאלתך], it is so.

of the sphere by them. And this remainder [שארית]: it is divided [נחלק] toward the centre [מתוך], a measure [שיעור] — it is possible at any time [אפשר בטוס פעם: ?] — parse uncertain] — and it cannot be [ולא יכול] reckoned so that you reach [שיתחקה] it in the sphere; for the sphere is a body [גוף], and there is a remainder [שארית: ? — sense uncertain] in another figure, its straightness being the more of the sphere; and from it [ומאי] you go on [תלך] until you reach the precise extent [תכליתו] of the great risings [העלות הגדולות] of the sphere, when its lines are all equal one to another [שוות זו לזו] — the lines [הקוים] of the body and its straightness, all of them, for each one of them [כל אחת מהם].

[The body of 22v continues the sphere-as-solid-of-revolution argument in dense procedural prose. The hand is legible, but extended technical clauses — about how the sphere's surfaces and "small parts" [הקטנות] are reckoned upon a single centre, divided into two pieces, and refined the more finely they are computed — recur in restated forms; I transcribe the recurring anchor-terms once and flag the connective sense rather than fabricate a fluent reading:]

The whole sphere [כל הכדור] — its whole [וכולו] is a part [חלק] of its pieces [חתיכות], one with another [זו עם זו]; and its parts [וחלקות] are equal each to its fellow [שוה זו]. And every surface of them [שטח מהם] is reckoned [מסתפקים — recte: divided], this together with that, in the sphere [בכדור], each one [אחד] separate, yet shared [משותף] among them [להם]; and the other surfaces [השטחים] are the bodies [הגופים]. Their name [שמן] in the reckoning [במחשבה] is given within the hollow [בחלל] of the sphere; and these are bodies upon its sides [מרכז כל אחד מהם הוא], because the centre of each one of them is one [על צדדיו]. The part [חלק] of the sphere, in the reckoning [במחשבה], is upon two pieces [שתי] [חתיכות], each piece of which is two [שתיים]; and let there be [ולו יהיה] firmness [חוזק] there, upon the surfaces [על השטחיות].

The finer [יותר קטנה] it is in the reckoning that we have called it [שקראנוהו] — its rising [עלייתו] — its reckoning is the finer [קטנה], and we said: a small motion [מכל] [יותר קטנה] for each one [אחת], from these [מהנה], reaches [ולעת] what we said [שאמרנו]; and the great risings [העלות], the small parts [הקטנות] — but [אבל] all of these are not equal [אין] one to another [זו לזו]. And they are not so in the smallness [בעבולות: ? — sense uncertain]; and the rule [ודין] of the small parts [הקטנות] within them [בהם] is at the level [חן: ? — parse uncertain] of the measure [לקצבה]; but as for the order [לסדר]; and that which [ומה] reaches the figure that is to be explained [שיתבאר].

What is within it [מה בו], and how much is in the surfaces, its straightness [?: — sense uncertain] in their measure [כמעצב: ? — parse uncertain] — how much its surfaces [שטחיות] are received [מקבלות]. As for how it is reckoned, whether fine [קטנה] upon its straightness [על שטחי], the small parts [הקטנות] are received [המקבלת] from it [מהם], and from each one of the surfaces, namely from the protrusion [מהבליטה]. There go forth [יצאו] from the surfaces [מקבלות] this, and a part [חולק], and it is fine [קטנה]; it is not explained [לא יתבאר] save by reason of [מפני] their fineness [קטנותם]. For all this is a surface [שטח] reckoned upon their centre [על מרכזם], and each one of the surfaces [שטחיות] by [וכל אחת מהשטחיות] their division [חלקת]. So this is the fineness [קטנות]: at this level [בה כן], from one

of the surfaces [שום אחת מהשטחיות], a part [חלק] of the small parts [הקטנות]; and one of the surfaces [שום אחת מהשטחיות], and these are fine [קטנים], this is so [זה לה]. And all that is to be explained [וכל מה שיתבאר], the more so their finenesses [עצמות]; and it may be [ואפשר היה] how much in their fineness [בעצמות] are the great risings [recte: the risings].

Their finenesses [עצבות — recte: their finenesses], all of them [כולם], by their level [על שטח]; the small parts [הקטנות] are received [המקבלת] from these [מהם], and from each one [recte: each one] of the surfaces; and they go forth [יצאו] in the reckoning [במחשבה], for these are the matters, as you see [כי תראה]; so it is in its revolution [? — parse uncertain] upon its centre [על מרכזה], one surface upon the surfaces [על השטחיות] and the small parts [הקטנות], the reckoning and its division [וחלוק]. So, as the Sages put it [לפי כן, בלשון חכמים], the small parts [הקטנות], that there are none [שאינן] fine [קטנים] for it [זה לה]; and it may be [ואפשר היה] fine; and it may be, in the fineness, the risings [recte: the risings].

[Display rubric, centred: **שער** [Gate] — un-numbered]

It is possible [אפשר] that the sphere, inasmuch as it is a body [מצד שהוא גוף], be light [קל] enough to be at rest [שקט]; and the question of its place [מקומו] and its motion [תנועתו] is the question "from where?" [מאין]. And it is possible [ואפשר] that a body [גוף], or one near-resembling it [קרוב], be in motion by its motion [להיותו במתנועה], and likewise [וכן] its motion [ותנועתו], it being possible [ואפשר היה].

In this manner [בכה] it begins [שיתחיל], by a rule [על דרך]; you must [צריך], in all events [על כל פנים], that its rising [העלה] be at rest [שקטה], and that it return [ויחזור] to its place [מקומו]; and one says [ואומר] that its place [את מקומו] is not changed [לא].

Not by rising, save in this manner: like a sphere [כדור] turning [סובב] about itself [recte: about itself], going round [והולך] and revolving [ויתגלגל] upon itself [על עצמו], surrounding [סבב] its centre [מרכזו], rotating [גלגל] and returning [ווחזר] and going round [והולך] another time [פעם אחרי]; thus its centre and its place are not displaced, and it revolves and surrounds [סביב].

Its revolution is reckoned in nine [תקרי תשעה]; and it is to be divided [שסק — recte: that it be divided] into quarters [רביעית], so that there rise [שעולה] in it [בין] a number of divisions; and so there rise [ותעלה] in it [numeral: ? — rubbed] of those that are not displaced. And so that which is reckoned [וזוה] from one revolution is changed in its place [ממקומו]; for there is none [כי אין], and it does

not totter [ולא ימיט]; and so [וכן] the revolution of the sphere [לכדור] of the heavens [השמים] is so [?: closing clause parse uncertain].

[Display rubric, centred: כלל [Rule]]

As for the table [הלוח]: there is one measure [שיעור] for the times [לזמנים] upon every degree [מעלה] of the degrees [ומעלות] of the sphere [הגלגל].

And it revolves [שסובבת] upon [numeral: ? — rubbed] degrees, and its centre [ומרכזה]; and this [וזה], and now [ועתה] [?: closing clause parse uncertain].

In this manner [בכך], its mark [סמך — recte: its support/mark]: the sphere [הגלגל] begins [שיתחיל היה]; and we say [וונאמר], by the rules, its rising [עליתו]; in its motion [בתנועתו] it goes round [והולך]; the small parts [הקטנות] of its rising [לעלת] are as the Sages put it [בלשון חכמים]; and the small parts [ומטוטות — recte: the small parts], this is good [זו טב זו]; and every one [וכל אחת] of the surfaces; that it begins [תקרי] from its name; and in the language of Yishmael [ישמעאל — i.e. in Arabic] its name is called [היא קראת] [?: Arabic term-name abraded] קע"ב [numeral-form = 172]. And let it be straight [ויהי ישר].

[Marginal foliation: 23 (upper margin, modern hand)]

and let it be straight. The point about which the sphere turns and at which it comes to rest is good [i.e. well-defined], and it is the axis about which it turns: it is the straight line [קו ישר] **fixed** [ברי"ק — rubricated; here a rubric-word marking the new definition], which passes through the centre. This line — which exists within the sphere — is its diameter, and it passes through it [the sphere] from end to end, touching the two extremities. Upon it the sphere turns.

Now know [ועתה — rubric/lead word] that you must grasp this: the [two] fixed extremities of the axis [?: reading of the two end-terms slightly cramped] — they are like two points, each one of them set opposite the other, and between them is the centre. Through this [arrangement] the centre of the sphere is established, and the turning of the sphere [is established], for it turns about these two extremities and about the centre. And the line that passes through the centre of the sphere, and reaches to its surface on every side — every such line, when its parts [its two halves] are equal one to another, is good [i.e. is a true diameter]. And know that the two extremities of the line which is the axis are the two **poles** [קטבים], and the upper one and the lower one [are] each opposite its fellow. The pole is the fixed point [נקודה] upon which the sphere turns and does not [itself] move; rather, all that is around it moves, while it [the pole] is at rest.

[The following two lines are continuous prose; read once.] Therefore, just as the line that passes through the centre [is the axis], so likewise that which encompasses it [the sphere] from outside [is its surface]: as the diameter [is one] and [the line] that surrounds it [is the other], so [too] the parts of every diameter are equal, and the centre divides it into two halves. [?: the doubling of "as the diameter / as that which surrounds it" reflects the source's own paired phrasing, rendered once.]

And so [it follows] that for any line you draw from the centre to the surface, when [its two] parts are equal, it is good. And [for] every such [line], its measure [is the same], and they are all equal; for the centre is the place [from which they go out], and from it they reach the surface on every side, the small ones [?: הקטנות — the lesser radii/parts, as above]. And in the language of Yishmael [Arabic] its name is called — [Arabic word abraded; cf. the value 172 = קע"ב noted previously].

they are equal in their measure; and this too is the law [reading: ההלכה]. For each pole is a point opposite the centre [?: opposite-arrangement], and the surface of the sphere — its [the pole's] place upon it is fixed, and from there the sphere turns about the centre. Were the centre to be removed [?: shifted], the sphere would not turn truly, and its turning would not be good. For the two poles and the centre are upon one straight line, and that line is the axis; and the place of each pole is fixed upon the surface of the sphere, opposite [the other], and the centre [is] between them, and the sphere turns about them.

Now know [ועתה — rubric/lead word] this matter, which is a foundation [יסוד] for all that follows. The diameter that passes through the centre divides the sphere into two equal halves; and the line [or circle] that encompasses the sphere upon its surface, [passing] through the two poles, likewise divides it into two halves. And every circle drawn upon the surface of the sphere whose centre is the centre of the sphere — its diameter is the diameter of the sphere, and it divides the sphere into two equal parts; and it is the **great [circle]** [העגול הגדול — i.e. a great circle]. But a circle whose centre is not the centre of the sphere is the **small [circle]** [העגול הקטן]: its diameter is smaller than the diameter of the sphere, and it does not divide the sphere into two equal halves, but [into a] greater [part] and a lesser. And the more its place draws near to the pole, the smaller it becomes; and the more it draws near to the great circle [that is] in the middle [i.e. midway between the poles], the greater it becomes — until, [at the point] equidistant [שוה] from the two poles, it is the great circle. [?: the run "near the pole → smaller; near the middle → larger" is restated in the source; rendered once.]

[The following is continuous prose, read once.] And therefore the great circle is one, and the small circles are many; for between the great circle and each of the two poles there are many circles, [growing] smaller as they approach the pole. So this is the rule for the great circle and for the small circles.

Chapter [פרק — rubric heading, set off] [?: this rubric stands alone as a display heading; no numeral is written beside it — the standing "Gate I / Chapter un-numbered" condition continues here.]

Its subject [?: טעמו / reading of the lead word]: the circles [that are] reckoned [/imagined] upon the sphere are three. [Following the source] the spheres [/circles] that are reckoned are good [i.e. well-established], and they are three: [the heading enumerates the three principal great circles to be treated]. And the imagined points are [?: numeral/count of points abraded]; and from them are the [further] circles, [some] greater and [some] lesser. And it is the diameter [?:...] of the great circle of the orb; and [there is] the equator [reading: קו השקרא/קו שוה — the equating/equinotial line, here "the line of the orb"] — [the remainder of the line runs into the lower margin and is faint].

[Lower portion of folio 23v is blank parchment below the text block.]

this matter, and its demonstration, as we have set it out among the premises of geometry. For all these [definitions] — though their study belongs to the science of geometry — are nonetheless a foundation and a root for the science of the sphere, and upon them its premises are built. Therefore it was necessary to introduce them here, even though their proper place is there [in geometry].

And now that the premises of geometry have been laid down — those that the science of the sphere requires — we shall return to our intended subject and begin to speak of the great circles imagined upon the sphere [galgal], from which the whole of this science is constructed.

Know that the great circles imagined upon the surface of the sphere are three in number, and they are the principal ones; and from them branch out the rest of the circles that are needed in this science.

The first of the three great circles is the circle that bisects the sphere into two equal halves, [such] that the two poles about which the sphere revolves stand equidistant from it on either side. This circle is called the equator of the day [קו משוה היום, "the line that equalizes the day"], and it is also called the arc of the day [קשת היום]. Its two poles are the two poles of the world, and about them the daily motion turns from east to west.

When the sphere turns upon these two poles, every point imagined upon the equator traces out the equator itself, while every point off it [traces] a circle parallel to it — smaller as it is nearer the pole. The portion of such a circle that lies above the horizon is called the arc of the day [קשת היום], and the portion that lies below it the arc of the night [קשת הלילה].

Diagram. A small sphere drawn as a single circle, with two diameters crossing within it — one representing the equator (the line that bisects the sphere) and one the axis — together with a curved line (an oblique great circle, the horizon) cutting across. Rim-labels are written around and within the circle:

- (upper right, written along the oblique line): חצי האופק — "half of the horizon"
- (upper left): חצי — "half"
- (center, along the horizontal diameter): קו האופק — "the line of the horizon"
- (lower center): אופק — "horizon"

[The lines at the foot of 24r continue the topic:]...the number of degrees of the arc is its measure, and from this is known the position [מצב], and the proportion that the one [arc] bears to the other...

[The lower third of folio 24r is blank parchment.]

the equator [קו המשווה], for it is a single circle and its halves are equal, and there is no place upon it nearer to the one pole than to the other; its poles are the two poles of the world.

The second great circle is the circle that passes through the two poles of the world and through the point directly overhead [the zenith] and the point directly beneath [the nadir]. This circle is the meridian [?: written here as a phrase rather than the later-standard term; the bracketing words are faint], for upon it the sun stands at the midpoint of the day, when it is at the highest of its elevation above the horizon, and likewise at the midpoint of the night, when it is at the lowest [שפל] beneath the horizon.

When the sphere revolves, this circle does not move with it but stands fixed, for it is bound to the horizon and to the two poles of the world, which do not change their place relative to a given observer [?: "to him who stands upon the earth"]. Therefore every star, in its revolution, crosses this circle twice: once above the earth, at the midpoint of its arc of day, and once below the earth, at the midpoint of its arc of night.

The portion of this circle above the horizon, from the horizon to the point overhead, is one quarter of the whole; and likewise the portion from the point overhead down to the horizon on the other side; and so too the two portions beneath the earth. Thus this circle is divided by the horizon and by [the line through] the two poles into four [equal] quarters.

And if a man stand such that the two poles of the world lie upon his horizon — that is, if he dwell upon the equator itself — then the meridian and the horizon meet at right angles, and the daily motion is upright with respect to him; for then the equator passes through the point directly overhead, and all the [stars'] parallel circles cut the horizon at equal angles, rising straight up [?: in a "right sphere"]].

But if a man dwell to the north or to the south of the equator, then one of the two poles is raised above his horizon by the measure of his distance from the equator, and the other is depressed below his horizon by that same measure; and then the daily motion is oblique with respect to him [?: in an "oblique sphere"]].

[Note at the foot of the text-block:] יסוד מוסד — "a sure foundation" [cf. Yeshayahu 28:16, "a tried stone, a precious cornerstone, a sure foundation"]. The accompanying lines read, in part: "...the knowledge of the discerning intellect [דעת השכל הנבון] is to know [?]... for the verifying of the [science of the] sphere [לאמתת התכונה] is to know [?]... the arcs [קשתות]..." — the interior wording remains partly faded; the rendered phrases are committed, the [?] gaps are genuinely effaced.

[Below the note, one final line of body text:]...and upon them are built the three principal arcs [קשתות], [as] we shall explain... [end of text on 24v].

[The lower half of folio 24v is blank parchment.]

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic semicursive hand. (folios 25r–25v).

the great circles, and the principal arcs that arise from them, and the matters that depend upon them. We have already explained the meridian (חצי היום) and its property, and now we set down what remains to be said.

The third of the principal great circles is the **horizon (אופק)**. This is the circle that separates the visible part of the heavens above the earth — the part we see — from the hidden part below the earth that we cannot see. Its poles are the point directly above our heads (the zenith [נקודת הראש]) and the point directly beneath

our feet (the nadir [נקדת הרגלים]). The horizon thus divides the whole sphere into two equal halves: the upper visible half and the lower hidden half.

For those who dwell beneath the equator — where the two poles of the world lie on the horizon itself — the horizon passes through both world-poles, and the sphere is a **right sphere** (כדור ישר). For those who dwell to the north or south of the equator, where one pole is raised above the horizon and the other depressed below it, the horizon is inclined relative to the equator, and this is the **oblique horizon** (כדור נטוי) of the **oblique sphere** (אופק נטוי).

When the equator is inclined to the horizon, so too are all the circles parallel to it inclined; and the [diurnal] arcs that the sun and the stars trace above the earth are no longer equal to the arcs they trace below it, except for [points lying on] the equator itself. From this inequality arise the difference in the length of the day and the night, and the variation of these from one region to another and from one season to another.

[Margin, left, later hand, faint: brief annotation of two lines — [Marginal note: verbatim text not securely legible; further identification requires further verification]]

The fourth of the principal great circles is the **circle of the zodiac** (גלגל המזלות), also called the belt of the signs. This is the great circle along which the sun runs in its proper motion throughout the year, the circle of the ecliptic. It is inclined to the equator, the two circles intersecting at two opposite points; and the greatest distance between them — the inclination [נטיה] of the zodiac from the equator — reaches its maximum at the points midway between those two intersections. [?: the body names the maximal-inclination value here, but the numeral is rubbed — [numeral: ?]] The two points where the zodiac and the equator cross are the two equinoctial points, and the two points of greatest distance are the two solstitial points.

The poles of the zodiac are not the poles of the world; rather, each pole of the zodiac is removed from the corresponding pole of the world by an amount equal to the inclination of the zodiac from the equator. By the inclination of the zodiac the seasons of the year come about, and the differences of the climes (אקלימים), and the varying lengths of the days, as we shall explain in its place, God willing.

And now that we have set down the four principal great circles — the equator, the meridian, the horizon, and the zodiac — and what depends upon each of them, we shall turn to the secondary circles that are drawn upon the sphere and the matters that follow from them.

[The discussion continues with the secondary great circles and the measurement of arcs upon the sphere.]

the [secondary] circle, and its position, and from this it follows that the matter is as we said. And all the circles that pass through the two poles of the world are called **circles of declination** (עיגולי הנטיה), since each of them is perpendicular to the equator and cuts it at right angles; and upon them is measured the declination of each point of the heavens from the equator.

Likewise, all the great circles that pass through the two poles of the zodiac, and cut the zodiac at right angles, are called **circles of latitude** (עיגולי הרוחב), since upon them is measured the latitude of a star — its distance, north or south, from the circle of the zodiac.

Among these, the great circle that passes through the four poles together — the two poles of the world and the two poles of the zodiac — is a single circle, for these four poles all lie upon one great circle. This circle is perpendicular both to the equator and to the zodiac, and it passes through the two solstitial points; it is called the **solstitial colure**. And there is a second colure perpendicular to it, passing through the two equinoctial points, the **equinoctial colure**.

By means of these circles the positions of the stars upon the sphere are determined, each star being fixed by its distance from the equator (its declination) and from the zodiac (its latitude), together with its place along the length of the zodiac. And this is the matter of the colures and the circles of declination and latitude, as we have set it forth.

[Lower half of 25v blank below the figures.]

Diagrams

Diagram. A sphere drawn as a large circle with internal great circles inclined within it, illustrating the horizon and the zodiac on the oblique sphere. Curved arcs cross the interior; the upper region is marked as the visible hemisphere and the lower region shaded with fine ruling (the hidden hemisphere). Rim- and arc-labels read:

- (upper arc, right): אופק חצי היום — the horizon / meridian arc (the two words run along the rim)
- (left, descending arc): גלגל המזלות — "circle of the zodiac"
- (lower arc): אופק נטיי — "oblique horizon"

- (lower left, beside the shaded sector): עגול הנראה [?: lower rim-label partly worn] — "the visible circle"
- point ה (mid-right interior): reference letter
- point ב (lower interior): reference letter
- point ה / ל [?: a third interior letter near the foot, worn]

Diagram. A right-triangle / quadrant figure (an arc with two radii) drawn in the right-hand margin area mid-page, illustrating the inclination of one circle to another. An arc spans between two radii meeting at a vertex; reference letters mark the vertex and the arc-ends.

- vertex (left): א [?]
- arc-end (upper): ג [?]
- arc-end (lower): ב [?]

[Labels worn; ≤2 securely read for label recovery.]

Diagram. A pair of triangular/quadrant figures side by side near the foot of the text block, comparing two inclinations — a larger and a smaller angle subtending arcs of the zodiac and the equator. Each figure shows an apex with two descending strokes enclosing an arc.

- left figure apex: letter worn [?]
- right figure apex: letter worn [?]

[Labels not securely legible]

Bodleian MS. Huntington 299 (1484), ff. 26r–26v. Spanish (Sephardic) Rabbinic semicursive, brown ink, single column. Conservation ruler and black mounting strip in the margins are photography furniture and are ignored.

f. 26r

[The text block on this side is set toward the gutter; the outer half of the leaf is blank margin. The running line of argument continues the discussion, begun earlier, of the rising-times (ascensions) of the signs and the inequality of day and night by terrestrial latitude.]

the measure of the rising-time of one of them together with the rising-times that follow it [?: cramped opening line]. And by this you will know that just as the rising-time of one [arc] differs from the rising-time of another, so too the part of the day [governed by it] differs accordingly. When the rising-time is large, the [corresponding] part of the day is large; and when it is small, [that part] is small.

And this is so because the rising-time is the cause, and the part of the day is the effect that follows from it.

And know that whatever increases for one of the dwellers [of a given clime] in the length of the day is the very same amount that decreases for the other, and the reverse [?]. For the day of the one is the night of the other, and the night of the one is the day of the other; and the cause of this is the inclination [נטיה, the obliquity of the ecliptic to the equator].

Now [ועתה], I shall begin to set out for you the names of the rising-times and their differences, so that this matter may be made plain to you.

I say: every sign whose rising-time is equal in the inclined sphere [the oblique horizon] to its rising-time in the right [sphere]—this comes about only at the equator, where there is no inclination of the horizon, so that the rising-times there are equal in both [reckonings]. But in the inclined regions [the latitudes that have a clime], the rising-times differ: some of them are greater than their right ascensions and some of them are smaller, in accordance with the place and the inclination of its horizon.

And there are [ויש] [signs] whose rising-time is equal [to its right ascension], and this occurs at the two equinoctial points; for there the rising-time is neither increased nor diminished [?].

And there are [ויש] [signs] whose rising-time is greater than [its right ascension], when [the sign lies] in the differences [the spans toward the solstice] [?]; for there the rising-time is increased over the right ascension.

And there are [ויש] [signs] whose rising-time is smaller than [its right ascension]; for there the rising-time is diminished from the right ascension [?].

And there are [ויש] [signs] in which the rising-time of one and the rising-time of another together complete a full quadrant [רביע]; and this occurs when one is large and the other small, so that the small completes the large [?]. And there are [ויש] those in which both rising-times are small together [?].

and there are [ויש] [cases] in which the [combined] rising-times complete the whole [arc], when this one is large and that one small [?]; for the small completes the large.

[The remainder of the written area on this side is taken up by the enumeration above; the lower portion of the leaf is blank margin.]

Diagram. A small spherical-triangle figure set into the right edge of the text column: a curved (arc-sided) triangle of the kind used to illustrate the relation of an arc of the ecliptic to its right ascension and to the horizon. No interior point-labels are legibly inked on this side.

f. 26v

[On this side the text block is set toward the gutter on the left half of the leaf; the outer (right) half is blank margin.]

and there are [ויש] [cases] in which the rising-time is large [?], when the difference [span] is large; and there are [ויש] those in which it is small and small together [?].

The differences [המרווחות] between the rising-times—[know] their reckoning [?]. For according to the place and the inclination of the horizon, this [span] was [reckoned]; and you already know [וכבר ידעת] the matter of the reckoning of these differences [?].

And there are [ויש] [cases] in which the rising-time of one together with the rising-time of another completes a quadrant [רביע], when one is large and one small. And there are [ויש] those in which the two rising-times are both small, so that they do not complete [a quadrant] [?].

Diagram. A spherical-triangle figure set into the left text column: an arc-sided (quadrant-like) triangle with two inner arcs drawn from the apex, illustrating the partition of a quadrant of the great circle into rising-time arcs. The text wraps around it. No interior point-labels resolve legibly on the scan.

Now [ועתה], just as I have set out for you the names of the rising-times and their differences—whether large or small—so I shall set out for you [the way] you may know the matter of these [combinations], whether the [combined] quadrant be large or small [?].

[Heading, in a slightly enlarged hand:] **שער וספרו** [Gate — heading-word(s): "שער וספרו" — see anomaly note]

the fifth [?: המשה], which we have arranged [שסדרנו] [?]. For in the reckoning of these rising-times there was [a procedure?]: when the sun reaches the [?] ... [the small/the large] ... [the line is cramped and partly faded; several tokens illegible] [?].

and the matter [reverts?] to the rising-time and the part of the day, the small or the large [?]; and the rising-time which we have arranged is to be reckoned together [?].

Table — the quadrant (רביע) formed by paired rising-times, large or small, by clime

[Ruled table, lower-left of f. 26v, three columns. Caption above the grid:] "Know [דע] that according to the two measures of the degrees [שתי מדות המעלות] ... the [combined] quadrant [רביע] will be either large or small ... " [the caption's final clause is faint] [?]. This is a qualitative classification grid: the cells carry category-words (גדול / קטן / רביע / מרווחות / שזות), **not** gematria values — there are no numeric entries to read. Logical reading right-to-left: argument column (right) → descriptive column (middle) → resulting quadrant (left).

Resulting quadrant [הרביע גדול או קטן או שזות]	The two paired rising- times [middle, descriptive column]	Quadrant [רביע] (entry argument, right)
quadrant [רביע]	such that, accordingly, each to each, they are equal [שהן לפי כן כן שזות]	quadrant [רביע]
small [קטן]	such that, accordingly, they were the differences [שהיה לפי כן כן מרווחות]	large and large [גדול וגדול]
small [קטן]	such that, accordingly, they are differences [?:] [שהם לפי כן כן ד?רות] middle token]	small and small [קטן וקטן]
quadrant [רביע]	a difference [arc] together with the large, and this together with the quadrant [מרווח עם הגדול ועם הקטן ? עם one [?:] [הרביע connective]	large and quadrant [גדול ורביע]
quadrant and small [רביע וקטן]	set together with the quadrant, and this together with the small [מנכת עם הרביע וזה עם]	small and quadrant [קטן ורביע]

Resulting quadrant [הרביע גדול או קטן או שווה]	The two paired rising- times [middle, descriptive column]	Quadrant [רביע] (entry argument, right)
	הקטן]	
large and small [גדול וקטן]	a difference together with the large, and this together with the small [מרוו?קת עם הגדול וזה עם הקטן]	large and small [גדול וקטן]

[The last two rows spill into the foot of the column: their entries read "... וזה עם
הקטן" plainly. Below the table the leaf is blank.]

Yesod Olam — Gate I (cosmography / spherical trigonometry)

the measure of [the arc] would be, and its [opposite] would not be — for it would not be [its equal] — and so on accordingly; for the line of demonstration of this is as set out above. Therefore, set down upon the surface of its plane that which we have computed: the proportion of [arc] to [arc], the bounding-arc, and the [angle], and likewise its complement [?]. So this would be [the case]; for the line [of] the bounding-arc of the [whole] sphere would be [thus], and its [chord] would be a known measure of nine degrees [?]. The sages, by contrast, drew the following inference [?].

Yet consider this: were it not so, it would not stand — for the position [would be inconsistent]. Once you know it, you have established the [arc], and so the rising-times [are] known by it, and the [arc] is known to be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous]; for it would be [thus]. And take note that the bounding-arc and its line [together] make up a single ratio [?], inasmuch as it is one degree of [each] of them; and likewise the rising-times: a single ratio. By that path, then, the bounding-arc and the complement [follow], and so do the remainder and its multiple [?]. Look now to the line of the bounding-arc: by it you set the [arc] to its [opposite], and you take the [arc] as it has been demonstrated to you [?] — for they observed it and set it out before us. And again: [the foundation of these matters] [?] is a fundamental principle, and let it be the part you apportion to it [?]. Take the bounding-arcs, two by two, of each one of them, and

their [several] product reaches the part [you require], and the bounding-arc comes out by it. So [as] they said, and this [is] the order in which [the matter] proceeds: the rising-times [are] required for the day and for [the points] inscribed; ascend, then, by this path, and the orders before you [follow]. And here is what would be, were the rising-times such-and-such, and were [the difference] from the [equator]: the sun [?] and the rising-time [are reckoned], so [too is] the [interval] for them — thus. So this is established by the computation of the heavens, and likewise their lines have established that this is so. And we have set out its [demonstration] from them, and we have begun upon the order:

החקר הראשון — The First Inquiry

[Display heading, brown ink, centered: "החקר הראשון" — "the First Inquiry." The prior pass read this ordinal as "Fourth"; on the scan the word reads הראשון, "the First."]

— and it is that which the sages refined regarding this [?].

What the practitioners of the discipline [?] handed down in their books — they have both opened and stated [?] that, in every example such as this, you set down: when [the body] is at the [meridian], or when the [bounding-arc] of the [obliquity] coincides [?] with a sign of measure [?], so it is by this path [?]. For when [the body] is at the [meridian] [?], take the bounding-arc by it, so that the bounding-arc of the [obliquity] would be [thus], and so its complement would be [thus]; and take the bounding-arc by it, [namely] the bounding-arc of [the obliquity], so that it would be [thus]. And so, take the bounding-arc by it, [namely] the bounding-arc of the third, the remainder beside the bounding-arc; the bounding-arc of the [angle] which would be the remainder [is then known], according as one [degree] would be its multiple [?]. So it would be, were it [thus]; and the bounding-arc by this path you would set, and the bounding-arc of the third [likewise]; and take it by this path: the bounding-arc of the [angle], so that it would be [thus]. And were it [thus], and so on accordingly — set the bounding-arc to its [opposite], so that there is the remainder beside the bounding-arc, [making] the bounding-arc of the [angle], the rising-times, and the remainder.

החקר השני — The Second Inquiry

[Display heading, brown ink, centered: "החקר השני" — "the Second Inquiry." The prior pass read this ordinal as "Sixth"; on the scan the word reads השני, "the Second."]

From it [proceeds] what would be when the [body] is at the [meridian] [?], in that [thus]. Take the obliquity such that its bounding-arc [is thus], and [take] its complement, which is the multiple — and so it would be: this. And take the bounding-arc by this path: the bounding-arc of the obliquity [?], so that the [arc] would be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous], and so it would be; for the bounding-arc of the [obliquity] would be by it [thus]. And take the bounding-arc by this path; and the line [?] would be the bounding-arc of the [angle], so that it would be [thus].

Diagram. A spherical (arc-sided) triangle in the right margin beside the body text: two straight base-lines meeting at a lower vertex and rising to an apex, the apex closed by an arc (the curved hypotenuse-arc of a right spherical triangle). The vertex marks are faint single brown-ink letters.

- א (apex): apex vertex
- ב (base, right): right-hand base vertex
- ג (base, left): left-hand base vertex

Diagram. A second arc-sided (spherical) triangle at the foot of the folio: two base-lines from a lower vertex rising to an apex closed by an arc, slightly larger than the first.

- א (apex): apex vertex
- ב (base, left): left-hand base vertex
- ג (base, right): right-hand base vertex

החקר השלישי — The Third Inquiry

[Display heading, brown ink, centered: "החקר השלישי" — "the Third Inquiry."]

From it [proceeds] what is asked, [namely] how you set down for every example such as this: when the [obliquity] is of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous], and the [rising-time] is known, you make it [thus]. Take the bounding-arc by this path: the bounding-arc of the [obliquity] would be [thus], and its complement would be the multiple [?]. And take the bounding-arc by this path: the bounding-arc of [the angle] beside the bounding-arc, so that it would be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous]; and take the bounding-arc by this path: the bounding-arc of the [angle], the remainder, so that it would be [thus]. And the rising-times of the [body] — they

are the remainder, and let it be the bounding-arc of the [angle] beside the bounding-arc, the remainder; and let it be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous]. And again [?]: the orders [follow], and the line [?] is the bounding-arc of the [angle], so that it would be [thus].

Diagram. An arc-sided spherical triangle in the upper-right margin: two base-lines from a lower vertex rising to an apex closed by a curved arc. A small dot sits inside the figure (a marked interior point). Vertex marks are faint single letters.

- א (apex): apex vertex
- ב (base, left): left-hand base vertex
- ג (base, right): right-hand base vertex

מוסד יסוד — A Foundational Principle

[Display heading, brown ink, centered: "מוסד יסוד" — "a foundation, well-founded" / "an established principle."]

The three inquiries [?], and their lines [?], [rest upon] the orders set forth [?]: the way of [demonstration] [?]. And we have set it out, and shown you that [thus]. [These are] three foundations [?], so that there is one beside the other, each beside [the other], according as the [body] [?] would be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous]; and let it be the bounding-arc of the [obliquity] [?], so that the [obliquity] would be of a known sign of measure, and so it would be [thus]; and the part [you apportion] [?] — take the bounding-arc and its complement, which would be the multiple [?]. And were it [thus], and the bounding-arc its complement [?] — let it be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous], and let it be of a known sign of measure [?: which gematria value the abbreviated סימן names is not disambiguable here — glyphs legible, referent ambiguous].

[The rising-times [?] — they are the remainder [?], and this is its proportion [?]: it would be the [given quantity] [?] and a known number; and were it [thus], so it would be a known number, and the bounding-arc by this path; and were it [thus], and the multiple [is] a number, and it would be: the third multiple, of known measure [?], and this would be a number, and the multiple is a number [?]. And the bounding-arc of the [angle] [?], the [computation] [?], according to the four numbers [?]; and the bounding-arc [?], so that there are remaining numbers [?]: how many of them [?], and so the sum is a number; and again [?]: the part you

apportion to the [body] [?] — let it be of a known sign of measure [?: which gematria value the abbreviated סמ names is not disambiguable here — glyphs legible, referent ambiguous], and let it be [thus], for it is known [?]; and the part [you require] [?].]

[...the bounding-arc its complement — let it be of a known sign of measure [?: which gematria value the abbreviated סמ names is not disambiguable here — glyphs legible, referent ambiguous], and the part you apportion [?], [reckoned] by the heavens [?], that this is so. So upon the part you apportion to the first [?], let it be [thus]...]

Diagram. An arc-sided spherical triangle in the left-margin area beside the body: two base-lines from a lower vertex rising to an apex closed by an arc, with the apex letter and the two base letters marked in faint brown ink. A small mark sits on the right base-line.

- $\aleph$ (apex): apex vertex
- $\beth$ (base, right): right-hand base vertex
- $\aleph$ (base, left): left-hand base vertex

Diagram. A further arc-sided spherical triangle lower in the same margin: two base-lines from a lower-left vertex rising to an apex closed by an arc. The apex carries a faint letter; the two base vertices are marked.

- $\aleph$ (apex): apex vertex
- $\beth$ (base, right): right-hand base vertex
- $\aleph$ (base, left): left-hand base vertex

[Marginal: foliation "28" in upper margin, modern hand.]

the line of the first arc, and it [the angle] was a known [angle], being acute; and the second [arc] was likewise acute, and the third was known. So consider this carefully. And it follows of necessity, by the line of reasoning of the other inquiry, between [the case in which] the third [arc] is known and [the case in which] its angle is known, that you may know by it the line of the fourth arc. And so the inquiry [proceeds] when there is one arc, with a known angle upon it, by the way we have set out, on the basis of the known [quantities]; for this was the matter, and it is the first inquiry. And it follows that the angle whose number is known [stands] to the arc whose number is known by [a fixed] proportion. And so it would be that if the number of the angle were known by the arc, then by the number of the arc its angle would also be known; and the inquiry would be the matter inverted, and it would be the inquiry of the [reciprocal] proportion of the

arc by the known angle, with [the case in which] the angle is acute and [the case in which] it is right [recte: the right and acute angles]. So this is one inquiry, and it has [the case in which] the number of the angle is known, that it is right; for this was the matter, and it is the inquiry of the proportion. And the portion stands upon the inquiry that we have set out, by [the case in which] the number of the arc is known, just as [in the case in which] the number of the angle is known; for the matter is good and known by the proportion of the known arc.

And after this, return and consider, and you will know by [the case in which] the angle is acute, that the inquiry of the proportion stands firm; and the known [quantity] will be greater [than] this. So know it. And this until you reach, by the proportion of the arc, by the known angle, the line of the fourth arc, which will be known, being greater. So consider the inquiry of the proportion by the line of the known arc, by [that] which came out for them in [the figure of] the triangles; and upon the matter—and it has been demonstrated already—you will know its reasoning. Look now, and you will be able to know, upon the matter, all that we have demonstrated, the line of the first arc, and the line of the remainder, and the line of the second arc, by the lines whose computation is known—that is, [the case in which] there is a known arc; and the line of the remainder, and the line of the second arc, and the line of the third arc.

ונתק [And it follows] that, since it is known to us at the outset that the angles of the triangle [taken] together amount to two right [angles], and the line of the second arc and of the third arc—

[Margin, second hand: brief gloss, ~one line; verbatim text illegible at this resolution. [Margin: [?]]]

—the wise men [or: geometers] have set out, and they have come to know the nature of the [right] sphere, and they have given [a procedure for] one of the three remainders; the matter [is], that you may know upon the matter [whether it] proceeds by [the case in which] the line of the angle is known: and it would be the procedure by [the case in which] the angle is acute, and [the case in which] the line of the second arc is known by the angle, and it is the first inquiry; and by [the case in which] the line of the second arc is known by the proportion of the angle, and it would be [recte: the case in which] the number was known, that it is good; and it would be the procedure of the proportion: that it [is] in the proportion of the angle, by the known number of the angle, that [it is] right [recte: the right angle]. And know it; and by the proportion of the angle, the line of the second arc would be known. And the portion stands upon the inquiry, by [the case in which] the angle is right, that it would be known; and the line of the

second arc is known by it, [and] not [otherwise]. So know the reasoning of the inquiry of the proportion, good and known by the line of the second arc, and the line of the third arc, and the remainder.

ויען [And further]: consider that we have set out, at the outset, the line of the first arc, the angles upon it, by the proportion that we have stated: that there are three arcs, set firmly in a known proportion [or: "established in proportion"]—the three angles. And consider it, by the way that the third inquiry [proceeds]: that the procedure is by [the case in which] the angle is acute, by the known number, just as [in the case in which] the number of the angle is known; and the line of the second arc is known by it. And there are three, and there is the procedure of the angle that is right. And the portion stands upon the inquiry, by [the case in which] the number of the arc is known, just as [in the case in which] the number of the angle is known. So know that the line of the first arc would be known, by [the case in which] the line of the first arc is known by computation, by the proportion of the known [arc]—

—the inquiry of the proportion of the angles, and between [them], and you will know the line of the [right] sphere, and the line of the second arc by the remainders.

ויען [And further]: consider that it is known to us that the line of the first arc was [equal to] the line of the second arc by the angle, by the line; and consider the inquiry of the proportion, by [the case in which] the line is known, upon their nature by the computation, for [the case in which] there is a known arc; and the inquiry of the proportion would be [the case in which] the angle is known—that is, by the proportion of the line. And the portion stands upon the inquiry, by [the case in which] the angle is right, just as [in the case in which] the number of the angle is right. And the line of the first arc is known by the proportion of the angles, between [them], and the line of the [right] sphere by the remainders.

ויען [And further]: consider that it is known to us that the line of the first arc was a known line, and the line of the second arc would be known, being greater. And this [follows] from the fact that all the angles [taken] together would be known: for the angle that is known, [the case in which] the number is known, just as [in the case in which] the number of the angle is known, and the line of the second arc—the inquiry of the proportion. And it is good; and the second arc, the line of the first arc, stands firm by the computation; and the line of the angle is known by it. And consider it, by the line of the third arc, of the remainder—the line of the second arc, the line of the third arc—and you will know by it, by the proportion that we have set out, the inquiry of the proportion of the first arc.

In summary [lit. "the end of the matter"]: how is it to be known? Look, how it [is]: for it comes out, and consider that the inquiry of the proportion of the [right] sphere, by the line of the angle that is known, and by the angle, by the nature of the matter, by the computations.

ואם [And if] it should be hard for you, return to the diagrams [or: "the figures"], by what they said, and you will set out the line of the arc, [the case in which] the angle is acute and [the case in which] it is right [recte: the right angle], and the number; and consider that, by the proportion of the known arc, by the angle, by the right angle—and by [the case in which] it is hard—by [the case in which] the number is firm: so consider the reasoning of the inquiry of the proportion. For he said: there is a known arc, and it cannot fail but that one of two: for [the case in which] the matter is, that this comes out true [or: "right"], by [the case in which] the known number was [the case in which] there were [right] angles. And by the matters of the right [sphere], by [the case in which] this is good, the reasoning is true. And the existing [matters], by the right [sphere], [are] of the third kind: by the computations, by [the case in which] the angles are known, and [the case in which] the angle is right, that it is good, by the matters; and by the computations, that they [are] in their nature: that they [are] right, [the case in which] there is no proportion, [the case in which] it is right [recte: the right angle], for [the case in which] there is a known small portion firmly [established] upon the matter, being right. So consider, by the computation of the inquiry of the proportion, [the case in which] the angles [taken] together [are] [equal to] the proportion of the existing matters—or [whether] the [matter] proceeds by the way that they said.

שער [Gate]: since the wise men investigated and made wonders concerning their matter, they continued upon it, and they brought [recte: and they brought] all the circles of the [right] sphere and the remainders. And this was by the way that we have set out for them—the [right] sphere, that it is the round one [or: "the spherical"]—just as the body is round [lit. "round of body"], and the example [or: parable] for it would be that they made: that, to its being a long line, by the [right] sphere, by the line of the second arc, [the case in which] the line of the [right] sphere, by the line of the [right] sphere, by the line of the great circle; for it is round, and he said that the [right] sphere [is] in its nature: that it is

[Two small circle diagrams on the lower portion of folio 28v, side by side, each bisected by a single horizontal diameter; see metadata block below.]

—the third of the third, of the third sphere; and so, if it is round by [the case in which] the sphere—the third—it would be a line of round body; the example [or: parable] for the [right] sphere, that it is round, that it is

[The page ends here mid-sentence; the prose continues onto the following folio.]

Diagram. Two small circles drawn side by side in the lower-left portion of folio 28v, each bisected by a single horizontal line (a diameter). The right-hand circle (first in Hebrew reading order) carries a faint interior letter-label, and the left-hand circle likewise. Both appear to illustrate the round body / great-circle discussion of the adjacent **שער** prose. Interior labels are faint at this resolution.

- Right circle, interior: ב [?] (or possibly a numeral; faint)
- Left circle, interior: ג [?] (faint)

[Margin, lower right of folio 28v, second hand (two short lines, brown ink): "בלעדי" [?] שכדורם [?] כל נתן כמ עורם / שונה לכדור ב' וק — a marginal gloss; verbatim reading uncertain at this resolution, no named authority legible. [Margin: [?]]]

[Margin, mid-right of folio 28v, second hand (one short line): "בחוף עגורי[ת] ועגלים" [?] — brief marginal gloss; further identification requires further verification. [Margin: [?]]]

Yesod Olam — Folios 29r–29v

for the divisions of the sphere are like its cycles: just as the sphere has divisions, so it has cycles. And the divisions are its cycles, and likewise its cycles are its divisions; for the cycle is its division, and the division is its cycle. So the sphere has three divisions, and one division upon them — and that is four. And this one is reckoned from that one, and that one from this one; and all of them return to a single point.

For the division of the whole sphere is threefold, and likewise its cycles are threefold; and there is one division upon them, and this one is reckoned from that one. So consider: the sphere has three cycles, and there is one cycle upon them, and this one is reckoned from that one. And this is the cycle that returns and goes around, and it comes back to its place, and the matter is settled; so understand this.

And as for what we said — that this one is reckoned from that one — know and understand that everything returns to a single point, and from there it begins. And the cycle goes around and returns to its place, and the matter is proper, and so it is.

שער [Bare chapter-marker, no number visible in display position]

The sphere is at rest as a body resting upon its base, and it does not depart from its place. For everything composed of the four elements [יסודות, "elements"] is ordered according to its weight: the heaviest of them is below, and the lightest of them is above. Thus earth, which is the heaviest, is at the bottom; and above it water; and above the water, air; and above the air, fire, which is the lightest of them — each one set in its proper place according to its nature.

And just as these bodies are ordered according to their weight, the heavy below and the light above, so too the sphere is set in its place and does not depart from it. And this is a body resting upon its base, and it does not move from its place; rather, it abides in its station. So consider this, for it is a clear matter, well established and made plain.

שער [Bare chapter-marker, no number visible in display position]

This chapter concerns whether the celestial sphere [גלגל] is one or many. And the matter is resolved: it is one body, even though its spheres and its motions are many. For although the sphere has many motions and many divisions, it is nonetheless a single body; and this body is one, even though the motions within it are many.

For consider: the mover [המניע] goes around the sphere upon the cardinal circuit [העקרית, "the principal/cardinal cycle"], and the sphere is set in its place; and this one is upon the eighth [העשמיית; recte? "the eighth," השמינית], reckoned this one from that one. And it returns to its place, and the host of the heavens [צבא השמים] proceeds from the other one; and the matter is proper, and so it is.

So consider: the mover goes around the sphere upon the cardinal circuit, and its motion returns and is reckoned upon the eighth. And the eighth sphere is set in its place; and the motions of the sphere, even though they are many, are nonetheless a single body, reckoned this one upon that one. And the host of the heavens [צבא השמים] proceeds, each one from the other, in their proper order — the host of the heavens upon the cardinal circuit.

And just as the going-around returns to its place, so the motions return, each one reckoned from the other, and all of them return to a single point; for the matter is one, even though the motions are many. So consider this, for it is established and made plain.

חתימה [Conclusion]

The author said: This is the conclusion of the chapter, as we set it down. So consider this. We have completed four reckonings [מספרים, "numbers/reckonings"], and they are reckoned this one from that one.

For the reckoning of the first is the reckoning of the second; and the reckoning of the second is the reckoning of the third; and the reckoning of the third is the reckoning of the fourth. And just as this one is reckoned from that one, so they all return to a single point; for the matter is one, even though the reckonings [מספרים] are four. And the proof of this is from the division [חלוקה]: this is the law [דין] of the matter, in the manner of the four reckonings.

And know and understand that the proof drawn from partition — this is the law, just as it holds for the four reckonings. For the four reckonings are reckoned this one from that one, and all of them return to a single point.

וכמו כן — And likewise — the author said: this is a further demonstration. Take a square [מרובע, "quadrilateral"] and divide it; for the proof of this is established from this division [חלוקה], just as the law was established from the four reckonings.

Take a square, and let its corner be ה, and its corner ז, and its corner ב, and its corner ד.

Diagram. An undivided rectangle (quadrilateral) with its four corners labelled; no interior dividing line.

- ה (upper-right corner): label *he*
- ז (upper-left corner): label *zayin*
- ב (lower-right corner): label *bet*
- ד (lower-left corner): label *dalet*

And just as the corner is ה, and the corner ז, and the corner ב, and the corner ד — divide it: let its corner be ז and ה, and ב and ד, and within it a dividing line; for this is the square [מרובע]; and so it is.

Diagram. A rectangle (quadrilateral) divided by an interior vertical line; the four corners are lettered and the word מרובע ("square / quadrilateral") stands beside the figure.

- ז (upper-left corner): label *zayin*
- ה (upper-right corner): label *he*
- ב (lower-right corner): label *bet*
- ד (lower-left corner): label *dalet*

- (interior vertical line — the dividing line; its label glyph is faint) [?]
- מרובע (beside figure): "square / quadrilateral"

So consider its corner: the corner is ק [?], and so it is; and its corner is ה, and so it is. And the dividing-line is ק [?]; this is ה, this is the law, and so it is. So consider this, for it is established and made plain.

And I say that the surface of a quadrilateral [שטח המרובע] is its length multiplied along the line, and likewise its breadth from this point to that point. The third [line] is its breadth, and the fourth its length [שן: ?] of the quadrilateral; and this surface is the fourth, for the surface of the third is [equal to] the surface of the fourth, the breadth and the length being equal. The surface from this point to that, and likewise the surface as it returns: thus the surface of the first line returns to the surface of the second, just as the surface returns to it. Its measure [?] is full and complete, for the line [ק] is straight; thus the surface returns. This is the surface, for the line [ק] returns to it [?]. It is the surface [שטח], a sixth and ten [?: יו]; it is the surface. So too this is a surface, for if a surface returns to a surface, then the surface [returns] to the surface.

So it will be: the surface of the quadrilateral is all equal, its length to its breadth, the third [equal to] the surface of the third; as we have said, the matter is established. And the lines being equal, so the surface returns, just as the surface returns to it — and this is established.

[End of Gate I / completion mark:] תם — Completed.

[A single rubric-word "פרק" stands isolated below, with a flourish; no chapter number is attached on this leaf. The remainder of the recto, and its lower margin, are blank parchment.] · "ושטח" · [?] "עצמ" [?] — verbatim, identification reserved for further review.]

The Second Treatise [המאמר הטני]

The Treatise [המאמר]. This is its compass [חבר בו: ?], and we shall set out the value [שווי] of the world and the order [סדר] of its motions and the manner [אופן] of its dispositions and their order [סדרים]. And we shall establish [ותקן] the standing-place [נצב] of the heavens [השמים], and that this standing-place [נצב] — it [is so]; and [we shall set out] the order [סדור] of the spheres [הגלגלים], that they revolve [?] continually [תדיר], the host [הצבא] and the firmaments [רקיעים], and the manner of the bond [קשר] of the motion; and we shall make known the length [אורך] of the circuits [ההקפות], and a host [?]; and likewise the motion of the

upper firmament [רקיע], and that which is bound to the host [?], and likewise the motion of the upper firmament, the host and the firmament; the surrounding [הקיף] of the firmament above the place of the host, for it returns; and there [שם] [?]; and this [?]; and the host is hidden; and it returns, and it stands and is hidden; the surface [שטח] of the host; and the upper firmament [רקיע], the surface of the firmament; and the surface as it surrounds, and the surrounding-line [קו ההקיף] of the firmament from [?]; and the day is hidden; and the day and the heat [חום], and the heat; the surface of the surrounding, and the host; and the surface; and a host of months returns, and the day is hidden; the surface as it surrounds is hidden, and the night is to it [?].

And it is fitting [?: ותחלה] that I begin in this.

And this Treatise, according to most of its content, is divided into five chapters [והמאמר הזה לפי רוב ענינו נחלק לה' פרקים]

Chapter	Content
Chapter One [פרק ראשון]	On the arrangement [בישת השלם] of the world and the order of the motions, and the order of its dispositions, and that it will be [?].
Chapter Two [פרק טני]	On the four foundations [היסודות] [הארבעה], and that [?] the heavens [היתה?] [?].
Chapter Three [פרק שלישי]	On the surrounding [הקיף] / circuit of the spheres [הסיבוב], and concerning [?] the witnesses [?], their length and their breadth [ארכו ורחבו], the length [אורך] of the firmaments [הרקיעים], and the host [וצבא].
Chapter Four [פרק רביעי]	On the seven [?: השבעה], [?] and the strength [?] and the host [ועצבא]; and the surrounding-line [וקו] of the surface [שטח] of the day [היום], [the position of the moon? מצב הלבנה].
Chapter Five [פרק חמישי]	On the matter [בענין] of the poles [קוטרי] of the sphere [העולם] toward the north [לצפן], and the spheres [?], the equator [המישור] [?], and the

Chapter	Content
	seventh [השביעי] [?].

Table of Contents of the Second Treatise (conclusion)

The list resumes from the middle chapters and runs to its end. Reproduced as a table in the logical right-to-left order (chapter ordinal | summary). The small ordinal glyphs are clear; some summary line-ends are cramped toward the gutter, and those words are flagged.

Chapter	Summary
פרק ששי (6)	The natural cause of the diversity of the seasons of the year and the difference in their character — how the heat departs and the cold returns [?: line-end cramped]
פרק שביעי (7)	The proportions of the moon's revolution and its computation [?: partial]
פרק שמיני (8)	Why the body of the moon appears at one time full and at another deficient
פרק תשיעי (9)	The seven climes (אקלימים) of the inhabited earth, and the differing character of each [?: line-end cramped]
פרק עשירי (10)	Why there is night and day, and how day equalizes the night [?: partial]
פרק י"א (11)	The regions in which the days and the nights are equal — those whose hours are equal [?: partial]
פרק י"ב (12)	The rising of the sun and of the moon [?: remainder of line abraded]
פרק י"ג (13)	The orders of the works of creation of heaven and earth [?: remainder abraded]
פרק י"ד (14)	The rising of the sun and its setting [?: remainder abraded]
פרק ט"ו (15)	The cause of the rising of the sun and its

Chapter	Summary
פרק ט"ז (16)	setting [?: remainder abraded] The order of the rising of the sun and the moon in their proper places [?: remainder abraded]

פרק ראשון — Chapter One

Now that we have set out the foundations of this science and the method proper to it, and have spoken of it as the whole subject requires, we resolve to begin our account of the heavens.

We say: since the universe is composed in graded order, from the highest of its parts down to the lowest, and since the proper procedure is to begin with the lowest of them and to ascend, little by little, until we reach the highest — for that is what the subject demands — we therefore begin from the lowest element and ascend by degrees [?: the connective syntax of this opening period is cramped and partly rubbed; the order of the argument is secure, a few function-words are uncertain].

The lowest of all is the element of earth; around it lies the element of water, around the water the element of air, and around the air the element of fire. Above the four elements lie the spheres of the planets, and their arrangement follows the order of the works of creation [?: line-end abraded].

[The body text runs only a few lines below the contents column; the remainder of the lower half of folio 31r is blank parchment, with conservation patches in the lower margin — not text loss.]

The proper order requires that the firmaments (רקיעים) be ranked one above another, each in its place. They differ one from another: this one is of one kind and that of another; this one moves while that one is at rest, and the one is still while the other turns; and so with the rest of them [?: the line-opening is cramped, but the contrast being drawn — differing firmaments, some moving, some at rest — is legible].

For the firmament moves and revolves, carrying with it all that is set within it; thus it opens the gates of heaven, and the firmaments are appointed over the divisions of the days [?: partial]. And the stars run their courses, each as it has been ordered [?: line-end abraded].

The arrangement reckons for them their composite ranks: the matter of the planets, the forms of their bodies, and their revolutions, each within its own sphere [?: this is the densest stretch on the page — the nouns (firmaments, stars, planets, bodies, revolutions) are read confidently and track the subject; several connecting words across these lines are cursive-cramped and not fully secure].

Within their bodies, and in the matter of the planets, these are seven in number. The highest of them is reckoned first [?], and beneath it the host of heaven (צבא השמים); and the stars are set, each in its station [?: partial].

The host of heaven are the fixed stars; their motion is measured over the days, and the matter is so ordered [?: line-end abraded].

As for the moon: there is, within its body, the sphere [that carries it], and some of these [bodies have their own motion] [?: the reference to the moon (ירח) and its sphere is clear; the surrounding clause is partly rubbed].

[ועתה sub-section:]

And now (ועתה), since you know that all these matters stand as we have described, we resolve to inquire into [their causes] [?: the *ועתה* opens a fresh investigative move; "since you know that..." and "we resolve to inquire" are read confidently; the precise object of the inquiry is partly rubbed].

For this was our purpose from the outset — to inquire into these things — and the matter rests upon the wisdom of [the Creator] [?: partial].

And so they were ordered as they are; and the inquiry into why this is so and that is so, and into [their reasons], proceeds accordingly [?: partial].

For the subject requires it, and the matter of this [inquiry stands as we have said]; there is nothing wanting in it, and it is to be set out by proper measures (כדיים) [?: this is the last inked line; below it the lower half of folio 31v is blank parchment].

[Margin: pencil foliation "32" in the upper-left margin, later hand]

[Damage: a horizontal tear/crease and an ink blot cross the upper text-block of f. 32r; the first line is partly affected but largely legible.]

the men of inquiry [חכמי המחקר], and they said that there are seven firmaments [רקיעים], set one above another, and that to each one of them a single planet [כוכב] is assigned [נתון]. And they ordered the spheres [כדורים] thus: each firmament above the next, and so on; and they said that the host of heaven [צבא השמים] is set in the highest of the firmaments [the eighth], which is above them all.

And the order of the firmaments, from the lowest of them to the highest, is according to the measure [שיעור] of each one's distance from the earth: the Moon is the nearest of them to us; above it Mercury; above it Venus; above it the Sun; above it Mars; above it Jupiter; and above it Saturn. And above them all is the eighth firmament, in which the host of heaven — the fixed stars — is set.

And this is a matter in which the men of inquiry differed [נחלקו], and they were not of one mind concerning the order of the lower planets [the Sun, Venus, and Mercury], some setting one above another and some below; each reckoned according to the measure [שיעור] that he established for himself.

ראובן [the enlarged mid-column display word "Reuven", opening the paragraph; read רֵאֲוִבֵן clearly — a worked illustrative proper name introducing the analogy that follows, not a numbered rubric]....for everything that is higher [עליון] is more honored [נכבד] than what is below it, and so it is with these firmaments, ordered this above this, and this above this. And for each of them there is a fixed measure [שיעור] by which the men of inquiry know its order, just as we have explained.

וְעַם הָאָרֶץ [the second enlarged mid-column display phrase, read וְעַם הָאָרֶץ — "And the earth / the produce of the earth", opening the next paragraph; NOT "and together with all this" as the prior draft read it]....the firmaments are like the foundations [יסודות] of a building [בנין], laid one course above another, each resting upon the one below it; and just as a building has its foundation laid first and its upper parts built upon it in order, so too are the firmaments ordered.

the four foundations [היסודות הארבעה], and every coming-into-being [הווייה] is from them; and this is like [כמו] the [?: a worn word, perhaps "second"/"acting"].....that which is like the quantity of the produce [תבואה] is established and endures;...that the foundation [יסוד] is the support [תכון], which is the [?: worn]... it is established [?].

[Margin, left, finer hand: a short note of a few words — "...the matter [?] is explained [שיתבאר], for them [להם]..." — verbatim text only partly legible; a constructive/clarifying helper note, no named authority asserted; further identification requires further verification.]

[The text of f. 32r ends here, a few lines into the lower portion; the remaining lower half of f. 32r is blank — original layout.]

[Damage: the upper portion of the leaf is blank (original layout); a small ink blot near the top edge. Text begins below the midpoint of the page and runs to the foot.]

The men of inquiry [חכמי החכמים] established, through their demonstrations [בחותמת?], that the highest firmament [העליון] — the eighth — was [היה] a single sphere [כדור] encompassing [קבוע?] all the rest. And the measure [שיעור] of the lowest firmament [התחתון], how it is set, and its order, the men of inquiry reckoned, just as we have explained; and the matter requires [צריך] that the higher encompass the lower, up to the highest of them all.

one within another, like spheres [כדורים] nested one inside another; and this is the order of the firmaments — the lower within the higher, up to the highest of them, which has none above it. And there is for each of them a fixed place [מקום] and a fixed measure [שיעור], just as a building [בנין] has for each of its courses a fixed place.

And every firmament [רקיע] has its own planet [כוכב], assigned to it and set within it. And the highest firmament — the eighth — is the one in which the host of heaven [the fixed stars] is set; and they are many, beyond [?: worn] number [cf. "the host of heaven that cannot be numbered," Yirmeyahu 33:22], and it encompasses [מקיף?] them all.

And the order of these matters, and their measures [שיעורים], and their reckonings — for each there is a known measure which the man of inquiry reckons; and the reckoning of them all together is one reckoning, having a beginning [תחלה] and an end [?: worn]. For the beginning of the reckoning is from the lowest firmament, nearest to us, and its end at the highest, which encompasses all.

And the place [מקום] of these firmaments, and the manner in which they are set one within another like a sphere [כדור], is as the men of inquiry [חכמי המחקר] established it; for the order of the matter requires [צריך] that the higher encompass the lower, up to the highest of them, which is the great encompassing one [הגדול], and it encompasses them and is set above them — just as we have explained.

[The text ends here a few lines into the lower portion of 32v; the remainder of the lower portion is blank — original layout.]

[Margin, right, finer hand, multi-line note: "...and one should know its measure [?], as it is explained [שיתבאר], that for them [?]/...the reckoning [?] in its place

[?]... /...for them [?]..." — verbatim text only partly legible; a constructive/clarifying helper note, not a citation of a named authority; further identification requires further verification.]

[Margin, left, finer hand: a very short note, only a few letters legible — content not recoverable; no named authority asserted.]

[Marginal note: top-of-folio foliation "33"]

and even though they were [created] in a single firmament, they were created in measure, in number, and in weight; and the seven firmaments are a covering, one over another, the upper over the lower. The firmament of the Moon is the lowest of them, and above it, one over another, the firmament of the Sun, and above them all the firmament of the fixed stars. **And the heavens** [ושמים] are above them all — their number being seven.

The men of inquiry [חכמי המחקר] were divided over the order of these firmaments. There is one who says that the firmament of the Moon and the firmament of the fixed stars are not in a single place [?: i.e. not adjacent], and there is one who places the eighth above them all. **And further** [ועוד]: there is one who says that the firmament of the Sun is the fourth, ordered in the midst of them, with three above it and three below it, the Moon below them all and the fixed stars above them all; and they said this is the order of the stars and the Moon, and that the firmament of the fixed stars is the highest of them all.

The stars and the Moon were created in their firmaments, and Ribbono shel Olam set each one over its service and its appointed task, each one in its place.

[A short two-line block, set off after a wide gap:] **...a building upon a building** [בנין על בנין — the building-foundations analogy]: the order of the spheres [הגלגלים] is a building upon a building, the lower one a foundation for the one above it; for so it is fitting that the structure of the world be ordered, just as a building is founded course upon course.

[Marginal note, left margin (lower 33r), partly legible: " ואחר זה אם ירבה ... עתה ... בזה שאמרו ... לבטל ... העיר ... ועל ... אבל זה כי הסכימו ... ולא ... אחד ... ולא ... ולמה ... במחקר ... מהם ... מתוך ... ועל ... " — a multi-line constructive helper note; further identification requires further verification.]

there it was set, and over each one [a star] that they might sit and go round in its course; and a star revolves, going round in its circuit. And over the firmament of the Moon there was set the firmament of the star [Mercury], which goes round;

and Venus [נוגה], whose course is likewise — these are the spheres; and how is the place of each one [reckoned], for each has its measure.

And further [ויש] — there are stars set one against another, each star above another: the star of Saturn [שבתאי] is the highest of them, and the distance between them is very great.

Its distance is very far, one from another; for thus is the place of each one reckoned, and so the men of inquiry said. **And further** [ויעוד]: know that the firmament of the Sun is the fourth, and there are those who say that this firmament — and its order is such — for thus they reckoned the order of the firmaments, with the firmament of the Sun in the midst of them, and the firmament of the Moon below them all, and over it the firmament of Mercury; and so it is fitting that they be ordered course upon course in the manner of a building. And the men of inquiry said that the firmament of the Sun is in the midst, for so is the order of the spheres, just as we explained.

[Lower 33v — the planetary rubric series, enlarged display words at line-heads:]

The Moon [הירח] — its firmament is the lowest of them all, and its revolution is the swiftest of them; the star [planet] that goes round, its place is [the lowest].

Mercury [כוכב — i.e. כוכב חמה] — the star of Ḥamah [Mercury], which is above it [the Moon]; its sphere [is the second].

Venus [נוגה] — the firmament of Venus is above it [Mercury], and its sphere is the third.

The Sun [שמש] — the firmament of the Sun is the fourth, ordered in the midst of them; and from this [point] Mercury and Venus serve it.

Mars [מאדים], **Jupiter** [צדק] — and above them the firmament of Saturn; and the firmament of Saturn is the seventh, and over them all the firmament of the fixed stars.

name ... measure [שם ... חבל — uncertain enlarged display words]; the firmament of the Moon is the lowest, and the firmament of the Sun [is in the midst].

the lower one a foundation, and the order is course upon course; and they reckoned each one — the place of each star, one from another; and there is between them [no gap]; this is what we explained.

[Final lines, lower 33v:] ...Ribbono shel Olam, may His name be exalted; and the order is course upon course, the lower a foundation for the upper, just as we explained; the measure, one from another.

[Rest of folio 33v blank — wide lower margin (not damage). A single dark ink stroke (vertical) sits low-center on the page — a stray ink mark / show-through, not text.]

Yesod Olam — Second Treatise, Chapter One (continued)

Bodleian MS. Huntington 299 (1484). Folios 34r–34v. Sephardic semicursive, brown ink. The chapter continues unbroken from the prior folio with no new numbered פּרָק rubric.

[Librarian note: "34" (foliation, upper-left margin)]

[The passage continues the discussion of the planetary orbs, ordered from the lowest and swiftest to the highest and slowest.]

in it more. And now I say that all of these [orbs] are such that this one moves more quickly than that one — each in its turn — in all of the computations, and therefore it was so. The lightest and swiftest of them all in its motion is the orb of the Moon, [and likewise the rest in order].

The Moon completes one circuit around the center of the universe in about twenty-seven days, by an approximate path. The orb of Shabtai [Saturn] is the heaviest [slowest] in its motion and the most distant of them all; it completes one circuit around the center of the universe in about thirty years, its daily cut [חֻתְכִּין, i.e. its daily mean motion] being [numeral: ?] [per day]. The orb of [the star] Tzedek [Jupiter] completes one circuit around [the center] in twelve years, its cut being [numeral: ?] per day. And the orb of Ma'adim [Mars] [completes its circuit] in [numeral: ?] years, its cut being [numeral: ?] per day. And the orb of Ḥamah [the Sun] completes one circuit in a full year.

the path is near or far [accordingly]; and the orb that is heaviest [slowest] in its motion is more removed than all of them, [as] in the orb of the star Tzedek [Jupiter].

And he made known that this is so, and that the measure of every part [of the circle] is equal to this — this part being equal to that. He called each part of it a "degree" [מזל / מעלה], and [so on].

[Display rubric, set off mid-page:] **The Eighth Sphere (והגלגל השמיני).**

This is the firmament of the fixed stars [הכוכבים הקיימים], whose stars do not change their position one with respect to another, but keep one fixed arrangement and one shared motion; and they are called the fixed stars. And the wise men called them by this name.

[Geometrical construction of the orb:] ...three great circles that pass over the navel-line [קו טבור, the central axis-line] and the south [תימן] of the universe ... to the [points of the] poles [קטבים], plainly, [forming] equal angles [זוויות שוות]. And the great circle that passes over the middle of this orb is the one inscribed [drawn upon it], because ...

on the line, and it is near or far [accordingly]; and there is a measure of [numeral: ?] degrees; and this part is equal to that, and so in every place.

Diagram. A vesica-shaped (lens / almond) figure set in the lower text-column, formed by two arcs meeting at an upper and a lower apex, with a horizontal axis-line drawn across its widest part. It illustrates the form of the sphere. A caption-word stands below the figure.

- (upper apex): קמ"ב [= 142; or possibly 152 = קנ"ב — the מ/נ discrimination is uncertain; both candidates noted]
- (horizontal axis, center): צורת הגלגל ("the figure of the sphere")
- (lower apex): קמ"ב [= 142; matching the upper apex — same two candidates]
- (caption below figure): צורת המזלות ("the figure of the constellations")

[Wide blank lower margin. A large stray vertical ink stroke sits in the blank margin — not text.]

[The chapter continues. The text introduces the twelve constellations of the eighth sphere and their single shared eastward–westward daily revolution.]

the matter of their motion, following the order of the parts of the firmament, for each one of them ...

that stand upon [each] star [or: upon its place] ... equal [angles], and there is no difference at all between the parts of the figure ... and likewise ...

then it will turn toward [the place of] a sign [מזל], and turn away from ... keeping the order of the fixed [standing] degrees. And the order of the firmament is its order toward the east and the west, in this order.

The twelve constellations, in order:

סרטן · תאומים ([Te'omim] = Gemini) · שור ([Shor] = Taurus) · טלה ([Tela] = Aries) · מאזנים · בתולה ([Betulah] = Virgo) · אריה ([Aryeh] = Leo) · סרטן ([Sartan] = Cancer) · קשת ([Keshet] = Sagittarius) · עקרב ([Akrav] = Scorpio) · מאזנים ([Moznayim] = Libra) · דלי ([Deli] = Aquarius) · דגים ([Dagim] = Pisces) · גדי ([Gedi] = Capricorn).

And they bear these forms [or: were given these names] ... because they are [grouped] so.

and the stars within this constellation are [grouped together], and they are called by this [name] ...

Diagram. A circle divided by twelve radii (spokes) meeting at the center, with the twelve constellation-names written around the rim between the spokes, and a single filled dot (point) marked inside the circle toward the left. It illustrates the arrangement of the twelve constellations on the eighth sphere. The rim-labels repeat the constellation names; the legible ones are:

- (top of rim): סרטן · תאומים ("the Twins" = Gemini) · סרטן (Cancer)
- (upper left): אריה (Leo)
- (left): בתולה (Virgo)
- (lower left): מאזנים (Libra)
- (lower and right rim): [further constellation labels present but not legibly resolved — [?]]
- (interior, toward left): a single marked dot (a reference point on the orb)

[After the diagram, the text resumes:]

because in this matter there is a great thing: that the center [מרכז] of the firmament ... is fixed, and all the parts of ... are called ...

[Display word, set off in the line:] **And now (ועתה).**

Now I shall make known to you the measure [שעור] of the orbs in the universe, and the order of each orb, up to the ninth [orb], the figure of which ...

[for] each year ... up to thirty years ... and the universe ... another ... in the universe ...

and these are the hidden things of the firmament ... which turn [revolve] ...

the heavens revolve, and the orb of the heart [לב] ... toward the west ... for whatever reason this is so, and they ... [the page ends mid-sentence; the text continues onto the next folio].

[Wide blank lower margin. A large stray vertical ink stroke sits in the blank margin, mirroring the one on 34r — not text.]

[Margin: "35" (folio number, upper outer corner)]

and they revolve [?: ומשפטו / "and its rule is"], each one above the other [ואחד מהן] [על העליון למעלה מזה]. The astronomers [חכמי המדידה — the measurers/astronomers], when they wished to know [?: שיתבאר] the magnitude [שיעור] of each star [כוכב] — and to know the [?] of all [ידיעת הכל]...

The order of the orbs [סדר הגלגלים]: each one revolves [?] — and the matter is established [?] — this one above that one [זה למעלה מזה], for the center of the world [מרכז העולם] is one [אחד]. And upon this order [ועל סדר] are the motions [התנועות] established, this one above that one [?].

for the body of each one was congealed [?: היה קבוע — "was fixed"] in its place [במקומו], and the matter is fixed [?] in the orbs [בגלגלים], this one above that one [?]...

and they are bodies [?: גשמים], and they revolve [?], one within the other [?]; and there is no void [?: ריק] at all, for the body of each orb [כל גלגל] is contiguous with [?] the body of the orb above it and below it [?].

of the astronomers [?: המודדים] [?]; their words [דבריהם] [?]; for this is a thing established [?: קבוע] by way of investigation [?: חקירה], and the matter is fixed [?].

[The mid-page lines run in a small, even cursive; the legible thread is the astronomers' determination of the orbs' magnitudes and their fixed nested order about a single world-center, with no void between contiguous orbs. Individual connective clauses marked [?] are flagged where a specific glyph or particle could not be resolved even under magnification; the recovered content is the author's, not supplied.]

and the center of the world [מרכז העולם] — its [?] — and the firmament [?] — and so the order [וסדר]...

And know for certain [הוי יודע] that [?]...

[Display word, lower right of folio 35r:] **ועתה** — "And now" —

for it was [?: כי היה] water [מים], and afterward [ואחר] it congealed [נִקְפָּא] [?: "and from it the heavens were made" — recovered theme, individual glyphs flagged]...

[Last legible line of 35r:] As the verse [הכתוב / הסנֶה] says [אמר]: "Let there be a firmament" [יהי רקיע] [Bereishis 1:6].

"in the midst of the waters" [בתוך המים], "and let it divide" [ויבדל] — "And God called the firmament Heaven" [ויקרא אלהים לרקיע שמים] [Bereishis 1:7–8]. The heavens [השמים] [?: שניות / "a second"] — [?]....

the face of the firmament [פני הרקיע]: for the heavens [השמים], when [?: כי המתן] [it divided] the water [מים] — and this is [?]....

to know [?: לדעת] that the heavens [השמים], when [?: כי כן] all the orbs [כל [הגלגלים]...]

the matter [?: היה], except [?: אלא] — [He] divided [?] for them [להם] the firmament [הרקיע]...

for this thing [זה] [שעשן / "that this matter"], being [?: חיון] — and so [?: דרך] the deed [מעשה]...

[Verbatim recoverable from this opening of 35v:] "...in the midst of the waters, and let it divide the waters from the waters; and God called the firmament Heaven" [the Bereishis 1 firmament verses, cited and expounded].

the order [?: וסדר] [is] established [?: קבוע] in the [?: בחלק] firmament of the heavens [רקיע השמים] [?]....

the matter [?] — afterward [ואחר] the firmament [רקיע]: He divided [המבדיל] between the waters [בין המים], and there was a divider [והיה מבדיל] between [?]....

and the bodies [?: והגשמים] [?] — and so [?] the firmament made [עשה רקיע]...

for it was [?: היה] a body [?: קבוע] made [נעשה] from the waters [מהמים], and so [וכן] it was congealed [קבוע]...

the waters [המים], for they are fixed [?: קבועים] above [עליו], and the waters congealed [?: מתחממים / "the waters are warmed"] — [?]....

[Marginal note, lower outer margin of 35v, two lines, small hand: "שהערב קמן ... ויקראו לומר א מים..." — a marginal gloss; verbatim text only is recovered, and no named authority or specific judgment is legibly present. Further identification requires further verification.]

for they congealed [?: כי קבועים] the waters [המים], and the orbs [?: והכוכבים] [?]....

to know [?: לדעת] that the firmament [הרקיע], when it divided [?: שאמרת], the heavens [השמים] [?]....

the moon [הלבנה] and the orbs [?: וגלגלים] — and so [וכן] it was thus [ואכן]; the order [?] of the firmament [הרקיע] — [?]....

afterward [?: אחר] — the waters above [המים העליונים] are divided [?: מובדלים], and these divide [מבדילים]...

the firmament [רקיע], by which [?: כמה] it divides [יבדל] the waters above [מים], and the lower [?: השפלים]; and how [?: ואיך] it divides [?]....

for the waters were divided [?: שמהמים נבדלו], and the order [?: ושיעורם] / "their measure", and afterward [ואחר]...

for the firmament was made [?: שעשה רקיע] a divider [?: מבדיל], and afterward [?]....

[Final legible lines of 35v:] ...each one [אחד], and they were made fixed [?: וניתחלקו] — one made the other [עשה אחד], and they were fixed [?]; ...it congealed [?: התחלק] above it [?: עליה] and below [?], and these are places [מקומות] [?]. [End of legible text on the page; the lower portion is blank parchment.]

[Folio 35v expounds the Creation account of the second day (Bereishis 1:6–8) — the firmament dividing the upper from the lower waters, God calling the firmament "Heaven" — and applies it to the order of the orbs: the firmament as a fixed divider between the waters, the nested orbs and their measures established in fixed places. The hand is small but even and largely legible under magnification; remaining [?] flags mark individual glyphs/particles in the small cursive that could not be resolved, not whole unread clauses. No numeric orb-magnitude or distance value was legibly committable on either folio; none was invented.]

Script: Spanish Rabbinic (Sephardic) semicursive, brown ink, single column, written page tilted in the scan. Modern pencil foliation "36" in the upper-left margin of the recto. Two later-hand marginal additions in the left margin of 36r. Wide blank outer/lower margins; photography ruler and black strip at the left of each tile are furniture, not text.

and the heavens are matter [chomer], and they remain enduring [only] as measured against the boundary of the place and the boundary of the surrounding body; and from this it follows that the heavens are bounded and that the

firmament is finite. The heavens, then, are a finite body, like the body of all the other spheres; and the firmament — that is, the surface dividing the heavens from what lies below the firmament — is itself finite.

The heavens that lie upon the firmament are bounded both in being surrounded from without and in surrounding from within; and even so, there is no body whatever above the heavens upon which they themselves rest. From this it follows that all of them — the heavens — are finite in measure and finite in number, and that there is no body of any kind above the ninth orb [galgal teshi'i].

And the words of those who discourse upon the heavens proceed from the measure [shi'ur] of the firmament. Know, then, that the firmament is finite; and that whoever would say it has no limit speaks of it as a thing whose end and whose measure cannot be grasped — and that is a deficiency. The heavens, therefore, are surrounded and finite, and the firmament that surrounds them is finite; and from this it is established that there is no body above the ninth orb, since the ninth orb is the outermost surrounding body, and above it there is nothing at all.

[Interlinear pointing-mark above the line here: a single stroke; no legible added word.]

Concerning this our Rabbis said: "It is the firmament" [hu ha-raki'a]. Rabbi Yehoshua ben Levi said that the firmament is firm as congealed water [k'mayim she-kafu], frozen above the heavens. And there are those who say that it is [itself] the congealed [mass], and that the heavens above it are congealed water; while another Rabbi said that it is congealed and the heavens are bright [bahir].

Rabbi Chanina said in the name of Rabbi Moshe: the firmament is fixed [or: of fire], as in the matter of [?].... and there is in it neither heat nor cold, neither water nor fire; rather the firmament is set fast in its place, with no rising and no sinking in it [ein bo me'al ve-lo matah], for there is no [change of] place within it. And concerning this they said: "the firmament that is over the heads of the living creatures" [ha-raki'a asher al roshei ha-chayot] (Yechezkel 1:22).

[Left margin, lower half of 36r — a later hand, ~5 lines of cramped semicursive, brown ink:] [Later hand, margin: "...Ibn Ezra z"l labored [over this]... for it is good on the day of... and our Rabbis... in the verse... by way of... in the matter... and understand."] [Marginal note: the gloss appears to invoke Ibn Ezra and a scriptural verse, but the full wording requires further verification.]

And now [ve-atah] we shall take up [the matter of] the firmaments and the heavens: that there are those who say there are firmaments above firmaments; [we shall treat] the measure of the journey [shi'ur ha-mahalak] from the lowest to the uppermost, and the [relative magnitudes of the orbs]...

על דרך המישור

[Centered display phrase at the foot of 36r — "by the straight (level) method" / "according to the correct reckoning" — a rhetorical formula introducing the disciplined computation that follows. **It is not a closing colophon: there is no "the Treatise is concluded" (נשלם המאמר / נשלם הפרק), and no numbered chapter or new מאמר rubric follows it.** The discussion of the Second Treatise, Chapter One continues unbroken onto 36v.]

and the scholars of the science [chakhmei ha-tevunah] call it [the orb]... [the sentence carries over to the verso].

[established] in its place, [namely] that the heavens are bounded — and this would be [so] in every place, [each firmament] brought to the boundary that surrounds it; and from this [it follows] that whoever keeps to the bounds [follows] the straight path. And there are others who name them [otherwise], [saying] that they stand each above the other; and as I have already made known to you the matter of the six [heavens — sheshet?], they stand one above the other, for the firmament stands always [tamid], with neither rising nor sinking in it.

נעשה [superscript above: עליו]

[Display word "we shall treat" (na'aseh), with a small superscript correction "alav" ("concerning it") inserted above it, opening the next argument.]

And know [ve-da] the matter of the firmaments and the heavens: that there is firmament above firmament, and so on in succession; they call it the "place of the firmament" [makom ha-raki'a], and the heavens are bright [bahir].

And the wise men who investigated [ha-chakhamim she-chakru] the measure of the upper orb [shi'ur ha-galgal ha-elyon] — its length and its breadth — found it to be a journey [mahalak] of fourteen years [arba esreh shanah], according to the journey [course] of the firmament. [The figure is such that] the journey alone is a span [so vast].

And [there is likewise] the matter of the path of the firmament [derekh ha-raki'a], the [course of] the journeyer through it, and the measure of the orb [shi'ur ha-galgal]; and they said: this is a wondrous thing.

And the wise men who investigated the measure of this orb — [investigating] how long [its journey lasts] — found that its length and its breadth, [namely] the firmament, [are so great that] a man could not traverse it [in a lifetime]; and [they gave] a measure of years.

ויש

[Display word "and there are" (ve-yesh) opening a fresh clause:] And there are [those who say] the firmaments stand above firmaments, each above the other, [and that] the path of the journeyer through the firmament [is greater still].

Our Rabbis said — in the matter of the heavens: Rabbi Yehoshua said to his disciples, and Rabbi Akiva ben Yosef said, and Rabbi Yaakov bar Chama [?] said — that the journey of the heavens is [of such vast extent]...; and they cited [in support]: "the place of the heavens" [makom ha-shamayim]. ...the measure of the journey of the upper firmament; and they assigned to it [a count of] years, [each] firmament above the firmament beneath it; and from this [one grasps] the greatness of the firmament and the greatness of the heavens. And [the Rabbi] said: from the earth to the firmament is a journey of [so many] years, and from one firmament to the next likewise; and this is the "place of the heavens," and the measure of the journey [surpasses] every count of the years they assigned to it — for it exceeds all reckoning of the firmament.

And all this [is given] not as bare measure, but as a received tradition [shemu'ah]; and there is in it no [exaggeration]... but a thing [fixed] in its place. As for the path of the journeyer through the firmament — its compass — they fixed it [by tradition], and [reckoned] one journey for the heavens [as a whole].

[Foot of 36v, final two lines:]...and from this you may grasp the measure of the upper firmament, and that there is no end to its journey nor to the measure of the firmament; and this is a wondrous thing, of which no man [she-ein adam] is able to grasp [the full account]... [the text breaks off and continues on the next folio].

Isaac ben Joseph Israeli, Yesod Olam, Bodleian MS. Huntington 299 (1484). Second Treatise: close of Chapter One and opening of Chapter Two (the roundness of the heavens). Spanish Rabbinic semicursive, small brown-ink hand; slightly tilted scan. Single-column layout with wide outer margins.

Know that, since the world is round and spherical, and since it is round and spherical it is encompassed [by the heaven] [?: one word], the world is fitting to be on the left side [?: sense], and it is called small.

פרק שני — Chapter Two

In what has gone before, we set out the order of the four elements, their place, and their nature; and we showed by demonstration and by the senses, as those before us said, that there is no body that moves of itself which is not a round body — save only water; for a vessel [?: 'לכ], if it were rounded, the place within it would be round as well. And so it is plainly fitting that the heaven, which encompasses the world, should be round, since it has no corner and no angle.

Reason itself requires this: that the heaven is round, and there is in it neither corner nor angle. For when a body revolves upon its circuit and returns to its place, it must of necessity be round, since there is nothing to impede its motion; and so it was shown likewise from observation, that the heaven and that which is within it move with a single motion. And this is a demonstration that the heaven is round.

And when each of the heavenly bodies revolves and returns to its place, this too is among the demonstrations; for were it not round, it could not revolve and return to the point from which it set out — and the foundation of its motion confirms this, and the senses confirm it, and reason requires it, concerning that which is within the heaven.

The demonstration of those who reckon [the stars] is likewise so, and the matter of [?: one word] is by reckoning; and the demonstrations of those who came after [confirm it] as well — that the heaven is round, and there is in it neither corner nor angle, and it returns upon its circuit. And the proofs of those who reckon confirm this.

And the matter of its revolution: the senses testify to it, and they are true [?: one word]. [A closing clause; the phrase here reads "the world of the righteous, and others" [?: sense uncertain].]

[The text on this side ends here; the rest of the folio is blank parchment. The vertical mark at the column foot is an ink blot, not a figure.]

and the roundness of the bodies is like the roundness of a single circle [?: clause]; and from the roundness of the heaven, which is round, [comes] the order of the sun, the moon, and the rest.

Just as every body that moves of itself is round, so too the heaven — by reason and by demonstration. And it is fitting that this is the way of [the matter].

And the roundness of the bodies within the heaven, and the demonstrations: they said, the more a body revolves, all the more does the heaven return and revolve.

And the order of the heaven, its parts joined together; it stands firm, and the heaven returns and revolves. And now: just as [we have shown], the demonstration is that the heaven is round.

The first [proof]: that the planets [the wandering stars] appear, each one of them, now at a higher altitude and now at a lower altitude. Were the heaven not round, they would not appear at varying altitudes; therefore the heaven is round.

The second [proof]: that we see the stars rising at the eastern horizon and setting at the western horizon, and they go on rising and setting. Were the heaven not round this could not be, for a body that is not round [could not do so]; and from this it is shown that the heaven is round.

And the [third] proof: that air enclosed within a hollow rounded vessel takes the shape of the vessel and is itself round, like the vessel that contains it; and so it is with the heaven; therefore it is round.

[Display word וכן ("And likewise") — left margin, second hand: ע' ד' [?: small cross-reference note]]

And likewise: when a body revolves and returns to its starting place, it is round; for were it not round, it could not return to the point from which it began. And the demonstrations of those who reckon [confirm it]: they said, "round upon round"; and so the heaven is round, and there is in it neither corner nor angle.

And the matter: when the body is round, and its revolution [is complete], so the heaven [revolves]; and they have said so. And the rounded vessel: the heaven is round, and so they return and revolve. And the heaven and that which is within it stand firm, and they said [so].

And now, in conclusion: that the nature of each one of the heavenly bodies is [its own]; and they return and revolve, and they stand firm.

[The final two lines:]...by reckoning the days, when [a body] is pressed inward [דחק], and on the day [of its return] it goes back behind [?: clause] and revolves once more.

[The text on this side ends here; the rest of the folio is blank parchment. The vertical mark at the column foot is an ink blot, not a figure.]

[the heavens] turn and revolve, and the [?] returns [?]. For if it were not so [כי אם ...], it would not [be possible?] [?]; and the firmament would not be [round?] [כדור]. For every body whose nature it is that it be round [שיהיה כדורי] —

and [?] — every single one of them must be [round?] [שיהיה], its nature [טבעו] being [?] that it be round; and this [וזה] is the firmament [הרקיע].

[The lines here continue the argument, begun in the prior folio, that the firmament must be spherical: each celestial body is of such a nature that it is round, and so too the firmament as a whole. The reading is partial — the hand is small and faint — but the recurring vocabulary (כדורי "round/spherical," טבע "nature," הרקיע "the firmament") is secure.]

and it has [already?] been said [שאמרו], and this [וזה] is [?] [a portion / division] [חלק], and this is [?]. And the [?] is round [כדורי] and [?]; for the [body that is round?] returns [?] to its place [למקומו]. And this [?] requires no [proof?] [צריך]; [?], and let this suffice [?] [ודי בזה].

the round shape [הצורה הכדוריית]; and [?] [?] the nature [הטבע] is that [שיהיה] the [?] [?] turning upon the [?]; and the [?] [?]. And were it not [?] [ולא היה], the [?] would not [?] [be carried / revolve] uniformly; rather it [would?] [?].

the matters of nature [עניני הטבע]; and this is [true and?] clear [מבואר ... וזה], and there is no doubt [ספק] in it [?].

[the air?] [?] [takes / receives?] [?], just as [כמו...] [?] [?] when [?] [the air?] [האוויר] is [small / contained?] [קטן] [?]. And [?] [in?] the hollow [vessel?] [חלל], the [air?] takes [קח] the [shape?] of [?] upon it [עליה]; from us [ממנו], and [?] [?], and it would be [?]. And the [?] [?]; and [?] [round?] [?]; for when the air is [confined?] in a [round?] hollow [vessel?], the [?] [?] its place [מקומו] [?] [?].

and this [וזה] is a thing [self-evident / clear?], and there is no need [ואין צורך] to prolong [להאריך] [the matter?] [?]; and this is [the case / sufficient] [?].

פרק שלישי [Chapter Three]

[Body heading, mid-folio, display rubric: **פרק שלישי** [recte: פרק שלישי — the scribe writes the defective spelling שלישי].

[Beside the rubric, in lighter ink: a brief marginal note / catch-phrase, "במזור" — verbatim text only; further identification requires further verification.]

[?] [Within the topic of?] the directions [המהלכות / המהדבות?] [?] and [?]; for [?] [the surface?] [?] [?] the figures [דמות] of the surface [שטח] of the [?] [המקיף], just as they said [כמו שאמרו] that when [?]; the [surface?] [שטח] of the firmament [שהוא שטח] [?] the [?] [המקיף], and revolves [והוזר] upon [?]. So [?] [the body that

revolves?] returns [חוזר] [?] to its place [?]; and likewise [וכן] the surface [שטח] of the firmament [?] revolves [?] upon its place [?].

And it has [already?] been [?] from the [direction / pole?] [?] [?] that the surface [שטח] revolves [?]; and the [?] [?]. And the [?] line [קו], its direction [?] [?], and the [?] line [קו] [?] [?] — [these naming the lines and arcs upon the figure].

We say, then, that since the firmament is round [עגול / כדורי] ... שהוא and revolves [וחוזר] continually [תמיד], and [?], it has of necessity a [fixed?] line [קו] upon which the revolution takes place [?], and this is [?] [what is called] **the line of the pole** [הקו הקטוב] [recte: הקוטב]. Its two ends [?] are the two poles [?], the one toward the north [צפון] and the one toward [?] [the south?] [?]; and [?] [they are fixed], not [moving?] [?].

The eastern point [נקדת מזרח] is [where?] [?], and the western point [?] [נקדת מערב] [?] [where it sets?]; and the line [קו] drawn from [?] [east to west?] [?] is [?] [the line / the diameter?] [?].

[?] ...and [?] [?] every place [כל מקום] [?] from [?] [?] [?] to a place [למקום] [?] [?]; its name [שמו] [is?] [?], just as [?] [?] [the matter?] [?] is divided [?].

And [?] [in / upon?] [?] [?] the round [body / circle?] [כדורי] [?]; [?].

And [?] [?] [?] is the **fixed transit** [עבור קיים] [?], and [?] [the?] [?] is [?] **the transit** [עבור] [?] — [these naming the lines and arcs marked upon the figure below]. [The two display words **עבור קיים** ("fixed transit") and **עבור** appear as sub-rubrics in the lower lines, glossing terms of the figure.]

[Diagram follows — a sphere/horizon circle with the directions and latitude-arcs labeled.]

Diagram. A circle representing the sphere (or the celestial horizon), crossed by a vertical line (the pole-line/axis) and an oblique chord/arc, dividing it into regions. Direction-names and "latitude" arcs are labeled within the circle. Two cardinal points on the circumference are lettered ד (south) and ב (west). The labels are written in a lighter brown ink than the body and several are faint.

- (vertical line, upper): קו הקוטב — "the line of the pole / axis"
- (right point on circumference): ד דרום — point ד, "south"
- (lower-left point on circumference): ב מערב — point ב, "west"
- (upper-left region, inner): צפון מערב [recte: צפון מערב] — "north-west"
- (left region, inner): רוחב [?] — "[?] latitude" [the qualifier word is faint]

- (left region, inner): רוחב קטוב [?] — "latitude of the pole [?]" [reading uncertain]
- (lower-center region, inner): דרומי מערבי — "south-west"
- (center, near the vertical line): אמצע [?] — "center / middle" [faint]

the views of most of the scholars, [namely] that they are close to one another; and the second view holds that they are far apart. Now [the region] inclining toward the south and east — and likewise, when two cities lie close together — is here a matter of east and west; [a star] rises, and the distance between them is great. And it appeared to me with respect to each of the four directions of the world that, although the distance between them be near, it is fitting [to reckon] by degrees of ascension. For the rising of a star, when its course follows this [reckoning], will reach you according to the length [of the days]. Its setting and rising, then, follow this same course.

What I have said is that there is a distance, and when it is fitting [to measure] east and west, then a star rises; and when it is fitting to measure, then the distance is near, and the portion that is south; and as for whether it is fitting [to measure] east and west, then [there is] the distance between two cities, one east and one west ...

And further: what has been established here — that you [should] know that most of the scholars' reckonings hold a single opinion; and they said that the inhabited world [היישוב, the οἰκουμένη], when it is fitting [to measure] from it, you may know the distance of a city's position, [whether] it be to the south.

And in which clime [region] there were words [traditions] of Shimon, and days, and others; and the reckonings, in their judgment, have here been clarified, as was explained. And as for them, and what their books contain, they said, with respect to the latitude [רוחב] that they are accustomed [to measure] — its length [of day]: just as you reckon the position [given] to them by the early [authorities]; and they saw that the inhabited world, by their reckoning, is here measured along the length. The clime of the east, and as far as a city's edge, [reaches] eastward to its measure; and against it, eastward, the position [is reckoned], so that [the reckoning] receives [a value]. The measures of ascension here are [taken] from the [position] given to them by the early [authorities], for the position [is reckoned] alone, [and] not by degrees [of ascension]; rather, [it is reckoned] by the nearness of the distance, by ascension and by descension. From the position they reckoned [it], both for [the city] and against it; and the [several] degrees of ascension remain, in the reckoning of the position. As for them, they said: how much is "close" [near] in the position? They said: so [too] is the

inhabited world; thus you will find the cold of the [northern] place, ever cooler the higher one ascends upon the path of the south.

Toward the south — and against it, eastward — they reckoned the distance [as you reckon] east and west; for so they said, [that] the position would be in due proportion, [reckoned] from east to the eastern edge of the inhabited world; and there is, here, a great deal in this. The boundaries of the position [are reckoned] alone, [and] one knows the measure of ascension [in the reckoning of] the position.

And in order to show you the figure of this matter, and its like — so that you may see it clearly — take a circle [of] a known measure, [and] set it [as] the position; and reckon it alone. Whatever you set [as] the position — and likewise the degrees of ascension — the position [will] govern it. And in the measure of the position, just as you measure [it]. The position [is reckoned] alone: that it be good; for [otherwise] there would be the distance of east and west. And I say to you: see, your distance increases when the position falls along the east-west line; the position is the boundary itself, and [its] reckoning falls in the position [reckoning] of the south. As for what they said, and what was here explained, [namely] that the position is in due proportion — you [should] know that the east-west position falls along the line of the east. And the clime, when in due proportion, [yields] the measure that has been established here in due proportion; the position [is reckoned] from the east. If it should fall along the west line — and the inhabited world, by the reckoning, is here measured along its length — then the matter would be this: that there would be a distance — long [along] the south, and a position [distance] of the south. As for what they said: and there were, as it were, opinions, [and] reasons here, in the position; behold, here you have made known the [city's] position — that the position be good [exact] in proportion.

And you [should] know the foundations of the position, and the cities, and their boundaries.

And further: what the scholars knew, [that the reckonings are] in due proportion, [reckoned] from there; [and] their measure [runs] up to [a certain number of degrees] [numeral: ?], and below [it].

The length of the inhabited world, [when] it is drawn out so that it equal the position — this, [when] you reckon it as it ought [to be reckoned], by degrees of ascension — runs to some [number of] thousands of miles [numeral: ?]; [for] their course [runs] through the four directions of the world, and so the reckoning will go for you, [whether] it be [reckoned] east to west. And by degrees: its distance [is

reckoned] as ascension [for] the position, so that the position go in a [single] course, just as you reckon the position [given] to them by the early [authorities]. Its course follows this [reckoning].

Now the length of the position, [its] distance, [reckoned] up to the eastern edge of the world: just as you set [as] the position, [the result] equals the position [of] this measure, [and] there is [thus] an ascension [for] the position, governing it. The measure of the position [is reckoned] so that the position go [as] one course. And the [several] degrees of ascension here, [counting from] the eastern [edge], and against it, eastward — they reckoned [the distance]. And [as for] the reckonings, here the foundations [yield] a position alone; here is the position. [As for] how much is "close" [near] in the position — they said: so [too] is the inhabited world.

And he set [it down]: see [now] the eastern direction, and the cities, and the figure [of] the inhabited world [as] it is drawn out, [running] through the four directions of the world; up to a city's edge, the [eastern] measure; and against it, eastward, [the distance] reaches — [and so] up to the city. Up to a city's edge they reckoned [the distance, going] along the path of a known measure, for [the city of] Jerusalem [is its] holy boundary; and as for the boundary, a position [distance]; and [as for] the reason for [the city of] Eilat [?: place uncertain] and the southern lands, in the measure of the position [reckoned] from there, [namely] the third [clime]; the position [reckoned] from the east; and the city, and the inhabited world's [length]. The other reckoning is [otherwise] told, and up to wherever [it is] empty [uninhabited]; and the order [of climes] from there, [up to] the third of the position; in the position, [reckoned] from the east, and the position alone. And so the foundation [stands], and so the boundaries of the position [are reckoned] up to the very limit. The reckonings of the inhabited world [are reckoned] thus.

And now, in order to show you the eastern direction, and the cities, and the circle [of] the figure [of] the inhabited world, and its boundary [as] it falls, and against it, eastward, upon the path of a known measure [for] Jerusalem — [that] the inhabited world's measure be in due proportion. The position [reckoned] from the east — see [it] as the boundary itself; for the position [is reckoned] alone, [it is] a known position, and the [position-]knowledge here governs three of the measures of ascension; and against it, eastward, [the distance] reaches — upon a [single] course [running] through the four directions of the world; the position [is reckoned] up to a city's edge; and a city's edge governs three positions; [and] there is a position [of] the measure [of] east, and up to a city's edge it reaches; and the position alone governs it. And here you have made known the position; thus

you will measure the position, and the position governs it. The reckoning of the length of a city's [position is reckoned] just as you reckon it, by the nearness of the boundary, [whether] it be near [to] you. The position [is reckoned] alone, [reckoned] upon the three positions.

And [as for] cities of the three [climes], [reckoned] from the south: in two of the positions, by degrees of ascension, [whether] it be near; and along the line of latitude here [is the city's reckoning], [reckoned] from north to south, [and] over against [each other]. The position-line [קו המצב], and the boundary-line: [reckon] just as you ought to reckon, [running] along its length toward the east; the position [is reckoned] up to a city's edge, and [as for] what reaches there, and [as for] the position — see [it] as the boundary itself, for the position [is reckoned] alone, [it is] a known position. The position-boundaries [are reckoned] up to a city's edge, as far as [it] may go; for it [is reckoned] up to a city's edge, [whether] it be near [to] you; [and] you reckon the cities, [and] up to a city's edge they reckoned [the distance]; and the city [reckoned] from the south — they reckoned [it] up to the position. As for what they said: how much is "close" [near] in the position? They said: so [too] is the inhabited world; thus you will find the cold of the place, ever cooler the higher one ascends.

Toward the south, and against it, eastward — [as] you reckon east and west: the position-foundations [are reckoned] alone, here, [running] along the length of a city's measure; the position [is reckoned] from east to the eastern edge. And the inhabited world, [reckoned] from the east — see [it] as the boundary itself; for the position [is reckoned] alone, [reckoned] from there, [whether] it be near [to] Jerusalem [along] the length of the inhabited world.

Diagram. A schematic sphere drawn as a large circle in the lower-left corner of the page, ruled with several horizontal parallels (lines of latitude) drawn across its interior, slightly curved. Direction-labels stand at the cardinal positions of the sphere, and individual letter-labels mark the successive parallels along the left edge. The figure illustrates the latitude-parallels of the inhabited world (the οἰκουμένη) on the sphere, between south and north.

- דרום (on the central horizontal parallel, mid-circle): "south" — labels the equator-parallel dividing the sphere
- מערב (lower-left interior, below the central parallel): "west"
- [small caption inside the lower band, two short lines]: אין בחצי הזה שוב [?: reading uncertain] — "there is nothing in this half" [?: gloss uncertain], glossing the southern band
- ל (right side, upper parallel): point-label

- ש (right side, parallel): point-label
- ק (right side, parallel): point-label
- ק (bottom row, near מערב): point-label
- פ (bottom row, near מערב): point-label
- ב (bottom row, near מערב): point-label

so it would be the like of the position from the east, and from the south, and the same in reverse. Two cities whose position from the east is one and the same, and yet their distance one from the other along the breadth [of the inhabited world] differs: the position of the one is to the north and the position of the other is to the south. And the closer a city's position lies to the equinoctial line, the closer it is to the south [?: clause terse]. And whatever you find for the length you find likewise for the breadth, and the same in reverse.

For if the position of two cities along the breadth is one and the same, while their distance one from the other along the length differs, then the position of the one is to the east and the position of the other is to the west. And just as you reckon the city's position along the length of the inhabited world, so you reckon its position along the breadth of the inhabited world. The position of the breadth is reckoned from the equinoctial line (קו השווה) northward and southward, while the position of the length is reckoned from the western edge of the inhabited world to its eastern edge.

And he said: and now [ועתה] — and now I shall set down [the rule] by which the position of the cities is known [?: clause terse]. The position of the city along the breadth is reckoned how far it is from the equinoctial line, and the position along the length is reckoned as we have said. For the place of the city upon the inhabited world is established [only] when both its position along the length and its position along the breadth are known; by the two of them together you find its place, and not by the one alone.

And by this means [ובכל זה / ובכן] you reckon how far it is from the equinoctial line, in which direction [the city lies], whether to the east or to the west, and likewise [whether] toward the north or toward the south [?: clause terse]. And so the heat increases the more a place descends toward the south, and the cold increases the more its position ascends toward the north; for the air grows ever hotter toward the south and ever colder toward the north.

And by the proportion that the near bears to the far, [so is the difference between places upon] the inhabited world, and accordingly the seasons differ [?: clause terse]. And the position of the breadth [is what determines] in which [part] the

city lies; and the more the place is northward [the colder], and the more it is southward [the hotter] — for the sun stands [more directly] over the southern places and is more slanted over the northern ones.

Jerusalem [ירושלם] [serves here as the reference point]; the more a place lies to the north of it, [the colder it is,] and the more it lies to the south, [the hotter] — for the sun stands more directly over the southern places. And this is enough concerning the matter of position [?: closing clause terse], as it shall be explained — all of this.

and their place is established by the position of the breadth [?: opening clause terse]. The wise men differed concerning [it]: some of them [reckon] in one way and some in another [?: clause terse]. For in the matter of the equinoctial line [there is a question?] whether [a given place lies] to the north of it or to the south of it. And he said: in the matter of the place [of a city] this is the rule, and so its position is known [?: terse].

And by this [reckoning] you know how far it is from the equinoctial line, and so [you know whether] this [place] is near and [that one] is far; and the whole nearness [or farness] is reckoned, as we have explained [?: clause terse]. And so the place [of the city] is established — that it is to the east [of one point] and to the west [of another], to the north and to the south; for the place is known by [its] length together with [its] breadth, and not by the one alone. By the two of them together the place is found, as we have said.

And he said: the [reckoning of the] near and the far, [is what tells] which places are the southern ones and which the northern; and so the reckoning of the near and the far [proceeds] up to the end of the inhabited world [?: clause terse]. And as for the [great] circle that passes [through a place] and the equinoctial line [17 השוה] — and so its nearness or farness [is found], and the distance [between them] [?: clause terse].

[?: a span of several closely-written lines here continues the reckoning of distance and position by the equinoctial line and the directions north/south, east/west; the lexicon of position (מצב), nearness and farness (קרוב/רחוק), the equinoctial line (קו השוה), and the directions recurs, but the individual procedural clauses are too terse to construe word-for-word with confidence]

And he said: what we have said hitherto concerning this matter [of position] is enough [?: closing clause of the section terse].

And afterward [ואחר] — [we turn to what follows].

פרק רביעי [Chapter Four]

[Body heading, rubricated: "פרק רביעי" — Chapter Four]

We have spoken in the foregoing treatise [שירתך במאמר שעבר] [of the reckoning of position]; and now [I shall speak] of this [matter], and I say [ואומר] [?: the closing words of the opening line are very faint]. By way of [taking up] what comes next, [I turn to] the place [?: terse] — just as I found the [reckoning of the] places [מצאתי המקומות], so [I proceed here]; and this [is] the rule [?: clause terse].

And I say: by [the rule of] the place [you reckon] your place, just as [?: terse] [?: the latitude/position word here is faint]; for it shall be [thus] [?: closing clause of the page very faint — the chapter has only just begun]. [The text breaks off here.]

the [solar] declination, and the day lengthens; but at the equator the day and the night are always equal. When the sun is at the head of Aries or at the head of Libra, the day and the night are equal for every inhabited place. From this you understand that the length of the hours of the day and of the hours of the night varies from place to place and from season to season. With this premise established, we say: the measure of day [חֶק הַיּוֹם] at any given place is the arc of the equator that rises together with the arc of the ecliptic traversed by the sun, from the moment of sunrise until its setting; and the measure of night [חֶק הַלַּיְלָה] is the remaining arc of the equator, which rises together with the portion of the ecliptic that lies beneath the earth, from sunset until sunrise.

When the sun is upon the equator — that is, at the equinoctial points — it has neither northern nor southern declination, and then the day and the night are equal in every place, for the arc that rises above the earth is equal to the arc that lies beneath it. But when the sun declines toward the north, the day grows longer than the night for those who dwell in the northern inhabited regions, while the night grows longer than the day for those who dwell to the south of the equator; and when the sun declines toward the south, the matter is reversed.

The difference between the measure of day and the measure of night is governed by the latitude of the place and by the declination of the sun. Every place whose latitude is greater — that is, farther from the equator — has the greater difference between its longest day and its shortest day; and a place that lies upon the equator itself has its day and its night always equal, with no difference between them at all.

At the head of Cancer the day is at its longest for the northern climes, and at the head of Capricorn it is at its shortest; and the reverse holds for those who dwell

south of the equator. For the longest day in the north is the shortest day in the south, and the shortest day in the north is the longest day in the south.

You already know the latitude of each place, and the declination of the sun for each point of the ecliptic; and from these two quantities you derive the measure of day and the measure of night for that place at that season.

There is an arc of declination, and the difference [in day-length] from one point [of the ecliptic] to the next, and the solar days and the hours [are reckoned accordingly]. And the right ascensions [מעלות העלייה הישרה] differ from the oblique ascensions [מעלות העלייה הנטויה]; for at the equator the ascensions are "straight" — the signs rising perpendicular to the horizon — whereas at a place of northern latitude they are "bent," that is, oblique.

By this reckoning the measure of each arc is determined and the difference between the [longest and shortest] day is found, as we shall make plain.

[The remainder of folio 41r is blank outer margin, with a column-foot ink blot below the last written line.]

and so it is: its arc rises with a corresponding measure, by way of the ascensions and the descensions; for at every place there is one arc of day and one arc of night for a given solar position, differing according to the latitude and the season.

Whoever wishes to derive the value precisely will reckon by the method of the ascensions, as we have explained — and this is the proper way to proceed.

And further: [ושוב] Now that we have made known the matter of the day and the night, and the measure of day and the measure of night, we proceed to set out how one reckons the place of the moon [מקום הלבנה].

When the matter is as we have set out above — that the day is the rising of the arc of the ecliptic above the earth, and that every arc of the ecliptic rises together with a corresponding arc of the equator — then the [solar] revolution is reckoned by the months of the year. The moon [הירח] likewise runs its course, and its place is reckoned by all of these [factors] together.

For the day runs from sunrise to sunset, and from sunset to sunrise is the night; and the measure of day and the measure of night vary according to place and season. The longest day is at one season and the shortest day at the opposite season; and likewise for the night, its longest arc and its shortest arc are reckoned in the same manner.

There is an arc of [right] ascension, and the difference from one point to the next, and likewise the [solar] days and the hours — for at the equator the ascensions are "straight," and elsewhere they are "bent," as we said before.

By this reckoning the equating arcs and the difference between them are determined; and the difference [between the longest and shortest day] grows as the latitude increases.

And likewise: [וכן] the matter of the longest day and the shortest day, and the place of the moon, [is to be reckoned in this same way].

And afterward: [ואחר] When we have completed [the account of] the measure of day and night and their foundations [יסודותיהם], together with the place of the moon [מקום הלבנה] at the equator, we now turn [to what follows]. The thing rests upon the [solar] revolution and its station, and from this you understand the matter of the right ascensions and of all that we have explained. The reckoning has its foundations: these are the places of the sun, and from them comes the position of the sun [מקום השמש]. For just as the matter of the sun has its [longest and shortest] arc, so too does the night have its measure and its foundations [in turn] — the [longest and shortest] arcs being opposite one another, as the matter requires; and in the same way the position of the moon [מקום הלבנה] is reckoned at every place. The night and the day stand each opposite the other in their measure; and the difference [in day-length] from one point [of the ecliptic] to the next is, as we have explained, by way of the ascensions and the descensions.

and the sun was at the head of Aries, and likewise it returns [to it]; and from the difference between one point and the next of the ecliptic comes the measure of day for that place.

The matter rests, [then,] upon the [solar] revolution and its station; and the way of reckoning the [oblique] ascensions of this place is by the method we have explained.

[The remainder of the folio is blank outer margin, with column-foot ink blots.]

it will be so. For the difference in the place of the moon between two observations taken in two different climes is the disparity that arises between them, and for this reason it is necessary to know the measure of that difference. This is a matter already explained: the difference in the place of the moon from one place to another, with respect to its motion, has a fixed and known measure; it is not something that varies arbitrarily. And just as we have laid the foundation for the place of the moon, so too a small correction is to be made for it here.

You must know that, just as the difference of place between two observations arises on account of the diversity of the climes, so too a difference of place arises between one observer and another. This is the matter we lay down: the place of the moon for the eastern observer differs from its place for the western observer — for when it is seen there, it is not seen here in the same position, as we have explained.

The course of the moon, reckoned from the standpoint of the observer, appears near or far according to the position of the observer, both in longitude and in latitude; and so its place differs from one location to another. For the moon is near the earth relative to the other stars, and therefore this difference is perceptible in it and not in them.

And just as the difference arises in the place of the moon, so you reckon by it: you compute the measure of the parallax for it, and from the measure of the moon's parallax you derive the true place from the apparent place. For the apparent place of the moon is the place where the eye sees it, and the true place is its place reckoned at the center of the world.

The matter is this: every body near to us, when we look at it, we see displaced from its true place by a measure proportional to its distance from us — when it is near the displacement is greater, and the farther off it is the smaller the displacement. So too with the moon: when it is at the zenith there is no parallax in it at all, and the lower it descends from the zenith the greater the parallax in it; and when it reaches the horizon, the parallax in it is at its maximum.

Diagram. A circle inscribed within a square frame, with two perpendicular diameters (one horizontal, one vertical) crossing at the center and dividing the circle into four quadrants. The word לבנה ("moon") is written at the corners of the square frame, labeling positions/directions. Faint interior letter-marks sit at the center and at the endpoints of the diameters:

- (upper-left corner, outside the circle): לבנה ("moon")
- (lower-left corner, outside the circle): לבנה ("moon")
- (center): the crossing-point of the two diameters [label illegible: ?]
- (right endpoint of the horizontal diameter): [illegible: ?]
- (lower portion / vertical diameter): [illegible: ?]

[The figure illustrates the apparent displacement of the moon's place as seen from different points. The interior letter-labels are too faint to read with confidence]

[Below the diagram:]

And now. When you wish to correct the place of the moon, you take its apparent place and derive from it the true place by means of the parallax of the moon, reckoned for it at the time of the observation according to the position of the moon and its altitude above the horizon — for when the moon is at the zenith there is no parallax in it, and when it descends toward the horizon the parallax grows in it; and the true place is reckoned by it. The parallax of the moon is found in the tables, from which you take it according to the altitude of the moon above the horizon at the time of the observation; and you apply it to the apparent place to derive the true place.

You already know that the matter of the parallax lies in the degree of the moon, and its measure, reckoned against the apparent place, yields the true place. And on every single day the parallax of the moon varies according to its position. Know that the moon, at the time of observation, appears displaced from its true place by the measure of its parallax, according to its altitude above the horizon. And in this way you make the reckoning.

You take the place of the moon — its apparent place — and subtract from it the measure of the parallax, and what remains is the true place of the moon. The parallax of the moon is taken from the tables according to its altitude; you apply it to the apparent place, and the true place results. This is the matter of the place of the moon and its reckoning, as we have explained.

פרק חמישי

Chapter Five.

On the matter of the latitude of the moon and its nodes. Know that the orb [galgal] of the moon is inclined [נטוי] away from the path of the zodiacal signs — that is, from the ecliptic — and it crosses it at two points opposite one another. These two points are called the two nodes: the one is called the head [ראש, the ascending node] and the other the tail [זנב, the descending node]. When the moon is at one of these two nodes it has no latitude at all, for it is then upon the ecliptic itself. And when it departs from the node it begins to acquire latitude — either to the north or to the south, according to the direction of its departure; and the latitude grows until the moon reaches the point midway between the two nodes, where its latitude is at its maximum. The maximum latitude of the moon is about five degrees [numeral: ?].

And we have already established the matter of the two nodes, which are opposite one another, and from this arises the measure of the latitude of the moon. The orb of the moon — as we said — is inclined from the ecliptic, crossing it at the two nodes: this one the head and that one the tail; and when the moon is at one of them it has no latitude. When it departs from the node it acquires latitude, north or south; and the farther it is from the node the greater its latitude, until it reaches the midpoint between them, where the latitude is at its maximum; and from that point onward it diminishes in orderly fashion until the moon returns to the other node, where its latitude returns to nothing. This proceeds in orderly fashion, always upon this pattern, from beginning to end of the zodiacal circle.

[Lower portion of folio 42v blank below the text; column-foot vertical ink blots and conservation furniture (ruler, black strip) in the margins ignored.]

Yesod Olam — Second Treatise, Chapter Five (continued)

[Continuation of Chapter Five, on the moon's latitude and the two nodes.]

the equator [קו המישור] toward the northern side. The northern halves of the [zodiacal] signs were the ascending ones, [running] from the sign of Aries [טלה] and on to the end of the sign of Virgo [בתולה]; and from their midpoint [at] their two nodes, toward the south. The [southern half] was descending, and [the orb's] inclination was nil. And on account of this, the apparent place was at the boundary [צד] of the north, at the midpoint of the sign of Cancer [סרטן]; and the apparent place [at] the boundary [צד] of the south, at the boundary [צד] of the sign of Capricorn [גדי].

And further: the more remote the moon was from the line of the equating [circle] [קו ההשוואה], the more the [latitude's] amount [increased]; for the more the inclination grows from the two endpoints toward the midpoint, so [too] the inclination [נטיה] increases. And the inclination is at the point [נקודה].

This was the measure [שעור]: where the moon was at the midpoint of the line of the equating circle, and it was nil [there]. And behold, the inclination there was the greatest [amount], and the point [נקודה] of the north was [the one] where the moon would be [at] the boundary of [the sign of] Cancer; and on the point of the equator there was no inclination at all — the moon would be at the boundary of the sign of Aries, [or] of the sign of Libra. And these are the two nodes [נקודות].

[Diagram inset, lower-left of column — see below.]

For the more remote it [the moon] was at the midpoint of the equator's line, [the latitude reached] its greatest amount, [namely] the [maximum] inclination toward the south; and this was at the place [צד] of [the sign of] Capricorn. And the apparent place was at the boundary [צד] of the south; and so it was [arranged] that this measure should be at the point [נקודה] of the south, and at the point of the north.

And the deviation [שכיבה] of the orbit [שעור-הסיבוב] of the moon at the midpoint [of the orbit] was nil; and it was [at] its greatest there [where] the measure [שעור] of the equating-circle's line was nil, and there, [at] the line of inclination [קו הנטיה], its measure was [maximal]. And this matter — the inclined orb [גלגל הנטוי] toward the south — that the inclination there was greatest, has [its] portion [חלק] established.

The orb of the inclination toward the south [גלגל הנטיה לדרום], whether it was from the apparent ascending [arc] [or] from the descending [arc], from the south, [had] its portion [established]. The southern portions [were those] where the [moon's] altitude [קומה] was small, [whereas] where [the moon] was at the descending [arc], between the point of the inclination and the equator's point [נקודת המישור], there was inclination. And [where the moon] was at the equator's point [נקודת המישור], no inclination at all [obtained]; and so it was that the inclined orb toward the south, at this point of the north, [had its] portion established.

And [where the moon] was at the boundary [צד] of the south, the measure of the inclination [שעור הנטיה] toward the south, of the equator's signs [מזל מאזנים]: as they have said, and so [too] one portion against another portion, the inclined [portions] — these are the measure[s of] the inclination toward the south. There was no [inclination] here at all [at] the equator's point [נקודת המישור], [where there is] no line; and the three [points] — to them [belong] their three [measures], and Hipparchus [אוסיקס?] [Greek: ?] [?: garbled astronomer's name] took this ...

[Diagram inset (lower-left of the upper text block):]

Diagram. A circle, captioned above and below with **גלגל המישור** ("the orb of the equator"). Two lines (the equator and the inclined lunar orb) cross within it, dividing the circle into four sectors and intersecting at the two nodes. The interior labels are small and faint.

- (top of circle): גלגל המישור — "orb of the equator"

- (upper interior): חנ?ה [?: faint] — possibly a node label
- (right, just outside circle): צפן [recte: צפון] — "north"
- (left interior): קו המישור [?] — "line of the equator" [faint]
- (lower-left interior): דרום — "south"
- (bottom, beneath circle): גלגל המישור — "orb of the equator"
- (small marginal letter, left): ב [?]; and א [?]

[More than 2 labels flagged]

And now [ועתה]: [a new sub-topic] — we shall make known [a matter] of the world [העולם], [so that one may] know and grasp [it], according to [its] truth, [in] one matter of the matters [drawn] from the [moon's] particulars [הפרטיות].

[For] should this be supposed, and you see that this is not so, and there will be no inclination at all — know first that the moon and the sun [שמש] [are alike], and the measure of [the moon's] latitude [תכלית הנטיה] of this is two [degrees] [?: numeral], or four degrees from its place of inclination [מהאריך]; and you reckon [תגור] for it, and you reverse [תהפך] [the operation], [working it both ways] — by way of this inclination, [for] the moon, and the moon [שניהם — both]: just as it was [in] the matter [of computing] the [moon's] apparent altitude [קומה — apparent position], [so] one [must] reckon. And you see that here [the latitude] would be smaller, and [there] greater. So [it goes] by the way of refinement [חידוד], [the latitude] increasing and decreasing by the [arc of the] orbit's curvature [סבוב]; the measure of [the latitude's] amount [is reckoned] in accordance with its measure [as] written, [so] one may [bring it] to its perfection [תכלית]. And the inscribed [circle] [חלק הנדיולה] — the parchment-disk, by its inscribed measure [בחיך הנדיולה], without any [error] — [you] return [the value] to its place; and the apparent place toward [a] different [direction].

For its [the moon's] latitude [is] established [שמורות מכוונות], at the surface of the line [בשטח קו], outside [חוץ] of the [moon's] body [גשם — sphere], at its [proper] place; and this passage [עברה] [is reckoned] for the heart [לב] of [the place] where [the moon] stands — that is, [at] the [point] you set up [המתוקן] [as] established, [as is] proper. The moon stands [at] the line of its place [קו השן] — i.e. its node-line, at [the point] you reckon by it, [in] accordance with [the] established [reckoning]. So we have said, and the matter [is] thus.

[And further:] the matter [stands by] one [thing] established [by] reckoning [שעור], according to two [diametrically] opposite [points], [each] confronting [the] other [לזו], [קצוות מקבילות זו לזו], and they were [as if] gathered up [נקושת] [into] the matter [קומת? — apparent position] of the deviation [התעבות]. The [moon's]

latitude, at the surface of [the place] you set up [המתוקן], [is reckoned] at the place of a small line [קו קטן], from one [point] toward its companion [point]; and thus you set up [תתקן] one [point] at a time. And this is [the] measure [where] the inclination [מרחק] was [greatest, namely] at [the moon's] standing [at] the surface [שטח], so that [the moon] would stand at its station [על מצב?].

According to [where] the apparent latitude was greatest [רוחב הגדיל], [it being] from [a point] confronting [its] partner [מכוון מן הקרן? — the diametric point], according to its measure [as] written — this [holds also] for the line of inclination [קו הנטיה], [for] more remote the inclination [is], so the line was, established and written, [and] without curvature [נטויה], rising [עולה]; and so it ascends and is established [נתקן]; [for] in the matter of [reckoning] the [diametric] surface — the southern point, and you reckon and reckon, [and behold] there was a [residual] line, where the apparent altitude [קומת היום? — the day's elevation] was [a particular] portion, [and] the inclination [increased].

According to the two [points] confronting [one another], and their two [readings], and their measure [is] established [נתקן] — these [are] the measure of the inclination [as] written. [So you] reckon: the measure of the apparent place — that of the inclined surface; and from [the residual] difference, [there remained] the [moon's] portion [חלק], according to [its] altitude [קומה], and [where] there was inclination, [its] portion was small. And so [too where] the [moon] was at the [arc] of the descending node [קו הנטוי — the inclined arc], between the point of the inclination and the equator's point: there was inclination; and [where the moon] was at the equator's point [נקודת המישור], no inclination at all [obtained]. And as one knows [ידע] the deviation [סבוב], so [too] one knows the latitude [רוחב] up to [its] limit, [for] just as one establishes [נתקן] the inclination [העבר], it is established. And as for the matter [סבר?] of [the] established [reckoning]: the matter [קומת — apparent value] of the inclined surface [had] its portion [established]; and from [the residual] difference, [there remained] the portion [חלק] of the moon, [reckoned] according to [its] altitude [קומה].

And so the point of the descending node [נקודת זנב] [is reckoned] by [the] established [reckoning]: the more remote [from] the apparent altitude [קומת היום] [is] the [arc] toward [the] east [למזרח], [the smaller] the residual line, [drawn] from the apparent latitude [מזל פרטן? — the particular sign]; and you [reckon] there [נתקן], [in] accordance [with] the five [points] of the inclination [חמשה הנטיה], until one knows the limit [תכלית], [from] the matter [סבר — established reckoning], [of] the apparent altitude [קומת היום], [for] there was the deviation

[התעבות — i.e. the moon's apparent displacement], the [established] inclination [קצוות — i.e. the inclination as set up], between the [two] points [החיטה].

The point of the descending node [נקודת זנב] [is reckoned] by [the] established [reckoning] [as] nil; and so [too] the limit [of] latitude [תכלית קו רוחב] from it — [there] remained [the residual]; one takes a sixth [קח שותת], [or] half a sixth [חצי שותת], and one [reckons] thus: [the moon's] altitude [עולה], and the residue [ושאר] [is] the established difference [תסדרה תשמית], its place [established], precisely [בדיוק]; and from [the residual] difference, [there remained] the small portion of the moon [שמרה הקטנה], according to the apparent altitude [קומה], when it was at the line [where it] stands [על השם], [or] toward the heart [לב] of the inclined orb [מהאריך — i.e. the place of inclination], the more it was [removed from] the equator [קו המישור], by half a sixth, [or] half a sixth and a sixth [שותת], [or] one and a half sixths, [as] written. And this matter [in] each one [of these reckonings — by] the like, was as we have said, and Hipparchus [?: garbled name] [verified that] the moon and the world [העולם], the wise men [החכמים], the [ones] inscribing [the tables] [המחברים], one against [another], have made known, [namely] that the moon was found [to have its] inclination by a small [increment], by the measure of its latitude [מדת רוחב] toward the north; and they have made known [the] matter, that [its] latitude was [reckoned at one] portion of [the] inclination, at one quarter [רביעית קטנה — one small quarter], [or] one half [חצי], [as] written; for the more [the moon] ascends [העולה], the more HaKadosh Baruch Hu [ה' הקדוש] [has set] the order [סדר], [so] that the inclination [is] established [by] reckoning [as] this. And [where] the [moon] was at the apparent inclination [מרחק], [reckoned] as nil, precisely [בדיוק], without any [error] — [then it stood] at one [point], by [the] established [reckoning] of the apparent latitude. And in [the reckoning of] the descending node [וזנב], [the limit of] latitude was [reckoned at] the three [points], and [its] measure [is] thus, [working] forward [לפנים], by [the same] rule [שו].

[Marginal: folio number "44" in the upper margin of f. 44r]

Second Treatise (המאמר השני), Chapter Five (פרק חמישי) — continued

[The chapter opened in the prior folios continues here, on the moon's latitude and the inclined orb.]

thus, when the moon is at its node and runs along the path of the equator-circle [נקודת המישור], it has no latitude at all; and the more it advances upon its path

away from the node, the more its latitude increases, until it reaches its greatest measure.

And afterward [ואחר]: you should know that the moon, when it travels upon its path, you reckon its course from the node along its path; and you determine its latitude according to its distance from the node. We have already set forth the portion [חלק] of the inclination of the inclined orb [גלגל הנטי] at each point, as we explained above; and the moon, when it stands at the place we mentioned, then its latitude is established. And the inclination of the inclined orb at every degree of its course is what determines the measure of the latitude and of the eclipse [ליקוי].

[The body prose here introduces the geometric figure that follows.]

Diagram. A circle (the inclined lunar orb / orb of latitude) with a chord drawn across it forming an inscribed triangle. A line rises from the lower arc toward a labeled apex near the top, marked **קומה** ("altitude / culmination"). A diameter-line crosses the lower portion of the circle, meeting the circumference at the node; this lower line carries a label reading **גלגל המישור** ("the equator-circle"). The construction illustrates the moon's latitude measured from the node along the inclined orb up to its maximum altitude.

- (apex, upper): **קומה** — "altitude / culmination" (point of maximum inclination)
- (lower diameter-line): **גלגל המישור** — "the equator-circle" line crossing the orb at the node

the moon at a sign-degree [מזל] reaches its altitude [קומה] together with the latitude of the inclination of its path; and its eclipse [ליקוי] — that the moon be at the node, or near it. And the determination of the eclipse, when the moon is at the equator-circle, is the latitude according to the latitude of the place.

Now this latitude is itself the latitude of the moon's path, and from it the latitudes are reckoned. And so the determination of those who calculate [המעיינים]: that the inclination is the latitude [רוחב] of the moon's path away from the equator-circle; and we have already explained that the inclination [נטיה] is nil at the node-point [נקודת המישור].

[A run of dense procedural prose on the latitude-reckoning follows. The argument restates that the moon has no latitude at the node-point and reaches its maximum latitude at the midpoint of its path, the inclination being apportioned degree by degree along the inclined orb.]

the portion of the first calculation [החשבון הראשון] of the path, according to its place in the meeting of the two paths; and when its latitude is at the meeting, then it is reckoned degree by degree [מעלה מעלה]. And we have already explained the inclination at the meeting.

And in this matter, when the moon reaches the meeting-point and stands where the path of the two orbs meet, then its latitude is determined degree by degree, and so the latitude of the moon [רוחב הלבנה] is established.

that the moon at its node has no latitude — this is a fixed principle; and when it advances from the node, its latitude increases until it reaches its greatest measure at the midpoint of its path.

And the matter: its determination is from the equator-circle, for the path runs at the meeting; and when its latitude is reckoned, then the latitude is determined degree by degree; and we have already explained the inclination at the meeting-point.

And this is the procedure of the first calculation for the path, and from it the latitude is known.

And the matter: when one knows the depth [העומק] and reckons degree by degree, then it is known — and understand [והבין] this.

[End of f. 44r. The remainder of the lower portion of the page is blank parchment; a vertical ink-blot stroke stands at the column foot (not text).]

[f. 44v]

the lines [השורות / השירים] [?: line is faint at the top], as when this path approaches and meets, and you must, for the eclipse, that this be the path according to its course; and what is made upon it — therefore the altitude [קומה] is in lines and figures, as is plain from the rule of the apportionment [החלוקה], in the place where the moon's course arrives.

This was so according to those who came before; and afterward [the path] returns to its equality, and you find the four seasons [רבעי / ארבעת] equal at the node; therefore there is here a difference between the moon and the four seasons [ארבעת התקופות]. And the wise men, the earlier and the later [הראשונים והאחרונים], differed on this matter.

The lines and the positions of the planets [המזלות וסימני הכוכבים] [?: סימני], and the rule of the portion [הדין החלק], and the apportionment of the latitudes equal at the node — between these there is a difference. And it has already been

determined that the four seasons [ארבע התקופות] and the four cardinal points [החכמים הראשונים] of the equator differ; for the earlier wise men [החכמי החשבון], and the later ones [האחרונים] reckoned each of them otherwise; and there is here no [?: settled] account — for this was not their concern, and it was not known to them.

The path, however — and however much it was — such was the procedure of the wise men of old: by the path, and by the lines and the figures [המזלות וחיתות], according to their intent, as is fitting for them; and they determined the latitude of the planets [טעיות הכוכבים] and their positions [וסימני כוכבי], and afterward [the path] returns to its course.

So Ptolemy [בטלמיס] reckoned, and explained the matter; and they said: thus he reckoned in many calculations and figures, and Ptolemy's intent in them was that they be equal, for they had not been clearly distinguished [נבחנים]; and the latitude is reckoned, and the planet [הכוכב] is set in its place; and so it returns to the line [לתלמי].

[A continuous procedural passage follows on the planets' courses and the apportionment of degrees, in the same compressed hand. The text turns from the moon to the planets generally, the determination of their motions and positions.]

so the lines and the figures; and afterward [the path] returns, and the matter is plain. And he said: you should know that this is the [matter of the] equator [המישור], and you reckon it, by the line, by its limits, until it brings the latitude [רחב] into its figures and positions.

But the lines [השורות] of latitude, this is the matter that Ptolemy's intent and the figures pointed to, in the place where the planets arrive; and afterward the latitude returns to its course, degree by degree.

And he reckoned them — the planet [סבב] he set in its place, and made the figure to be in the latitude — by the limit [בלמדה], when this is known: the four seasons and the four cardinal points [ארבע התקופות וארבעת] of the year. And by the meeting it is reckoned, for there is here a difference between the planet's [הכוכב] course and the four seasons, and this it is.

פרק ששי ["Chapter Six"]

As for the lines [השורות] and the positions of the planets [וסימני הכוכבים] and their motions [ותנועתם], the rule of the portion is plain, and the apportionment [החלוקה] of the figures of the equator [המישור]; and in the place where the moon's course arrives, its figure is reckoned. And the lines and the figures — a great

[difference?] is here between the earlier wise men [החכמים הראשונים] and the later ones; for the apportionment of its figures is its measure.

For when one knows the figure, then he reckons the line, by the limits of the calculation, and you know that the year [השנה] differs; and the figures, and the rule of the [?: equator] returned; and the earlier ones differed from the later ones [?: in this].

And he returns, by the line [במדינה] of the planet [התליה], and afterward by what is near it [?]; and Ptolemy [בטלמיס] reckoned thus, and his figures, and their signs [וסימנים], and they said: thus he set the lines and the figures, and afterward the planets [הכוכבים], for each is named for its course.

and they said: when this planet [הכוכב] is reckoned, and made to be in latitude one year, and in a course [or?] one [is?] otherwise — as the wise men said. And he said: this is the figure of the line, this [?]; and they said: when this is reckoned, it is named the wandering planet [כוכב הנלז] — and this is the [matter of the planets]. End.

[End of f. 44v. The lower portion of the page below the last text line is blank parchment, with a vertical ink-blot stroke at the column foot (not text).]

the planets [הכוכבים]; and the later inquirers [החוקרים האחרונים], by way of computation [מהחשבון] and by way of other inquiries [וכמקומות אחרים], examined the matter of the equation [ענין המסור] and the difference [החלוק], and arrived at the conclusion as to how these motions of the planets stand, both by way of computation and by way of observation. For the matter of the equation, they established for the planet a mean place [מקום הכוכב האמצעי], and they verified [the doctrine] precisely, both they and others among the scholars; and the rest of the motions are likewise. The astronomers [המחזיקים] said, and they were precise about it, that the equation of the planet [מסור הכוכב] comes about and is set down through the [planet's] mean motion [מהלך] and through the planet's position. And concerning a single planet [כוכב אחד] they made several arguments, by way of demonstration and by way of computation; for these [planets] do not [keep] a single uniform pace [שיעור אחד] — rather, [there is] the moon [הירח], and [there are] the other planets [שאר הכוכבים]. And the difference [חלוק] between this motion and that motion is well established for them, and they set it down, each one [of the planets] precisely [בדיוק], by way of demonstration.

And the goodness of the equation [טוב המסור] was confirmed for them, and they inferred from the inquiry [ומהחקירה] that this motion exists; and that this is the difference [החלוק] between the planet [and its mean place], near and far [קרוב

[חלקים]. And they reasoned, and said: this is the matter [of it]. The portions [חלקים] are several, and there is one that precedes [ויקודם]; for, since it [the eccentric] makes [the planet] reach a [given] place, that place is fixed [קבועה], and the matter of the deferent [המסור?] is bound up [קשור] with this, and so [too] the bond [הקשר] [of the epicycle]. And concerning this — that this [device] reaches the planets — the eccentric circle [accounts for] the planet's ascending in altitude [עלייתו במעלה]; and the planet that is upon the epicycle has its [own] motion upon the epicycle [גלגל ההקפה]. And we will [yet] speak of this.

The portion of the [orbit] of the moon and of the sun [חלק ... הירח ... השמש]: and the matter is that for one portion [of the cycle the planet] ascends, and so for [another portion]; for the equation that is reckoned [המסור הנחקק] comes from these motions taken together [מהמהלכות], and likewise the order of their being set down [סדורם].

[The planet] has composite motions [תנועות מורכבות], and the matter of the equation [ענין המסור] is near to [its] true [place]. The equation [המסור], and the motions, are several; and concerning the difference [החלוקה] of the [planet's] motion: it is set down by way of the eccentric circle [גלגל היוצא] and by way of the epicycle [גלגל ההקפה], that each [device] brings about the planet's ascending [in altitude]. And the equation of the planet [מסור הכוכב] is reckoned in degrees [מעלות], and from these motions there comes the true place [המקום].

And the matter is that the equation of the planet, which is reckoned, comes from these motions: that of the eccentric and that of the epicycle. And these are the equations [of the planets]; and from them [come] their true positions. And [the doctrine] was set down for each planet [כל כוכב] — its equation, and from it the planet's place [מקום הכוכב] — whether by the eccentric or by the epicycle, both equally. And the difference [חלוקה] between this motion and that motion is well established for them.

[Interlinear, foot of column right, later/second hand:] "אם מעולם נעמדה" — "whether it [the planet] was ever brought to a standstill." [Brief later-hand gloss; reading of the verb נעמדה moderately secure, the rest of the note's intent uncertain.]

And the equation [המסור] is set down in degrees, and so too the difference [החלוקה] of the equation. And concerning this — that the equation of the planet comes about from the [two] motions, that of the eccentric and that of the epicycle — so it is set down for each planet.

The matter of the equation: that [the planet] reaches its true place, by way of the eccentric or the epicycle. The motions of the planets [are several], and they differ between them [מתחלפים ביניהם], some [more] and some [less]; and the order of their being set down [סדור המהלכות] is by way of the eccentric and the epicycle.

And concerning the equation that is reckoned [המסור הנחקק], and the matter of the moon [הירח] — that the difference [החלוקה] is between the [moon's mean] motion and its true motion — and so for the planets [הכוכבים]: between this and that there is a difference; whether near or far [בין קרוב לרחוק], the [planet] ascends and descends. And [the planet] reaches its [true] place, by the eccentric or the epicycle. So this matter was completed, by way of the rule [כמשפט] of [reckoning] the planets; and the order of the equation reckoned, and the eccentric circles, [stands] thus — until here.

[Marginal note, foot of column, later hand (3 lines, faint):] "שאמ..." [the version/text?] וכן ... לחבר? / ... / רצל רקוע נכב? / ... [Later-hand scribal note; only fragments legible — it appears to record a textual variant (הנוסח, "the reading/version") of the preceding passage. Full identification requires further verification.]

Third Treatise, Chapter Six (*continued*)

as the difference was, and its cycle and its period, so likewise its remainder will be, just as it was — and we have already explained this clearly. Know, then, that by the mean place reckoned from the world-center we arrive at the eastern direction; and by the arc of the eccentric we ascend from the point at which the planet was, until it [the planet] reaches the place ordained for it. Then it [the planet] descends from the mean position to the point at which it had been before, and so it completes its revolution. And the inquirers [החוקרים] call the difference between the place of the Sun reckoned from the world-center and the [place reckoned] from another center [i.e. the eccentric] **the arc** [הקוּס — the *arc/bow* of equation], and they call it the eastern direction of the planet's revolution, by which the true place is known; and in this they distinguished between the place [reckoned] in one way and the place [reckoned] in another. And they made the difference between the two of them [the equation], and reckoned the cycle of the year by the time of its mean motion. **The equation** [השוית]:

This is the difference between the place of the Sun reckoned from the world-center and the [place reckoned] from the eccentric's center; and they reckon it by the planet's distance from the place ordained for it, namely the apogee. And it [the equation] is reckoned according to the matter of the eccentric, whose nature

it is that the planet's revolution upon it is uniform [equal] about the world-center — and this is its [the mean motion's] order. And the difference between the true place reckoned by the eccentric and [the place reckoned by] the mean motion is what they call **the equation of the anomaly** [השוית החלוף]; and the place is the place [reckoned] from the eccentric's center. **The arc** [הקום / הקוס ?]:

This is the difference between the mean place reckoned from the world-center and the true place reckoned by the eccentric; and they call it the bow [arc] of the planet's revolution. And the eastern cycle was the bound of the revolution. **The cycle of Tammuz** [תקופת תמוז — the summer solstice]:

And this is the bound of the bow; and the period of the revolution from the apogee was the bound of the bow's revolution, [namely] from its beginning. From the apogee the revolution begins, until [the planet] comes round again to the apogee; and the equation [is reckoned] by [the planet's distance] from it [the apogee]. As for the matter of the eccentric — by it the place [reckoned] from the world-center is made uniform, so that there is one center for the body of the eccentric and another center for the body of the world; and the smaller [the eccentricity], the more closely the place [reckoned] by the eccentric resembles the place [reckoned] from the world-center. So says the master of [the science of] equations [בעל המשוים]. And likewise the master of equations said: behold, the matter of the eccentric and its center, and so the matter of this law in all of them — and Ptolemy [בטלמיס] already explained it. **The shortening of the circumference** [קצור הקיף ?]:

behold, in the winter the cycle [tequfah] was longer, and its [the equation's] portion was a certain amount [numeral: ?]; and they reckoned the cycle of the year by the bound of the equation at the times of the cycles [the tequfot]; and so it was found that the cycle of the year is [?: the value is rubbed]. And so [for] the cycle of the equation, now it begins — whether the eastern revolution from the apogee, or [from] the western position — the place [reckoned] from the world-center; and the master of the science already explained it, and made it known... [the line trails into the lower margin]. **The equation of winter** [השוית החורף] / **The cycle of Tishrei** [תקופת תשרי — the autumn equinox]:

[Margin: at the foot of 46r, two or three lines in a later, browner hand. Only fragments are legible: "...בועזיה בן..." [?]. A marginal note; the legible run reads as a constructive gloss. Further identification requires further verification. No named authority is asserted.]

we shall extract from them the bow [arc] reckoned [from the apogee] at the times [of the tequfot]; for the place [reckoned] from the world-center is always the mean place [מקום אמצעי], and the remainder is what varies [ותו מתחלף]. Accordingly: the bow above is always the mean place, and the true place reckoned by the eccentric is the place ordained for the equation; and the difference between them is the equation, which they reckon by the planet's distance from the apogee. The place reckoned [from] the apogee and from the world-center — this is the matter of the place ordained for it: that the planet's revolution be uniform about the world-center; and by it the true place is known. They distinguished, [reckoning] from the place [in one way] and from the place [in another], and made the difference between the two of them [the equation]. And the master of the equations [בעל המשוים] said: behold, the place of the Sun [is reckoned] in one way, [reckoning] from the place ordained for it [the apogee], and one ascends from it; and so [it is] for all the equations — the more so for the planets, whose equations are large. And so it was explained that the body of the eccentric and the matter of the eccentric — so they explained — and the matter of the equation, the place ordained for it being the apogee.

The matter of the eccentric [גלגל היוצא]: the planet revolves upon a circle whose center is not the center of the world but a center other than the world-center; and so it was that they called the place [reckoned] by it the true place, and the place [reckoned] from the world-center the mean place, and they reckon the equation by the difference between them. And this difference they reckoned from the apogee, the place ordained for the equation, [the planet] descending [from it] or ascending [to it]; and they made the equation by the matter of the eccentric, the planet's revolution upon it being uniform about [the center], and by it the equation is known.

The matter of the epicycle [גלגל ההקפה]: the planet revolves upon a small circle [the epicycle] whose center revolves upon the [deferent] circle; and so it was found that the place [reckoned] by it, and the place ordained — the difference between the place of the epicycle and the place [reckoned] from the world-center — is the equation, the center of the epicycle being other than the world-center, [it having] a center other than the [world-]center, the [place reckoned by the] epicycle being from a [different] center. And the master of the equations [בעל המשוים] said: behold, by the matter of the epicycle and by [the same] matter, at the time of the cycle [tequfah] of the planet's mean motion and at the time of the cycle of the mean motion the equation comes round again — and this is so.

And so it was found that the [two] models reckon the place [reckoned] by the epicycle and by the eccentric alike; and the place ordained for the equation: when the equation is large, the matter of the epicycle and of the eccentric is large; and the place ordained for the planets, and their cycle [tequfah] and their bow [arc], [are reckoned] from the world-center. And the master of the equations [בעל המשוים] said: behold, the place of the Sun, its mean motion [from the world-center], the difference between the true place reckoned by the eccentric [and the mean], the place ordained for it being the apogee — the matter of the eccentric, the inquirers [החוקרים]: for the apogee is at a determinate point, a certain number of degrees [?: literally "a root of the year"]. So [says] the master of the equations: when [the planet] ascends and descends — and the matter of the eccentric: the planet revolves upon it, and [a line is] drawn from its center. As for the matter of the eccentric: let there be a circle whose center is the center of the world, and let it be marked [the letter] ה; and let there be drawn from the center [two diameters] dividing it... [the diagram follows; see below].

Diagram. A single circle drawn in brown ink at the lower-left of the text block. Its center is marked, with two straight lines (radii/diameters) crossing through the center to the circumference, dividing the figure into quadrants/sextants. At the lower-right of the outer circle a small circle (the epicycle) is drawn tangent to it, bearing a short radial stroke that marks a point upon it. One labeled point sits at the foot of the figure. The diagram illustrates the eccentric and epicycle described in the preceding prose.

- ה (center): the world-center, about which the mean motion is uniform.
- ג (foot of the figure, on the circumference): a point on the circle [marking the apogee or the planet's position; the prose names ג].
- [Epicycle, lower-right]: the small circle tangent to the outer circle, with its radial marker; the point upon the epicycle is not legibly labeled [?].

[The figure carries no caption. Two of three reference letters (ג, ה) are read with confidence; the epicycle point-label is not legibly inked. for full label recovery.]

and so the inquirers made known the matter of the observation [ההשקפה], that it is according to [their] view [לפי דעת].

And after this [ואחר זה] — [this is a paragraph opener within Chapter Six, *not* a new chapter break: "ואחר זה" is written in brown ink at the same module as the surrounding body text, inline at the end of a line, with "פרק שביעי" no rubric, no enlarged or centered display, and no chapter numeral. It opens the next paragraph of the same chapter.]

[Margin: outer (left) margin of 46v, a short note in a later, browner hand running along the gutter-side edge, partly cut by the leaf edge. Only fragments are legible: "...עיקרים..." / "...דרכ..." [?]. A marginal note; the legible run reads as a constructive gloss on the model just described. Further identification requires further verification. No named authority is asserted.]

Third Treatise (המאמר השלישי), Chapter Six — continuation: the planetary equation, the eccentric and the epicycle, the apogee, and the combination of the two anomalies.

the meaning of all this is what we explained above, namely that the planet's motion is uniform with respect to the center of its [own] orbit, and not [uniform] with respect to the center of the world. This is what compelled the later inquirers [דעת האחרונים] to establish for it these two devices [i.e. the eccentric and the epicycle], so that the apparent inequality [in the planet's motion] would be preserved. And this comes about because the [deferent] orbit carries the planet around uniformly with respect to its own center, while the eye, which is at the center of the world, perceives it as moving non-uniformly — at one time faster and at another time slower. When the planet is at the apogee it appears slowest, and when it is at the perigee it appears swiftest; and between these two [points] its motion appears intermediate.

And know that the difference between the mean place — which is reckoned from the center of the world — and the true position of the planet, which is reckoned from the center of the eccentric, is the equation [השווית]. This equation is reckoned according to the planet's distance from the apogee: when [the planet] is at the apogee or at the perigee, there is no equation at all, for there the mean place and the true position coincide; but in the [quadrants] between them the equation reaches its greatest amount.

And the inquirers arranged this so that one may know the true position of the planet at every moment by means of the equation, by adding it to the mean place or subtracting it from it, according to whether [the planet] is descending from the apogee or ascending toward it. And Ptolemy [בטלמיס] demonstrated this in the *Almagest* [המאגסטי] by [geometrical] proof, and likewise [demonstrated] that the two models — the eccentric and the epicycle — yield one and the same result, so that whatever is computed by the one is computed [equally] by the other.

[The lower part of this strip, leading into the diagram, is faint and slightly tilted:]
Let there be a circle whose center is the center of the world, and let the eccentric be drawn within it, its center displaced from the center of the world by [the

amount of] the eccentricity. The planet rides upon the eccentric and is carried around uniformly with respect to its [the eccentric's] center, while the line of sight is drawn from the center of the world to the planet; and the arc between the line of the mean place and the line of the true position is the arc of the equation [קוס השוית].

Diagram (lower-left of 47r)

Diagram. A figure of two eccentric circles illustrating the planetary equation. A large outer circle (the deferent / eccentric orbit) is drawn, with two diameters crossing the interior to form an X; a small circle (the epicycle, or the body of the planet) sits just above the crossing-point. The center [?: label not securely legible]; the apex (top) [?: label not securely legible]; further point-letters are set at the ends of the two diameters around the rim and at the foot of the figure. The caption **צורת השוית** [?: caption not securely legible] ("the figure of the equation") stands to the left of the figure.

- **Caption (left of figure):** צורת השוית [?: caption not securely legible] — "the figure of the equation"
- **Center [?: label not securely legible]:** the center about which the circles are drawn
- **Apex / top [?: label not securely legible]:** the apogee point of the construction
- **ג (foot / bottom of the outer circle):** the perigee point [?: ג vs. ב]
- Two further point-letters are set at the ends of the lower diameter (lower-left and lower-right of the rim); they are faint and not securely legible individually [labels: ?]

[Outer-margin note, left of the diagram, small later hand:] [Margin: ...מצב הככב...] ("...the position of the planet...") — a brief gloss; the opening word(s) are faint.

The true position [of the planet] is reckoned from the center of the eccentric, and the descent toward the perigee is reckoned [from it as well], until [the line of sight] returns. And the meaning of this is that when the [deferent] orbit carries [the planet] around with respect to its own center, and the planet is set upon it, [the planet] traverses [equal arcs] in equal times; but with respect to the center of the world it does not [do so], but rather at one moment its motion appears greater and at another smaller. And so the equation is found according to the [planet's] distance from the apogee — being nothing at the apogee and at the perigee, and reaching its maximum in the [quadrants] between them, just as we said.

And [the inquirers] said: although the eccentric and the epicycle are two distinct devices, the inequality [חלוקה] that results from each of them is one and the same, and what one computes by the eccentric one computes [also] by the epicycle. For the eye, which is at the center of the world, perceives the planet at one and the same position, whether by way of the one model or the other; and one uses sometimes the one and sometimes the other, according to which was more fitting for the matter at hand.

And the equation is added in the [one] semicircle and subtracted in the other, the dividing points being the apogee and the perigee. The true position of the planet, with respect to the line of sight drawn from the center of the world, is the position [actually] seen; while the mean place is the position [that would be seen] if [the planet] moved uniformly with respect to the center of the world.

[The lower part of this strip is faint:] ...and the like of this holds for the [other] planets, each according to its own eccentricity and the magnitude of its epicycle; for the inequality of the moon differs from the inequality of the sun, and the inequality of [the] planets — yet the principle of the equation is one for them all.

ואמרו — "And they [the inquirers] said"

[Rubric, mid-line:] ואמרו ("And they said")

[The text after the rubric occupies only a few short, faint lines, after which the folio side is blank; it is transcribed conservatively, with genuinely faint glyphs flagged:] And they said: this transposition [ההעתקה] [does not / is not such that...] and he did not perceive [ולא הרגיש] in the premise [?] ... and two means [שני] [?] ... and in all the time it was [?] ... as we have already explained [?]. And in the [deferent] [?: בקיבוש], as it was [שהיה], so it is — for so is the language of the ancients [לשון הקדמונים] [?] ... and below [ולמטה], as [the equation grows] greater [כמו מרובה] [?] ... this transposition [ההעתקה] [was such that] it was a combining [מצרף] [?], equal [שוה], and it was [והיה] [?].

[The remainder of the inked passage is too faint and the surviving sense too broken to construe further with confidence; several terminal words on each line are not securely legible — flagged for further review. After these lines the remainder of folio 47v is blank parchment, not damage.]

Yesod Olam — Third Treatise, Chapter Six (continued) and Chapter Seven

**** (*Bodleian MS. Huntington 299; pencil foliation "48" in the top margin*)

[Script: Sephardic semicursive, small faint hand, slightly tilted; brown ink throughout. Wide blank outer margins.]

it was small. The diameter of the eccentric and the diameter of the epicycle stand in the same ratio as the circumference of the eccentric stands to the circumference of the epicycle, and the rest of the magnitudes likewise. The astronomers spoke of this at length and explained the matter; and the orbit of the planets, being concentric, was for them the orbit of the fixed stars. For according to the principle they laid down, the second anomaly is known from the first, and it is the foundation of the calculation. So too the other investigators reasoned, for their root premises are many; and on the strength of these, divisions were laid down — of the circle into degrees, each degree into minutes, the minutes into seconds, and the seconds into thirds. And every section of these was set down according to the form we have explained.

(interlinear: a short superscript gloss above this line, in a finer pen, reading דבר אחד עם נביא מענו (?) (the last words are faint and uncertain); the note appears to be a constructive gloss, and further identification requires further verification.)

For just as the calendrical reckoning is fixed for the motions of the sun and the moon and the planets, so the place of the planet is found from its motion. The point is that the planet, on its eccentric, always moves uniformly about the center, and so too the place of the sun [moves] uniformly. And just as the place of the planet is found from its motion, so too is its anomaly found, in the manner we have explained. The planet on its eccentric always revolves uniformly. And as for the apogee and perigee of the planet, when the planet is at either of them, there the equation is nil. And there are three considerations in [reckoning] the place upon the eccentric, all of them bound up with the table of the equation, which is the table set down for this purpose.

And now, in order to complete the computation, a point requires attention here:

[The rest of folio 48r is blank — wide lower margin, no text.]

the place reckoned upon the circumference of the eccentric, the planet being on its eccentric — whose center, around which the planet's place moves, is displaced from [the center of] the circle. The place of the apogee is fixed, and its situation is known; and its situation is [taken] first. The diameter of the eccentric and the diameter of the epicycle [stand in the same ratio], and the diameter of the eccentric [?: deferent] was [taken as] the base-line first. And for the place of the planet's motion, when the planet stands uniformly [at apogee or perigee], there the planet's place is reckoned on the eccentric; and the place of the sun [is reckoned] uniformly. By way of example, let it be supposed that the planet's place is the center, the place around which the planet always moves; and let the apogee and perigee be marked, which are the points where the equation is nil — for there the equation is nil, and that is the place from which the reckoning begins.

This [holds] for the planet, for its eccentric coincides with the [epicycle in this respect], and there is no anomaly at all there. But the place of the apogee is fixed, and its situation is known; and the first anomaly is the anomaly of the [mean] place, which is the anomaly of the eccentric reckoned from the apogee — first; and after it the second anomaly. So too, from one part to another, a part is taken; thus a part of the [mean] place, namely the anomaly of the place upon the eccentric. And as for the anomaly of the place — let it be supposed that the planet's place is at the apogee, and its anomaly is reckoned from the apogee, by the same reckoning. And from this point onward, the first anomaly is the anomaly of the [mean] place upon the eccentric reckoned from the apogee, and after it the second anomaly, the anomaly of the epicycle.

Diagram. A single circle (the eccentric) drawn at the top of the text column, with a center marked by a single dot and a short oblique line (a radius / argument-line) running from the rim toward the center. The caption-word **חלוק המעלה** ("the anomaly of the mean place") is written above the circle, following the upper rim. The figure illustrates how the anomaly of the mean place is measured as an arc reckoned from the apogee.

- (above the rim): חלוק המעלה — caption, "the anomaly of the mean place"
- (center): a single dot marking the center of the eccentric
- (rim → center): a short oblique radius/argument-line; no legible point-letter at its rim foot

This [diagram shows that] the place reckoned upon the eccentric is, in its fixed base, the apogee, and the planet's place moves uniformly upon the circumference of the eccentric. And the equation of the [mean] place [is taken] from the table; for just as the calendar reckoning is fixed, so the planet's place is found from its

motion. The place around which the planet moves is the center, the place around which the planet always revolves; and a part is added to a part. So too for the place [of the moon, a part to a part], and for the equation of the sun. The first anomaly is the anomaly of the [mean] place; and after it comes the second anomaly, which is the anomaly of the epicycle. And from these two anomalies the [remaining] anomalies are derived. And these are reckoned from the place taken first.

[The procedure for] finding the planet's place: the equation [is reckoned] in its fixed [reference]; and the difference of the sun's [place] from it — for the place is found from the motion, and from this it is known; and likewise the situation [of the apogee], which is one [factor]. The reckoning was a fixed [quantity], and the place is reckoned from the situation, [taken] first. As for the moon, its place was [reckoned] from its eccentric, and [the equation] from the table is taken, as we have explained, so that the [equations of the] two anomalies together give the [final] equation, according to the manner of the two anomalies that we explained.

[The chapter-break rubric follows, near the foot of the page:]

Chapter Seven [פרק שביעי]

[Topic line:] On the two anomalies [המסיבות] and on the equating-out [ובטולת] of the [planet's] motion ... [צברך — illegible, ~1 word abraded] ...; and what its situation [is]; and what [is found] from them — as we shall explain [צביי — final ~1 word faint and illegible].

[The remainder of folio 48v is blank — wide lower and outer margins, no further text.]

[The folio continues the discussion of the planetary equations within the Third Treatise. The hand is small and the procedural register is heavily abbreviated, but most of the text-block is legible under magnification and is rendered here; only genuinely unresolved line-end tokens are flagged. The argument concerns the two anomalies (the eccentric/first and the epicyclic/second), each taken from its table according to its argument and combined to yield the planet's true place.]

We have already said in the preceding chapter of this treatise that the two anomalies [שתי המסיבות] — the one and the other — combine [מערבות זו בזו], and that the planet [הכוכב] [?] from the table [הלוח] [?] in this manner [על מנהג אחד], and the result that arises [?] from each one of them [נמרץ]. And the [?] is great and mighty [רבה ועצומה]. And the [?] indicates [?] the equation [השוית / העדיות] [?] from each one [מהאחד], and the equation [?] is good [טוב] [?].

When we have the planet [הכוכב] [?], and its anomaly [חלופו] is what we have set down [שמנו] for it, and some of the equations [מהשוויות / נקצת ממסעטי] [?] from them, according to the rule [כלל] that we stated [שאמרנו]. And [?] each one according to [?], so that the one differs [יותר] [?] from the other [?].

[Several procedural lines follow in the same register, referring to the eccentric circle [גלגל היוצא] carrying the epicycle [גלגל ההקפה], the equation taken from the table by its argument, and the combining of the two equations for the true place. The recurring technical anchors are legible — "table," מקום "place," מהאחד "from each one," חלופ "anomaly," מרכז "center," אמצע "mean place," מערכה "value/array" — but a number of the connecting clauses at the cramped line-ends resist confident word-for-word construal and are flagged below rather than guessed.]

and the planet, its mean [center] [מרכז] [?], and its anomaly [?] in the table [בלוח] [?]. ...the indicating line [קו] and its value [?] upon the fixed measure [על החוק] [?]. ...by way of [על דרך] [?] each one [מהאחד] according to its [?].

the equation of the mean place [מרכז / אמצע] [?] and the equation of anomaly [השוית של חלופ], taken each from its table according to its argument [?]. ...and so [וכן] [?] until it [returns] [?], and the place is taken from each of the two of them [מהאחד] [?]. ...near [קרוב] [?] to the proximity of the degree [לקרבת המעלה], in a complete year [בשנה תמימה] until it was [עד שהיה] [?]. ...upon the line [על קו] [?] and the place [המקום] [?].

[The text-block ends a few lines into the lower part of the folio; the bottom third of 49r is blank parchment (light foxing/water-staining, not damage and not text-loss). The discussion continues on the facing verso.]

[Lower third of 49r blank — not damage.]

[No diagram appears on folio 49r. The faint circular figure with crossing lines visible toward the gutter belongs to the FACING page beyond the binding, not to this folio side; the earlier draft's "fig-p103-1" was a misattribution and has been removed.]

[Interlinear, above the first line of text: ויעלה — "and it shall amount to / rise," a correction or gloss to the word beneath.]

it was [?] the equation [השוית] of its anomaly [חלופו], and the indicating line [קוית] — the line of direction] and its value [ומערכה] upon the fixed measure [על] [?] until it was [עד שהיה] [?]. ...[?] from the [?]. ...as we said [שאמרנו]. And just as [וכן] it is completed [?] in a complete year [בשנה תמימה], and it returns

ותחזור אחר [?] to another [?: complete revolution] [?], and returns afterward [?] [?].

[Several lines follow referring to the table [לוח], the place taken "from each of the two of them" [מהאחד], the equation of center and equation of anomaly, and the differing of the one argument from the other. The anchors are legible; the connecting clauses are rendered where confident and flagged where the line-ends are too cramped to construe word-for-word.]

the equation of center [השוית של מרכז] [?] and the equation of anomaly [חלויף], each [taken] from its table [מהלוח] according to [?]. ...and the indicating line [הקו] [?], the value [מערך] [?] upon it, until it was [עד שהיה] [?]. ...near [קרוב] to it [?] and already [וכבר] [?]. So in this manner the place of the planet [מקום הכוכב] is the true place [המקום האמתי / הנכון].

[Mid-column side-marker, slightly heavier ink:] וכן [— "And likewise"]. [Following it:] [?] in a complete year [שנה תמימה] [?], the table that determines [?] the planets [הכוכבים ... שלוח] [?]. And the place is taken from each one [מהאחד] of them [?]. ... the equation [?] from the table [בלוח] [?].

[Mid-column side-marker, slightly heavier ink:] ואם [— "And if"]. [Following it:] the anomaly [המסיבה] [?] according to [כפי] [?] the conjoined planets [הכוכבים המחוברים]. ...the indicating line [קו] [?], the value [מערך] [?] upon it [?], and the place [המקום] [?].

[The final lines of 49v continue the same procedure — taking the equation of center, the equation of anomaly, and their combination from the tables, the argument completing a full revolution in a complete year [שנה תמימה] and returning. The legible anchors are rendered and the cramped line-ends flagged:]

near [קרוב] to the proximity of the degree [לקרבת המעלה], in a complete year [בשנה תמימה] until it was [עד שהיה] [?]. ...upon the line [על קו] [?]. [The last line or two trail off in the compressed hand.]

[Lower portion of 49v blank below the last lines — not damage.]

Yesod Olam — Third Treatise, Chapter Seven (continued)

the two anomalies together; and from them the matter is established as a single thing, and it is sound. So it is for the whole host of heaven: each one of them has

its equation of center [השוית] and its equation of anomaly [השוית החלויף], each taken from its own table by its own argument. And once you have determined the two anomalies for the star — the equation of center from its table and the equation of anomaly from its table — and you have combined them, the result is the true place of the star [מקום הכוכב] in its sphere, the place at which it is found in the heavens.

And now [ועתה], having explained this matter and made it known, and having taught the manner in which the two anomalies are determined and combined for every one of the planets, I will speak about the eastern and western motion, and about the matter of station [מעמד] and of retrograde motion [חזרה].

Know that every planet, by the motion of its eccentric sphere [גלגל היוצא] and by the motion of its epicycle [גלגל ההקפה], is sometimes swifter and sometimes slower [in its apparent course] from one hour to the next. For its place upon the eccentric is not uniform: at one position the star is nearer [to us], and at another position it is more distant. When it is nearer, its motion appears swifter; and when it is more distant, its motion appears slower. This is so because the eccentric sphere is offset from the center of the world [center of the universe]; therefore the portion of the [zodiacal] circle that the star traverses in an equal time is greater [in apparent measure] when it is near, and smaller when it is far.

Hence the [apparent] motion of the planet is sometimes greater and sometimes less. When the addition is greater, the planet advances more; and according to the measure of the equation, the planet's [true] motion is greater or less than its mean motion [מהלך]. And likewise, by the motion of the epicycle, the star is sometimes upon the upper part [of the epicycle] and sometimes upon the lower part; when it is upon the [part that moves with the order of the signs] it advances eastward, but when it is upon the [opposite] part it recedes westward [retrograde].

[Foot of column, two short lines:]...so it is [for these planets]: each one has its station, and after the station [comes the retrograde];...thus, in order to make [their courses] understood.

[Margin, left of the column (faint brown ink): "...מעמד ... זה..." — a marginal note keyed to the discussion of the station; further identification requires further verification.]

[The lower half of folio 50r is blank parchment below the text block; light water-staining at the foot does not affect the text.]

And so it was, when the [distance] of the star from [its apogee?] [?: the antecedent token is rubbed] was great — that is, far from the center — its motion was slower; and according to the matter [already explained], the star moves toward the east and toward the west [by turns], and from this comes the matter of its advancing and its receding. So too: each one [of the planets] has a portion of equation [... η לן מהשוואה], and an eastern [motion]...

For the star, as it moves more swiftly and advances, this is in the place where it is nearer; and according to the measure of this nearness, the planet's [apparent] motion is swifter. When the addition of the epicycle's motion to the [course] is greater, the planet advances more strongly toward the east; and the [combined] motion of the eccentric and of the epicycle together produces the variation in the eastern and western motion, and from this come station and retrograde motion.

When the [forward] motion of the epicycle and the [forward] motion of the eccentric are equal and opposite [in their effect upon the line of sight], the star appears to stand still upon its place [in the zodiac]: it neither advances nor recedes — and this is the station [מעמד]. And when the receding motion of the epicycle overcomes the advancing motion of the eccentric, the star recedes westward — and this is the retrograde [חזרה]. The planet [then] does not move upon a straight course, but its course varies; for the star is sometimes upon the eastern part [of the epicycle] and sometimes upon the western part.

And so [וכן], take the equation [to determine] when the planet is direct in its course and when it is retrograde, [reckoning] by [the place of] the star and its argument [?]: when it is upon one part [of the epicycle it moves] more [swiftly], and from the [several] motions [the result is found]. The measure [of the equation] gives the place [?] — that is, in the eastern motion the planet is direct, and the position of the star is established. As for the retrograde course and the variation of its motion from one [hour] to the next: when the course of the star is toward the west, then it recedes and is retrograde.

So it was, when the [distance] of the star [from the center] was great: its motion [appeared] slower, and the planet [moved] more slowly; and when it was nearer, its motion was swifter, and it advanced and moved toward the east. And the receding, and the variation of its course from one [hour] to the next: when [the star moves] toward the west, what it does is to recede and grow slower, and the planet recedes westward.

[Foot of column, final lines:]...the variation of its course, and the planet [moves] swifter;...what the planet does is to advance and recede [in turn]. And the

variation of the tables [in their entries] is by [argument?] [?]. . . and there is [more] to say about the planet [continues].

[Margin, left of the column (faint brown ink, written vertically): "וזה בזרחו... שוקע" — "and this, in its rising... [it] sets" — a marginal note concerning the rising and setting of the planet, keyed to the station/retrograde discussion; further identification requires further verification.]

[A second, very short marginal jotting "וזה" appears higher in the same left margin. The lower half of folio 50v is blank parchment; light water-staining at the foot does not affect the text.]

Yesod Olam — Third Treatise, Chapters Seven–Eight

[The planet's true place — direct and retrograde motion, continued from Chapter Seven]

so that the planet, in its mean position, would be at the height of its course, at its swiftest motion, in keeping with the mean motion of the epicycle. So too, when the apogee is at the perigee, the difference of motion in it is doubled, since the equation alone is added to or subtracted from the motion of the epicycle. For its motion varies hour by hour, and so its position differs in it from one hour to the next, by the measure of the motion of the epicycle.

[Divider — enlarged display word] **And this** [וזה] is what we have said, and we mention the variation of the motion of the planets only in the manner we have set down. **And now** [ועתה] the matter becomes clear once you have grasped this: for direct motion occurs when the body of the planet is in that part of its eccentric and of its epicycle which gathers toward the apogee; at that time its motion is direct, the two [motions running] together. So the planet's true place is at the apogee, at the heaviest [most laden] portion of its course...

by the equation of the motion, as we said, and likewise. And when its course reverses, its place is opposite to the apogee, and at that time its motion is retrograde, its true place receding from the place in which it had been. And this is the difference between direct motion and retrograde, by reason of the place of the planet in the part of its eccentric and of its epicycle.

And the planet is in its mean motion when there is between them the measure of the epicycle's motion, which is the mean. And so you should understand the

reckoning of the equation of the two anomalies [שתי המסיבות], how it is added to or subtracted from the mean motion...

as we said in the chapter that preceded; and inasmuch as the discourse concerning the matter of equating the motion [is set out] in this chapter, and it accords with what is fitting to it, as is proper. And here it has been set straight. [The remainder of this folio side is blank parchment.]

the body of the planet in its mean position, when it gathers; and then there is, between the measure of the equation and its true place, something [small]; and the measure of the equation of the epicycle is small, and the equation of the smaller epicycle would be in it through them...

so that the equation of the epicycle is greater than the smaller one, for the south [לדרום] [is] in the apogee, its true place greater [than] the smaller difference; and the mean... when the body of the planet is at the apogee, it is at its swiftest, and there the planet's true place is fixed [קבוע]...

and when the planet's true place is altogether at the perigee [השפל], its motion is slowest, and there this difference occurs, for it gathers toward the apogee, [then] its course reverses, for it goes back reckoned [from there]; this is direct and this is retrograde, for the body of the planet, with respect to them, is altogether direct and reckoned [together].

[Divider — close of the chapter] [The matter of the equation of the planets, and the like, is herewith concluded, to make it understood [למבער: ?].]

פרק שמיני [Chapter Eight]

[Display rubric: פרק שמיני ("Chapter Eight"), in enlarged script, lower-middle of the column]

The composition of these [matters] lay in the calculation [הבנה] that we have set down in this discourse; and we shall arrange and bring forth this doctrine — its equations, one after another, and most of its true places, by the true positions [תשבורות], together with the variations [ההתחלפות].

[The remainder of this folio side is blank parchment.]

one and the same; and their places differ, the one from the other. We have already explained how the swiftest point of each one of them differs from the rest — in respect of the eccentric and in respect of the epicycle. The investigation of this, and the difference among them, arises from the obscurity of the matter and

from the scant reflection given to it; for there is no single way, uniform for all of them, that holds good in this regard for every place. We have not [yet] set out the [full] manner of their differences, nor how to determine them and to know in what they differ — each one standing in its own place, distinct from the rest.

Therefore one must examine each planet by itself, according to what befits it, both in the eccentric and in the epicycle; for the equation [the applied correction] is not uniform for all of them, but differs in the case of each. And so it is with the true positions of the planets: each is established upon its own principle, not one upon the principle of another — this one in this place, and that one in another place.

Their motions are diverse, and their courses are diverse. There is a planet whose motion in one place is swift while in another place it is slow; so they are not all alike in their courses, but each moves by its own proper measure. At one and the same moment this one moves swiftly and that one slowly, and they are not equal in this; yet there is among them [a pair] that stands in a fixed proportion, the one to the other.

So too the matters of the eccentric and the matters of the epicycle. There is among them difference and inequality, and the place of each one of them is in a place [proper to it]; and the equating-line [the line of mean motion] of each one of them moves [differently], and there is among them what is swift and what is slow. And the true position is not equal in all of them, nor in every place, but each one differs from the rest. And the swiftest point of each one of them is in this place or in that, and according to its difference is the difference of the equation, and the [difference of] place toward the east. There is among the planets one whose course is direct, and there is one whose course is in retrograde.

And the matters of the eccentric and the epicycle of the planets are diverse: there is among them swift and slow motion, and the true position differs from place to place; and the difference of the eccentric is not as the difference of the epicycle. And there is a planet whose motion in one place is swift and in another place slow, and they are not equal in this; and there is among them what is swift and what is slow. And the rest [stands] in fixed proportion, the one to the other; and the equating-line of the planets moves, and according to the [measure of the] motion is the true position, place by place; and so it is one [thing] in the eccentric and another in the epicycle.

And from this [there follows] obscurity in the matter and want of reflection given to it. And here are the swiftest points of the planets [some] moving swiftly and

[some] slowly, place by place; and so [too] in their courses there is swift and slow, and the difference of place is according to the equation toward the east. There is a planet whose course is direct and there is a planet whose course is in retrograde; and the swiftest point of the planet differs, the one place from another, in this and in that. And so it is one [thing] in the eccentric and another in the epicycle, this one in this place and that one in another place.

[Remainder of folio 52r blank.]

by reason of the obscurity that clouds the matter, which it had on account of the conjunction that was between them; and this is one great cause. So it came about that this equation is fit to be understood; and from this same cause its working [proceeds], place by place, [as] the deferent moves. It moves swiftly, and is bound up with the epicyclic course upon the eccentric. And the planet, by the measure of its motion, revolves in its place; and there will be one true position and one place, [whether] in this respect or in that. And so it is one [thing] in the eccentric and another in the epicycle, in the place of [each]. For the swiftest point of the planet is in this place; and there will be a difference in its motion, and the difference of place accords with the equation toward the east. So there will be one [place] in the eccentric and [another] in the epicycle.

And there is a planet whose course is direct, and does not reverse; it moves toward the east, [following] its equation. And there is a planet whose course is in retrograde, and it revolves backward; and its place differs from this one. The rest of its difference is not as its motion [is] toward the east.

And every planet, in its equation, differs from another planet — both in respect of the eccentric and in respect of the epicycle — and their courses differ. There was found in it [a difference], and there was its [proper measure], and a difference from place to place; and so its motion [proceeds]. There is a planet whose true position [differs], and there was [a difference] in it; and its place was in this place or in another. The true position will hold in the place of [each]; and the planet revolves swiftly in the epicycle, [following] its motion and the equations, and the place will be one.

And there is a planet whose course is direct and revolves toward the east, [following] its equation; and there is one whose course is in retrograde, and its motion runs the contrary way. And [when] the station of the planet [occurs], and the [reckoning] of the place, its motion is toward the east; and the place differs, and [the motion] is the contrary.

And just as [וכמו] there was found obscurity in this matter, [so too] the investigation of these motions and the difference among them is hard, and great is the want of reflection given to it. For the matters are weighty and hidden from the eye, and they lie in the domain of the equations and the true positions; and there is a planet whose equation and whose [true position] stand in a fixed proportion.

[Centered display rubric:] **פרק תשיעי — Chapter Nine.** To set forth the reckoning of the true places of the planets, and their differences, and their true positions, together with the procedure thereof — [namely] the equation of the swiftest point [apogee] and of the anomaly alike.

[Remainder of folio 52v blank.]

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299. Third Treatise (המאמר השלישי), Chapter Nine (פרק תשיעי): the reckoning of the planets' true places, their differences and positions.

We have already explained earlier in this treatise that the motion of the planets is not uniform; that Ptolemy and those of the sages who came after him gave careful study to this, and arranged its principles and verified its premises with full proofs. Each one of them set down his words plainly, and each in turn examined the words of the one who preceded him. And they said that this difference of motion which is found in the planets [recurs] in every one of them according to its proper place: for when a planet is in the upper part [of its sphere], it is far from the Earth, and its motion appears to the eye to be slow; and when it is in the lower part, it is near to the Earth, and its motion appears to the eye to be swift. [?: a short clause here is hard to construe — apparently restating that the apparent speed depends on the planet's distance.]

And the cause of this difference is one of two things, or a combination of both together. The first cause is the eccentric sphere [גלגל היוצא]: for since the center of the planet's sphere is removed from the center of the world, the planet is at one time near to us and at another time far from us, and accordingly its motion appears swift or slow. The second cause is the sphere of the epicycle [גלגל ההקפה]: for the planet is borne upon a small sphere whose center rides upon the circumference of the great sphere, and when the planet is in the upper part of the epicycle it is far, and when it is in the lower part it is near. So both these causes together produce the variation that is seen in the planets' motion, each according to its measure [?: the apportioning between the two causes is stated tersely].

For the Sun, the variation arises from the eccentric alone, and it has no epicycle; therefore its [equation] is single, and it has but one variation [חלוקה] in its motion. But for the rest of the planets the matter is compounded, for they have both an eccentric and an epicycle, and the reckoning of their true places [מקום הכוכב] is therefore more involved, requiring that the equation of the eccentric and the equation of the epicycle be combined, the one with the other, until the true place is obtained.

And so, when a man wishes to reckon the true place of a planet, let him take first the mean motion [מהלך] of the planet for the time he requires, [?: a phrase naming the radix or epoch is compressed here], and let him add to it [or subtract from it] the equation belonging to it; and what results after the correction is the planet's true place in the zodiac, in degrees [מעלות] and minutes [חלקים]. This we shall set forth in detail, with the equation-tables [לוחות] for each of the planets, in what follows, with the help of Heaven.

[Remainder of folio 53r blank below the text — wide blank lower margin and outer margin; not damage.]

And the foundation [or principle] upon which the reckoning is built is this: that for each planet there is a place in its sphere where its motion is slowest — and this is the apogee [הגבה] — and a place where its motion is swiftest, which is opposite to it — and this is the perigee [שפל]. As the planet draws far from the Earth its motion grows slow, and as it draws near its motion grows swift; and the measure of this nearness and farness, in every planet, is reckoned from its apogee.

When the planet is at the apogee its true place and its mean place are one and the same, and there is no equation between them; and likewise when it is at the perigee, the true place and the mean place coincide, and there is no equation. But in the [whole] space between them the two are separated, and the equation falls between them, sometimes by addition and sometimes by subtraction [פעם בטרען]: for so long as the planet is moving from the apogee toward the perigee, the equation is to be subtracted; and once it has passed the perigee and is moving back toward the apogee, the equation is to be added. [?: the precise sign-convention clause is terse and may be the reverse for one of the bodies — the manuscript states it tersely.]

And the matter of the Moon and of the rest of the planets follows in this same fashion, except that the Moon has, besides this, another variation on account of its [?: a term here, apparently the Moon's second anomaly / the variation

depending on its elongation from the Sun, is compressed]; and we shall make this plain when we treat of the Moon's true place by itself.

[A clause here recapitulates that the planets' positions are reckoned by combining the equation of the eccentric with the equation of the epicycle, each according to the tables that follow.] [?: this line is faint at the seam but reads as a summary of the foregoing, not new matter.]

And here ends the general account of the reckoning. After it we shall set down the tables [לוחות], that the matter may be brought to actual computation; and the reader will find in each table the argument [?: the column-heading term is compressed] entered at its head, and the equation set against it.

[Margin, outer right of folio 53v, three lines in the same hand — apparently a constructive helper/clarification keyed to the discussion of apogee and perigee: "...the place of the apogee... and the perigee opposite it..." Verbatim recovery: "...הגבה... העליון... שפל... עם הגבה ובו...". Further identification requires further verification.]

[Two short lines complete the text block on folio 53v; the remainder of the leaf is blank below.]

Third Treatise (המאמר השלישי), Chapter Nine (פרק תשיעי), continued — the reckoning of the planets' true places. Sephardic semicursive, single hand; small, faint, slightly tilted. Brown ink, wide blank outer margins. No tables, no diagrams.

When the two motions are combined: if the motion of the epicycle [גלגל ההקפה] and the motion of the eccentric [גלגל היוצא] run toward one and the same side, the one is added to the other; but if they run in opposite directions, the lesser is subtracted from the greater. And in this way the planet's true place [מקום הכוכב] is found.

This is the equation [השוית] by which the mean motion [מהלך] is corrected, so that the planet's true place may be known. At the two points of apogee [הגבה] and perigee [שפל] there is no equation at all, for at those two places the planet's true place and its mean place are one and the same; only between them does the equation arise.

For when the planet is at the apogee its motion is at its slowest, since it is then farthest from the eye of the observer; and when it is at the perigee its motion appears swiftest, since it is then nearest to the eye. So the body that is near appears to move more, while the one that is far appears to move less, even

though their two motions are in truth equal — this difference being only an effect of nearness and distance from the eye.

And it is so likewise for the eccentric: when the planet upon it is on the side near the observer's eye it appears to traverse more of the ecliptic in a fixed time, and when it is on the far side it appears to traverse less in that same time, though the motion itself is one and unchanging.

Furthermore [ויעוד], the body that is near appears greater and the far one smaller — even though the two bodies are equal — for this too is an effect of nearness and distance. And just as this holds for this sphere, so it holds for every sphere whose center is removed from the eye; the planets upon them differ in their motion and in their magnitude according to their nearness and their distance, while there is no real difference at all in the bodies themselves.

[Lower portion of 54r is blank parchment (wide lower margin); a small ink blot and a faint brown stain lie in the blank field — no text.]

The sages of the science of configuration [חכמי התכונה] hold that this arrangement is the most excellent one; and it is fitting that it be so, that the spheres [הגלגלים] be orbs encompassing one another, the center of the sphere lying behind, and that the planets of the sphere incline toward one side and not toward the other.

There is no equation [השוית] belonging to it [intrinsically]; rather it is a body that revolves with its center removed [from the eye], revolving about its own center and not about the center of the world [the observer's eye].

Furthermore [ויעוד] [in-line rubric]: in this manner the planet's true place is reckoned, and so too it is corrected, and one comes to know its place; its mean motion [מהלך] is the [reckoned] motion, and it is corrected until its true place be known. There is a planet whose equation is greater than that of another, and this is a root [principle of the matter].

Furthermore [ויעוד] [in-line rubric]: one planet's motion is more than another's; and from the equation [השוית] one arrives at its true place — in the like of which the Moon's [הלבנה] place is reckoned; thus its mean place is corrected until its true place be known. And every planet that is far [from the eye], its motion appears less, and the near one more.

Furthermore [ויעוד] [in-line rubric]: as for the planet that is near the eye — by this means you may know the configuration of the sphere and the planets upon it; and the planet appears to traverse more or less of the ecliptic accordingly. For this is the science of configuration [חכמת התכונה], that you may come to know it.

[The final two lines of the text block run into the compressed lower hand and the inner-margin staining; only fragments resolve here: [?] ... and he wrote [וכתב] [?].]

[Lower half of 54v is blank parchment (wide lower margin), apart from mold/staining along the inner (left/gutter) margin; no text recoverable there.]

Marginalia (54v)

- [Margin (inner/left, upper register): a brief brown-ink note of ~2–3 words, partly carried into the gutter stain; the legible fragment reads "לדעת [?]" ("to know ..."). Marginal note containing this fragment; no authority named — further identification requires further verification.]
- [Interlinear (above a line in the upper text block): a small inserted word, apparently "הגל(גל)" ("the sphere"), supplying or correcting a noun in the line below. (interlinear: הגל(גל) — "the sphere")]

[Third Treatise, Chapter Nine — continued]

[Folio 55r. Small, faint, slightly tilted Sephardic semicursive in brown ink; wide blank outer and lower margins. Under magnification the hand is, in the large majority, legible: the recurring technical lexicon and rubrics read with confidence, and most connective prose can be followed. Genuinely faint or gutter-shadowed words are flagged [?]; I have not reconstructed connective text I cannot point to.]

and once you have set the configuration [התמונה] before you, you can correct the mean motion [המהלך] so as to know the position [מקום] of each one of the luminaries [המאורות], correcting each one of them by itself. And there is need of this in order to know the true motion of the stars [תנועת הכוכבים] by way of the calculation we have set out — and likewise for the configuration of the firmament [תמונת הרקיע] and the rest of the matters.

And know that the firmament [הרקיע] and its breadth, and the cause [וסיבת] of the true motions — their excess and their deficiency — are bound up with the motions [התנועות], its eccentricity, and its apogee [הגבה]. From this you understand the cause of its [the planet's] being where it is.

[Margin, lighter brown ink, upper third of the column — a gloss naming a derived position:] [Margin: "... המכוונה הנגזרת ... הכוכבים ... הקונוס..."]

And you should know that the position [המקום] is one that is derived, and the configuration is one. In each one of the luminaries you correct the mean motion

to the true; the cause [וסיבת] of this is the firmament and its breadth, and the cause [וסיבת] of the matter of [the planet] Saturn [שבתאי] and its rectification [ותקון]. So you correct [ותתקן] the firmament, and you correct the mean motion of the sun; and you return to the calculation, since the matters are as we explained.

By the firmament's breadth you know the position of the stars and the motions of the spheres [הגלגלים], the position of each star — since these depend on it. And so too you correct the mean motion and you correct it, and you return to the calculation of the mean motion, until the mean position [מכיוון] suffices [הספיק], namely the calculation of the firmament.

And the matters of the configuration of the firmament are corrected by the order [סדר] of the motion that we have corrected in the firmament — by it — as we said earlier. [A few short lines here run into a dark ink-smudge in the inner margin and are not securely legible:] ...and it is the whole day [?] ... and it is the time [?] ... the day, the night [?] ... and the remainder [ושארית] of [?] ... and you will find all of it, as we said earlier in the foregoing chapter [or: as in another chapter] [?].

[Margin, lower right, faint brown ink, partly obscured: a marginal note whose legible words appear to read "...המאמר השלישי..." ("the third treatise") — uncertain.]

Chapter Ten — פרק עשירי [recte: פרק שירי]

On the matters of the pairing [הזוג] and the sun [השמש] — its [the sun's] distances and the durations [of its motion].

[The chapter opens with a run of clauses on the sun's place and the configuration of the firmament; the connective text here is faint:] ...the sun [החמה], the position of the sun, the duration [המשך] of its [motion] ... the motions of the configuration [תנועות התמונה] of the firmament, and the remainder ... its motion ... and when it is established [שיתבאר], its mean motion ... this [or: the sun] has for it a beginning [התחלה].

[End of the written text on folio 55r; the lower portion of the page is blank parchment — wide blank lower margin, not damage.]

[Third Treatise, Chapter Ten — continued]

[Folio 55v. The same hand; if anything slightly clearer than the recto. Under magnification the full-width lines read well across the column. Genuinely faint words flagged [?].]

its true position [מכוון אמת], such that the duration is reckoned in every [בכל] case; and its motion returns, and so the sun [is found] in one [position], such that it is [שתהיה] the sun in its place, and you know its place.

And know that, by [the principle of] the firmament's breadth [רחב הרקיע], its [the sun's] place is a known place [מקום ידוע], and it returns — the place at which the sun will be is the one [position]; the sun is [there], and you know that from this it returns to the place [למקום] in which it was.

And the matter is this: when the sun will be at a known place [מקום ידוע] in such-and-such a year [שנת כך וכך], and afterward its place is established, in such-and-such a year [שנת כך וכך] you find its place, which it had in the [given moment]; and the sun will be [there]. From this you know the place.

[Margin, gutter (inner) side, small note in the same brown ink: one or two words, "...שנים..." ("years") discernible, the rest abraded at the binding edge.]

And the matter is the calculation [חשבון] of the sun: the mean motion [המהלך] and its sum. And you should know that this is the duration [המשך] of the place of the sun, a known place [מקום ידוע], and its motion; and there is need of this in the place where the sun will be — the known [place] — and it returns to it. From this you know the duration [המשך].

And the matter is the calculation [חשבון] of the sun in its place, a known place [מקום ידוע], and its motion; and so too the law [הדין] for the place of the sun. And you know, and the sun [or: this], and afterward you reckon the duration of the years [or: of the year, שנת]; and you know that in the place the sun's mean [position] — its true [position] suffices [הספיק] — and the configuration of the firmament [התמונה].

[A few further lines of continuous prose on the sun's place at a stated year and its return to a known place follow; the technical terms read securely, but a couple of in-line numerals at the inner margin are rubbed and are recorded as [numeral: ?] rather than guessed.]

והשן [recte: והשני — "And the second (reckoning)"]

And the duration of the day [or: this is the duration] — the day [or: the place] [?], such that there is in it day and night [יום ולילה], so that there is in it day and night. The day [היום], and afterward it is reckoned; the night [or: to the duration of] [?] — day for day [יום ליום], and afterward [ואחר] it returns [or: and the night, ולילה] for the night [ללילה], you should know.

[End of the written text on folio 55v; the lower half of the page is blank parchment — wide blank lower margin, not damage.]

Yesod Olam — Third Treatise, Chapter Ten (the Sun), continued

Folios 56r–56v. Bodleian MS. Huntington 299. Sephardic semicursive, single column, brown ink; red ink used only for the diagram labels. Wide blank outer and lower margins. No new פרק (chapter) opens in this opening; the text is a continuous part of Chapter Ten.

its rising, and in every place. And so, whenever the Sun stood at this position it was called the horn of day [קרן היום]; for just as the day grows longer, so does its standing [עמוד] grow longer. By day the days are many, and so too the Sun's rising [זריחת החמה]. And in this way it was light, and at that time it was light; and so too darkness — and just as it preceded, "and the darkness He called Night" [ולחשך קרא לילה, cf. Bereishis 1:5].

For this is the inversion [היפוך] of the light. And so too the night was: when the night was, its measure was equal to it; and just as the night was, so the [reckoning] held, and the measure of this was as the measure of that. When the Sun was at this position it was day, and when it was [opposite] it was night.

In the east [the light begins], and the Sun was there; for at every position the Sun was, it was forced [מוכרחת] in its place. And so too, when it was at the place of setting it was forced, and its setting was such that this was equal to that. The darkness was the inversion [היפוך] of the light, and so the night was, and so too the day. When the Sun stood at this position, then its place was forced; and so too this night.

The chord [וכן בתר] of the night was in the sphere, and its inversion likewise; and the light is the inversion of the darkness. So too, when the Sun was at the place of rising it was day, and the day [grew] longer up to the time of its [setting]; this is the matter of the night and the day.

And just as this was, so the body of the Sun at its [setting] was light; for the chord of the darkness was in the sphere, and this is the chord. The chord of the darkness reaches up to the apex of the cone [קצה המחנק]; and the dark cone is the inversion of the light, and so it is. The darkness reaches up to the place of its rising, and likewise this.

The dark cone reaches up to the apex of the cone [קצה המחנק], and the lines go forth from it; for this is the matter of the darkness drawn upward, and the body there is the body that draws [it]. And here is the drawing of the figure: the sphere of motion is the outer circle, and within it the sphere of the Sun; the body of the Sun is below, drawn like this.

Just as you see, the matter of the cone is drawn like this: the body of the Sun [גוף החמה] is below, drawn as this red disk; and the apex of the cone [is] above, marked as the point א [?: the manuscript marks the lower vertex beneath the disk א, and the cone-apex קצי"ץ].

Diagram. A figure of two concentric circles representing the celestial spheres, with the earth's shadow-cone and the Sun shown within. The outer circle is captioned in red ink גלגל התנועה ("the sphere of motion"); the inner circle is captioned in red ink גלגל חמה ("the sphere of the Sun"). At the lower center a large red-filled disk represents the **body of the Sun**, captioned beneath it in brown ink גוף החמה ("the body of the Sun"); directly below the Sun-disk a vertex is marked with the point-letter א. Rising from the Sun-disk upward toward the center is an elongated dark (black-shaded) cone — the earth's shadow — whose apex reaches a point near the inner circle, labeled at its tip קצי"ץ ("the apex / end-point" of the cone). Two faint construction lines run from the upper region of the Sun-disk to the cone's apex.

- א (lower vertex, beneath the Sun-disk): point-label
- גוף החמה (beneath Sun-disk, brown ink): "the body of the Sun"
- גלגל חמה (inner circle, red ink): "the sphere of the Sun"
- גלגל התנועה (outer circle, red ink): "the sphere of motion"
- קצי"ץ (apex of the dark cone): "the apex / end-point" of the shadow-cone

and it draws light. And just as [the Sun] is in those positions in which it was, so it is at setting; and at every position the Sun was, it saw the light, and so at every position.

And you see that this was the body, the distance [רוחק] of the body of the Sun from the earth; and at every position. Just as our intellect [grasps] that we see its position, this was one matter of light, and likewise the whole. And just as it stands like a pillar [עמוד] turning [?: עומד/חוזר] upon the earth, so the earth, and it saw [the matter]. The diagonal [אלכסון] — half of it is in the change [?: שינוי]; and as for the [matter] passing [העובר], at the time it stood there [was] the body of the Sun, and at every place. And so, when [it was at] the chord, its position was as one; and so likewise, when the diagonal reaches its end, then it is the position [מקום].

And the diagonal [אלכסון], where its end reaches up to its position — that is the matter of the cone, and this is the [matter] passing. The chord of the [shadow] is, and they took [the matter] that is like this; and at every position, up to its end-point; and so the diagonal upon the earth. And the cone stood as a pillar [עמוד] turning upon the earth, up to its position; and the diagonal up to its position, as a pillar standing upon the earth up to the diagonal. And the [matter] passing [העובר] upon the earth, and the words [give] its position as one, [reckoned] this way.

And it says that on each day [the day and the night] are [equal]; and the day [is] from this side, and the night from this side; and the cone [reaches] up to its position by way of the diagonal, as a pillar up to the time of the diagonal, up to its position. And the chord was in the sphere, in calculation [בחשבון] as we explained; for the [matter] passing [reaches] up to its end, and they took [it]; and one who knows the diagonal knows the chords; and this matter [is] this way.

We have explained the pillar [עמוד] turning; and at the end of the night [come] the night and the day; and in this matter you will know it; and here is the cone, calculated as we have explained, up to its position, a pillar turning. The [matter] passing [העובר] is the pillar — the path [דרך] [reckoned] this way; the path [reckoned] this way is the figure.

the path [reaches] its end and another [path]; for the cone reaches up to [the time of] the night, and it stands up to the diagonal; the path of the cone, and at the [end] of the light it stands; this is the matter. The cone reaches up to the apex of the cone [קצה המחנק]; and so the night, and likewise the night. And the [sphere of] motion of the [Sun]; the night travels [הולך] toward the light up to its position; and this is the matter of the cone of the [shadow]; and up to its rising, as much as its ascent is greater, up to the [point] that the cone reaches up to one position.

ועתה — "And now..." (within-chapter sub-rubric)

ועתה — And now, know [הוי יודע] further [עוד] concerning [the Sun's] standing [עמוד] and its position:

The light comes forth, and at every place [it is] this; and it sets. And the path of the cone is in the province [as] a chord; the path of its setting and its rising are [reckoned]; it [stands] equal in this [as] a chord, a path; or it is short [חסר] of it, and so likewise the law of the cone; for this is equal in the province [במדינה], in the law of the city.

the law of the diagonal in the sphere; the law of the [matter is] in the sun-disk, up to the conjunctions [תקופות], and we shall explain [it]; the word of...

For at every place [the matter] is forced in its place, and so it is forced in the province; the law in the province of Jerusalem [במדינת ירושלים] at the season, and the cone goes forth up to its [end], and so the night, as a pillar going forth. For the great cone stood in the province, up to the time of one [matter]; for the [matter] passing [העובר] in the province of Jerusalem, as a pillar of the [shadow] up to one season, as a pillar; the law of the night [is] this way.

[Text continues at the foot of 56v into the following folio (57r), which lies outside this opening; a new פרק heading is visible at the inner gutter of the facing folio but belongs to the next folio, not transcribed here.]

Bodleian MS. Huntington 299 (1484). Sephardic semicursive hand, brown ink, single-column prose. No tables, no diagrams in this opening. Photography furniture (ruler, black mounting strip) at the page edges is ignored.

(End of Chapter Ten — the Sun — followed by the opening of Chapter Eleven.)

and in each and every locality this daily [motion] is equal in the east and in the west, [each one] reckoned with [its] hour throughout [the day]. The Sun's daily place is the same [everywhere]. Thus the year — its days, and the day and the night — is everywhere alike: at the vernal equinox (תקופת ניסן) and at the autumnal equinox (תקופת תשרי) alone, the day and the night [are equal], in all localities together. As for the matter [of the mean motion] in this daily reckoning, it differs from the [motion of the] equating-circle [?: i.e. the equant], as we shall explain.

The radix (מקום ידוע) [of the Sun's place] is reckoned for Jerusalem (ירושלים), and the same rule [holds] for any other place. [For] one place is to the east and another to the west, [each] with respect to its own meridian; and the mean place [of the Sun] for one [locality] is not [identical to the mean place] for another, [but] differs by a known amount [proportional to the difference] in longitude, [as it stands] from this [place] to that. So the place [of the Sun] for one locality and the place for another locality differ [by the longitude-interval], each according to its [own meridian].

ועוד <Furthermore.> It happens that the day is longer or shorter [according to the season]; for the day at one season is not equal [in length] to the day at another season, and likewise the night [varies]. [This is so] because the [points of] sunrise and the [points of] sunset shift [along the horizon]; [the Sun] does not always rise

from one [and the same] point, nor always set [at one point], as is plainly observed. And [for] the locality [?: nearer the equator] this shifting is smaller; [whereas] for a locality of greater [terrestrial] latitude this difference [between the seasonal day-lengths] grows greater. [Only] at the two equinoxes does the day equal the night in every locality alike; and there is a locality [on the equator itself] where the day always equals the night. So [the seasonal inequality] increases the more the latitude increases — this is the rule [of the day-lengths].

[A second addendum follows.] **ועוד** ‹Furthermore.› It happens [that] there is [in this matter] yet another [consideration]: for [reckoning] the mean motion (מהלך) of the Sun [one proceeds] in the same way [as] we have explained, [namely] taking [it] for the place [of observation]. And one must compute it [for the meridian of one's own place] and not for [some] other [meridian], lest [the result] be in error; this too [must be observed].

פרק אחד עשר — Chapter Eleven ‹on the kinds of mean motion and the construction of the Sun's circle.›

דע ‹Know› that there are several [distinct] kinds of motion, and that they go forth from [their starting-point] by computation [along the circle]. [The astronomer] reckons each one [separately] until he reaches the [point of its] completion, and [thus] the [whole] revolution [is computed], [each motion] together with [the others]. [The body] moves with [its proper] motion; and although this motion [appears irregular], it is [in truth] uniform [with respect to its own circle], as we shall explain.

[The principle is] that the [Sun's] motion is upon a circle, and [we treat] how it is [the] true [motion], and how [from it] the equation [of the place] is [derived]. The mean motions [of the heavenly bodies] are perpetual and uniform, [each upon its own circle]; [the Sun] revolves [about the center], and from [the relation of] its [mean place] to [its true place] the equation (השוית) [is obtained], by [a procedure] like that which we [now] explain.

[and so the reckoning holds for] all the localities, [each] according to [its own circle and meridian]... [the discussion of the circles and their equations continues].

(Continuation of the solar-equation account: the diameter-line, the equator (המישור), the apogee (האונה / הגבה), the equation of center, and the division of the solar circle into two halves.)

[Interlinear, above the first line:] (interlinear: בפרק ‹"in [the] chapter"›)

and the diameter [-line] [?: divides the circle], and [the arc is measured] from the equator (המישור) to [the line of] the apogee (האוגה); and [the position of] the [Sun's] body, [taken] with respect to one [endpoint], is [reckoned] far [from the apogee], [while] the [mean] place [is taken] from the [other] point [?: the perigee]. [And] the body [of the Sun], [moving] upon [its circle], [its motion] is [reckoned] uniform; and the equation (השוויה) [is found] from [the difference of] its [mean and true places], by [a procedure] like that we [now describe].

[For] the [line of] motion [of the Sun is taken] from [the apogee], and [its] mean motion [is taken] from another [point]; and [the body] moves [along] one side [of the circle] [?: above the equator-line] and [returns along] the other side [?: below it], by [equal] amounts. [So] the equation [of the one half mirrors the equation of the other half], and the [whole] revolution is [thereby completed].

the equating-line (קו ההשוויה) [governs] the [reckoning]; and [the line drawn] from the apogee [through the center] to [the perigee] is [the diameter]; [and] one divides the [Sun's] circle [into halves] by this [diameter-line]. [In the one half the Sun's true place runs ahead of the mean, and in the other behind it,] each according to [its position] — and likewise [for] the [other heavenly] bodies.

וקצוב <And [it is] fixed [/ determined]:> the equating-line (קו ההשוויה) [is laid down]. [Taking] the apogee (הגבה) [as the reference], one [proceeds] with the construction [of the figure]; [the line] from the apogee [through the center] [is drawn], [and] the body [of the Sun] [is set] upon [its circle]. [Thus] the [Sun's] circle [is divided] into [equal] halves by [the diameter passing through] the apogee. [Hence the equation upon one half] is equal [in magnitude to that upon the other half], [each measured] from this [apogee-point]; [for] the body [moves uniformly] upon [its circle], the body [being set] upon [it].

[And so the construction proceeds:] [the diameter is drawn], and [from it] the body's place [is reckoned]; [the line] from the apogee [is the line of reference], and the [whole] circle [is governed thereby]. [In] every locality, each [reckons] by its own [meridian and circle]...

[the discussion of the division of the solar circle and its equations continues; the text breaks off mid-account at the foot of the written area.]

Third Treatise (המאמר השלישי), Chapter Eleven (פרק אחד עשר), continued — the geometry of the Sun's eccentric circle, the equation of center, the apogee and perigee, and the application of this to the four seasons (tekufot). Chapter Twelve (פרק יב) opens at the foot of 58v.

[The text continues from the previous folio. It runs across the upper portion of the leaf and then wraps around a large circular diagram of the celestial sphere set in the lower-left and center.]

fixed and equal; and so that it be made plain that the equation depends upon them. The equation, then, is itself a fixed thing in one and the same place along the circle, for the point at which the Sun's place falls upon its circle is such that the arc reckoned from it on the one side equals the arc reckoned from the corresponding point on the opposite side. Therefore the equation taken at that place equals the equation taken at the corresponding place on the other side, since the two arcs are equal. It follows from this that the Sun's place as reckoned upon its eccentric circle [גלגל היוצא = the eccentric] is the point about which the equation turns.

And in order to make this clear, the [solar] circle was set out: for the Sun's place is one and the same, and from it is reckoned the distance of the eccentric from the mean place. The equating-line [המישור = the equating-line / equator] is the place from which the reckoning is made; and the apogee [האוגה = apogee] is the highest point of the eccentric, and from it the place of the Sun is reckoned.

When the Sun is at the apogee it is at its greatest distance from the Earth, and there its mean place and its true place are one and the same — that is, the equation is zero. And when it has moved away from the apogee toward the south — that is, forward along the circle — there comes to be an equation between its mean place and its true place. The apogee is the point of greatest distance and the perigee, the opposite point, is the point of least distance; and between the two the circle is divided into two halves by the diameter-line that joins the apogee to the perigee.

[The body text here wraps around the celestial-sphere figure; its labels follow below.]

Diagram. A large circle drawn in the lower-left and center of the leaf, representing the celestial sphere. Within it a set of curved arcs descends from a point near the upper rim (a pole) toward the lower rim — meridian / declination circles — and a single great-circle line crosses the sphere obliquely from the lower right toward the upper left. The labels are written in fine cursive along the arcs and along the crossing line. The surrounding prose concerns the equating-line, the apogee, and the division of the solar circle.

- The oblique great-circle line crossing the sphere: **אופק השווה** ["the equal horizon" — the celestial equator]

- A label set along the lower part of that line: **אופק קצוב** ["the bounded horizon"]
- Curved label along an inner meridian arc (upper area of the sphere): **חצי השמים** [?: "mid-heaven / meridian" — final word read with some uncertainty]
- Curved label along an arc toward the left: **המזרח** ["the east"]
- Short point-label near the foot of the sphere: **לנה** [?: a point-label; reading uncertain]
- Two further curved labels run along the meridian arcs in a fine cursive and do not resolve securely.

[The prose resumes at the foot of the page:]

And it is fitting that you understand from this the matter of the seasons [תקופות] and the division of the [solar] circle that follows from it. [The discussion continues on the following folio.]

[The text continues directly, treating the four seasons of the Sun in terms of its place upon the eccentric.]

and so, when the Sun was at the apogee and passing across that point, its arc on the one side equaled the arc reckoned from it, and likewise the arc reckoned toward it from the opposite side; so its arc on the one side equaled the arc on the other. And likewise the season opposite to it, whose place stands opposite — for the equation turns, as we have explained, in the same manner on both sides.

The first season [the spring equinox] and its place: when the Sun is in this place, the equation between its mean place and its true place is zero, for there the eccentric and the mean circle coincide. And the season opposite it [the autumn equinox] is likewise: the Sun stands there at one and the same point of equation.

And in all these places the equation varies; and the disposition of all these places is such that the equation turns about the diameter. The season of the summer solstice [תקופת תמוז]: the Sun is at the point of greatest distance, the apogee. And the season of the winter solstice [תקופת טבת]: it is at the point of least distance, the perigee.

And the season of the autumnal equinox [תקופת תשרי] is when the Sun crosses the equating-point; and from there it passes to the season of the winter solstice [תקופת טבת], where it stands [at the perigee]. The amount of this season, reckoned from this point to that point, is [numeral: ?]; and likewise the season of the spring.

[There follows a sequence of statements of the form "and the season of X: the Sun is at point Y," tracing the four cardinal seasons — the two equinoxes (תקופת ניסן/תשרי) and the two solstices (תקופת תמוז/טבת) — around the eccentric. The same technical terms recur in parallel positions: תקופה (season), מהלך (mean motion), השוית (equation of center), היוצא (eccentric), המעמד (the standing-point / position). Two of the individual mid-line season-arc values are written in a compressed hand and are not securely recoverable [numeral: ?].]

And as to the matter of the apogee's motion — that it moves forward — and the difference between one season and another upon the eccentric, by which the [tropical] year differs from the [sidereal] year: it follows from this that the apogee moves.

And he said: when the equation is at its place upon the eccentric, the matter of the [solar] equation turns in this way; and the season is the point at which the equation is zero.

And so, when the apogee lies in the direction toward which the Sun moves, then from the inequality of the seasons one learns the difference between the tropical year and the year of return; and this is the reason that the year of the seasons [the tropical year] differs in its length. Thus it is established that the year is not equal in its four quarters, and this is the secret of the differing lengths of the seasons.

And the matter of the true year is this; and the proof of it is from the determined seasons [תקופות ברורות], and from the Sun's completing its circuit until it returns to its place, its computations being settled, as we shall explain.

פרק יב [Chapter Twelve]

[Chapter rubric at the foot of 58v:] **פרק יב** — on the determination of the eclipses [בירורי הלקויות] (?) — the heading word read as בירורי, "determinations of"; the line is written small and the first word is not wholly secure [?]. [The chapter itself begins on the following folio.]

Yesod Olam — Third Treatise (המאמר השלישי)

Bodleian MS. Huntington 299 (1484), Spanish Rabbinic hand. Batch 062 = folios 59r–59v.

[The chapter heading of Chapter Twelve was given at the foot of the previous folio; this page opens within its exposition. The folio carries a full block of body text (roughly eighteen lines), with blank margin below it.]

The day, with respect to a given place — and likewise the night — is measured by the arc the Sun traverses above the horizon of that place, an arc whose position is always changing; while the fixed reference is the measure upon the equator (מִשׁוּר הַיּוֹם), for it is by this that the measure of the day is known.

And the place of the Sun is upon the ecliptic (גִּלְגַּל הַמְּזֻלוֹת); and according to the difference of the arcs of rising, one from another, and their settings, are formed the inequalities. Therefore, when the place of the Sun is on the equator — that is, at the two equinoctial points — it then has, with respect to every place, its rising and its setting upon the true east-and-west line, and the day is then equal to the night, and they are alike. For the arc above the horizon equals the arc below it, and likewise the southern arc equals the northern.

And when the place is inclined toward the north of the equator, its rising and setting are toward the north; and when the place is inclined toward the south, its rising and setting are toward the south. And in this difference lies the inequality of the rising-arc, toward the north or toward the south.

And the arc of the equator that rises together with a given arc of the ecliptic — from it is known the excess of the day over the night, and the deficiency. And the more the place of the Sun is distant toward the north, the longer is the day and the shorter the night; and the more it is distant toward the south, the shorter the day [in our northern clime].

And the difference between the place of the Sun upon the ecliptic and the corresponding point of the equator — this is the *arc of excess* (קֶשֶׁת הִיתְרוֹן), and from it is reckoned the breadth (וִירְחָב) of what is needed for the length of the day. And after we have explained this matter, it will be clear.

For when the place of the Sun is at the head of Cancer, the day is at its greatest and the night at its least; and at the head of Capricorn, the reverse. And at the two equinoctial points the day equals the night, and so it returns in its course. And this holds for every region, each according to the latitude of its horizon and according to the inclination, and so forth.

in this measure, from place to place, is the difference of which we have spoken — that the day increases and the night decreases. This is the matter according to the principles of the seasons (תְּקוּפוֹת) and their variations; for it has already been

written for you earlier. [The foot of the written block is faint but legible; the lower portion of the folio is blank margin, not damage.]

[Marginal note, upper-right margin, second hand, brown ink — faint abbreviated cursive:] *[Margin: גניך לא קצב מולק[?]]* — *a marginal annotation; the reading is uncertain. Further identification requires further verification.*

[The exposition continues:] And the measure of the day is known by the place of the Sun, and likewise by the breadth of the rising-arc at the equator. And from there it either ascends toward the north or descends toward the south; and in the measure of this difference is the inequality of the rising-arc, toward the north or toward the south.

For when the place of the Sun is on the equator — that is, at the equinoctial point — it rises due east and sets due west, and the day equals the night; for the arc above the horizon equals the arc below it, and likewise the southern equals the northern. And the inequality of the rising-arc is according to the inclination of the ecliptic with respect to the horizon, and according to the place of the Sun upon it.

And the wise have taken the breadth of the rising-arc, and after that whatever is needed for the length of the day. And here is set down the figure that makes plain this matter — the figure of the celestial sphere, the horizon, the equator and the ecliptic inclined upon it — and in it are the several inclinations, each according to the latitude.

The arc above the horizon, together with the arc below it, completes the whole circle; and when this arc is greater [than a half-circle] the day exceeds the night, and when it is the lesser the day is the shorter. And here is the figure for the latitude of the horizon, with the inclinations, as written.

קשת היתרון [**The Arc of Excess**]. [A sub-rubric in a slightly enlarged hand beside the diagram.] That is, the increment: it is for the latitude of the horizon, and it shows the several inclinations. Its purpose is to make plain that the length of the day there is the greater — that with every day [of summer] the day grows long as the Sun ascends, and the night is the dark portion. [The final lines beside the diagram are faint but legible to this effect.]

Diagram. A large circle representing the **celestial sphere** for a given terrestrial latitude. Across it run several great circles: the **horizon** cutting the sphere obliquely; the **celestial equator** / **equinoctial line**; and the **ecliptic** (path of the Sun) inclined to it. A family of parallel arcs (the diurnal day-circles) descends across the sphere from a pole at the upper left. The construction illustrates how

the arc traversed above the horizon — and hence the length of the day — varies with the Sun's position on the inclined ecliptic.

Legible labels (positions approximate):

- יורם — upper interior of the sphere (the **zenith** / **vertex**, *rom ha-rosh*)
- אופק — on the oblique great circle (the **horizon**); the word recurs lower on the same circle (second intersection)
- קו ב צפון — at the left intersection (**the equator-line, north** [?: reading קו ב / uncertain])
- חופן / אפק — at the mid intersection of the inclined circle (apparent variants of **horizon**) [?: reading]
- מהלך השמש — along the upper-left inclined circle (**the path of the Sun**, i.e. the **ecliptic**)
- נטות — along an arc at the left (**inclination**)
- אופק חצי היום — toward the lower right rim (**the meridian** / "**horizon of midday**")
- צלה / גלה — at the lower-right rim [?: reading]
- A row of single construction point-letters around the lower rim: ס, ג, ו, ק, ... and ז, ה, ד, ב, ג, ד, ה, ו, ז (with ד, ש, ת toward the top) — several rubbed [label: ?]

[More than two labels in this diagram remain flagged [?].]

the duration [of day and night] varies as well. When equinox-point Aries [ראש טלה] rises and equinox-point Libra [ראש מאזנים], the point of the autumnal equinox] sets, day and night are equal; and likewise when the autumnal equinox-point rises and the vernal equinox-point sets, day and night are again equal — for in both cases the Sun is then moving along the equator, and over equal time-spans equal arcs of it rise and set. By contrast, when the Sun has declination, the lengths of day and night become unequal; and the more its declination grows, the greater the inequality between them.

You should know, then, that this inequality of day and night arises only from the difference between the rising-times [מקומות העלייה] of the several arcs of the ecliptic. The premise that establishes this, and its proof — which, when you grasp it, will let you understand the matter — is that every two arcs of the ecliptic lying equidistant on either side of one and the same equinoctial point, the one a rising-arc and the other a setting-arc, are equal to each other; and their two corresponding [day-]arcs likewise correspond. So the matter stands; consider it well.

[ועד] And further: every arc of the ecliptic, when it is at one of the two equinoctial points, rises along the equator; and a rising-arc and the arc corresponding to it are equal to each other in the manner we have explained. From every such [pair] there results [a measure of] the day; and likewise the arc of the ecliptic, when it rises over the equator, its day-arc corresponds. And from these [arcs] one finds [the duration of] day and night, each by its arc-measure — and the difference between the day-arc and the night-arc. And when you know the rising-times of all the arcs of the ecliptic, you can compute the length of every day and every night throughout the year.

it is small; and when its [the Sun's] declination is great, the inequality is great. And so the rising-point moves toward the north, and likewise toward the south, in proportion to the declination.

[ושוב] And again: the longest day-arc **[קשת היום הארוך]** and the shortest day, and likewise the end of [each clime] — these too are governed by the latitude.

The arcs that are equidistant [from the equinoctial point], the one a rising-arc and the other a setting-arc, are equal, as we said; and their day-arcs over the equator correspond, and so it is for night as well. For as to the rising-times over the equator, the rising-arc is equal to the setting-arc, in the manner we explained above [as in the figure].

the rising-arcs over the equator: the day-arcs and the night-arcs correspond; and from this you may know the day-arc and the night-arc, each over the equator. And so too [is the procedure for] all the climes.

And the rising-arcs over the equator — the day-arc and the night-arc together make a quarter-circle **[רבע ח"ש = a quarter of the [great] circle]**. ...to the equator, this [day-arc]; and when the Sun is at one of the equinoctial points, the day-arc equals the night-arc — for then this [day] equals that [night] over the equator and over the inclined [ecliptic] alike.

the rising-times of the arcs, and from each [pair] one finds the [length of] day and night.

And as for the longest day over the equator: it is greater [than the day at other declinations]; and so too the shortest day, over the equator. And the longest day-arc **[קשת היום הארוך]** over the inclined [ecliptic] is greater than over the equator.

and from this you understand the longest day and the shortest day, over the equator and over the inclined ecliptic. And so the matter stands over all the climes.

over the inclined ecliptic, the longest day is longer, and the rising-point shifts toward the north; and from this results the length of the longest day, and so it is for the procedure we explained.

[The text continues toward the foot of the page beside the diagram:] and the longest day over the inclined ecliptic — so too this — and the rising-point shifts toward the north. And so the matter stands in this, over all the climes; the longest days are the greatest. Now consider this, and what we have set down in the figure [הצורה] — examine it.

Diagram. A celestial-sphere diagram in the lower-left of the folio (the standard local-sphere figure for the day-length argument of this chapter). A large circle represents the sphere as seen for an inclined (oblique) terrestrial latitude. The horizon is drawn as an oblique great-circle (אופק) cutting across the sphere; a family of parallel arcs (the diurnal day-circles / parallels of declination, *gilgalim*) sweeps across the figure from upper-left to lower-right, each arc crossing the horizon. Small letter-markers along the lower horizon mark the successive intersections of the diurnal parallels with the horizon. The region above the horizon is the visible (day) portion; the region below is *night* (לילה).

- אופק חצי הכדור (upper arc of circle): "horizon — half the sphere" [the horizon dividing the sphere in two]
- עולה (upper-central): "rising"
- שונה (upper-central, below עולה): "varying" / "differing" — labels marking the day region
- אופק (the oblique great-circle line, right of center): horizon
- לילה (lower-central, letters spaced): night (לילה)
- אופק חצי הכדור (lower arc of circle): "horizon — half the sphere" (repeated at the lower boundary)
- גלגל / גלגל המזלות / ...גלגל... (the several parallel arcs, upper-left and lower-left): "circle of ..." — the diurnal parallels (parallels of declination), one of which is the ecliptic (גלגל המזלות); the fine qualifying word after each *gilgal* is at the resolution floor on several arcs [word: ?]
- point-markers (along the lower horizon line, left): successive horizon intersections of the diurnal parallels [letters small and faint: ?]

[Diagram fig-p126-1 — the fine *gilgal* arc-qualifier words and the small horizon point-letters remain at the resolution floor. The principal labels (אופק, אופק חצי הכדור, עולה, שונה, לילה, גלגל המזלות) are now read.]

of the days of the season of Tammuz; and likewise at every place [of the Sun] you will know which is the longer of the two with respect to its remoteness from the [solstitial] point. For the day of the season of Teves, when the Sun is at the head of Capricorn, is the shortest day of the year, just as the day of the season of Tammuz, when the Sun is at the head of Cancer, is the longest day of the year. And [in the same way] each individual day with respect to the appearance of the Sun [over the horizon].

And likewise in this manner, just as the Sun, when it stands at the equator [i.e. at the two equinoctial points], makes the day equal to the night, so too—the more the Sun's place inclines [in declination] from these two points, the more the inequality between the day and the night grows, until it stands at the head of Cancer or at the head of Capricorn, where the inequality is at its greatest. And [the rate of] this inequality is not uniform at every place [along the ecliptic], but rather it is greater near the equator and smaller near the [solstitial] point. Therefore, at the [solstitial] point and near it the appearance of the Sun is more nearly equal [from day to day], and there it [the day-length] is at its greatest—as you find from the appearance of the Sun when it is near the equator: for then the [daily] increase of the days, with respect to the inclination, is at its greatest, whereas at the [solstitial] point itself and near it the [daily] increase is at its smallest. And know that at every place [of the Sun] and [its opposite] place [180° away], it [the day-length condition] is reversed.

[Margin: brief scribal pointer; the gloss is faint and only partly legible — verbatim text not fully recoverable. [?]]

And now that we have explained all this, we shall return and complete what we set out to do. We have already explained well, and it is known [from what came before].

A place [along the ecliptic] is either a division [of the circle]—one and another and another—from the equator [outward]; and you have already heard of the equating of the inclination and the equating of the rising-times [ascensions]. From the equality [of these] and from the division into parts [of the arcs] you [can determine] the arc of the night and [the arc of] the daytime portion. And we have already explained that the arcs of the rising-times are not equal but vary; so [from] the appearance of the Sun, [you derive] how [much] is the length of the daytime portion of the day and the length of its night.

the season of Teves; and [in turn] it returns and reverts. So too in this manner you shall find the inequality of the days, which is small over the equator; for [there] every day is equal to the night.

It was [in our reckoning] in the labor of equating the inclination that this [matter of inequality] arose: that the more the place [of the Sun] inclines [from] the equator toward the south, the longer is the daytime portion of every day, and the day grows longer. And likewise toward the north—and [the converse] reverts in the same manner; and we have said that the inequality of the night is in proportion to the inclination of the place [of the Sun] from the equator. And [the daytime] grows until the season of Tammuz, and then it returns and reverts, until [the Sun] reaches [a place] of equal [day and night] again, [namely] the head of [Aries / the equinoctial point], where the place comes to be [one of equal] day and night. And so [the cycle continues]: the inclination of the place [of the Sun] from the equator, and the inequality is in proportion to it. So too you shall find [this] for the southern [hemisphere]: when the Sun is in the [signs of] southern declination, [the conditions are] the reverse of what they were [for the northern].

And [from] the rising-times of the latter [arcs], the night of [those days is] long; and the daytime portion of the day is [correspondingly determined]. So too you shall find from the [tabulated] rising-times the length of the day and the length of its night, and [the manner in which] this returns and reverts. [The rate of] this inequality is not uniform: rather, the daytime portion of the day, when the Sun is at the head of Cancer, is [more than] twice [the night?]. [?: the precise proportion stated here is uncertain.] And the rising-times of the arcs—for they vary [in length]—[are such that] the difference [in day-length] from one [arc] to the next is at its greatest near the equator.

And from this [it follows] that when the daytime portion of the day, when the Sun is at the head of Cancer, is the longest of the days, the night is then the shortest of the nights. And so, the more the place [of the Sun] inclines, the more there is added to the daytime portion of the day; and it shall be in proportion to the [tabulated] rising-times of the [several] arcs, near the equator and [far from] it.

And from this, all of it—and so as we set it out—it was that the inequality of the days, at every place [of the Sun] and [its opposite] place, is reversed: for the rising-times near the equator [are such that] the difference [in day-length] is great, whereas near the [solstitial] point it is small; and so it goes round at every place. And know that this [inequality] grows and increases at every place from the equator, near it—and we have explained that the rising-times of the arcs differ [one] from [another] near the equator. And the inequality near the

[solstitial] point is small, and so it returns and reverts. The night near the [solstitial] point is short; and the daytime portion of the day, near the equator, [the increase from arc to arc] is great. So too you shall find the inequality of the days small over the equator, where every day is equal to the night.

And it was [established] over the equator that there [the day] is equal [to the night] over all the inclined [ecliptic], with respect to the [tabulated] rising-times: there the day is [equal], at the head of Aries and at the head of Libra. And the day, when the Sun is at the head of Cancer, is the longest of the days; and likewise the night, when [the Sun] is at the head of Capricorn, [the daytime] increases, and it is [in proportion] to the [tabulated] rising-times.

And it was, over the equator, that there it [the day] is equal at every place of the inclined [ecliptic], with respect to the [tabulated] rising-times of the arcs. The rising-times of the arcs near the equator differ; and the difference [in day-length] from arc to arc is at its greatest. And [over] the equator, the inequality of the days is small; for [there] every day is equal to the night.

And [the daytime portion] grows and increases at every place [along the ecliptic, the more its place inclines] from the equator; and we have explained [this]. And [the converse] reverts in this manner: the inequality of the night near the [solstitial] point is small; and it grows and increases the more it [the place] inclines from the equator—at every place, the inclined [ecliptic] near the equator [yielding] the [greater] difference.

And it was [established] that when [the Sun] inclines toward the south, the daytime portion of the day is short; and it returns and reverts. And this [increase and decrease] goes round, with the increasing [of the day from arc to arc], as we have explained; and [the converse] reverts at every place of the inclined [ecliptic] in proportion to the rising-times, near the equator—where the difference [in day-length] from one arc to the next is at its greatest, and far from it [it is least].

[Wide blank lower margin follows.]

[Margin (right, brown ink, contemporary hand): "סימן י"ג זה לעמיר" — a marginal note marking the section (siman 13); the final word is uncertain. Further identification requires further verification.]

for that same hour. The arc traversed, and what corresponds to it of the rising-times, was equal on both sides, and the day was therefore of equal length. So too on the eastern side: there the day was longer, and what is added to it along the

way is added to it. The course of the Sun was set in motion, and what corresponds to its position corresponds to it.

To the south, then, the path of the Sun ran along the equator, and along the way it ran toward the south and grew greater. The matter is as we have explained: when the Sun's position is in the northern signs, the day grows longer, the reason being that the day stands in proportion to the daylight-arc. When that arc is greater the day is greater, and the contrary in the contrary case; for the night is the complement of the day, and the night grows long where the day is short. This is the matter we wished to set out, so that you may grasp the cause and grasp it upon its proper basis.

It is now established for you that the daylight-arc, when people compute it, is what they reckon. For the daylight-arc varies according to the difference in the Sun's position and according to the difference of latitude of the climes — that is, the difference of the regions in respect of their distance from the equator, north or south. The further a region's latitude lies from the equator, the more its days and nights differ from the equality of day and night that obtains at the equator itself; and the matter is reversed for those who dwell on the other side of the equator.

There is, besides this, a further cause that affects the daylight-arc: namely the declination. The Sun's position upon the ecliptic, and its declination toward the equator on either side, is the chief cause, and there is moreover this further consideration. We have said, by way of the daylight-arc that the computers reckon, that the Sun's path runs higher, toward the upper region, the more it ascends; and the night-arc and the day-arc are each of them, for a given day, of the proper measure to the north: the daylight-arc on the longest day, and likewise the rising of the Sun by day, by the day-arc on that day.

Know, then, that the Sages of the several regions reckoned the rising of the Sun by their position toward the rising-point and toward the setting. The rising of the Sun and its setting differ from region to region; therefore they assigned to each region a horizon of its own. And so each region has, by reckoning, its own rising and its own setting; and from the difference of these two points arises the difference of the day, and of the way it is reckoned, by which the day stands as it does. This is the matter, and it follows from what we have said.

[Foot of column 62r, new discourse, opening word enlarged in brown ink:]

Now then, return to the question of the daylight-arc and its computation. Mark well and consider it, for this is exact: that the rising-times of the several climes,

and the position of the Sun upon the ecliptic, and its declination upon the ecliptic — all of these vary. Each region has its own rising-times, those of one region differing from another, and this is the cause of the difference of the days in the southern climes. Each one differs from the next.

And it will become evident to you that the path the Sun runs returns and circles back, so that the rising-times of the southern climes...

region of the regions differs, and there will be a point from which it begins...[end of column; wide blank lower margin]

Diagram. A sphere drawn as a large circle set into the lower inner (gutter) margin of folio 62r. Across it run a series of curved lines representing the principal great circles of the heavens — the horizon, the equator (קו השווה), and the oblique ecliptic (גלגל המזלות) with its declination — cutting the sphere into a daylight portion (above) and a night portion (below), and a graduated arc of small lettered divisions runs across the upper region. The construction illustrates the daylight-arc / night-arc argument of the surrounding text (the day-length inequality and the meridian-altitude of the Sun). Several labels are written along the arcs; the lower-left labels lie at the gutter and are partly cramped. Labels recovered (positions approximate):

- יום ("day") — upper region of the sphere (the daylight portion above the horizon)
- לילה ("night") — lower region (the night portion below the horizon)
- אופק חצי היום ("horizon of midday" — the meridian) — beneath "night," at the lower boundary
- קו השווה ("the equator") — running across the middle of the sphere
- גלגל המזלות ("the ecliptic") — the oblique circle crossing the equator; the words run along the oblique line (upper right)
- נטית המזלות ("the declination of the ecliptic") — along an inner oblique arc (mid-left)
- חצי קשת ("half-arc") — labelling the daylight semi-arc; written three times along successive arcs on the right (one reads "חצי קשת ט", with a division-letter ט)
- קושטרוס (?) — a transliterated, non-Hebrew term written twice at the ends of the outer arcs (left and lower); reading uncertain (a Romance/Latin loan, perhaps for the bounding circle/quadrant). Recorded verbatim; further identification requires further verification.

- A row of small alphabetic division-letters (א ב ג ...) marking graduations along the inner arc at the lower left

[Diagram: the term (2×) קושתרוס and one חצי קשת division-letter carry [?]; the remaining labels are now resolved.]

heated, and there came to be a proper interval of rising-times. There the Sun is upon the equator: there it is in the north of it and there in the south of it. And what is added to it along the way is added to it. From the rising-points of the outer region there is a fixed point from which the region's rising-times begin, and what is added to it is added to it.

And there came to be a proper interval of the daylight-arc, by reckoning, from the point of the ecliptic upon which the Sun's position falls; and there came to be a difference arising from it. And just as there is, from region to region, a difference in the rising-times of the Sun, so likewise there is a difference of the daylight according to the Sun's position.

When the Sun declines from the equator, the daylight-arc is governed by its position, differing from one position to another. And the matter varies in the several regions in respect of the daylight-arc — that is, in respect of what is added to the daylight-arc — for the day is short for one and the contrary for the contrary case. The rising-times, by reckoning, are not equal to one another, for each one is by itself.

We therefore now set in order the rule of the difference of the Sun's position and the difference of the daylight, namely the rising-times of the day. And the matter varies among the regions: the daylight for one is greater than the day for another. On every such difference there is a difference between them by reckoning; and to every region there corresponds, by its rising-times, a difference among the regions.

For the path runs higher, and the rising-times of one region differ from those of every other region. By the computation and the reckoning we have explained the matter of the regions; therefore the differences of the rising-times are the greater, those of one region greater than another's.

Now then, know — that you may know — the way of the knowledge of the difference of the rising-times by reckoning, for every region; and the computation and the reckoning. And behold the matter: the difference of the regions...

for it, and on this account the difference of the rising-times of the Sun; and this follows from it, a difference along the path. The Sun's position, and what

corresponds to it of the daylight, and its course was set: for the Sun runs higher, toward the height, the more it ascends; and the more it ascends, the more it adds...

[Faint marginal/interlinear addition above the line, left margin, brown ink, partly legible:] "...על אחר... [?]" — a marginal note; further identification requires further verification.

and what is added to it; and the difference of the rising-times. The difference of the rising-times of the day, the difference of the day, was established from the difference of the rising-times, for each one is by itself; for the day stands in proportion to the daylight-arc.

For the Sun runs higher, toward the height, the more it ascends; and we have already explained the matter from the difference of the regions in respect of the daylight-arc.

And it has now become evident, from the difference of the daylight and from its course that was set — and a difference of rising-times arises from it — that the day is short for one and long for another, by reckoning.

For each one is by itself; and a small difference is enough, for it suffices that you know that it stands upon its proper basis, known in itself, and that we have set in order the rule of the difference of the rising-times.

from another region it differs, and we have already explained the difference of the rising-times — which is the matter we set out [end of text; wide blank lower margin].

the eastern horizon, from the rising-place in its arc: wherever it is, there it will be. So too in the matter under discussion — when, for the given position, the number of the rising-times (the ascensions) of the day is a certain amount, the number of the rising-times of the night is its complement. And once you know the rising-times of the ecliptic-degree at the horizon — which is the number of the rising-times of that degree at the equator [קו השווה] — you will know the daylight-arc and the difference of the rising-times.

For when you know the rising-times of the day at the equator, you then take half the difference of the rising-times of that degree, and from this it follows what the rising-times of the day are. The number of the rising-times of the day is the one value, the number of the rising-times of the night is its complement, and the difference of the rising-times of either half follows accordingly.

So likewise here: when you know the rising-times of the ecliptic, this is the rising-times at the equator; and the difference of the rising-times of that degree at the equator is half the difference of the rising-times. The number of the rising-times of the day is the one value, and the number of the rising-times of the night is its complement.

Know, further, that whenever the difference of the rising-times is added to the rising-times of the ecliptic, the result is the rising-times of the day; and when it is subtracted, the result is the rising-times of the night. And half the daylight-arc together with half the night-arc complete the rising-times of the half-day and the half-night.

When you examine this, you will know the difference of the rising-times — which is the surplus over the equatorial value. Examine it, and you will know the difference of the rising-times of that degree.

Diagram. A circle representing the sphere, divided by the horizon-line (a diameter drawn across it) and by an arc of the day-circle. The interior is labeled the day (יומם) above and the night (לילה) below; the bounding diameter is the horizon (אופק). Construction-letters ב, ג, ד, ה are marked at the intersections of the lines with the circle, and an arc of the daylight-circle is drawn between them. Labels:

- ב (upper-left intersection): construction point
- ג (foot / lower intersection): construction point
- ה, ד (intersections on the horizon diameter): construction points
- (upper-left band): חצי הנקודות — "half of the points"
- (upper-right band): רביעי"ת — "a quarter"
- (interior, upper): יומם — "day" (the daylight-arc)
- (interior, on the diameter): אופק — "horizon"
- (radial chord, interior): חצי קשת היום — "half of the daylight-arc"
- (upper-left, outside circle): צפון — "north"
- (left band): חלק עשר — "tenth part"
- (interior, lower): לילה — "night" (the night-arc)
- (lower-right arc): אופק חצי היום — "horizon of the half-day"

And know that for every place on the ecliptic and every place on the equator — the standing-place [מעמד], that is, the position in question — the rising-times of the equator and of the hours are reckoned along the path you draw; and you must take care to set up the rising-times of the year (the annual reckoning). The

standing-place is a place that rises over the horizon, and so the rising-times of the day and the rising-times of the night are paired.

And when you wish to know the difference of the rising-times of a given degree — and this too is a degree — you know it in degrees, and how it is apportioned in degrees, and so forth: the rising-times, the equal-hours, and the time-degrees [חלקים], for each day and each night. This is the surplus over the rising-times.

[Lower portion of folio 63r: blank margin.]

פרק שלשה עשר — Chapter Thirteen

[Body heading, enlarged script: **פרק שלשה עשר** ("Chapter Thirteen"). This corresponds to the right-margin **siman י"ג** flagged in the prior folio's discourse — confirming the dual marginal-siman / body-perek numbering.]

On the difference between the day and the night with respect to the equal-hours and the seasonal hours; and on the difference of the hour as measured in its time-degrees [חלקים], and on its standing-place.

Know that there is a difference between the seasonal hour and the equal hour, but not always — for there are positions in which they are equal and positions in which they differ. The place in which the Sun stands, its time-degrees [חלקים], its measure and its surplus: in this matter you must take care, and in the manner of reckoning it.

The way in which the equal-hour exceeds in its time-degrees follows from the rising-times of the half-night; and when this has a certain value, the number of the rising-times of the day is its complement. And whenever you know the rising-times of the year by computation and by the science of astronomical reckoning [תכונה], and you reckon, you will know the number of the rising-times of the day — for the rising-times of the year are the basis, and likewise the rising-times of the day and of the night, each of them.

And know that whenever the difference of the rising-times is added — for this is its measure — the standing-place is determined; and they set it out by way of the equal-hour. For there are positions in which it is so and a position in which it differs; and the rising-times of one degree, and one degree, they reckoned by the rising-times of the half-night, and half of it is its measure.

The wise men of astronomical reckoning [חכמי התכונה] divided each degree into sixty time-degrees [חלקים], and called each one a chelek; and they divided each

chelek into sixty seconds [שניים], and called each one a sheni; and they divided each sheni into sixty thirds [שלישיים], and called each one a shelishi; and so on likewise. And the rising-times of each degree they reckoned in this way.

The rising-times of one degree, then, are in this proportion. And the equal-hour is fifteen degrees — that is, fifteen time-degrees — like the seasonal hour at the equinox; for at the equinox the equal-hour equals the seasonal hour. The equal-hour is fifteen degrees, and this is the standing-place; the equal-hour is fifteen time-degrees, at the equinox.

ואחר [And another reckoning] — a sub-discourse [rubricated opener]:...for that position. This is the case when you do not know the Sun's position, and a matter of such reckoning, and so on, by this reckoning.

By the science of astronomical reckoning [התכונה]: when the seasonal hour [is reckoned], so too is the difference of the day with respect to the equal-hour, whether [a difference arises] or not, and along each path; for as we have said, until the Sun is at [its position] — along the path of the rising-times of the day, for each day and each night.

For at the solstice of Tammuz [תקופת תמוז, the summer solstice] the half-night, on the equal-hour [reckoning, behaves one way]; and at the solstice of Teves [תקופת טבת, the winter solstice] a portion [differs]. The matter of the day [follows accordingly].

The position in which it is the seasonal hour: it is more than [numeral: ?], and the rising-times of that degree, and the difference is [numeral: ?] — the matter of the day. For when the rising-times of the half-night are more than the equal-hour by [numeral: ?], the difference of the rising-times of the year follows, and so on.

The rising-times more than the equal-hour by twelve [chalakim — מהחלקים מ"ב — reading 12 = י"ב], and the time-degrees [are reckoned]; and this is the law [הדין] — thus is the measure of the heavens [השמים] in their variation [בחילופם].

[Lower portion of folio 63v: blank margin.]

as we have said, by way of example. For the seasonal hours of the daytime and the seasonal hours of the nighttime together complete the whole revolution, and the whole revolution comprises the degrees of its rising. Now in respect of a known place — that is, in respect of its difference — when you wish to know how many equal hours there are, and how many seasonal hours correspond to them, take the daytime, that is, its hours, and divide it; and you obtain its seasonal

hours, for each hour is a sixth of the daytime, and likewise that of the nighttime is a sixth of the nighttime.

So they called the sixth of the daytime "a seasonal hour" by way of example, and so too the seasonal hours of the daytime and the seasonal hours of the nighttime complete the whole revolution. And the number of minutes [חלקים] of the risings, the risings of the degrees, will be such that the number of degrees of the sun in the daytime, and the night likewise — the night too has its degrees of rising — and the number of seconds [שניים] follows in the same proportion.

And the seasonal hour is a portion that varies, and by way of example, by the example of the day-arc and its variation — that is, in the risings of the degrees of the ascension upon the horizon — these are the hours, and likewise the seasons [תקופות], whether they be of the daytime or of the nighttime. And by way of the rule, whatever the arc is, by the same measure the hour is; and the daytime varies, and so too the night. And the hour is the sixth of the daytime, and you should know, then, that the seasonal hour of the daytime together with the seasonal hour of the nighttime makes one equal-hour pair.

Now reckon how many degrees the sun traverses, and by how much: it traverses fifteen degrees, and that in the whole revolution. And the number of minutes of an equal hour: for each equal hour it traverses fifteen degrees, and that is the number of minutes. So the number of equal hours of a whole revolution is twenty-four, and the number of seasonal hours is twenty-four, whether of the daytime or of the nighttime. And the number of equal hours of the daytime together with the nighttime — the matter is known, as is the number of the risings of the degrees.

And the seasonal hours, and the count of their minutes, by reckoning: for this you take and find the number of the risings of the degrees; this is the number of an equal hour, and by it you reckon. And the minutes of an equal hour comprise fifteen degrees, and that is the number of equal hours; and the number of seasonal hours follows, whether of the daytime or of the nighttime.

And the number of seasonal hours for a given day, and the minutes of an equal hour there — the matter is known. And so the daytime, and the equal hours, the matter is known; and you must take heed and not err in this. And a known place, whatever it is — you must reckon each of these accordingly, and you should not err in it: take the number of seasonal hours and the minutes, by reckoning.

Now the matter is plain, by way of example: that whatever is in equal hours, you divide it, and from this you obtain its seasonal hours, and likewise from this the

equal hours. And from the rising of the daytime, and so too of the nighttime: each degree contributes its portion, by the example we gave; and so too for the seasons of the daytime in the risings of the degrees.

The matter is plain: for one seasonal hour you take from the night-arc; and the hour is the sixth of the daytime or of the nighttime. And as for equal hours, whichever they are, it follows that the seasonal hour of the daytime together with the seasonal hour of the nighttime makes the pair. So is the matter, plainly: the hour of day and that of night together, by the example, upon a known place among the places that lie upon the equator — they have established their reckoning accordingly.

as we have explained: and when you reckon the account of the day-arcs and the seasons [תקופות], that place is as we have stated, by way of example. And what we said concerning a known place — namely, in respect of its difference — and its reckoning upon it: so too for every place, this holds; and upon the rising of the degrees, each according to its portion.

פרק ארבעה עשר (Chapter Fourteen) [= siman ד"ד]

By way of example, concerning a known place in respect of its difference: how the matter is to be set out, and for this we have ordered the discourse.

The reason is this: that the differing of one place from another in the risings of the degrees arises because the difference of their positions is a real difference upon the earth, as we have established. And the risings of the degrees differ from place to place, each according to its position; for if a place differs from another, its hours differ, and its seasons as well.

And as for the spacing from place to place, by the risings of the degrees and the difference: there exists a known line [meridian], and the difference is reckoned from it; and the risings of the degrees differ from place to place, each according to its position. For if one place is east and another further east, there is a difference between them in the risings of the degrees, corresponding to the difference between them upon the earth.

Consider an eclipse [קדירות], which occurs in the body of the luminary [המאור] and is seen from every place that sees it: in the easterly place, for there the daytime has advanced further; and at the same instant in the westerly place. And so the eclipse is one and the same, yet in the easterly place it falls at a later equal hour, while in the westerly place at an earlier one. And the difference between them in the equal hours corresponds to the difference between them; and the

differing of the equal hours reflects the differing of the places. By way of example: at the easterly place a given equal hour of its day, and at the westerly place an earlier equal hour of its own day; and the eclipse is one and the same, and the difference between them in the equal hours is the measure of the difference between them.

And so by the eclipse — for the eclipse is one and the same, and the difference between them in the equal hours is the difference between them, that is, the difference of their positions upon the earth — from this one knows the difference between two places. And the procedure is: observe the eclipse, and note the equal hour at each of the two places, and the difference between the two readings in the equal hours gives the difference between them; and from this we determine the difference of the place we seek to know.

And as for the difference between two places — and we explained how the matter stands, and that each equal hour reckoned there differs accordingly — by the eclipse of the luminaries and the difference of the equal hours between them, you know that the place lies so much east or so much west. And as for a known place, namely in respect of its position, the matter is plain.

For whichever place is the one we seek to know — its position, whether east or west — this is the way; and we seek to know its position east of the reference place, and how much it is. And one who knows the position of his own place, and the eclipse observed there, can determine the position of another place from the difference; for the eclipse is one and the same, seen from either place, and the difference between them gives it.

And one who knows his own place — its position — and the position of the place he seeks to know, and so too of the other place — reckons the difference, and thereby determines it. And so you know, by the eclipse observed from either place, that the place lies east or west.

The reason for all this: that the heaven carries the luminaries, and from the order of the heaven we reckon, by way of example, upon the horizon.

[The lower portion of folio 64v is blank parchment — wide blank lower margin, not damage. Text resumes on the following folio (65r).]

Third Treatise (המאמר השלישי), Chapter Fourteen (פרק י"ד) — continued

and seasonal hours [שעות זמניות], and the [number] of equal hours [שעות שוות]. And you already know the difference between the seasonal hours and the equal hours [from the preceding chapter], so that you may grasp this and understand it. [?: the opening words of 65r continue an arithmetic of seasonal vs. equal hours carried over from 64v.]

Therefore the difference [between the two reckonings] is such-and-such a number of equal hours, and from it [you derive] the corresponding number of seasonal hours. And just as we have explained this for the daytime hours, so it is for the night hours.

[Here the discourse turns to the longitude-difference and the eclipse.]

When you wish to know the longitude-difference [הפרש האורך] between two places by means of an observed eclipse [ליקוי] — that is, an event [the eclipse] which is one and the same, [yet] seen at the two places at differing local hours — you take the equal hour at which the eclipse was observed at the first place and the equal hour at which the same eclipse was observed at the second place. The difference between the two [recorded] hours is the measure of the longitude-difference between the two places in time, [reckoned] at fifteen degrees [of longitude] for each [equal] hour.

And whichever of the two places observed the eclipse at the later hour is the one that lies to the east [מזרח], while the place that observed it at the earlier hour lies to the west [מערב] of it. For the eastern place, the celestial sphere has already turned [further], so that the event there falls at a later hour, while at the western place it is still earlier.

[The text gives a worked example of converting the hour-difference into degrees of longitude:] for each equal hour, fifteen degrees; and for each [time-]minute, a corresponding part of a degree, and likewise for the [time-]seconds — preserving the minutes [חלקים] and seconds [שניות] exactly.

And know that this method holds only when the eclipse is one and the same event seen at both places, observed [carefully] as to its [exact] hour at each — for if the observations are not of one and the same event, no longitude-difference can be derived from them.

Diagram. A circle drawn at the lower-left of folio 65r, representing the local sphere/horizon-circle, with two straight lines drawn obliquely across and below it converging toward a point at the left. The construction illustrates the sun's rays striking the midday horizon — the geometry underlying the eclipse-timing and meridian argument of the chapter. The labels are descriptive Hebrew phrases written along the lines and at the top of the circle (not single point-letters):

- Top of the circle: **אופק חצי היום** ("the horizon of midday" — i.e. the meridian / midday horizon)
- Along the upper oblique line: **נצוצי חמה** ("the rays of the sun")
- Within the circle, beside the inner radii: **ניצוץ** ("ray") [written twice, labelling two ray-lines]
- Along the lower line at the left: **אופק הגל** [?: reads *ofeq ha-gal*; the second word is uncertain — possibly "אופק הכל", the all-encompassing horizon]

[The body prose immediately below the figure (page foot of 65r) continues:] ...the station/camp [מחנה], the centre [מרכז], the circle, the east... the longitude-differences from the meridian [קו אמצע השמים]... [?: the lower lines of 65r are construable as a recapitulation tying the diagram's rays and midday-horizon to the longitude-difference measured from the meridian, but several abbreviated tokens here are individually uncertain]. And these are the rays of the sun [רמות / רמות קו החמה]...

[The remainder of folio 65r below this is blank parchment — wide blank lower margin, not damage.]

its rays, the line of the sun's light [אור החמה המשוך], for this [is] its meridian [קו האמצע / העמוד] — that was the [reference] meridian [קו חצי היום / מהאזריה] — And just as this [holds] for the place, so it is for [the second] meridian [קו] — this [is] the meridian [העמוד].

[?: the top lines of 65v continue the meridian argument: each place has its own meridian-line, and the longitude-difference is the arc between the two meridians.] And from this you already understand how to take the longitude-difference between the two places: it is [the arc] between the two meridians [שני / שני העמודים / קוי האמצע], measured in degrees of the equator.

And the difference between the [local] hours of the two places corresponds to this [arc]: fifteen degrees [מעלות] of longitude to each equal hour, and to each [time-]minute its [part] of a degree.

[The text then restates the rule, naming the eastern and western place:] the place whose hour is the later is to the east, and the place whose hour is the earlier is to the west; and the difference [in hours] between them, converted into degrees, is the longitude-difference [הפרש האורך] between them.

And this [whole procedure] is what was sought, and by it the longitude-difference [between two places] is known when an eclipse, [seen] at both, has been observed as to its hour at each. And this is enough for [Chapter] Fourteen [סוף סימן י"ד].

[Marginal note, outer margin of 65v beside these lines: "[Margin: לעודה]" [?: a brief marginal jotting; reads roughly *be-sof le-uda* — most likely a constructive note marking "at the end" of the section; further identification requires further verification]. A second, shorter marginal word appears lower in the gutter margin: [Margin: החזקת] [?].]

פרק ט"ו — Chapter Fifteen

[Heading written centered in the line on folio 65v: פרק ט"ו]

When the [times of the] eclipses are known, [as established above], for every place and for every... [?: the chapter opens by carrying the eclipse-timing result forward], and the hours have been recorded, then you will know [how] to derive the longitude of [each] place [אורך המקום] and to take it [exactly], its minutes [חלקים] and its [parts].

And know that the eclipse [ליקוי] is one and the same event in the heavens, [seen] from places that differ [in longitude]; therefore the time-difference [in its observed hour] between any two places yields the difference of their longitudes — [reckoned] in degrees, at fifteen degrees [of longitude] for each equal hour.

[The chapter continues:] so that you may take, by means of the recorded [eclipse-]hours, the longitude of a place from a place [of known longitude] — and the places east and west [are distinguished] thereby — and from them [you derive] the longitude of each place [reckoned] from [the reference meridian]. And whatever is known of the longitude-difference, you take [accordingly]: for each equal hour, fifteen degrees, and for each [time-]minute its part of a degree, preserving the minutes and the seconds.

[?: the lower lines of 65v restate the conversion rule once more — equal-hour ↔ fifteen degrees, time-minute ↔ degree-part — applying it to the longitude of a place reckoned from a known meridian; the individual abbreviated numerals here are construable as "fifteen" (ט"ו / ט"ז) but no other specific numeral is

committed.] ...the rays/measure [רמות], the line of the sun [קו החמה]... [?: trailing tokens].

[The lower half of folio 65v is blank parchment — wide blank lower margin, not damage. Chapter Fifteen continues onto the next folio.]

and you divide it [the longitude-difference] by fifteen to obtain your distance [in equal hours]. This will give you the longitude-difference of the day between the two places. The arc of the circle [the meridian-arc] is the measure of the distance between the two places, and likewise the measure of the distance from this place to that one.

The figure of the circle is the picture of the horizon, and within it [are drawn] the picture of the equator [קו השווה / טבעת השווה] and the picture of the zodiac [גלגל המזלות]. Take the equator and the arc upon the equator [as your reference], and the arc of the meridian-circle [קו אמצע השמים] that stands between this place and that. For the distance is the arc enclosed between the two meridians — the arc that lies between this region and that — and upon the meridian-arc you measure how far apart they are.

Therefore, when you wish to know the distance of one place from another, and you know the difference of the day between them, you will know it [the longitude-difference]; for the arc of the meridian [קו אמצע השמים] is the measure between them, and that is the rule.

Should it [the arc] be ninety [degrees], you will know that the distance has reached its [maximum] limit; and when it is less than that, the places are nearer to one another. And this is the way of the matter, for the arc of the horizon and the arc of the circle [together] yield it. Now consider this: take the meridian-circle [קו אמצע השמים] upon which the place lies, and the arc of the daily circle [מעגל היומי] which it traverses in the course of the day; for the daily circle is divided into [its] parts, just as we said. And it is so.

The difference [in time] amounts to so-and-so equal hours, and it is divisible[?: the source gives a specific count of hours, written as cursive gematria and partly rubbed — see Numerical readings]. The count [המספר] is this: the [first] place is at such a degree, and the [second] place is at such a degree; and the longitude-difference [הפרש האורך] between them is so-and-so degrees and so-and-so minutes[?: the specific degree- and minute-values are written as gematria but are partly rubbed — see Numerical readings]. You then convert it into equal hours by dividing by fifteen, since fifteen degrees correspond to one equal hour; and the remainder [of degrees, less than fifteen] you convert into minutes of an hour, for

each degree is four [time-]minutes [רביעיות, "fourths" = 4 minutes of time], and so forth. And this is the rule whereby you derive [the longitude] of a place from a place of known longitude.

[The reckoning runs through the signs:] one degree from Aries [טלה], and one degree from Taurus [שור], and one from Gemini [תאומים]; one degree from Leo [אריה], one degree from Aquarius [דלי]; one degree from Capricorn [גדי] and from Pisces [דגים], and from Cancer [סרטן]; and one degree from each in succession. The reckoning is by degrees, and by the [time-]minutes that issue from them.

And by this path you derive the longitude of the place in question from the place of known longitude: the [time-]difference between them is converted, and the equal hours that result, and the remainder of [time-]minutes [רביעיות]; for the daily proportion [היומי] draws it along, just as we said. And now I shall return [to the discussion].

Diagram. A horizon-circle figure drawn in brown ink to the left of the text block (upper-left quadrant of folio 66r). The outer circle represents the horizon; two great-circle arcs cross its interior, intersecting at a marked interior point, representing the equator and the zodiac (or the meridian and the daily circle) referenced in the adjacent prose. Descriptive-phrase labels (not point-letters) are written along the arcs and around the circumference, consistent with the labeling convention noted on the earlier horizon diagram (fig-p135-1). Interior point-letters ב and ה (and possibly ק) mark intersections.

- Top of the outer circle (arc label): אופק [horizon] / חצי היום [midday — the meridian]
- Upper interior arc: מזרח [east]
- Lower interior arc: מערב [west]
- Interior intersection points: ה, ב, (and an interior ק) [point-letters marking the crossings]
- Along the circumference (lower-left arc): גלגל היומי [the daily circle] [?: partly rubbed]
- Along the circumference (lower arc): טבעת השוה [the ring of the equator] [?: reading of the circumference legend uncertain — abraded]

[Margin: a faint smaller-hand gloss in lighter brown ink runs along the middle of the text block (level with the worked illustration). It is largely abraded; the legible fragments read approximately "...גורל וכלג..." [?: marginal note, verbatim text not securely recoverable — further identification requires further verification]]

and to make known the [longitude of the] place from [that of] a known place, and the way and the manner; you shall know the proportion of the [time-]difference, so that you may set it in order rightly. And in this manner [you proceed for] hours and minutes [רגעים]. Take care lest you stumble in your calculation; or [reckon] from the meridian [קו אמצע] of the zodiac [המזלות].

And by way of summary, whenever you know the distance of this place from that place, in equal parts and minutes, the proportion of the degrees [המעלות] is equal [throughout]; the place is at such-and-such, equal to this and to that.

Now I shall make known to you the matter of the picture [הציור], for the picture is the form drawn. Just as we made known the picture of the equator [טבעת השווה / קו השווה], so [we make known] the arc upon the meridian-circle [קו אמצע], and we have set down the [time-]difference.

The proportion of the daily circle [הגלגל היומי / מעגל היומי] which the place traverses: take the meridian-arc [קו אמצע] which is between this region and that, the arc [קשת] that lies upon the daily circle [מעגל היומי], being so-and-so [degrees]; and the longitude-difference [הפרש האורך] is so-and-so degrees and so-and-so minutes[?: the specific numeral-values are written in cursive abbreviation and only partly legible — see Numerical readings].

And the daily circle [היומי] which it traverses: its arc [קשת] is divided into so-and-so parts[?: a count is given but written in heavy abbreviation — see Numerical readings]; the [time-]minutes [רביעיות], how many and how much they are.

Take the arc [קשת] that lies upon the daily circle [מעגל היומי], which is so-and-so; and the longitude-difference [הפרש האורך], how much it is, in degrees; and you divide the difference by fifteen, [yielding] equal hours[?: the equal-hours count is given but abbreviated and partly rubbed]; and that which remains you reckon as so-and-so [time-]minutes [רביעיות].

And the remainder, the small portion which is left over — the [time-]minutes [רביעיות] are known; and by this you arrive at the result. And know the measure of the meridian-arc [קו אמצע], and this is [the matter] of the daily circle [היומי]. Understand [it] before [taking up] the meridian of the sun [קו אמצע השמש] and the picture [הציור]; and consider it now.

For in the figure of the daily motion in this picture, which is the outer circle, [there is] the proportion — and this is the proportion of the meridian-arc [קו אמצע], being so-and-so [degrees]; that is, [the place] which is known to you by way of what was said above — its remainder, for [it is] the daily circle [היומי]

which is sought, being known. And by way of this picture you derive what was sought [המבוקש]; the sages of the science of computation [חכמי התכונה] [proceed thus]. And thus you know...

and you direct your reckoning [the sentence runs on — the text continues onto the following folio; the prose does not close Chapter Fifteen on this opening].

Diagram. A horizon-sphere figure in brown ink occupying the lower-left quadrant of folio 66v. An outer circle (the horizon) encloses several crossing great-circle arcs that intersect at marked interior points; the construction illustrates the daily circle, the equator, and the meridian referenced in the adjacent prose. Labels are descriptive phrases written along the arcs and around the circumference, with a few interior point-letters at the crossings — the same labeling convention as the recto figure and fig-p135-1.

- Upper-right interior arc: מזרח [east]
- Interior arc (mid): מערב [west]
- Lower-left circumference legend: אופק נמצא [the visible/found horizon] [?: reading uncertain]
- Lower circumference legend (right): אופק חצי היום [the midday horizon — i.e., the meridian] [?: partly rubbed]
- Lower interior arc: מערב [west] (repeated) / מעלות [degrees] [?: uncertain]
- Interior intersection points: ה, ק, and additional unlabeled marks at the arc crossings

[Margin: a multi-line gloss in a smaller, lighter-brown hand fills the right margin of 66v alongside the upper text lines. It is faded; partly legible fragments include "הוקח ולענקה מתמלם... אמרו קב ח נוקרירם... קה תיא ידועם עלי' ה' והב המקום שמוח..." [?: marginal note, several words not securely recoverable — the gloss appears to record a side-computation (a "known measure of the arc" and a derived value), consistent with a constructive helper rather than a named-authority citation; further identification requires further verification]]

[Margin: a second, very short gloss in lighter ink at the left edge alongside row 1 ("חידוש...") [?: a one-word marginal mark, reading uncertain]]

The continuous calendrical exposition of the preceding chapter runs on at the head of this leaf, treating how the difference between one place and another is to be reckoned. The text turns to the way in which night after night is inscribed, as it were, upon the world: וכן ירשם על תבל לילה ולילה — "and thus night after night is

marked out upon the world." Each locality has its own boundary, and the rising of the sun (זריחת החמה) and its setting differ from one city to the next, so that the same hour is not shared by every city alike. The longitude-distance (מרחק האורך) governs this difference: as one advances eastward or westward, the moment of sunrise advances or is delayed accordingly, and so too the moment at which any given hour falls. This is the principle that applies between one city and another (מדינה ומדינה), and likewise this is the rule (וכן זה הדין) for every place upon the inhabited earth.

[The faint opening lines at the very top of the column, partly compressed at the line-ends, carry this same longitude/sunrise material; a few connective tokens at the right edge are not letter-resolvable — [?: ~2 lines, line-end tokens not fully resolvable] — but the substance is the longitude-difference and the rising of the sun, continuous with the chapter that precedes.]

The exposition continues: since each city has its own meridian and its own horizon, the parts (חלקים) of the hour and the equal hours (שעות) by which sunrise at one place precedes or follows sunrise at another must be computed from the longitude-difference between them. And once this is known, one knows the difference (הפרש) in time between the two localities, both by day and by night, and can convert it into hours and into the parts of an hour.

פרק ששה עשר [Chapter Sixteen]

ועתה — "And now": now that the foregoing principle has been laid down, the chapter turns to its application. Now I shall explain to you [?: the immediate clause after the display word **ועתה** is faint at the line-ends, but it introduces the working-out of the longitude-difference between places] — concerning the difference (החילוק) that there is between this place and that, and the choice [?: וברחור / a token here not fully resolvable] of the matter.

The argument proceeds: a man should already understand [?: כבר הבנת / "you have already understood"] what was said above, and so [וכן] it is set down for places east and west; and the difference [?] between this place and that is established by the longitude. Then [the text gives the worked principle] for the meridian and the horizon: the rising of the sun (זריחת החמה) at one place differs from its rising at another, and likewise its setting, so that one place has day while another still has night (לילה ולילה), and thus the same hour is not common to them. From this it follows that the tekufah — the season-point — when it falls at a given hour in one city, falls at a different hour in another, in proportion to the longitude-difference between the two cities. [?: the lower lines of the column on

this leaf, near the foot, are faint at the line-ends; the recurring terms תקופה, resolve, but a few connective spans are not letter-resolvable — [?: ~2 spans].

that the difference of the tekufah [?] and likewise of [the months] of the year [?], according to the places (מקומות), and in proportion to the meridian (קו אמצע) [?: the closing line of the legible text runs] — for in this chapter [the matter pertains] to the distant [places] (כי בפרק זה לרחוק) — concerning the cities (המדינות), and I shall now begin (ואתחיל).

[The lower portion of folio 67r is blank parchment below the text column — the text column ends partway down the leaf and the remainder of the page is an intentional wide blank margin, not damage and not lost text.]

The exposition resumes and develops the worked rule. And I [further] say to you [ואומר כי] that already, and again [והוזר], it is so inscribed: night after night upon the world (וכן ירשם על תבל לילה ולילה). For the day is one and the moment is one [היום אחד הרגע מצוייין] — "the day is one, the moment fixed"; and the tekufah of Tishrei (ותקופת תשרי), and likewise [the season-points of the rest of the year], as seen from the meridian [קו אמצע השמים] — when the tekufah falls, and likewise [?] — is reckoned eastward by the longitude-distance (מרחק האורך) [from city to city].

The tekufah of Tishrei in Jerusalem (תקופת תשרי בירושלם) falls at a given hour; and from the longitude-distance of the eastern cities — Babylon (בבל) and Damascus (דמשק) [?: these place-names resolve at this resolution as בבל and דמשק in the run of the column; read with reasonable confidence from the parallel meridian phrasing] — the same tekufah falls at a different hour, since the eastern city's sunrise precedes that of Jerusalem. And so night after night, day after day (לילה ולילה ויומם ויומם), the difference is carried over by the meridians of the places (מקומות).

The text continues to elaborate: in eight [hours?] and three [?] — שמונה ... שלושים — and the parts (חלקים), [the computation runs] for the equal hours and the parts of an hour, eastward of the meridian. From the rising of the sun (זריחת החמה) and its setting [the difference between the localities is derived], and the night (הלילה) is divided into its parts (חלקים) according to the places. For this is the matter [?: the line resolves כדי ... היה כי זה / "for this is, as it were, in order to..." of the sun, by which one knows the tekufah and the difference between this place and that.

And likewise, when the sun sets in one city [תשקע ... וקודם / וקודש] while in the eastern city — Babylon — its sunrise [comes earlier] by the longitude-distance,

[the difference is] so many hours; for the meridians differ between them, and so too their horizons. From this the parts of the hour are derived, and the equal hours, and one place precedes the other (יותר תאחר / "this one is later, that one earlier").

[Lower in the column the same worked material recurs:] And thus you know that the rising of the sun (זריחת החמה) in this place is at one hour, and in that place at another hour, and the difference between them is the longitude-difference; and likewise the setting; and so one place is "near" (קרוב) and another is "distant" — according to the cities (המדינות), and I shall begin (ואתחיל).

The final legible lines on the leaf carry the recurring formulae of the worked example: between the rising of the sun and the meridian [בין ... קו אמצע השמים] and the place (ומקום), eastward [for] three [hours?] (עד שלושה) the parts [are] so many [מעלות ... חלקים]. [?: the very last line-ends, near the foot, are faint and the trailing tokens are not letter-resolvable — [?: ~1 line, line-end tokens].]

[The lower portion of folio 67v is blank parchment below the text column — a wide blank lower margin, not damage. A conservation ruler / scale-bar and a black photographic strip run down the outer edge of the leaf — furniture, ignored.]

Yesod Olam — Treatise Three, Chapter Sixteen (continued)

Folio 68 (recto facing the camera) — main legible leaf

[Reading the clearly-photographed leaf right-to-left. The opening of the passage continues a sentence from the preceding folio.]

[so much,] and the matter of the sunset, accordingly, [holds] for [these places] [?: line head abraded]. ...and the law of its sunset, [reckoned] for Babylon [בבל]. ... [reckoned] eastward toward the [point of the] wind, [and so] for the southern [direction] [על הדרומית]. ...[for] the southern, and you will wish [to determine it] for the city [ויש תרצה לעיר — reading uncertain]. ...and by [the rule of] my words it will be a [proper] reckoning [ובדברי יהיה קוראת].

the waters [or: peoples? (המים)] [are] first, [and] the law of this is in the land [כובדין] [דין החשך זה — clause uncertain]; ...the law of the darkness, this [is] gold [זהב — reading genuinely uncertain]. ...its sunset, accordingly, by table [טבלי], and it will be [thus] [?]. ...the law of its sunrise [is] complete [תמים = תמים], and its sunset [ושקיעתה]. ...the day, [these being] joined together [משתפים], altogether [?: clause uncertain]...

the places of the settled world [קומות הישוב = מקומות הישוב], and I will begin [על שתי] ...these places [are] upon two [foundations / cities] [ואתחיל]. ...toward Jerusalem [לירושלם], and there is [a city] that [lies] to the south [שהדרומית — reading uncertain]. ...this [matter], and its rule is [thus] [ומשפטו הוה]. ...and I will begin from the provinces [or: cities] [ואתחיל מהמדינות], for [thus] [שכן]. ...of Jerusalem [(?ירושלם)], each one separately [אחד אחד]. ...[that] it would be the city of Tunis [תוניס = עירת תנשסת] [?: place-name reading uncertain]. ...[it is] requisite [that], if the day be this [one] [חייב אם יהיה היום ההוא]...

[Foot of the legible block, continuing the comparison:] ...the eastern [reckoning], by [the rule of] my words [thus] [המזרחית בכרי כתל] — reading uncertain]. ...the time [or: this place] within [it], behold you will hear [קנה תשמע = הנה תשמע]. ...the sun rises [in / when] turning about [שתזרח החמה במתהפך]. ...[reckoned] thus [דינה] [the] distance [מרחק]. ...in all [cases], [in proportion to] how great the longitude-distance [מרחק האורך] is. ...the western city [comes] first [המזרחית קודם]. ...the longitude-distance will be [מרחק]. ...the eastern [comes] first [before] the western [המזרחית קודם]. ...[that] this day be [its] sunset [שקיעה]. ...it is requisite [from the?] distance [מרחק ... יחייב]. ...the longitude-distance [is] thus [האורך]. ...like the eastern, [it comes] first [קודם].

Facing leaf (seen edge-on at the gutter)

[The narrow strip of text at the inner edge of the photograph belongs to the facing leaf, captured foreshortened and at a steep angle. Only isolated word-fragments are recoverable — קוסה / קחק / טבעו / רחמה / קוסה / וני (per the visible strip); continuous reading is not possible at this resolution.] [?: facing leaf, foreshortened — not reliably legible]

western [region], in the matter of the distance of the longitude [longitude-difference] in their longitudes, and in the matter of the additional [time] that is in [the longitude-difference]. So too, when their longitude-difference is the same, the addition of their longitudes [i.e. the equivalent time] will be the same. And if their longitudes are equal, then there is no longitude-difference between them. [?: the clause continues tersely about when the two cities share a meridian.]

For their longitudes, the time-minutes will be the same. And whatever event [מקרה] occurs at sunrise in the eastern [region]—when it occurs—the addition for the longitude-difference [will be reckoned] likewise, so that there will be an addition. For if the event were [observed] in the east, then its longitude-difference would be earlier [קודם]—it would precede [in time]. So too, by the longitude-

difference at sunset [שקיעה], the event would be earlier, since the longitude-difference at the western meridian [קו אמצע השמים המערבי] would be [a corresponding interval], so that there would be an addition. For when an event occurs at sunrise in the east, and the longitude-difference [reckoned] there is the same, the [observers] will be of the same [time-reckoning].

And if the event were to occur at the rising of the [heavenly] bodies [המאורות]—when it occurs in the east—then by the longitude-difference at the rising of the sun [חמה], the event would be [reckoned] in the eastern [region], so that there would be an addition. For at sunset, by the longitude-difference, the event would be at sunset, and there would be a [corresponding] addition; and this is [the case] both at sunrise and at sunset.

The longitude-difference, when their longitudes are the same, is itself the same; and this is [so]. And here is the addition [or: the corresponding time]. The reverse [or: the inquiry] and the reckoning of the time-minutes [הרביעיות] are reckoned; and this is [so]. And here the longitude-difference and the time [are computed], because the event in the east [precedes], and likewise in the west, [there is] the addition with respect to the meridian. For this is the rule [הדין] in this matter, [namely] that the difference in the time-minutes for [a place that is] more easterly is greater than [for a place that is] more westerly. So far as you are able [to reckon] for [each] city, [proceed] thus. And [for each] city, the time-minutes are [reckoned], and [their] arrangement is [made] in the time-minutes for the easterly [places]; and this [is so].

And here [follow] the [further] cases that [pertain to] the meridian: that a city, when it [is reckoned] before the [other] city, [its event will be earlier]. And you are able to compute for the easterly [city] and the [other] city accordingly; and the cities and the rules [are reckoned] in the time-minutes [?: the line-end is terse and the precise referents are compressed], so that you can find what is sought by it.

וחזרה ["And in return" / "And conversely"]—you will understand the matter, that it will be [reckoned] so far as [needed]. When you have for it [the position of] the sun, or the moon, or any [other heavenly body], or the [angular] distance of one from another—how far one is from another, like the [position] of the moon, or [a position] such as it—and you reckon it by the equation of its longitude [תקון אורך], or by its altitude [or: its true place], or by the eclipse of the sun, or [by] another phenomenon that there may be: for [in] all of them there will be [a reckoning], whether by night or by day [?: the polarity "night/day" is read but the surrounding clause is compressed]. And in the matter of any [reckoning], it is

known [that the place is] longer [in longitude]; and it is known by the longitude [that it is] more [easterly or westerly]; and that it would be [reckoned] like the [position] of the world [העולם], [where] one is [set] before the other [?: עולם is read here, not עצם]. Now its time [or: now this time] [is reckoned], and at the time the event [occurs] it would be [observed] in another city. And the [city of] Damascus, [where] there would be the [reckoning at] sunset, [its event] would be [reckoned] as it is [proper] to say:

For at the time the event [occurs], [if] it would be [reckoned] before [the time it would be] in the city, [then] the place [as a whole would be reckoned] before [it] in the time [or: the longitude-place precedes]. [?: the line is dense; the sense is that an event seen at one city is seen earlier or later at another according to its longitude.] By the place [or: by the meridian-place], the time being [reckoned] thus: this very year [שעתא], or this very hour, [is reckoned] for [the city]; for it is known [by] the longitude-difference [?: שעתא is read as Aramaic 'hour/time'] that there is a [corresponding interval].

And it is known [for] the longitude that he should [add] for [the city]; and [the difference] is more easterly. So [reckon] the moon, or [a body] such as it: there would be [a position] for it, and it would be like this—the moon being [set] before it, or the moon [being] already set, [so that] you have [reckoned] for it. The [reckoning of the rising of?] the eastern [body is computed], so [reckon] thus. And the calculation [חשבון] of this [matter] is [proper]—it is fitting to do all of this; and you should know whether the event [occurs]...

by the longitude-difference in their longitudes. So too, in the matter of [the place] when it has settled [or: when the matter is settled], in the path [or: by the procedure], that you should compute it in [each] place [in turn]. Afterward, [reckon] by the [new] moon [מולד הלבנה], and there [follows] an event by night, that [the bodies] go forth in a certain longitude-difference, and they will be of the same [reckoning], [as is] fixed [קבוע]. By [their] longitudes, [reckon] thus—you have [the means] for the moon [or: for the night] and for the day, [as] in Jerusalem; [proceed] for the latter, [it being] of [a certain] hour [or: by the addition of] hours [שעות], and a fifth [of an hour] [חומש], and five [units]; and [for] a [certain] time, [reckon] up to the half of the [day-]hours, that there would be [a position] for the sun, [reckoned] thus, like [the position] in their longitudes. So too in [the matter] of all [of this].

So far as [needed] thus, and accordingly this [is so]. So far as their longitudes [extend, that] the event occurs at the moment of the rising of the sun, or [at] the moment of [a body's setting] [?: the moment between rising and setting], or at the

moment [the longitude-difference] settles in the place; and at the moment this place [is reckoned], all of it [is reckoned] in [one] place; and this [is so].

When the great corruption [or: the great fault?] of the place [is removed], and the corruption removed by the [reckoning] of the time of the sun—at the rising of the sun [זריחת החמה], the event would be [observed]; and at sunset [שקיעה], by the longitude-difference, it would be at sunset. So you have [the means], both at sunrise and at sunset, to reckon and to know how each goes forth; and [the difference] of those who reckon is [accordingly]. And in the bounds [גבול] of [the matter], and in the times, the reckoners know it; and they reckon it. So too, again, a people [of one city] differs from another, so that they would [each] reckon for themselves by the time of the [given] phenomena, by the longitude-difference for the rising of the sun, or [by] the fault [or: deficit] of this place [or: in [the difference of] the place], in [their] places. And one should not [confuse one] place [for] another, or its [reckoning] for itself, [as is proper] to them. And here [we] return [וְחָזַרְנוּ], so far as [needed], by the [following] example [מִשָּׁל].

[?: A worked numerical example begins here; the figures are stated tersely.] How far [is the longitude-difference], that the [body] would be [reckoned] in [a certain] place—the path being [reckoned] by [the place] when it has settled, and you should know it [as reckoned] up against the [position of the] sun. So know it, and [it would be] additional in the time-minutes [לְנוֹסֵף בְּלֵקָה... = and an addition in the time-minutes]. And its eclipse [or: its equation] [לְקִיטָה] would be [reckoned] like one [unit], [as] from the moment that the [position of the] body settles [or: the equality settles], that the event [would be reckoned] for it in [a certain] place. So too, [the body] settles in [its] longitude [בְּעֲלוֹתָהּ / by [its] ascent]. And [the reckoners?] reckon it in [its] own [longitude] [or: among themselves], so that you may know it. And you know [it] by the moment of the sun [or: by [the moment] this thing] [?: ז']. So that it would be [reckoned] [accordingly], whether [a position] for it would be by night, [reckoned] at sunset, [or that] the [position] settles up against the [place] in Babylon [בְּבָבֶל]; and it would be [reckoned] up against [the place].

[The reckoning] was equal in respect of the west [הַמַּעֲרָב] [?: the body's ascent in the west], and additional in respect of the west by fifty [units] [or: by five], and an addition [or: a deed] of [a certain measure] [מַעֲשֵׂוֹת] and five [units], so that there would be [reckoned] a [certain] hour, [namely] three [units] [or: thirty] and [some] fifths-of-an-hour [חֲמוֹשֵׁי שָׁעָה], and [more], six [units] of a fifth-of-an-hour and a time [or: and a [further] hour], so far as [needed] thus; you have [the means] for the night and for the day. So far as [needed] thus, and to say]:

A [certain] time [is reckoned], the [longitude-]difference being equal—six time-minutes [רביעיות] for this [city], and an [equal interval] for Babylon [בבבל]; and the [place] settles in its longitude [or: at its ascent], [it being] more easterly, [a position] which it was [reckoned to have]. And the [reckoners] reckon it, the [city] being more westerly: [an addition of] fifty [units] [or: of five] in Babylon, fifty [or: five] and ten, and an addition [or: a deed] [מעשות] [?: the numerals here are dense—fifty/five and the units]. And [for] another time [the difference is] thirty [or: three], and three fifths-of-an-hour, [for] another [time] thirty [or: three], up to [or: until] the moment of the event; [for] all this [is reckoned] in Babylon. And [for] the city [whose] longitude is [given], and its eclipse [or: equation] [לקיתה] is in the longitude-difference [or: the city of long [longitude] settles by the difference]...

So far as [needed] thus, and accordingly this [is so]. So far as [it is reckoned] in Babylon, and likewise the longitude-difference, that it is fixed [or: that there was a [reckoning of] a single hour]. And the place was the hour [or: the place [was reckoned] at the hour], and likewise its [reckoning] for [the place]; and likewise the [reckoning] of the whole world. As they have said: and conversely, a [given] settled [position]—[so far as] for Jerusalem, it [is reckoned] as it stands [or: as it has risen]; for [reckoning] thus this [is so]; another event likewise [is reckoned]:

For [reckoning] this [matter], so far as [needed], a [certain] time, and one [unit], and three fifths-of-an-hour [חומשי שעה]—[for] a [certain] time, three [units] and three fifths-of-an-hour; this is [so] in respect of the west [or: it being more westerly]. And it would be [reckoned] to be more [easterly]: so [reckon] the rising of [a body] in [respect of] the place, [it being] settled in its longitude [or: at its ascent]; and the place [was reckoned] up against the [other], [where] there would be [reckoned] a settling [or: a [reckoning] equal in respect of the west]. So too, [in] the [place] when its [reckoning] is settled, the [body] settles in its longitude.

And he said: by the [reckoning] of the western [region] [המערב], that this is [as it is] proper. For [in] this [matter, so far as needed], a [certain] hour, and one [unit], and three fifths-of-an-hour [or: equal times, three fifths-of-an-hour], at a time before the [time at the other] place [or: at the time of the rising of the sun before the other], [where there is] no eclipse for them [or: where the difference is]; for [the calculation of the] time-minutes [רביעיות / הלקיות] of this [matter] was [reckoned] [?: לקיות is read; the precise referent—'eclipses' or 'time-fractions'—is uncertain here].

[?: dense passage] [The rule] of [the matter], so far as [needed]—it was already [reckoned] that there was [a position] for the moon, or for a people [of a city], or it was [reckoned] for them; and likewise the moon would be set for them [or: the

moon would already have set for them]; for [reckoning] thus this [is so]. And the [reckoners] of the eastern [region] [reckon it], and accordingly all of it [is reckoned in] place [or: among themselves]; [for] doing all of this, one should know the time, that the event [occurs] for one [city] before [another]: for in the place [or: by the meridian-place], the event would be [observed] in one place, and [for] another, [it being] more easterly or westerly. And so far as [we have spoken of] this matter—I will [treat] this matter

more fully in the last treatise of this book, with God's help [בע"ה].

ועתה ["And now"]—now that you know what [is involved in] the operation [המעשה], and you have [the means for] reckoning it [as] the reckoners reckon, namely that they wrote [it down]—nota bene [נ"ב]: the reckoners [of] longitude, [reckoning] the equality of the [day-]length [אורך הישוב] [or: by [its] full extent], and by the equation of the longitude in their longitudes—because [there are] tables [לוחות = ?שלימים], and... [?: a list of items follows] from the [place of] the rising of the east [ממקבה מזרח] up to the [place of the] setting of the west, so far as [needed], so as [to reckon] for the [position], and for the time, and well [ובכן ולבון = "and so, and so, and to clarify"].

the moon at the time of its eclipses, you will see that they are equal, and that its eclipses are likewise equal. But at sunset the eclipse will be observed at one point in the sky, and at the eastern horizon at another; for at the beginning of the night the moon shows one eclipse-magnitude, and at the end of the night a different one. The observers' reckonings of the eclipse-times, therefore, do not agree when they are compared; rather, each observer reckons the eclipse according to where he stands. From this the scholars learned how to determine a man's longitude-difference and his local hour-of-day: for if a man's eastward longitude is known to him, then his hour-of-day is known as well.

And if the hour-of-day was known to him, then his eastward longitude was likewise known. But further inquiry into these matters [must wait], since they cannot be apprehended except by [observation of] the lunar eclipses [as they occur] at the differing places; and so they [the scholars] established this matter from the lunar eclipses, in order to know each man's longitude-difference, and from it to know his hour-of-day in relation to [the meridian of] the other regions. The reason for this is that they could find no other [phenomenon] that occurs simultaneously, as one and the same instant, at [all] places — except the lunar eclipse, which is in fact one [single event] for all who [happen to] see it. So they fixed the matter upon it [the lunar eclipse], and they reasoned: since the differences of the regions [in their] longitudes are [a matter] of so-and-so, and the

[eclipse] occurs at a [single] real moment, then by it [the eclipse] the differing longitudes of the places may be known; whence [from this] the hour-difference is the [measure of the] longitude-difference between them.

And this matter — that the lunar eclipse is a single event — they explained as follows: since it occurs at one and the same instant at every place, let it serve as the common standard.

[Display opener, enlarged script, set off by a line break:] **פרק שבעה עשר — Chapter Seventeen**

I have already laid out for you in the earlier chapters how to determine the terrestrial longitudes and latitudes of the regions, and the celestial longitude and latitude as well, together with the other necessary foundations. Now, God willing, I shall make known to you the matter of the hour-of-day and its local time-difference. The way to determine it is as follows: take the longitude-difference — that is, the difference between the meridian of the region you wish to compute for and the meridian of the place whose hour you already know — and reckon four time-minutes for each degree of that longitude-difference, and one hour for every fifteen degrees [$15^\circ = 1$ hour, since $360^\circ = 24$ hours].

The exposition then turns to the hours of the day and of the night, and to the rising and setting of the sun, as already treated in Chapter Sixteen of this Third Treatise.

the eclipse occurred at one and the same instant, yet at one place earlier and at another later; and the difference between the differing places, reckoned from that single real moment of the eclipse, yields the hour-difference. And so they established this matter from the eclipse, so that the observer's place might be known. They had no other phenomenon available to them, since this matter cannot be apprehended except by observing the lunar eclipses at the differing places.

So they set it up [thus]: when the [eclipse] occurs, [observe] at what point of the [sky] it is, and from the differing [observed] points the [true] difference of the places is known; for the lunar eclipse is one [single event] for all who see it. And from it [is computed] the longitude-difference of the regions. And the rule [is]: the eastward [reckoning] proceeds [from west to east], and the western [reckoning] correspondingly; and the [observers] who reckon — each according to where he stands.

the eclipse passed over its points; there is a place where it is seen more eastward and another more westward; and to reckon for all the places, you take the luminary's motion along its course and its tabulated points. The luminary stands at one eclipse-point as seen at one place, and at another point as seen at the other, according to the terrestrial longitude — by which the hours of the day are reckoned. For one degree corresponds to...

the directions; the diagram is divided into its points and its quarters, and thereby its course is known, by which one knows the locations of the places in the regions appointed to them. The masters of the Talmud, the masters of computation, and the geographers arranged this, since they had no other possible foundation. So you, the reader — understand it well — see how it has been arranged for you, that you may grasp its whole structure and its intervals. For the closer two places are, the smaller their longitude-difference; and the farther apart, the greater. Know, then, and understand, that the matter is as drawn here:

Diagram. A figure of two concentric circles crossed by two perpendicular diameters (a vertical axis and a horizontal axis) meeting at the common center, dividing the field into four quadrants. The small inner circle at the center represents the Earth; the large outer circle represents the encompassing sphere of the luminary. The horizontal diameter is labeled as the equinoctial line (the equator/equator-of-day), running east–west.

- Center (inner circle, upper line): קו השווה — "the equinoctial line" (the equator)
- Center (inner circle, beneath, with the reference-letter): ה — point ה; below it הארץ — "the Earth"
- Left end of the horizontal diameter: מערב — "west" (with the curved label המאיר, "the illuminating [luminary]," beside it)
- Right end of the horizontal diameter (toward the gutter): למזרח — "toward the east" (set as a vertical curved label opposite מערב)
- Upper inner arc: לנכח הזריחה — "opposite the sunrise"
- Outer ring, upper-left arc: גלגל המאור — "the sphere of the luminary"
- Outer ring, lower-right arc: גלגל המאור — "the sphere of the luminary" (repeated)
- Lower diagonal, near center: גלגל המאור — "the sphere of the luminary" (lower-left fragment of the ring-label)

[The horizontal axis is the equinoctial circle (equator); the vertical axis the meridian. West lies at the left end, east at the right, with the Earth at the center and the luminary's sphere surrounding it.]

the hour-difference of the region's point from the reference point; for each degree you reckon four time-minutes, and so the sun travels through the signs of the zodiac. Concerning this matter the rule is as follows: its proof rests upon the equator, the equinoctial line, which is a true measure; and you reckon the longitude of the region's point from the reference point.

The exposition continues: the eclipse-points observed at the differing places yield the longitude-difference; and for all the terrestrial places you reckon the luminary's motion along its course and their tabulated points, the luminary standing at the eclipse-point — seen more eastward at one place, more westward at another. Its proof rests upon the equinoctial line, which is a true measure; and you reckon the longitude of the region's point from the reference point.

and there is a place where it is seen more eastward; and to reckon for all the terrestrial places, you reckon the luminary's motion as it stands at the eclipse-point as seen at one place, and at a more eastward point as seen at another. The observers' reckonings differ, each according to where he stands; therefore the tabulated point is needed, reckoned from the reference point. [This stretch restates the procedural template in highly compressed form.]

the luminary stands at the proper hour of the eclipse; and you reckon it upon the equinoctial line. The observed hour is as drawn here in the figure, namely for the eastward places.

the reckoner takes the eastward value of the hour... one hour, from which the luminary departs from the point [?: foot of the column; the last words read approximately "מ' ימות [?] חד מ' [?] עת", two glyphs genuinely abraded].

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic semicursive hand. Third Treatise (המאמר השלישי), Chapter Seventeen (פרק 17) — close — and the opening of the Fourth Treatise.

[f. 71r] — Chapter Seventeen, conclusion

[The discussion of converting longitude-difference into time continues from the preceding folio. The text is in a small Spanish Rabbinic semicursive and is largely legible; renderings below track the ink line by line, with verbatim Hebrew

anchored at the points where the construal is firm, and brief sense-flags only where a phrase genuinely resists construal.]

So too [וכן הדין] the reckoning [חשבון] holds. For each region the times [העתים] differ, [each] according to its place [מקומו]. The east of one is the [west] [מערב] ... [מזרח], and likewise [וכן] the law holds for the rest of the regions [ומשאר בני אדם — and the rest of mankind / the rest of them]. [?: one mid-line clause here is faint at the seam.]

This is the measure [between] them, and from it [you may] know [the difference] [כבוד ... ידיעה — by which you know] each one [of them]. And this is well — understand it [וזהו טוב טעמו ויסתכן / כיוב טעמו והבן].

[The body of Chapter Seventeen ends here. The exact wording of two short clauses across the gutter seam is faint; rendered conservatively rather than over-specified.]

[Closing colophon of the Third Treatise]

[A short displayed block in the same hand, set off and centered, faint brown ink — apparently a rhymed/abbreviated doxology closing the Treatise. It is partly rubbed; transcribed as legibly recoverable, with uncertain spans flagged. No named authority is legible.]

Yah [the LORD] for [?: למרנבן — unclear], and to all His hosts(?) [וכל הריאיון] — uncertain]; the hosts of the heaven of the firmament, here [?: פה הם] [?: a line of versified praise, ~5 words, too rubbed to construe]; ordered and fixed for their courses(?), and [?: ...]; for the Maker of the intellect [?: לברי השכל], it was [?: שחתו] and its matter [?: וחומר] ... [?: a further line, ~6 words, faint]; [?: another line referring to "so many" measures, partly legible].

And it is written [ויכתוב]: [?: a short rubric, partly legible — "and concerning the matter of..."].

The gates [chapters] are sealed [החתם השערים] — this [marks the close of the Treatise]. [The formula "החתם השערים", "the chapters/gates are sealed," closes the Third Treatise in place of an explicit השלישי המאמר.]

[Wide blank lower margin (not damage).]

[f. 71v] — [Opening of the Fourth Treatise]

And now [ועתה], in order to explain and to set in order [לכתב ולתקן]:

[The text continues with the sun, its rising and setting, and the hours, in the same register as the foregoing chapter. The leaf is legible; the renderings below anchor the verbatim Hebrew of each line and hedge only where a phrase genuinely resists construal.]

For in what is sensible [to observation] [במה שמרגיש / בקמ מענה], the sun is [שהיא ...] [?: the predicate of this opening clause is faint]. [It is reckoned] from the east [למזרח], as it is written / as we said [כמו שאמרנו / כמו שכתב]; and this is the matter [וזו הענין] from which it follows [מתחלת עליון] [that...]. [?: the close of this clause is faint.] The reckoning of the hours [is] established [... העשבון / החשבון] [השורה].

When the sun is darkness, it is night [הוא חשך לילה — i.e. when the sun is below, it is night], since [the sun] is a turning-point [מקום מהפך]. [?: a connecting clause here is faint.]

And [as for] the rising of the sun [עת זריחת החמה], it is [reckoned] from the place / from the east, from which it follows; for the moment of the sun's rising differs — it is "early" for one [region] and "late" for another [היום היה לזה ... היום היה לזה] — the day is [thus] for this one ... the day is [thus] for that one]. [?: the parallel clauses are legible as a contrast of "early/late," but the exact governing nouns are faint.] By its measure [the difference between] this region and that [region] [לזה ... לזה ... כשעור]; the reckoning [returns / completes] [מקצה ... חוזר].

The law of the regions [דין המקומות] that is established [שנקבע / שבקצה], so that the longitude [reckoning is completed] [המקור]; the east of one is the west of another [עבור החל שם עבור — one place's east is another's west], [a span] of so many [degrees] [משפט ... עשן].

And know that [וּתְדַע] you compute it [יִפְתָּר לָךְ], understand it [וּתְדַע]; the reckoning is established [מִתְפַּשֵּׁט / מִתְבַּשֵּׁט עֲלֶיהָ בִּקְצָה]; [each region] has its own [moment] [זֶמַן] — it is "outside/other" for one and so for another]. And the setting of the sun [וְהוֹרִידָהּ / וְהוֹרִידָהּ מִטָּה] [is reckoned] [מִטָּה מִצּוֹה]; each one [is] good / fixed in its place [בְּעֵינֵי כִּי טוֹב בְּכָל אֶחָד], and [so this is] its measure for this [region] [וְזֶה ... לְחֵיר עַל אֶחָד וּבִקְצָה] — according to what belongs to it [each place].

[Wide blank lower margin (not damage).]

Diagram. A small circular figure at the inner (gutter) margin of the verso of the preceding leaf (70v), partly within the frame of this opening — the same Earth-and-luminary diagram begun on the previous folio. A central circle (the Earth,

הארץ sits within an outer ring (the luminary's sphere, גלגל המאור); a horizontal line crosses the figure (the equator / equinoctial line, קו השווה), with the directions east and west marked at its ends. The labels are faint at this resolution.

- (center): הארץ — the Earth
- (outer ring): גלגל המאור — the luminary's sphere [?]
- (horizontal line): קו השווה — the equator / equinoctial line [?]
- (left end of line): מערב — west [?]
- 2 further labels [?]

in this order, so it was, descending upon the [respective] positions, and this revolution [היסוב] returns to its place. For at the time of the position [מעמד] of the center [מרכז] of the sun [החמה], when its light is brightening as it travels and the [computation?] grows distant, until it is [?], so the [respective] positions come round, resembling the moment of the [sun's] generation [of light?] [?].

It says: this is fitting, and properly so. This is the [great] reckoning [?], complete [מכלל], and the day comes to be — at the reckoning [בקעת] of the day, and its [setting?], by the cycle [עבור], the day [?]. When we said this — "a day of light and a day of the reckoning [בקעת] of [?]" — for the quarter [רביע] [?], that one might [?] the rotations [?], to confirm what is made plain regarding [?] this, which they did [?]; and [?] upon it; and there is no [?] over [?] the cycle [עבור], [?] [?].

And day by day, since the days of the work of Creation [מעשת ימי בראשית], as it is said of it [in Scripture]: "and there was [evening, and there was morning]" — this reckoning [המחשבה], just as it [is], "and there was evening" [ויהי ערב], by the reckoning [בקעה] of [the evening]. [And so came round] the cycle [עבור]: thus too was the position [מעמד] of the center [מרכז] of the sun [החמה]...

in [?] order, the work of the heavens [מלאכת שמים]. And He [?] called it [?]... "and all their host" [וכל צבאם] [cf. Bereishis 2:1]; and [?] it does not fail [לא יחסר] in the cycle [עבור], and there is nothing in excess [ולא יותר] [cf. "nothing wanting and nothing in excess"], apart from this [?]...

this was [decreed in?] the work of the heavens [מלאכת שמים]; and so it was, the [?], and still [ועדין]...

the work of the cycle [מלאכת המעוב]; and is it not so — how then is it sustained [מקיים]? [?] all of this [?]...

[?] the boundary [גבול], for the whole is complete [שלם], that this reckoning [הרעש] was at the time of the completion [עת נמר]...

[Centered display heading:]

ראש עולם — Rosh Olam ["The Head of the World" — the epoch of Creation]

וכו' [etc.] ...

[Bottom of leaf:]

at the head of the world [ראש העולם], the cycle began [הוחל], and so this was the reckoning [?]; and so by the position [מעמד] upon [?]...

as it is said of the [first] light: "let there be light" [יהי אור]; at the beginning [תחלת] [of] the returning light [החזר], to give light [להלויך/להאיר] and to [?];...; and so [it serves] to teach [ללמד] and to make known [להודיע], [setting] evening [בערב] [as] darkness [מחשך], so that there be no failing [ומחסר] and no [?] in the matter of [?].

to the beginning of the hour [לתחלת השעה], and it was; Rabbi Avraham bar Ḥiyya [אברהם בר חייא — the astronomer, author of Sefer ha-Ibbur] [stated] in what manner [?]; at the time of their creation [בעת בריתן], in the year [בשנה] [?];...; rather, at the time the center [מרכז] of the sun [החמה(ה)] was [?]...

[in] the work [מעשה] of the moon [?] and [?], and eastward [מזרח] it turns [רוחין] it, in such a way that [?]; and the rest of the [respective] positions [שאר המקומות] it turns [רוחין] [?]...

over [?], and round [?]; for [?] in the work of [?] the [?]; in the firmament [ברקיע] [?], the constellation [מזל] [?];...; as far as the matter of the words [דבריו] of [our sages] of blessed memory [ז"ל] [?]; do not raise an objection [לא תקשר/תקרה] against this [?]; "it did not arise upon his heart" [לא על לבו], and there is nothing wanting [ולא חסר] [?].

You have heard, then, [?] that [?]; this reckoning [?] did not come to be exact [לא] [?] [בא לדייק] [?]; the luminaries [המאורות] were set [נטעת], suspended [תליות] [?]; the luminaries [are] in the firmament [מאורות ברקיע], over [?] the heavens [השמים]...

the stars of the firmament [כוכבי רקיע], and at the reckoning [ובחמת/ובקעת] [?]; but [?] those that [?] the writing [הכתוב] [?] the stars [כוכבים]; just as [?] to give light upon the earth [להאיר על הארץ] [cf. Bereishis 1:15]; [?] the order [הקו/הקו] of the luminaries [מאורות], a cycle [עובור] [?]...

between day and night [בין היום ובין הלילה], this [?]; and the night [והלילה], cycling and cycling [עוברים ועוברים] [?]; and the stars [והכוכבים], they are swift [הם מהירין]; and they were set [ועשו/ועשו] for signs [לאותות] and for [?] the luminaries [מאורות] [cf. Bereishis 1:14]...

how do they recognize [היכן מכירים] a portion [חלק] [?]; the tongue [the wording] [הלשון] of "for an appointed time, that [?]" [למועד אשר] [?]; in them [בהם], concerning the cycle [על המעוב], which they said [שאמרו]...

to the peoples [לעמים], when they hear [כשמעו], or [?] there shall be [יהיו]; "they said: days, or [seasons / weeks?]" [אמרו ימים או שבתות] [?].

[Lower margin of 72v: a drawn **manicule** (pointing-hand nota-bene mark), brown ink, no accompanying text.]

so it was for them. And likewise it was for them [the luminaries], that their courses were ordained; for so He charged them and spoke concerning them. The matter of the great luminary [המאור הגדול = the sun] follows from its position [מעמד], and there is no concern here for the calculation [חשבון] of its course [מהלך = course].

And since the sun's position is [a fixed] reckoning, it serves us as a fixed measure [שיעור], so that we need not trouble ourselves over it either for the early reckoning or for the late; for the position is the established root from which they reckoned. And from this they ordained the [further] computations.

The matter of the lesser luminary [המאור הקטן = the moon], however, is otherwise: for it has many courses, and on their account its reckoning is required, so that we may know its position at any given time and the measure of its course. This is why, concerning the sun, it was said that it needs no [further] reckoning, while concerning the moon it was said that its course must be calculated.

Between the early reckoning and the late there is a difference, and a disparity accumulates between them; this is the accumulated difference, and it is the root of the intercalation [העבור = the intercalation]. And so they computed it by judgment and by [fixed] measure.

The position of the great luminary is a single position, a fixed root, requiring no [further] reckoning; whereas the lesser luminary has many courses, and on account of them its position must be reckoned, so that one may know where it is at every time. And the reckoning of its course proceeds thus: at the beginning it is at one point, and after it has moved it is at another, in order to distinguish the position from the course, and the early from the late.

And so, in the heavens, the bodies of the luminaries revolve. The matter of the great luminary [המאור הגדול] is according to its position: it is fixed, and it has no [further] reckoning. The lesser luminary, by contrast, revolves and moves; at the beginning [of its course] it is at one point, and after it has moved it is at another

point. And so one must distinguish, in the heavens, between the body that moves and that which is fixed, and between the position and the course [מעמד and מהלך].

This is the difference between the two luminaries: that the position of the great luminary is a single fixed measure [שיעור], so that there is no concern for early or late [reckoning], whereas the lesser luminary moves and is reckoned at every time.

[Two slanting final lines, compressed into the lower margin:] ...and so it is said, "let there be lights" [Bereishis 1:14], and Joshua son of Nun [יהושע בן נון] — for so it was. The position of the great luminary has no [further] reckoning; and there are differing opinions [סברות] concerning it [?: line-end fades].

So He ordained the luminaries, and likewise. Yet they have one fixed place: for one luminary [the sun] is fixed in the heavens, while the other [the moon] revolves and has many courses, and there is reckoned for it the measure of its position in the heavens through the whole year; and from this the reckoning proceeds.

[שנתייסר לך — enlarged display-initial word] And it was ordained for you [לך] that the lesser luminary is reckoned, so that one may know its position at every time, and the measure of its course. And this is why HaKadosh Baruch Hu fixed [קבעו הקב"ה] the position of the great luminary [המאור הגדול] so that it needs no [further] reckoning, while the lesser luminary must be reckoned, so that one may know its place at every time.

The disparity between the early reckoning and the late is the accumulated difference; and this is the secret of the intercalation [סוד ... העבור]. For so it is now, and this disparity is the root. And HaKadosh Baruch Hu fixed [קבעו הקב"ה] the molad [מולד] — Israel having been commanded concerning the intercalation [נצטוו ישראל בעבור], for so it was — and according to it the lesser luminary is reckoned.

So Israel reckons. And the great luminary remains as it was, while the lesser luminary has many courses; and on their account the root of the matter is to know the statutes [החקים = the statutes].

This was their reasoning [סברתו], according to the calculation of the Torah [לפי] [חשבון התורה]; and the renewal [התחדשות] of the moon — the seasons [התקופות] = the seasons] and the festivals [המועדים = the festivals] — is the time of the renewal of the moon. And there is no season nor festival otherwise.

When did the renewal of the moon begin [מתי מתחילין החדוש]? From the beginning of the night [מתחלת הלילה]. And so the law for the months and the renewal of the moon: each one begins at its renewal, and one reckons from it; the beginning of the month is the renewal of the moon, and from this the festivals are fixed. And one calculates the beginning of the moon [התחלת הלבנה].

The day is reckoned from the evening [מערב], and so it is fixed: as it is written, "and there was evening and there was morning" [Bereishis 1:5]. There are those who reckon from the morning, but the law of the Torah is that the day begins from the evening — and likewise the renewal of the moon and the months begin from the beginning of the night.

And so the new moon [ראש חדש] is reckoned from the beginning of the night. From then until now the festivals are called holy convocations [מקראי קדש = holy convocations]; in the seasons [תקופות] and the festivals [מועדים] it is so.

[Slanting lines toward the foot of the column:] ...the new moon from the evening; and so it is fixed; and the festivals are called holy convocations [מקראי קדש].

And so all Israel received the Torah; and from then until now [the day begins] from the evening, at the beginning of the night; and this was received, this tradition, generation upon generation [דור דור = generation upon generation].

[Final two lines, brown ink, foot of column:] ...and likewise to begin [להתחיל] the sanctity of Shabbos [קדושת השבת = the sanctity of Shabbos] from the evening; generation upon generation [דור דור], as it was, so they received it.

Yesod Olam — Fourth Treatise (continued)

of profound import. They were sages of great accomplishment, and they fixed the reckoning of the molad [the conjunction marking the new month] and of the tequfot [the seasons]; for this reckoning is a great and good thing, fitting to be chosen and relied upon.

And now [ועתה] — know that the matter of the seasons and the months, and the reckoning of this thing, depends upon the rising and the setting of the sun. It does not have a single moment that is one and the same for the whole inhabited world; rather, the sunrise of one region is the sunset of another, and the time of one place differs from the time of another. For when it is sunrise in the east, it is already a later hour toward the west, and what is morning in one place is already evening in another.

The sages, may their memory be a blessing, said concerning this — and so it is correct — that one must know that the inhabited world is round, and the [celestial] sphere likewise. Therefore the reckoning of the seasons depends upon this principle: that the hour differs from place to place. From this it follows that there is no single sunrise common to all; rather, in each and every region, the day begins from its own [horizon].

And every place reckons its day from evening to evening — that is, from the setting of the sun until [the next] setting of the sun — for so the matter is ordered: night, and then day. And this is the measure of a full natural day [?: construing the elided clause as the complete day-cycle]: from one sunset to the next sunset.

And the seven planets rule over the hours, beginning from sunrise: each one rules in its turn, in the known order, hour after hour, until the cycle returns to the first of them and begins again. And this matter is well known and does not require [further] explanation here.

[The remainder of the column is blank margin.]

it is said: and one is obligated [to reckon] from the setting of the sun. And this is the principle for the Land of Israel: from the beginning of its eastern horizon to the end of [its western horizon] — those who dwell at the eastern edge, and the reckoning of the day between them.

The sun, from its rising to its setting — that is, by the reckoning of the day — and at its setting [?: construing the elided clause as the completion of the daylight span]. And so, when there is daylight in one region while it is night in another: those who dwell to the east precede, and those who dwell to the west follow, for the eastern dwellers see the sun before the western dwellers.

Therefore the difference [in time] between the [eastern and western] regions is anchored to the Land of Israel, [taking] Jerusalem [as the reference point], since it is set in the middle [?: construing the elided clause as "the center of the settled world"]. And the reckoning of the difference between this region and that depends upon the words of the early authorities concerning the configuration of the inhabited world.

Know that there is a difference of hours between the regions, and that each region reckons the onset of its Shabbos by its own sunset: the eastern region enters Shabbos before the western, [each] according to the setting of its own sun. And one must distinguish carefully between this region and that, so as not to err in [the reckoning of] the sun's setting. Therefore each place keeps its Shabbos by

its own [horizon], and Jerusalem [is taken as] the [reference], may it be rebuilt — and this is the reckoning of the difference between the regions, by which Shabbos is fixed for each one according to its sunset.

And now [ועתה, second display word] — concerning the gnomon [השען, the sundial / shadow-instrument]: this is a matter that has [its own] computation. Know that the gnomon is set up to determine the moment of [the sun's] passage, [namely] from the time the sun rises until it sets. By it one knows the hours of the day and the configuration [position] of the sun.

for those who dwell in Jerusalem, [the gnomon shows] the difference [in time]: when it is [a given] hour, [the shadow falls] one way, and at another hour another way — those who dwell to the east, and the inhabited world. And the reckoning of its seasons and the end [of its day] depends upon the sunset [?: construing the elided procedural clause].

Shabbos of those who dwell in [one] region — the matter is as it was first [explained]; and afterward, [the same holds] for [the calculation of] the hours.

And so the matter is ordered [for the third case] [?: construing לשלשי]: for that hour one must [reckon] by night and by day. And [for] the day of Shabbos, until [the moment one] returns — from the time the sun rises until the onset of Shabbos, [reckoning] by night the onset of Shabbos. They dwell in [one] region — Jerusalem — at the setting of the sun in the inner [region] [?: construing the elided clause].

[The hour-figure here reads 9 = ט'; a parallel hour-figure below also reads = ט' 9.] At the ninth [hour] [9 = ט'], thus: there are nine hours [ט']; in this [reckoning], the gnomon and ...

[...following the words of the early authorities concerning the difference of the regions: those who dwell in Jerusalem reckon by sunrise; those who dwell to the east; and the inhabited world...]

the words of the early authorities — at the first hour [?: construing בראשונה] of the day, by the [great] instrument [שען]; and afterward, for the other hours [שעות אחרות], according to the words of Rabbi [?] [the named authority is not legibly recoverable], may his memory be a blessing.

[The remainder of the column is blank margin.]

[Fourth Treatise (המאמר הרביעי) — on the Hebrew calendar / intercalation. Continuing the discussion of local time and longitude: the same astronomical or

calendrical event occurs at a single instant of true time, but the clock-hour and even the calendar day to which it is assigned differ from place to place across the inhabited world, according to how far east or west the observer dwells.]

and this proves to be so on account of the intercalation [עבור]. By the latter [reckoning] [כאחרונה] — that is, by the reckoning of those further west — the matter holds for every place [לכל]; and likewise the sunset [שקיעת] and the [calendar] day [יום] in the intercalation. For the [people of the] eastern extremity [קצה המזרח], the hours are reckoned for them, and so for their fellows; and so it would be for them [?: the close of the clause is elided].

And further [ועוד]: at the eastern extremity [קצה המזרח], the hours were reckoned for them, and they reckoned them [ויחשבו]; and so it would be for them. For at the time that the sun is at the western extremity [קצה המערב], it would be — for those in the east — daytime hours [?: the relation of hour to extremity is elided here], whereas for the easterners it would already be the rising of the sun [שקיעת/זריחת השמש — the scribe writes שקירת; from context "rising," not "setting"].

Therefore one must reckon according to the place [מקום] from which one reckons the day; and the day [יום] from which the occurrence [קרית] of the day is reckoned. And these [reckonings] follow one upon another [זה אחר זה], for the sun [moves through them in sequence].

And the moon, likewise, by the same reckoning, is reckoned at the setting [בשקיעת] — at the sunset of the western extremity.

At the setting of the day [שקיעת היום — the scribe writes שקלת], the hours ... among us [מאתנו]; so they have said, and so it is for us [וכן הוא לנו] in this [matter of] the hours.

at the eastern [extremity]; and so it would be for them — the occurrence [קרית] of the day [?: the predicate is elided].

The [people of the] east [המזרח] — for them it is the favourable [reckoning] [הטוב], and the occurrence [קרית] of the day is [reckoned] for them; and so it would be at the setting of the day [שקיעת היום — the scribe writes שקלת]. As for the hours, therefore it was said that it is not so [ולא כן — the scribe writes בני], [namely for] all the places of the inhabited world [כל מקומות הישוב], one after another [זה אחר זה] in due order [על הסדר].

The west [המערב], in the latter [reckoning] [באחרונה], would be [reckoned] so that it falls in the inhabited world [בישוב] ... for us, according to our reckoning

[הישוב]; and that [holds also] in the east [במזרח] of the inhabited world [הישוב], one after another [זה אחר זה] [?: the close of the paragraph is elided].

set it in order, and so according to their reckoning [לפי סברתם]; and you should set in order [ותסדר] ... so that it be in due order for them, one after another [?: the connective clause is elided]; and they reckoned [it] ... at the western extremity [בקצה מערב].

And further [ועוד]: at the time that the sun is at the eastern [extremity] [?: the predicate is elided].

And now [ועתה]: by [the very] words I have set out for you [כדי לבאר אמרתי] — the occurrence [קרית] of [the event] in the inhabited world [בישוב], and the place [?: a word here is elided], at the eastern extremity of the inhabited world [קצה המזרח]; and the days [וימי] of the occurrence of the day [קרית היום] — this [is] the favourable [reckoning] [הטוב] for us.

And by the same reckoning [וכן], in its place [במקומו], it occurs [תקרה] ... in the east [מזרח]; and there is neither lessening nor [addition] [ולא ... ולא]; and to its end [ועד סוף] there are twelve [יב] hours, [which is] the difference [שינוי] — the scribe writes [הין] between [sunset] and the rising [זריחת] of the sun.

In all twelve [בכל היב], [there are] the six hours [ששת השעות] [?: of night, or of the difference — elided]. By this order [הסדר], the rising [זריחת] of the sun is at the western extremity [בקצה המערב], and likewise [וכן] the setting [שקיעת]; and the sun would be at the eastern [extremity], and it would be reckoned among the daytime hours [?: the construal of hour-to-extremity is elided here as on the recto]; ... the sun [שמש] ... there is [no] reckoning for it [לו] [?: the negation is reconstructed from sense, not fully legible].

and the occurrence [קרית] of [the event], the rising [זריחת] [of the sun], one after another [זה אחר זה] each day [בכל יום].

And the place from which [מ...מקום] [the reckoning proceeds] is the favourable [reckoning] [הטוב]; and the days of the inhabited world [וימות הישוב] — the scribe writes [ומות], this [follows] one after another [זה אחר זה].

[The remainder of the folio side below this line is blank parchment — wide blank lower margin, not damage.]

[General observation on this opening: throughout 75r–75v the argument is a single sustained one — that the assignment of any solar or lunar event (and of the calendar day on which it falls) to a clock-hour, and even to a particular day,

varies with the observer's longitude across the inhabited world, eastern dwellers reckoning the event at a higher hour / later, western dwellers earlier; the same event can therefore straddle the boundary of a Shabbos or a day depending on whether one stands at the eastern extremity (קצה המזרח) or the western extremity (קצה המערב). The terse, heavily elided calendar Hebrew leaves several clause-level construals uncertain, but the recurring technical vocabulary — שעות "hours," קרית "occurrence (of the day/event)," זריחת/שקיעת החמה "sunrise/sunset," ישוב "inhabited world," מקום "place," קצה המזרח/המערב "eastern/western extremity" — is secure.]

this, according to the order we have set out, for an observer who looks from the eastern extremity to the western extremity, and from the western extremity to the eastern [?: construal of the opening clause, which continues a sentence begun on the previous folio]. So too the sun rises and sets, and removes itself [from one place], and [the same applies] at another place. Saturday night, and even [the rest of] the week, [the reckoning] is determined for them according to this same principle, since they are all bound to one another.

[The matter] of the new moons [ראשי חודשים]: from the place that is best [suited] for it [?: מקום שהוא טוב — "the place that is favorable"], by which we mean the place fixed [for the reckoning]. For according to this, the day is reckoned [variously]; and the day is reckoned for them according to the [reference] place — for one who is to the east of that place reckons it later, and one who is to the west reckons it earlier [?: בקצה המערב / בקצה המזרח construal carried from the prior argument]. And it returns [to its starting point] — at its beginning and at its end, that hour and that day [continue] to follow it.

The walking [course of the day] and the [Shabbos]: thus it is determined for them, according to the principle [we have stated]. The new moons [follow] the same principle for the eastern [dwellers] and the [western] — those who dwell to the east are still [reckoning the day] while those who dwell to the west [have already passed into the next]; and one and the same hour, by this [reckoning], is [a different hour] for each of them. [The same is true] for the new moons.

And he said [?: a sentence-opener I read but cannot construe with full confidence]: and what is said is this — that an hour is one [unit common to all], and yet [each] place reckons by its own [hour], so that the reckoning [of the moladot] differs for the [eastern dwellers] from [that of the western]. For one who dwells [to the east], the molad [of the moon] occurs while it is still [day or night] for him, and the western [dweller reckons it] at another [point]. So too the eastern [dweller] is still [in one day] while the western [dweller] is [already] in

the next; and the difference between them is according to the [span of] the longitude that lies between them [המשך — the longitudinal "drawing-out" between the two places]. Shabbos, [too,] for those who dwell [in different places], [differs] in this way.

[For] one place it is Shabbos, and [for] another it is not Shabbos, since their hours are not equal; and the difference between them comes from the longitude that lies between them. Shabbos of one is the weekday of the other [?: שבת לשם / חול — "Shabbos for the one, weekday for the other"].

The eastern [dwellers] reckon the molad and the day-beginning at one [moment], and the western [dwellers] reckon them at another; and the day for the eastern [dwellers] is still [in progress] while for the western [dwellers] it is [already past]. This is good and clear — that one place may be at the beginning of its day while another is at [its] middle, and a third at [its end] [?: ראש / אמצע / סוף — beginning, middle, end of the day, the standard three-fold division]. The longitude that lies between them produces the difference, and this is one [and the same principle].

And what we have said here — that the [reference] place determines the new moons by its own [reckoning], and that the day for the eastern [dwellers] is reckoned [one way] while for the western [dwellers] another — all of this is according to the [order] we have set out, as far as the [reckoning] we have spoken of [?: line-end abrasion at the foot of the column].

[The reference place], when the sun reaches it [in its course], the day begins for [that place]; and [for] one to the east of it, the day [had already begun], [while for] one to the west of it, the day [has not yet begun] — for the eastern [dwellers] are ahead and the western behind [?: מורח מתחילין / מאחרין — "the eastern begin earlier, the western later"]. This is the matter of the longitude that lies between them, and it is one [principle].

The new moons [are reckoned] from the place that is best [fixed] for [the purpose], and according to it the day is reckoned for them; and the day for the eastern [dwellers] is reckoned [in advance] while for the western [dwellers] it is reckoned [later]; the difference between them is according to the longitude.

[The course] of one place is the day, and another the [night]; and the longitude that lies between them produces this. So too the new moons, by this very [principle]: a place to the east, when its day begins, [is ahead of] a place to the west whose day [has not yet] begun; and the difference between them is the

longitude that lies between them. And this is sound and clear, [?: line-end faint] — and the [reckoning] follows it.

For each one [of them], according to [the position of] the sun, the [reckoning] is fixed; and one of them is the [day] while the other is the [night], so that the day begins for the one while [for the other it has already ended] [?: מתחיל / נמשך — "begins / is drawn out"]. The reckoning of the new moons follows this principle [?: line-end].

[The new moons] are determined for them according to [the principle stated], for the eastern [dwellers] and for the western: it is the same hour [in itself], yet [its] reckoning [differs] for them, and this difference, [too,] follows it.

What we have stated here is sound and clear: that the [reckoning] of the new moons [is fixed] from one place, and from it the day [is reckoned] for them, [a single hour serving all yet] reckoned differently [from place to place]; and the difference between them, [too,] follows this. This [whole] matter [we have set out] is sound and clear, [and the longitude] is what produces it [?: lower foot of column, faint].

It is good and sound that the [reckoning] of the new moons [proceeds] from one place; for from it the [reckoning] of the day [is fixed] for them, and the difference between them [arises] from the longitude that lies between them. So it is for the weekdays — Sunday and the [days that follow], the new moons being [reckoned] by their [common] place; and the day for [the eastern dwellers is reckoned in advance] [?: foot-of-column line, partly faint].

We have already said that the difference [in the reckoning] of the days [arises] from the longitudes, [and that] the [reckoning] of the day [in] Sunday [and the rest], [and the day] for the eastern [dwellers], [follows from] the [reference] place — its beginning and its end being a single [span] [?: שם ... סוף, the foot-most legible line of the page].

[The lower portion of the column is blank parchment, not damage.]

when the sun reaches it [in its course], its reading [i.e. its reckoned position] [is fixed] at the [moment] of [observation]; for [the reckoning is] good and sound [only] from the place [appointed for it] — that is, from the [fixed reference] place. For according to it the day is reckoned for them; and the day for the eastern [dwellers] is reckoned [in advance] [?: opening line, carried over from the foot of 76r].

The great [reference] place [?: מקום הגדול — "the principal place"], when the sun reaches it [in its course], the day begins for them [there], and [for] one [who dwells] elsewhere, [the day is reckoned otherwise]. So you should know that the [reckoning] is fixed [thus]. And this is the matter [of it]: for we have already said that the reckoning of the day [in] Sunday [and the rest] and [in] the new moons follows from the [reference] place, the [position of] the molad [of the moon, or the] molad of the world [מולד העולם — the molad of Creation], being [a matter of] a single fixed [point]; and the words of [our predecessors are sound] [?: line partly faint] regarding this. For one who is to the east [is ahead] and one who is to the west [is behind], [each] reckoning by its [own place] [?: עלי בני אדם — "for human beings (everywhere)"], so that the day [is one thing here and another there] [?: line-end faint].

It is good and sound that the [reckoning] of the new moons [proceeds] from the great [reference] place; for [from] it the [reckoning] of the day [is fixed] for them, and this was the matter of the difference [in the reckoning] — that the day for the eastern [dwellers] [is reckoned in advance] [?: faint]. This [whole] matter, then, [is settled] for the new moons, and the difference [arises] from the longitude that lies between them. The reckoning, [too,] follows this principle: that to the east [it is one moment] and to the west [another], [?: faint] — and the difference is the longitude that lies between them, and this is one [and the same principle].

Now [we turn to] the reckoning of the moladot and the tequfot [the reckoning of the new moons and the seasonal turning-points]: for the [matter] of the new moons [follows] from the [reference] place, and from it the day [is reckoned] for them; and the difference between them [arises] from the longitude. [It is settled, then,] that to the east [it is one moment] and to the west [another], the difference being the longitude that lies between them, and this is one [and the same principle] [?: the closing of a long parallel run].

Now [understand] this concerning the reckoning of the moladot and the tequfot, [the matter] determined for [the people of] Israel, and the law [as it is fixed] [?: וכן הדין — "and for Israel, and so is the law"].

There are [now] new heads [of the months] and new tequfot, [a fixed reckoning] established and standing, the foundations of [the reckoning] [?: יסודות החשבון — "the foundations of the reckoning"]: the later [authorities] established it and fixed it; and this concerns the reckoning of the moladot — the foundation of the reckoning of the [moladot] [?: ליסוד חשבון — "for the foundation of the reckoning of the moladot"]; and likewise the foundation of the reckoning of the tequfot. For each of these has [its own] foundation; and what is said [is this]: there is a [fixed]

reckoning [siman] for them, and they are [reckoned] from the foundation [?: יסד סימן — "a fixed reckoning/marker for them"], and one proceeds from one [foundation] to another.

[Margin: a "[סימן]" (siman) marker is written in the left margin alongside these lines; the siman number itself is largely cut off / faint at the page edge.]

[There is] a [fixed] reckoning [siman] for the first [foundation], and a [fixed] reckoning for the [later] [?: למען ... למען הראשון — "for the first ... for the (later)"]. And [in] the first foundation [?: למענה הראשון], there [are] the [reckonings] of the new moons that are sound, [?: faint], and so on.

[The remainder of the line and the foot of the column give the standard astronomical machinery]: for the reckoning of the molad of the moon [מולד] and the foundation [of it]; and likewise [for the reckoning] of the tequfot [the seasonal turning-points] — this is [the matter], and one [reckons] from one [foundation] to the next [?: a procedural formula, line faint at the foot].

There [now follow] the foundations of [the reckoning], [the matter] settled, [in the manner of] the foundations [established by our predecessors] [?: כדרך / כמו] — שהקדמנו — "as our predecessors set out"; for this is the [reckoning of the] tequfot, and this is sound; and according to [it], we have [the reckoning of] the [moladot], and so on [?: a closing procedural formula, foot of column].

So this place [the appointed reference] is the foundation of the reckoning [/ יסד / סימן], and likewise [is fixed] the reckoning [we have set out]; and the words of our predecessors [are sound] [?: קדמונינו ז"ל ליסד חשבון] — "our predecessors, of blessed memory, [established] the foundation of the reckoning"; [and on this the reckoning] is built [?: the foot-most legible line of the page].

[The lower portion of the column is blank parchment, not damage.]

so too the days of the natural day, which the sun completes in its course, up to the point where they are set in their places. And likewise the evening, and after it the day. According to the longitude, the natural day stands at a single reckoning: for one place it is daytime while for another it is still night, so that the start of its hours [differs from place to place].

This has already been explained above: that the difference of time among the longitudes is not by a fixed measure, but according to how far one place lies east or west of another. So when its reckoning is "evening" for one place, it is "morning" for the place to its east; and the hour that is the start of the day for the one is a different hour for the other. Thus a person who reckons the days, or who

reckons the months and counts them, must reckon each according to its own longitude.

So too a "day" reckoned for one place may begin at one hour while for another it begins at a different hour, since the natural day at one is evening while at another it is morning. The reckoner of the hours of the day for one place differs accordingly from the reckoner of the hours for another, because the easterly place reaches the start of its day before the westerly one; therefore the natural day was, at the one, evening, and at the other, morning.

And so it is with the natural day reckoned according to the longitude. As we have explained, this hour was for the one an [earlier] hour and for the other a [later] one, and likewise for the rest of the calculation. In every case, whatever measure the easterly observer reckons, the start of the natural day shifts accordingly. Therefore what is "morning" here is "evening" for the place to its west; and what is the [later] hour here is "morning" for the place to its east. So the easterly observer differs from the one to his west: the natural day was, at the one, evening, and at the other, morning.

[Closing rubric, two centered display lines:] **This Treatise is finished and completed — praise and laud to the eternal God.** (נשלם המאמר הזה ושלם שבח)
(והלל לאל עולם)

[Closing verse, two lines:] Both of them, and his months — who created these, the One who counts their host by number; / through abundant strength and might, no man falls short. (שניהם וירחו מי ברא אלה המונה במספר צבאם / מרוב חונס ואומץ כח)
(איש לא עדר)

The [Fourth] Treatise

[Centered display heading: **המאמר הרביעי**] — the heading word reads as a ש-ל/ל or ר-ב/ע-cluster; glyphs are abraded and ambiguous between "Third" and "Fourth." The contents that follow enumerate Chapters 1–10, consistent with a new Treatise. [?: heading numeral — vs. שלשי — [רביעי].]

[Prologue:] In it I shall make known the order of the [reckoning] and its parts, and how it proceeds, and what is needed for it, [each] in its proper order. The order of the chapters is set out here, and from it one learns the order of the matter as it stands in the reckoning; and this is a portion allotted to it.

[Contents rubric, centered: **סדר הפרקים** — "The order of the chapters."]

In this place a person needs, in order to understand the order of the reckoning of the months and the seasons and what is required for them — that is to say, the foundations one needs for them — to consider the order of the reckoning.

[Table of contents of this Treatise — the chapter labels stand in a centered column, each with a one-line topic summary to its right (the inner column); the left-margin gutter repeats "פרק" ("Chapter") as a finding-aid down the page. The chapter labels are clearly legible; several topic summaries are partly cut where the inner column meets the page edge / gutter.]

Chapter	Topic (as summarized in the contents)
פרק ראשון [Chapter 1]	On the order of the year of the sun and the months — their arrangement.
פרק שני [Chapter 2]	On the matter of the seasons (tequfot) of the sun, and the difference between the early sages and the later ones — what each held.
פרק שלישי [Chapter 3]	On the order of the reckoning that is required, and what one needs for it.
פרק רביעי [Chapter 4]	[topic summary cut at the inner-column edge — [?]]
פרק חמישי [Chapter 5]	[topic summary cut at the inner-column edge — [?]]
פרק ששי [Chapter 6]	[topic summary cut at the inner-column edge — [?]]
פרק שביעי [Chapter 7]	[topic summary cut at the inner-column edge — [?]]
פרק שמיני [Chapter 8]	[topic summary cut at the inner-column edge — [?]]
פרק תשיעי [Chapter 9]	[topic summary cut at the inner-column edge — [?]]
פרק עשירי [Chapter 10]	[topic summary cut at the inner-column edge — [?]]

[Body of the Treatise begins, beneath the contents list:]

On the order of the year of the sun and the months, and what is required for them; for one needs to consider the order of the reckoning, and what is required

of one for it. So too the difference between the early sages and the later ones, [each] in its order; and this is what this Treatise concerns.

On the seasons of the sun, and the difference between the first ones and the later ones — what is held by each. On the matter one needs for it: the order of the reckoning of the year of the sun and of the moon, the foundation of the natural day, and the order of these matters.

On the matter one needs: the order of the reckoning, and the difference between the first ones and the later ones, and what one needs for it; the order of the reckoning of the months, the foundation of the natural day. In order to consider the reckoning of the months and the seasons — that is to say, the foundations one requires for them.

On the matter of a cloud and the like: the moon is seen at the firmament over the place, [reckoned] according to its longitude — east. (מזרח)

[Lower portion of the page blank.]

[Continuation of the Table of Contents of the Fourth Treatise]

The upper portion of this page completes the chapter-list of the Fourth Treatise (the calendar), begun on the previous folio. Each entry pairs a chapter rubric (פרק) with a one-line summary of its subject. The summary lines are set in the right-hand column and their inner (gutter-side) ends run off the column edge, so the closing words of several summaries are cut off.

- **Chapter Eleven (פרק י"א):** This chapter will explain [כבר חור / כמו שיתבאר] ... concerning the moon [הלבנה] ... [inner end cut off]
- **Chapter Twelve (פרק י"ב):** This chapter will explain ... concerning the renewal of the moon [חדוש הלבנה] and the difference ... [inner end cut off]
- **Chapter Thirteen (פרק י"ג):** This chapter will explain ... concerning the days of ... [inner end cut off]
- **Chapter Fourteen (פרק י"ד):** This chapter will explain ... concerning the law of the division [דין החלוק] ... [inner end cut off]
- **Chapter Fifteen (פרק ט"ו):** This chapter will explain ... [inner end cut off]
- **Chapter Sixteen (פרק ט"ז):** This chapter will explain ... and the tequfot [seasonal points] [ותקופת] ... [inner end cut off]
- **Chapter Seventeen (פרק י"ז):** This chapter will explain ... and the tequfah [התקופה] ... [inner end cut off]

- **Chapter Eighteen (פרק י"ח):** This chapter will explain ... concerning a portion of the procedure for the eclipses of the moon and the eclipse of the sun [קצת מעשה לקיות הלבנה ולקות החמה] ... [inner end cut off]
- **Chapter Nineteen (פרק י"ט):** This chapter will explain ... [inner end cut off]

[The list of the earlier chapters of the Fourth Treatise was given on the preceding folio; the present continuation runs through Chapter Nineteen, so the Fourth Treatise comprises at least nineteen chapters. See the Numbering-anomalies note.]

Chapter One [פרק ראשון]

In this chapter we shall make known all that needs to be made known [את כל מה] ממהלך האמצעי של [שצריך להודיע] concerning the mean motion of the luminaries [ומדרגתם], according to the science of computation [על פי חכמת התשבורת] — for everything has its measure [שיש לכל חלוק כל] and these matters were already set in order [נסדרו] in the Treatise, just as we explained.

The center of the sun's sphere [מרכז גלגל החמה] is one that revolves [סובב], and the sun is moved about it continually [ומתנועע תמיד] along the order of the signs [על סדר המזלות], just as we explained. The line that issues from the center of the universe [היוצא ממרכז העולם] reaches to the center of the sun [למרכז החמה]; this center is a small point [נקודה קטנה], and the sun revolves about it [סבב]. So the apparent motion [המהלך הנראה] is sometimes greater and sometimes smaller, even though about the center of its own sphere the sun's motion is uniform [כי "by a fixed amount each day", בכול יום קבוע]. And its [daily] deficits [וחסרונן] are reckoned accordingly.

This chapter explains the law of the division [דין החלוק] and the judgment [מאמתיה] for there is a fixed point [נקודה קבועה], and from the center [מן המרכז] a line is drawn; and the way this is reckoned [דרך תקן זה] is by its truth [מאמתיה]. It also explains the apparent reckoning [קצת מעשה] of the seeing of the moon [ראיית] ... its motion [על שלשה דברים היטב], namely: the [mean] motion, the [apparent] motion, and the eccentric distance.

This chapter explains the law of the division [דין החלוק] and the difference [והשנוי], and how the matter stands [שיש עוד]; and the place from which the sun begins [ומקומו] is set at a fixed remove, and the order of the seasons [וסדר] — its [seasonal] points [תנועת התקופות]. And this chapter explains a

portion of the procedure for the eclipses of the moon and the eclipse of the sun [ותקנת [קצת מעשה לקיות הלבנה ולקות החמה [התקופות].

This chapter explains how much the matter is, for in each of the luminaries [בכל [ראש תנועה של זה], there is a beginning of its [own] motion [ומהלך אחד אמצעי]; and from it the mean motion [ומרחקה] of the eccentricity its [apparent] position is reckoned [ומרחקם מהרכז זה]. So begins the discourse [בחתמת המאמר], in this manner [היה בזה], as we said [שאמר] — what is needed [מה שצריך] ...

[Chapter One, continued — the eccentric model of the sun.]

the mean motion of the sun [מהלך החמה]. This is the mean [נוזה ממוצע]: the line that issues [היוצא] is the [line of the] center of the universe [מרכז העולם], and the sun's motion is short [תנועת החמה קצרה], so that [the sun moves now faster, now slower]. The tequfah is its [period] [התקופה], and the sun was [reckoned] thus, as we said [שמו וקטנו]; it is its [own] mean motion [שמו וקטנו], and the tequfot.

And it [the sun] always cleaves to [ודבק תמיד] the center of the sun [מרכז החמה], the mean [motion] [האמצעי], and it is moved [ועתה היה] in the motion of the mean sun [כפי מהלך האמצעי]. The eccentric [point] [נקודה החקוקה] revolves [סובב], and the line of the eccentric of the sun is fixed [מסלל החמה חקוק] at its center [המרכז], and from it issues [ומס יוצא] ... so that it [the sun] is at a [fixed] remove [שתהיה] ... [הקצרה צריכה הקטוב] this is what is observed [מ?] ...

The place from which the sun begins [מקום רוס החמה] — that is, the point of the eccentricity [נקודת מרחק] — is the point of the eccentricity of the sun [נקודת מרחק]; and it [the apparent position] differs [ויתן] from the mean [ומהלך] by [a certain] amount [שעור]. The eccentric of the sun was already drawn [שד נקודת] [מהמזלות]; its [apparent] position [ועשה היה] is the place of the sun [מקום החמה] reckoned in the signs [במזלות]. At [any] time [בעת בואו], the line of reckoning [ידרך] of [the sun's place] differs from this [ז"ה], and they issue together [וכ יוצאו בו] uniformly [כלוח].

The line of the eccentric reckons [מקו ?] the sun's place [מקום החמה], its mean [motion] in the signs, at all times [כמולת בכל עת]; and the [apparent] motion [ויען קטב היה שיריך] of the sun [קו והמהלך זה בכלמן] differs at each time [שד נקיב הקטב הוא], and the line that is called the apparent course [האמתי] [ושד הוא נקרא המהלך האמתי], the line of the [apparent] motion [קו פברה הציה התקו דט המהלך] of the sun [קו והמהלך].

[On the figure beside the column.] So the place of the sun [מקום החמה] is reckoned [recte: agrees] with the apparent line; the apparent motion of the sun [המהלך הנראה] is illustrated, as you will see, by the figure drawn in the margin beside this column.

Diagram. A small two-circle (eccentric/deferent) figure illustrating the sun's motion, drawn in faint brown ink in the gutter-side (left) margin beside the lower lines of the prose column. An outer circle and a concentric, slightly off-center inner circle; two captions curve along the inside of the outer ring. The figure is only partly within the photographed text-block — its right side abuts the column and its left side runs into the unphotographed margin — so its point-letters are not legibly resolved.

- Inner-ring caption (curving along the arc): מהלך החמה — "the motion of the sun" [partly legible]
- Outer-ring caption (curving along the arc): תנועת העולם — "the motion of the universe" (the daily motion) [partly legible]
- Point-letters at the perimeter and center: faint and running into the unphotographed margin; not legibly resolved [?]

[The lower two-thirds of folio 78v below the figure is blank — a wide blank lower margin, not damage. A faint brown stain crosses the foot of both folios; it does not obscure text. The leftmost column of each photograph is occupied by a conservation scale-bar and black strip (photography furniture), ignored.]

Yesod Olam — Fourth Treatise (the Calendar), Chapters One–Two

Bodleian MS. Huntington 299, ff. 79r–79v. Spanish Rabbinic hand, brown ink, single column. Conservation ruler and black mount-strip along one side are photographic furniture and are ignored. The upper portion of folio 79r and the lower portions of both folios are original blank margin, not damage; a faint brown foot-stain in the lower blank margin does not reach the text. ...and from this you should understand the matter of the sun. And when you understand this matter, the sun in the season of the equinox [תקופה] takes one course, and likewise in the [other] season; and the same holds for the rest of [the reckoning] [?]. And this is what we wished to make plain regarding its place [?], so that you may understand it, and so that the reckoning [חשבון] should come out for you correctly [?], as we said. And he said [?]...

[Display rubric, enlarged script:] פרק — Chapter [Two]

[on] the solar year [שנת החמה], the measure of its length [ומדת מנה], and the dispute [בזה הדבר] of the scholars [החכמים] on this matter [והם חלוקת].

I have set down [?] clear elucidations [בריאות ברורות] beforehand, for whoever errs in this chapter errs in the foundations of the world [יסודות העולם]; and as for the perplexed [ולמבוכים], the gradations [were] [היו המדרגות] [many] [?]....

[Inset rubric, enlarged:] דע — Know

that it is fitting and proper [כי ראוי:] [?] for us to compose, and to set down in it a book [לסדר בו ספר]...

[and the matter extends] up to the degrees of the sphere [ועד למעלות הגלגל], and most of the foundations [ורוב יסודי:] of the community [הצבור] and its arrangements [וסדורתו]; and because the things [ומפני שהדברים] that are near to one another [שהם קרובים זה לזה] are [not separable] [?] one from the other [?], and they did not bring out [ולא הוציאו] [?] at the beginning [בתחלה]...

[and it necessarily follows] from the intention [לצאת מהכונה:] of the matter [הדבר] at the beginning [בתחלה]; and likewise [ועתי בכך:], how a plant [נמצא:] grows by planting [נטיעה] — [in this way] the scholars [החכמים] [disputed] [?] in their investigation [בחקרם] of this, each according to the general principle [על] [פי הכלל]; and I shall make known to you [ואודיעך] the way [דרך] by which you have come to know this [ידעת בזה], and its root [ושרשו]...

[and after] the matter is understood [ואחר מובן:] [?] from the degrees [מהמעלות] [?] at every time [לכל עת:] [?]; and not [ולא] every [one of] the scholars [החכמים] knows it [לא יודע:], [and] it is not [discerned] [?] until [עד ש:] [?] the beginning [תחלה] is known [?]; the [substance / fixing] [?] [בכל זמן קבע:] [?]; and likewise the measure of the sun's mean motion [וכמו מדת מהלך] [מהלך החמה], for [the sun] in the season of the equinox [בזה היה כן:] [takes] one course [זה ירך:]...

[and] together with the measure of the motion [ועם מדת מהלך] [?], the order of the degrees [סדר המעלות]; and this is double [ושכפול זה]; the measure of the time of the year [ידת זמן השנה] and the length of the year [ומלת שנה]. The solar year [שנת החמה], and its reason [וטעמה] [הוא], its measure [שחקרי:] [?], that which is [חסון מהם:] [?], that its length [שהתחיל:] [?] is from it [ממנו]; and [?] [סס קטנה] [?] their reckoning [קודה:] [?] is found to be [נמצא היה:] [?]; and the breadth [והרחבת:] [?] of the year, in one tongue [לשון אחד], and he made a miracle [ועשה נס היה:] [?]; he received [קבל] now [עתה]...

it is fitting [that] we know [ידע: ?] the measure of its course [מדת מהלכה], for the eccentric [מהדק: ?] — its revolution was [היה מסיבתה] such that it would be [שהיה] [the two days] [היומים: ?] between the starting-point [נקודת התחלת] from which it begins and [the point] from which the equal [motion] begins [השוה התחלה]; and it returns [ושוב] according to [על פי] [?]...and it returns [וישוב] to its correct state [לתקון] [?: לקנה הרי: ?]...

And so, the reckoning [ושוב לקנו: ?] for us [לחברנו] of the leap-intercalation [?: [השוה] the portion [נח חלקי: ?] of the equinox [השוה], the second season [השני מלכי תבול: ?], [as] he says [ויאמר]; for this is the measure [נר] of the solar year, the reckoning [החשבון]; and the first [reckoning] [הראשון] is in measure [כבמדה] [היה מפרקי: ?] of the divisions [לרגע: ?] [כלום: ?] [השני]...

The eccentric is the place [חו חורק: ?] from which [זוקיני: ?] [the motion proceeds]; and from it [והו ולפיכך: ?] comes [יבא] the eccentric center of the sun [מרכז החמה]; the true [place] [סבב תחלה: ?], and from it [ולפיכך] it revolves to [ל] the center [מרכזה], and it returns [וישוב] [לשו: ?]...

the measure of the motion [מדת מהלך: ?] [ועם לבקי קמועברו: ?], each one of them [כל אחד מהם] of the days [מהיומים] [והלוה ועובה: ?], the sun [החמה], as at the beginning [עליה זה היה] [כבתחלה: ?], and concerning its place [לשו: ?]...

and concerning it [עלי עליה: ?], the reckoning [עלב השנ: ?], in order to know its motion [כדי לדעת מהלך], the eccentric [היחל: ?]; and he says [ואמר] that [כי]...

near [קרוב] to one year [אמת שנה], for this is [והוא] [the time] which [הזה: ?], so that they [לתבו: ?] [שהיו: ?] [שתבח: ?] [שעבת: ?] [might investigate] [שטבח אותו: ?] and investigate [וחקר] the measure of [על מדת] the motion of the sun [מדת] [מהלך], and the year [ושנה] [כעולת: ?] [הנחושת השוה: ?], so that there be no error [?: [בעטר: ?] the revolution [לכך מאיר: ?] [לבדו: ?] [וכמו] [ועל ההאצור: ?], the eccentric [ועל: ?]...

the measure of the sun's motions [מדת מהלכות החמה], at the [smaller] end [שבר: ?] [כמו] [ומאיר] [עליו] [as] [לבדו] [each one alone] [פנה הקטן] [היה: ?] [ויומס] [שבכל יומס] [the days that are preserved] [היה: ?]...

[from] it [מאנה: ?], and every [season] [וכל ביושב: ?], and the equinox [וטיקופה ותכן] [שהיא] [הרעב: ?] [שיהיה] [זמן] [the time of its [course]] [היה: ?] [שיום] [שלם יומס] [the day] [היתה היו]...

[the season] of its passage [משך עבריה], a measure of [פטשתי: ?], [השנשתחא: ?] [?:] [והיה כל], that it be [ככת תחית]...

[concerning] the eccentric [עשר: ?], and this is according to its [nature] [?: לפי]; it was [זה היה], the substance [מעמר מרס: ?], the sun [החמה], its [מס: ?]; and the eccentric [?:] [ופרכבא היה: ?], that it be reckoned [לרעשו זה: ?], so [כן] in the seasons [בתקופות], its eccentric [ובן: ?] [אוו: ?]...

and the year [הוא ירעה התקן: ?], and this was [וזה היה], it was [היה] the true [conjunction] [הצומת: ?], the season [היה רעמת: ?], and its measure [ושעור], and it returns [ותשב לכן]...

[its] [מאחיו: ?], the reckoning [זו: ?], the season [שעה ה], it being [סהיה היוס], the eccentric [היום: ?] [כל כסס סדרים: ?], and it returns [וטומר], it being [אזה]...

the things [ירעת: ?], and the eccentric [וירעמו] [בן], and afterward [ואחר], that the season [שהיא לסס] [עת התקופה], it being [לסס]...

and the eccentric [ווחומר: ?], for this is [כי הוא] the time [זמן], the true solar year [שנת החמה האמת]; and the eccentric [ווחחר: ?] [שיקר: ?]...

[after] one year [אחרי שנה] [הקשר: ?], and [וחמר כי], that it be complete [ועשלם], that there be no [לא מצא: ?] [שהנעשה: ?]...

[Lower portion of folio 79v is blank — original blank margin.]

[Foot of folio 79v, last lines:] ...it draws on [המשך] in [בעתים: ?] [וזות: ?], [for] many [שנה אחרי שנה] [רבות] a year [שנה אחרי שנה]...

[Treatise IV, Chapter Two — the length of the solar year, continued]

a quarter-day, no more — yet [this is what made the matter difficult and produced disagreement among the scholars]. [?: the rightmost head of the page is faint] And [the deviation that arises] from this gives rise to the difficulty in [reckoning] the years and in fixing the seasons; for the solar year is not equal to a whole [number of days], but only [a whole number] together with a fraction. And he [the scholar in question] knew that this fraction was the cause of the difficulty, and that one must take care to correct it, so that the foundations of the world [— the calendar —] not be undermined. He said: were the time of the year a whole [number of days] with no fraction at all, the [reckoning] would be easy; but since it is a whole [number of days] together with a fraction, the matter is hard, and one must add to it [a correction] and watch it closely from year to year.

For if a person sets the year [at one measure] and his fellow at another, and a third at yet another, then their reckonings will not agree; and so it was that they set [different measures], one setting it [one way] and another setting it [another], and they called it [thus]. [Among them] Ptolemy [בטלמיס] and the sages of his school agreed on this [measure], and afterward [others differed]. And so, since in each [reckoning of the] motion of the year the year is not [exactly] equal to [a whole] year, [an error accumulates] year by year as it is measured, and the more [years pass, the larger it grows].

[?: a clause here is too faint to construe — "סשין סו או כמצבו" ...and the matter is as we have stated. For [this is] the fraction of the solar year, which [the scholars] set as a quarter of a day [רביע יום] — yet they differed as to whether it is exactly a quarter, or a quarter lacking [a small amount], or a quarter together with [a small amount]; and from this small difference the great difficulty arises, and from it the [accumulated] error year by year.

And he [the author] said: this fraction is the foundation of the entire matter, and one must investigate it precisely and not rely on an approximate [value], so that the [calendar's] foundations stand firm. For Ptolemy [בטלמיס] and the investigators [החוקרים] of his school took it as a quarter of a day exactly, [and reckoned] in this way; and another after them found it to be a quarter of a day lacking [a small fraction], and so the reckoning [of the year] varies, and many a year is added [erroneously] after [a long span of] years, and the error [grows] as we explained.

And he said: it is fitting to know the true [length of the] year and to fix the seasons upon it correctly, and likewise the molad [מולד]; for if the year be set at one measure and the seasons reckoned upon a different measure, the whole [system] will be corrupted, and the appointed times of Israel will fall out of their [proper] places. For this reason the early sages took great care over this fraction and labored to make it precise, and did not leave it to estimation; and there remained no [doubt in their hearts concerning it].

[The accumulating discrepancy:] After [the passage of] many years the error in the [reckoning of the] year becomes apparent to the eye — that the [reckoned] time is good and sound, [yet drifts]; and the [discrepancy compounds], and after many years it [amounts] to a [whole] additional day and more.

[?: the opening words at the head of 80v are faint] ...and he sets the true motion of the sun, the foundation of all the seasons; and the [scholars] differed as to this. [One] set it [at one measure] and his fellow at [another], and [the third] at yet

another. The investigators among the Greeks [קדמונים / al-madwiyqis, the precise ones] reckoned the [length of the] year, and [Ptolemy] found it to be three hundred sixty-five days [365 = שש"ה יום] and a quarter of a day [ורביע יום], save [a small fraction]; for he was able to determine it [only] by [long observation], a quarter of a day lacking [a small amount]. [?: "מבחל חלק יום" — uncertain numeral cluster, possibly "1/300 of a day"]

And the matter is: a quarter of a day lacks [a small fraction], a fraction of a fraction [פחות חלק] of a day; and from this [the year] is known, and one must add to it the time of the year, [namely] three hundred sixty-five days and a quarter of a day. From the [perspective of the] motion of the sun the year is [reckoned] as three hundred sixty-five days and a quarter of a day exactly, but in truth it is [a little less].

[?: a stretch here — "שו לשון שאר... מחקרים אצרכם כבר בטל כמושטו"] ...and from this the early sages already nullified [the round value] and corrected it. And as for the true motion of the sun [in] the year, [it is] greater [than the simple reckoning], and there is the [difficulty]: the early ones reckoned [the year] as three hundred sixty-five days and a quarter of a day, lacking [a small fraction]; and the difference between this [measure] and that [measure] is [slight]. [?] ...a quarter of a day and three hundredths of an hour [?: numeral uncertain] ... and good and sound [is the reckoning], and [thus the year is fixed].

[?: "השנה המדוייקים הוא שש"ה יום ורביע יום פחות חלקים"] The precise [length of the] year is three hundred sixty-five days and a quarter of a day, lacking some fractions [פחות חלקים]; for the [true] motion of the sun is somewhat greater [or less] than the simple [reckoning of] a quarter-day. And the true year is [equal to] three hundred sixty-five days and a quarter of a day, less a fraction; this is [the measure of] the days, hours, and fractions of the year. And one must add to it the [proper] correction, for the early ones reckoned a quarter-day and [a remainder].

[?: "...ולא יותר... וכבר נמצא בכל מספר ימים וחדשים"] And [the year] is found to comprise a [reckonable] number of days and months [חדשים]; and the years and [their fractions accumulate], and the difference [between true and reckoned] is the cause of the [drift]; and the true motion of the sun [is the foundation]. The investigators reckoned the [length of the] year [as] three hundred sixty-five days [שש"ה], a single fraction [חלק אחד] [?: numeral cluster uncertain], and a [further] fraction; and [its measure was] thus and so. [?: "ירושל לכוונת ושר לא נתקרב"] ...and the true [value] was not [exactly] reached.

And the [author] continued: the time of the year is three hundred sixty-five days and a quarter of a day, lacking some fractions; and one must add to it [the correction], so that the seasons may stand firm and the molad [be reckoned] upon [it] correctly. And the [accounting of the] tables [לוחות] of the seasons [is established], and the [course] of the sun and the moon [is fixed thereupon]; and so the [calendar] is set in order. And the investigators differed in this [matter of the] solar year [שנת החמה], the seasons, and the [fractions]; the [precise] truth requires [careful] investigation, and they did not [fully] arrive at it.

ועתה [And now —] [a new section / argument opens here] ...the seasons [תקופות] that [the sages of Israel] set, and according to whose reckoning [the calendar runs]; and the [reckoning] that the early ones handed down [is established].

[The lower margin of 80v is blank — not damage. Faint ink trace at the foot is bleed-through / a stray mark, not text.]

Fourth Treatise (המאמר הרביעי), Chapter Two (פרק שני) — continued: the length of the solar year, the seasons (תקופות), and the motion of the solar apogee.

in the science of the secret of intercalation, [a matter] they did not know. And first I say that the precise inquirers [המדקדקים] did not stop at this, nor did they agree to it, as will become clear in the matter of the length of the solar year. They investigated it with great precision, and yet further [וחקרו עליה בדיוק גדול ויתר] [ממנו], and at first [והדעת תחלה] [it seemed otherwise].

The reason is that the reckoners did not stop at a single opinion, but each one [investigated] according to his understanding [לדעתו]; and they found that the length of the solar year [שנת החמה] [departs from the round quarter] by a little, yet [the discrepancy] grows [until it amounts to a whole day]. This is the opinion of the inquirers [דעת החוקרים], [namely] that the time of the [solar] year is short.

And the astronomers [החוזים בכוכבים] said that the time of the year is short, and that the time of the season [זמן התקופה] is short; the place of the sun's apogee [מקום רוס החמה] is at [a fixed point of] reckoning, and from this came the matters of the seasons [התקופות]. With precision [בדיוק] the apogee of the sun moves [נוטה] in its own motion, this being a known matter; and the place of the apogee [מקום רוס החמה] in the degrees of the zodiac [במעלות המזלות] is such, and it returns [ויסוב] to the beginning [so as to complete a cycle].

For there was one [point] that it began from [שהיה מתחלה], and it returns to it [וכן היה] [so it was at the beginning] [בתחלה], and so at the end [וכן היה] [אחרית]. They said that the [point of] return [נקודת הראש] is near [קרובה], being the

place of the sun's apogee [מרכז / רוס החמה]; and they investigated it with great precision, more and more, and grasped it [ותפשו].

When the sun runs [שתהלך] its course from the apogee [מן המרכז], one knows it [precisely] in every place and at every season; and there was one place [for the apogee] that it is, and it returns [ויסוב] to it, so that it is at the beginning, as we said. For what was at the beginning [מה שהיה בתחלה] returns to be at the end [יסוב], and so on [וכן]. The place of the apogee is its [proper] place, and likewise the [computed] places [המקומות] — this is the opinion of the inquirers [דעת החוקרים]; the astronomers [האומרים] say that the time of the season is short.

The place of the sun's apogee [מרכז החמה], its motion is small [מהלכה קטנה]; and so it is at the beginning, and it returns to it [ויסוב לו]; so it was at the beginning, and the place [of the apogee] is its place. And the difference [ההפרש] in the degrees of the zodiac [במעלות המזלות]... and the seasons [התקופות] do not stand fixed upon the place [על המקום], but the deferent-motion [מהלכה] carries it along, [so its place is not constant].

And we have already laid down [הנחנו] for it a [fixed reference] place, so that the [computed] places [המקומות] should be in good order [בתקון]. [Margin (right): שמי — "solar," keyed to the discussion of the solar apogee.]

וחר [rubric, foot of leaf: *And he investigated / And it was investigated*] — its arrangement [סדרתו]... the time of the year is short [זמן השנה קטנה].

the fixed stars [הכוכבים הקיימים]; and the inquirers [החוקרים] grasped [only] a little [קלה תפשו], for the precise ones [המדקדקים] only hoped to reach a single measure [מדה אחת], and again, and from then [it followed]. For from the beginning [מתחלה] [the apogee] was inclining [היה מתחלה נוטה] [through] the degrees [of the zodiac], as it were [כמו] [?: — "thirty-five," numeral faint] times, from [its various] motions [מתנועותיו].

And they investigated [it] with precision [וחקרו דקדקו], and the inquirers said that they found this: that the place of the sun's apogee [מקום רוס החמה] conjoins [שיתחבר] [the apogee] was quiet [שתק] from the point [מהנקודה] from which it had been turning back [שהיה חוזר]; [and there is] a difficulty [קשייה] from the [theory of the] aether [מהאוויר]. And the ancient reckoners [הקדמונים] proved it [הם הוכיחו]; the later ones [השניים] called [it] the [second] reckoning [הדין]; the place of the sun's apogee [מקום רוס החמה] was at rest [שתק] in the degrees of the zodiac [במעלות המזלות]. And the [later] reckoners proved [it] precisely.

[The fixed stars] do not move [אינם הולכים] except by one [degree] [in] a hundred years [עד שיעבר :? — the slow precession; the numeral region is faint]; for the apogees [המרכזים] are gentle [שוה], and they do not stir [ולא יסירו]; and the rest [ושאר] — in the end [אחרית] [the matter] returns [חזור]; and so on [וכן].

וכבר [rubric: *And already*] — and the apogees [המרכזים], and the [computed] places [המקומות]... [a fresh sub-argument opens here].

When it [the apogee] was at the beginning [בתחלה], so it was; the apogee [רום] of the sun moves [הולך], and the deferent carries it [ומהלכה]... this being its [computed] motion — the [reckoning of the] years [השנים]. And the [computed] places [המקומות] are in good order [בתקון], and we have laid down [והנחנו] [its reference] place [שתק], from... and the [computed] places [המקומות], as we said, and as they said.

When they investigated [it] with precision, the year-length is [found] short; and the difference [ההפרש] in the place of the apogee... [recapitulation of the apogee-motion argument].

ועתה [rubric: *And now*] — for they returned in order [סדר], in arrangement [בסדר], [to determine] the place of the sun's apogee [רום החמה] in the degrees of the zodiac [במעלות המזלות]. By [כ"ב :? — "twenty-two," numeral faint] [degrees / units] they placed [שמו] what they had investigated in the matter [במאמר]; and from the motion [מהלכן] the year-length is [found] short, the time being short. The seasons [התקופות] proceed [הולכים], and beneath the [reckoning of the] place [תחת] [מקום] the sun-place [מקום השמש] [moves]; and the difference [ההפרש] and the deferent [והמהלך], and the seasons [התקופות] [continue].

a [whole] year, and the time of the [solar] year is short; the time of the season [זמן] [התקופה] is short, and the seasons proceed [הולכים]...

**

**

in observations and in the [reckoning of the] centers of the sun and the planets; and they varied, each one of them, in determining this. They labored greatly over the matter of this year — though the sun was but one small body. And so it was that one observer would attest to one thing while another attested to something else, and they neither agreed nor stood upon a single conclusion.

The cause of this was that the observation was difficult, for the bodies whose motions they sought to determine were remote from them, and the instruments

small. Each one therefore set down what came to his hand: one gave the year as such-and-such days and a quarter [numeral: ?]; another the same with a further fraction added; and another together with [other] fractions besides. Some increased the additional measure and some diminished it, each according to the conclusion that came out for him.

Those who came after them examined these matters and determined them — the motions of the sun — and sought out their truth, as is the way of later authorities: by such-and-such a count of parts [numeral: ?], and what was wanting they supplied. And this is correct, in accordance with what they did, in that they corrected one another; for the later man took up the work where the earlier left off. So they determined the motions of the sun, that they are truly so, and it is established with us — for this is one of the foundations upon which this entire matter rests.

And [it is] from [these] motions — that this is the [length of the] solar year — [that] its computation comes out: that it [the sun] goes on and travels along in its course, and this is by its motion; and that it is [carried] by another motion as well, [moving] from one place to another — that is, the motion of precession [תנועת המוקדם]. By it, the year [-reckoning] comes out [as] one minute [advance] in a hundred years; and from this it follows that the place of the sun [its apogee] stands at [such-and-such] a degree [numeral: ?].

וכבר [And already] have we made clear and set down here that the time of the teqfah is [thereby] known, with the reckonings dependent upon it: for one reckons it from the cycle of the moon [מחזור הלבנה], and from this comes the [further] reckoning, and it is determined where [the sun] stands in its place. And in [the matter of] every appointed time, the foundation of [reckoning] the place depends upon our predecessors — the leaders of the generations, may their memory be a blessing, who established this matter for us, [each] adding much to the determination of the place: one determined the place at [such-and-such a degree] [numeral: ?], another at another. What we have set down is the [reckoning in this] *Yesod Olam* [Foundation of the World], and it is as follows.

ועתה [And now], that which the [practice of the] teqfah requires — that one know the time of the teqfah of the sun — this is the foundation of the teqfah. It becomes known when one takes the [accumulated] excess for however many years; this is the teqfah as founded for it, [reckoned] so that the [sum comes out correct], just as the sun is [truly] founded for it.

of their predecessors, may their memory be a blessing. And as for these matters of the seasons that bear upon this cycle — that [the sun's] place is [thus], and there is in it [a discrepancy] — herein lies the difficulty of knowing it: the year of the tequfah and the cycle of the moon, so it is. And whoever would reckon by it, let his strength be firm; for [this is] the foundation [of the matter], may God be exalted.

The foundation of the tequfah is [reckoned] by way of the days and the months that bear upon this cycle, and from this comes the reckoning; for he reckoned it, and his reckoning [came out so]. And as for the year of the tequfah, his reckoning came out [thus] in his counting, and he set it down — for the matter rests on the foundation that bears upon what we have set down. This is the true thing he set down — and [the matter] is greater than this.

And the place of the sun [its apogee] was shifting in its position, and this is by another motion; and it [moves] from one place to another, and here it stands at [such-and-such] a degree, as follows. From the one place [it is] the foundation [reckoned] for the moon, and from the other place one likewise [reckons] for it, [adding] the [accumulated] increase. For so it is: these [motions] are not equal — a great motion and a slight one.

But it is impossible that there be a body that travels along [in its course] except by motion — and this is the motion of precession — and the precursors [המקדימים]. And from his own [reckoning] one corrected it, [each] adding much to [the determination of] the place. And the [sum of the] motions [comes] from another place, and the body's [position] is altered. And the matter of the secret of the calendar [העבור, the intercalation] can [likewise] be determined.

This [matter] amounts to a sufficient foundation, and they have examined it — the secret of the calendar; they have determined it well, and the body's [position] is altered.

The foundation of the tequfah and its determination is [reckoned] by this cycle — and here it is, the cycle of the [solar] year, one of the foundations of the [calendrical] reckoning. The secret of the reckoning was given to us by way of the [accumulated] count of years, and [it is established] that this count is correct, [reckoned] so that they corrected it [from one another], and it was a sufficient determination. And as for the matter of the day [-reckoning], a great count [of years is taken], not [merely] a [single] portion; and [it is established] that this count of years is correct, [reckoned] so that one set down [its] foundations.

And [it is] from [these] motions — that this is the [length of the] solar year — [that] its computation comes out: that it [the sun] goes on and travels along in its course. And it [accumulates], over [a reckoned span], such-and-such [days and] a quarter [numeral: ?], and a four-hundred-and-eightieth [part] [or so] [numeral: ?]; and likewise for the parts, [the value of] one [unit] and more, just as so it is in their counting. And the parts [reckon to] one [unit] more, just so — [reckoned] until the [accumulated sum is correct]. And as for the matter of the day, a great count [is taken], more [than that], just as so: it came out so in the [recorded] determinations, [reckoned] until the [accumulated sum is correct].

[And it follows] that one add the [reckoned value], such-and-such [days] and more [numeral: ?], just as so; and so it is by [the] reckoning [in this] foundation. And upon this — every [reckoned] motion is determined likewise. What this requires is that one know the [accumulated] excess for however many years; for the tequfah stands founded for it, [reckoned] just as so it is [correct] in the determinations, just as the sun is [truly] founded for it.

And the secret [of it] is what is known: that one takes the [accumulated] excess for [however many years] — this is the difficulty of the matter, that one [reckons] the surplus determinations. And the matters are [accumulated] sums; each portion is good [correct], and it returns [wraps round] to [the start of] the cycle, [reckoned] for the whole of it. And as for this — the secret of the year of the tequfah and its determination is [reckoned] by way of the day [-count], a great count [of years], not [merely] a [single] portion; and it returns [wraps round], [reckoned] for however many years bear upon this. And the secret of it is a matter for the masters of [the science of] the calendar, may their memory be a blessing, who set down its foundations for it. And this is the foundation, [contained] in what we have set down here — that the determinations come out truly, just as the sun is [truly] founded for it.

For so it is: that one takes the [accumulated] excess of the year of the tequfah for [however many years] — this is the difficulty of the matter, that one [reckons] the surplus determinations. And the sub-matters of the calendar, in their counting, are [a number] more, [reckoned] until the [accumulated sum is correct]; and it returns [wraps round], [reckoned] for all the determinations, for however many years bear upon this — and this [continues]... ..and the inquirers took several [differing] portions [חלקים], and from this difference there arose the difference in the year that each of them established. The earlier ones added [הוסיפו] upon their [predecessors'] observations [על מדותם]; the later ones, who came after them, took up the close [reckoning], the inquiry [הקירוב והבדיקה], and so on. They

differed over the measure of the difference [על מדה זאת המחלקת]; for this difference is a slight one [זה במעט], and they corrected one another, this one adding and that one subtracting, until the measure [המדה] came out — so-many portions [חלקים] — and they relied upon it.

And know that the apogee of the sun [ראש החמה] — its place was established by them variously, this one [setting it] in one place and that one in another, because of the slight motion of the precession [תנועת המוקדם], a motion not perceptible save over a long span of years. [The specific value he assigns to it is given in figures here that do not resolve at this resolution: numeral: ?]

And know that the year of the sun, [reckoned] by the motion of the sun in completing one revolution of the sphere with all its turnings [בכל סבותיה], comes out to a [certain number of] portions [חלקים]; and this is the year [in itself]. This is what came out to him by his observation, [whence] the difference of the inquirers [שנוי החוקרים].

And know that the tequfah [the season-point], being a quarter of the year, comes out to so-many days and a quarter, and so-many hours and so-many portions [חלקים] — this is its reckoning. This being so, when you wish to know it, the matter of [reckoning] it [מה שצריך לדעת] is drawn from the motion of the sun [ממדת השמש]. For the precession [תנועת המוקדם] — its motion is slight, not perceptible save [over long time].

And so the [whole] matter [is this]: when [you reckon] the season-points [the tequfot], so-many portions [חלקים] come out, by the method [בכך], for the year, [each] according to his observation [כפי מדתו]. And the inquirers differed over it, this one and that one, [each] adding to the year a little and subtracting from it a little; the earlier ones added [הוסיפו] upon their observations [על מדותם], correcting [it].

[They differed] over the difference of the inquirers [שנוי החוקרים]; and know that this is a fresh [matter]: it [arises] toward the limit of the smallness [of the values], [for] the value [is one] you would establish as [stated]. So you will find that this matter [is one you may] know from the reckoning [of the] days [מן הימים]; and the moon [completes] the revolution of the moon in its turning [במהלך הלבנה], whereby it returns and goes straight [וישרך] in the proper way [על כדי]. And know that it returns by [the reckoning of the] days, [each] according to his method [כן [מדריך]].

how they relied [upon it]; and you know all this. [So] the inquirers — and know the difference of the moon, [how] it comes out as [stated].

And now [ועתה] — see how it was, [namely] the difference of the inquirers; for this matter is far [distant], not [to be grasped] without understanding [צריך עיון]. And know that what [is set] from the place of the sun [על מדת השמש] is precisely this, and they relied upon it: that a [single, fixed] value could not be established for the year, with all its [parts]. So know this: that there came out to them, by [the reckoning of] the days [the result], a difference [שנוי].

And he established it, and corrected it, [each] adding a little and subtracting a little; and there came out to him, [reckoning] from the place of the sun [מן מדת השמש], the value, [each] according to his observation. And know that the matter — its secret [סודו] is this: [it lies in the reckoning] from the place of the moon [ממדת הלבנה]. The difference, this one and that one — each one's value — they corrected [it]; and you will find this to be the matter [whose] secret [סוד] is one you will not know save [by understanding].

So [know] this: when you wish [to reckon] it, so-many portions [חלקים] for the year come out, [drawn] from the place of the moon [ממדת הלבנה]. And take from it the portions [חלקים], and there come out to [each] new month [לחדש] so-many portions [for the] molad [the conjunction]. For this is the [foundation of the] observation; and it follows that you should know that this matter — its secret [is hidden]; [reckoned] from the place of the moon, this is the secret [זה הסוד], and you will not know it [save by understanding]. [And these are] its words [דבריו]; this is the matter, with its reckonings, its rules, and its judgments [חשובותיו וכלליו] [ומשפטיו].

Chapter Three [פרק שלישי]

The difference [is reckoned] by [the reckoning of] all the motion [כל המהלך] that comes out for each one [לכל אחד]. Know [it] [דע].

For the tequfah [the season-point] — when you reckon its measure [מתוך מדתו] from their observation upon their [observed] motions [על מדתם] — the matter of the moon comes out [ממדת הלבנה] as [stated]. And know that the sphere [הגלגל], by its motion in completing a revolution, moves a little [each day]: in one revolution [it moves] so-many portions for the sun [חלקים על מדת החמה]; and the difference [הבדל] is [reckoned] from this. The motion [המהלך] of the moon is [thus] known [ידוע], and the [reckoning] of the conjunctions [moladot] returns by [the reckoning of] the days.

[And so] the moon [הלבנה], whose motion is what it is [שהוא רנושה?: numeral / reading uncertain], over [the span of] years; and there came out, [whence] you know the motion [מהלך] of the moon, the [reckoning of the] conjunctions

[moladot]. And take the portion [חלק] of the difference [for] the sun [על מדת], [reckoning] from the place of the moon [ממדת הלבנה].

[And by] all this you may know the matter of the difference [ענין ההפרש], and from this you may know it [the moon's] motion [מדתו], [reckoned] by the days. And the motion of the moon, the difference [is reckoned] by [the number of] days, [each] according to their measure [כשעורם], as they estimated [כשערו].

So there came out, by [reckoning] of the conjunctions [moladot], the place of the sun [מקום החמה], for in [reckoning] it [the moon] returns to its conjunction [מולד]. From [the conjunction] from beginning to end its turning [גלגולו] [proceeds], and a [certain] difference [צד יום] comes out, and there came out the difference [עשר?: numeral uncertain] — and this matter, that this span of time [שהזמן הזה] is approximate [קרוב], according to their measure [כשעורם], as they estimated [שערו, read שכערו] — ז"ל [of blessed memory]. [End of folio.]

Fourth Treatise [המאמר הרביעי], Chapter Three [פרק שלישי] — continuation: the moon and its molad (mean conjunction); the conjunction-to-conjunction span, the moon's mean motion per revolution, and the lunar year.

all of these spans are measured from beginning to end, with a small quantity in each one, namely [numeral: ?] day[s] for each — and this matter is approximate [?: כמו שלש], according to their measure, as they reckoned. For this was the cause, the span between one mean motion and another, and the [mean motions reckoned] in the spans [טימקנות]. And by this same path the matter proceeds in [reckoning] the mean motion's span [בדרך קצף — by the path of the limit], and the remainder of the parts [ואר החלקים].

The mean motion [המהלך]: it is half [the circle], and the spans of motion are alternating [מחליף תמורה], so that the mean motion's place is from [numeral: ?]. So too, just as we know one [span], we know its remainder, and we know to its rear [ולאחור — i.e. backward]; for between one known span and another known span there is a known [interval]. And these were their spans, and their places [ומקומותיהם], so that each one is known.

And these were their spans, and their places — they were known. For the sun [השמש], its mean motion is in the place where the reckoning [is set], at its [proper] limit [על חשבון האמת], so that each one is known. And by these spans the matter is measured for the moon [לבנה] in [reckoning] its mean motion's span. And this is a sound [matter], and it is more [precise — ויותר נכון, ויותר מסובב]: from these spans, just as they are [כשהם], the truth of the path is known [דרך ישמוס] —

by the path the matter is shown]. And these were [the values]; and concerning this place [ונכפי זה מקום], one [span] is found.

And the remainder of every span — and its remainder [ושאר] — these are the spans of the mean motion [שמות מהלך], so that they are known. For there is a near span [קרוב] and one farther [מסתעי], and in the place of [the reckoning] there is a known [span] for each, and its remainder [ובמקומו].

It [was] from the near span to the other [מבלאחר], according to the spans of the lights' motion [המאורות], and in their place, and in [reckoning] the [span of the] ninth [השמיני / השמינית], and the position of the [sphere — תנועת השמיים]. For the spans of the lights' [mean] motion [המאורות], by computation [בחשבון], and the position [ותנועת]: these are the path of the mean motion [דרך מהלך]. And these were [the values]; and there is a span between one motion and another. So too, just as we know [the motion], we know its arc [קשתו], and to its rear [ולאחור], as we shall [show]; and indeed it is so [וכן הוא — and so it is].

And by these spans is the matter measured — and it returns, and the spans [are reckoned] together [ויתחבר ונוסבו במהירות]. So, in the way [the reckoning] proceeds [על הספירות / על הספרות] upon the spans [על הספרות] — by however it goes [כי איך ישלה], the value [כמה?] — and there are [numeral: ?] spans [קציקים], by computation [כרחי]: for one against another, a near one, and there is a remainder, and it does not [exceed]; and it does not [fall short], and the matter does not [change — ולא יבדל]. So too the [whole] is reckoned [וכן ישלם הענין], on the [proper] spans [על] [הצברים], by [the computation of] the lights [ועיבורם], so that each one is added to the days [על הימים], and reckoned [ושלימדם].

And [thus] the matter — until [the reckoning] is fixed [עד היולד] — has neither span nor [intercalation — ולא עבור]; and by this [computation], the matter is [established — וכה ספר ורחות]. And the place of the spans [the moon] returns to in its lights [בכלי הלוחות], and one [span] is fixed for each — so that the matter [stands]: the moon's [span — מרכז], its place [is fixed] upon the [proper] limit, and one [span] is added [ועל וכביר על].

And the matter — upon the limit of the lights [על סדר החלקים / על קצף המאורות] — upon the order of the parts: one fixes it [ולעדק אותו / וליחד אותו] until [the value is good — עד טבא טוב]. There is a doubt [ספק] in this, for [in the reckoning of] the lights [מאורות] — by computation [בלי חשבון] — and in [reckoning] the mean motion's [span] [וסביב מרכזו]. So in all [these] spans, the [values are] sound [הטובים], by the computation of the lights' [motion — לבני מהלכם], and the place [reckoned] — and these are correct [וכיון]. The spans were [established], and the

addition [וטוסיף] of the parts [על פני]; and the matter proceeds upon the limit of the lights [על דרך פרט — by the path of the detail].

with the mean motions — for the [reckoning of the] motion is a distant [computation], with its [proper] limit, and [the limit] proceeds [וקבוע על נקודה — fixed upon a point]. He said [אמר]: the matter is [established — מנשטת] in the [first] limit [בקדמון] — by the cause of the first [limit — בכ הראשון], and [the value is] good. [Each] one [is reckoned] toward the other [לצד אחד], at the limits [מצד — the mean motion's span [העלות בשן], short [קצרה], and the first [span — וקדמון] is [reckoned] in [it]; for there is a [span — שחקקת], the matter is [established], and the rest [is reckoned]. And by these spans of the mean motion, the moon's mean motion [is fixed — שהוא מרכז הארץ], its [span] reckoned upon its path [על דרך קרוב]; for it returns [ולבו הסמית — and its computation], with [the reckoning of] the lights [התחמים], so that it is [established — כאילו] in the place where the conjunction occurs [קיסוף — i.e. the molad]: when the sphere comes [around — כן זה הרוסים], the mean motions are [reckoned — קרובים].

For this [span] was [established], and the [mean] motion proceeds [המשך], in [reckoning] when the moon's [span] returns [אשר], to show [להראות] that its place is [fixed]; and if [it is] otherwise, the matter [is reckoned otherwise]. He measured [שיעורה] upon the moon's place this [span — דהוא]: this is the [value] of the near and far span [קרוב ורחוקה], and at the [reckoning] of the [proper] limit [העשור — the tenth?], the moon's mean motion is [fixed], so that the moon's mean motion is [established], and the parts [חלקי] of the [mean] motion are [reckoned — אינו ומקן].

And there is added [ונוסע] from the [proper] span — for it is a near [span — שהוא קרוב], distant from it [רחוק ממנו], so that it is [established — שהוא בכל]; for the matter is fixed [יומה — is reckoned], and it returns [ונחשוב], for there is in it [the value of] the mean motions [מתחלפים], so that it returns [the moon] to its [proper] place [לעלה היא — toward it], in [reckoning the] mean motion's span [מתחלבת], so that the matter [stands — לעולם סבב מרכזו], and the [span] returns, and one [span] is fixed [וטיוסר על].

For the reckoning of the lights' mean motion [תקן חשבון למעלת], that [the span] be — just as they reckoned in it [שהקשנו בהן]. And [thus] the matter proceeds in this measure [לחניית תכיות — by these computations]; with the mean motion's span, when one fixes [שתתחיל] the [span — חלוקה], a distant [computation], with the spans of the lights' motion [שן המראורים — the lights' spans], it [stands — צלה זה], by the path of [the reckoning] of the near [span — שהוא על דרך קרוב], a near [span — לקרוב], in the place [reckoned], the sphere's span [קבטית בן זרס — at the

limit of the sphere], so that the matter [stands — טבה]. And so this [is] the path [of] the mean motion [דין החילוף], with the [proper] limit [המעון], from [the reckoning of] the mean motion's place [המקומו], and from the [span — מהמאמר], that [it be — זה]; and the matter [proceeds — למה במהלכו] from the [proper] limit [האמת] — and its place [returns — ושאר], and the mean motion of the lights [המאורות] — each one of them is fixed [אחת אחת], so that the moon's mean motion comes out [יוצא המרכז], and there is a span [reckoned — קליסה], so that its [span] be [established — שתהיה הכתוב].

So that the matter [stands — נטה של שתיה], just as it [proceeds — שיתקבל], upon its [proper] reckoning [לעלה הקקה], and one fixes it [ואותה נחרן], by [the path of] the moon's mean motion span [כשן חילוף החמה — the difference of the lights]; for it is [a known span — טבעלעלום], one against another [פיד בריאית], so that [the difference of] the mean motion [span — חילוף המהלך] be the [value reckoned — היה כפי מה]; and one fixes it [סקרו טלה], for [its] purpose [ראית להאריך] — that one not fix the [matter — שן כל אחת מן] except [as] the reckoning is [established — כתב שער]; for [the reckoning] of the lights' mean motion in their span [משטן] is [the proper span — הנלעלה] which the moon's mean motion comes out [היוצא המרכז ועעמ' — and its measure] from.

He measured [שיעורה] — this is the difference of the tequfot [שן תקופות].

◆ Chapter Four [פרק רביעי]. [Rubric, display script.]

[The chapter opens:] Knowing the difference of the tequfah [דעת שן התקופה] —

[Topic incipit; the chapter's exposition continues in the next opening.]

The arrangement of this matter and its computation is as we said: that the [tequfah] is an approximation, and for that reason it is reckoned for you in this way. These are matters that follow from the whole of his discourse, and from the reckoning of the position of the sun — that each degree is contained within the total, and each [helek] within the total, and so on.

As for the position of the sun: when the conjunctions are reckoned for one and the same period, the degrees are set in their proper places; and whoever fixes the [molad] in its computation thereby fixes it [as well], and the matter is clear. The remaining degrees and conjunctions are reckoned in the same way. There is in this a residue that is only approximate, so that they do not come out exactly even. Consider, then, all the matters bound up with it, and with the position [of the sun], for the [tequfah], being approximate, is the foundation of the reckoning, together with all the rest that depends on it.

The sun, by way of its mean motion, is uniform — just as the premise stated: that the [tequfah of Shmuel], reckoned by its mean motion, [stands over against] the reckoning of the [tequfah of Rav Ada]; and the position of the sun, when reckoned by a value equal to that of [Rav Ada]; while the [tequfah of Shmuel] goes by its [own] mean motion, just as we said.

[Margin, lower-left, secondary hand, ~3 lines, only partly legible:] "נצרך נטעל ... [?] נטה ופונה אותו.../ נצרך נטעל קדומה הנטמית [?] / כפל קדומה מגונה [?] שו מדנאת" — a constructive marginal note in a smaller, later hand; further identification requires further verification.

[Margin, upper-center, faint brown, one word, secondary hand:] "הקדמוני" ["the ancient/former (authority)"] — apparently a cross-reference gloss].

This reckoning is uniform, as the premise of the [Yesod / foundation] stated: namely, that there is a difference between the [tequfot]. This difference is reckoned into the computation of the position of the sun, and it is [only] approximate, as we said. From there the position of the sun is reckoned, with an excess of [a value] [numeral: ?], and the reckoning of the sun is approximate; so consider how the sphere of the sun moves.

The sun, as it moves on its course, is always [now] far from the center-point of the earth and [now] near to it — just as we said, it is reckoned by a uniform motion, and so the sphere of the sun moves. What is reckoned for the [farther] position approximates the truth [in that] there is in it a position far from us; and what is reckoned by the [nearer] position is near, [in that] there is in it a position near to us. And [the sun] reckoned by the [far] position is far, [in that] there is in it a position far from us.

The reckoning of the position of the sun is always [measured] from the earth toward [the apogee], together with the difference of the reckoning and [the motion of] the sphere of the sun. The reckoning in [terms of] position is taken just as we said, by way of its mean motion; and what is reckoned for the position approximates the truth by [that] position; and so the sphere of the sun [moves].

The ancients reckoned its testimonies in another way, and it is so: that it grows faint and returns; and the computations of the course [give] a reckoning of the sun's position [as it comes] near to us. The reckoning of position approximates the truth from the [body of the] sun, [namely] what is near to us [or far] from it.

The reckoning of the sphere of the sun is uniform, and it is the [tequfah], just as the premise stated: that the [tequfah], being approximate, is the foundation of the

reckoning. As for the difference, when it is reckoned by an equal value, consider it; for there is no [exactness] in the sphere of the sun, so reckon accordingly. And the remaining matters [follow] by way of the difference [of the tequfah]; the reckoning of the sun is approximate, so consider.

The sphere of the sun is uniform on its course by way of the difference [measured] from the center-point of the earth, and there is in it a reckoning near to us; and the sun reckoned by [its] position is so reckoned.

They observed the reckoning, and it is drawn out from here and from there up to the limit, and so the [tequfah] was reckoned [with] a residue [in excess] over the point of the reckonings. [So too] the reckoning of the sun's point, and the difference of that point within it. The verification of this difference is [in] the sphere of the sun, and so its excess was reckoned at [a value] [numeral: ?].

וְשׁוּב [Return / And he returns — display rubric]: this is a designation of the [tequfah] [?: terse] when the reckonings are computed by way of the premise of the [foundation], and consider this.

If you wish [to know it], take the difference to be the sphere of the sun, just as we said — that is, by way of its mean motion. For the reckoning is itself far from the earth and [then] draws near toward [the apogee], up to the limit of its course, at the center-point of the earth; for so it is reckoned, by way of its mean motion. And [this is] the matter of the point of the sphere of the sun; after that it returns and draws near, [coming] from us, approximating its [true] position, up to the limit.

And just as it draws near toward [the apogee] of the sphere, so consider [it] by way of the difference of the course: that this difference, which approximates the truth, [carries] up to the limit far from us; from here it draws near toward [the perigee] of the sphere, and its course [runs] far from us, while the reckoning draws near. Consider it.

[As for] knowing the difference of the [tequfah]: a reckoning is reckoned that yields the point approximating the truth; and from here it draws near toward [the apogee] of the sphere, and its course draws near, [coming] from us; and from here [it draws near] toward [the perigee], and [so runs] its course.

For the course draws near toward the center-point of the earth, just as we said: it is reckoned by an equal difference of the course; and it approximates [the count of] the days of the year [made] equal, for it draws near [by] a course equal to it on its track, up to the limit. The course returns one excess up to the limit, at the center-point of the earth; and so it was reckoned: that the days of the [solar] year

are reckoned [as so many] whole [days] [numeral: ?], and they are reckoned [with] a difference. Such is the matter of the days of the year made equal, and of what is reckoned; and the sun moves on its course.

The remaining [portion] of the sphere of the sun: from it the [tequfot] are reckoned; and the reckoning of the days, made equal, draws near to its limit.

For the sphere of the sun is uniform on its course — this course approximates the truth — and from [the perigee] up to [the apogee] runs its course; and [such is] the matter of the reckoning; so reckon it [numeral: ?].

וְהִשּׁוּב [And reckon — display rubric] [this is] a designation of the [tequfah] for its computation; a designation [whereby] the discourse returns and reckons that the [tequfah of Rav Ada] yields the [tequfah].

[In] its computation: a reckoning is reckoned that yields [a result] approximating the truth, just as we said — so it is. And the residue [in excess] of the reckoning is [made] equal up to the limit, and so it was reckoned: that [this is] the reckoning of the difference of the [tequfah].

The reckoning of the sun, as we reckon its position, [is] so [that] the days of the year are reckoned equal: namely, that the reckoning [given] in the fourth [perek] [?: possible internal back-reference] is reckoned [accordingly]. So too the position of the sun is reckoned, for you already know that the matter of the reckoning of the [tequfah] is reckoned [in] whole [days] [numeral: ?].

For the difference of the [tequfah] is a reckoning [carried] up to the limit, [reckoned from] the point of the reckonings made equal, [which] yields [it]. Therefore this reckoning — that the position of the sun is reckoned [with] a difference — yields [the result].

The difference of the sphere of the sun [pertains to] its course; this difference, [taken] into the difference of the [tequfah], approximates the truth [and] yields its excess made equal.

Diagram. An eccentric-circle diagram of the sun, drawn as a set of concentric circles at the foot of folio 85v. The outermost circle is the sphere of the zodiac; an inner circle is the sphere of the sun (the deferent), which carries the body of the sun — here a large red disk set on the upper-left of the inner ring, off-center from the figure's geometric center (the eccentric of the standard solar model). A vertical diameter runs through the figure, marked with point-letters from top to bottom. Rubricated (red-ink) labels name the spheres and the sun; black-ink

labels give the zodiac sphere, the cardinal points, and the lettered points on the radius.

- (outer arc, top, black): גלגל המזלות — "the sphere of the zodiac"
- (red, upper-left, on a ring): גלגל — "sphere"
- (red, center): גלגל — "sphere"
- (red, beside the red disk, upper-left): שמש — "sun" (the red disk = the body of the sun)
- (right, inner arc, black): גלגל החמה — "the sphere of the sun"
- (vertical radius, top→bottom, point-letters): ז · ה · ד · ג · ב — lettered points along the diameter
- (lower-right, black): [צפון = צפן] — "north" [?: defective spelling]
- (bottom, black): [דרום = דומה] — "south"

Treatise Four (המאמר הרביעי), Chapter Four (פרק רביעי) — continued

the rising in the sky [of the sun] and its setting is the most distant [point], [the point] about which its center lies — that is, the center [reckoned] from the center of the sun. And the place where its rising in the sky is least is the nearest [point], [the point] about which its center lies — that is, the center [reckoned] from the center of the world.

For the rising of the sun [reckoned] by [the path of] its rising and setting: when its rising in the sky is greatest, that is the most distant point; and the place by which its rising in the sky is least is the nearest point. The place of the most distant point and the place of the nearest point — these two are opposite one another. Behold then that you are to consider concerning these two points: the most distant point — its place is in the sphere of the zodiac; and the nearest point — its place is in the sphere of the zodiac; and know the [position in] the sphere of the zodiac of each of these two [points].

For the sun, [its course] from its most distant point is the most distant about which its center lies, [reckoned] from the center of the sun, [whereas] from the nearest point it is the nearest about which its center lies, [reckoned] from the center of the world. The reason that they called this rising in the sky "the most distant" [is] this: behold, the most distant point about which its center lies [is] in the sphere; the matter [requires] explanation [עם בדל: ?]. Whoever wishes to discern the difference [?] between the rising of the sun [seen] from its most distant point and the place of the sphere of the zodiac, and [to grasp] this

difference [recte: זה] which it brings about — [let him do] thus, for so it must be; and this is the tequfah [solar season].

פרק חמישי — Chapter Five

Chapter Five. To make clear how the rising of the sun [comes about as it does], and how its setting [and] its [apparent] disorder [arise], and why it [appears] uneven.

And in order to make this clear, and to show you why the rising of the sun [is] uneven: it must be that the sphere of the sun moves at one [uniform] motion from itself, just as the sphere of the zodiac is borne [at one motion]. The figure of the sphere of the sun [is such] that it turns about a point which is its center, [reckoned] from the center of the world, and its course about that point is even and constant. And from this it follows that the rising of the sun is uneven; for so it must be, that the rising of the sun in the sky [should appear] uneven, since [the sun] is borne about a point which is its center [reckoned] from the center of the world, and not about the center of the world itself. And so the matter is explained, according to the truth, concerning that which is borne.

There the place of the sun [seen] from its most distant point is the most distant about which its center lies, [reckoned] from the center of the sun; and from its nearest point [it is] the nearest about which its center lies, [reckoned] from the center of the world. And it is established that the sun, [reckoned] from its most distant point [and] from its nearest point [?: שהיא בה שני המקומות], [appears uneven], for the place of its most distant point and the place of its nearest point are opposite one another. And so the place of the sun [seen] from the center of the world [is] uneven by its [own] course. And whoever wishes to know and to make known [these things]: the place [reckoned] from the most distant point and from the nearest point [stands] over against the [center of the world] [?: על נקודתה]; and the sun moves and is borne [accordingly] [?: ויתישרו].

there the place of the sun was the most distant, when the sun [is] opposite each one [of these points] upon its [own course] [?: על נקודתה], in its place. And the reason for this, that the matter [must be] thus, [is] that this is the most distant point [?: עקרית]. And so the rising of the sun and the rising of the sphere of the zodiac [differ]; and the rising of the sun and its setting are good in their course, for so it must be in its place [reckoned] from the most distant point. And the rising of the sun and its setting differ, and [come] to it [?: ולהם מה]; the matter [stands] in its whole motion [about] the center of the sun...

Diagram. An eccentric-circle figure of the solar model: two roughly concentric circles (an outer circle and an inner circle offset from it), crossed by two diameters meeting near the middle, with several straight lines (radii / chords) drawn from the upper rim across the figure. Cardinal letters mark the rim of the outer circle, with א (or ה) marking the central point region. Interior captions name the two spheres; the red caption ראשונה ("first") stands at the lower left below the figure.

- (top of outer circle): rim letter [?: ה]
- (bottom of outer circle): rim letter [?]
- (right of outer circle): rim letter [?]
- (left of outer circle): rim letter [?]
- (center region): מרכז העולם ("center of the world / universe")
- (offset center): מרכז החמה ("center of the sun")
- (right interior, vertical): גלגל המזלות ("sphere of the zodiac")
- (interior, near center): גלגל החמה ("sphere of the sun")
- (lower-left, red): ראשונה ("first")

Treatise Four, Chapter Five — continued

[ועתה / Now] in order to make clear how the rising of the sun [comes about], and its setting and its [apparent] disorder, and why it [appears] uneven [?: כדי להראות]: for the sphere of the sun [moves] from itself, [and] the difference of the [solar] sphere [arises] from the reckoning of the rising and the setting, the time [being] reckoned [?].

When the sun stands above the center of the sphere of the sun, [reckoned] from itself, just as [it is reckoned] from the center of the world, its course is even; and [it moves] about the center of the sun, and is borne in its course by the order of the zodiac [סדר המזלות], so that it is borne upon [the zodiac sphere].

And so it follows that one says concerning the [position reckoned] from the [zodiac] sphere: its setting [is] thus; the place [where] the rising of the sun [is reckoned] from its most distant point [?: על נקודתה]; and the matter [is established by] the difference of the sphere of the sun — that is, it is the most distant point [?: זזה הוא עקרית]; for the rising of the sun [reckoned] from the center of the world [appears] uneven, just as the place of the sun [reckoned] from the center of the world [is uneven] [?: כמו זה כמו].

The course of the sphere of the zodiac — its motion comes first [?: מהלך]; its place [is] thus, the same [as that of the sun] [?]; [the sun] is borne in its course

one degree [?: מעלה אחת] by the reckoning of the difference of the [zodiac] sphere. The course of the sphere of the zodiac — the rising of the sun [reckoned] from there, for that is the most distant point [?: נקודת].

And there is no doubt about this; for [reckoning] from the center [of the world], up to a quarter of the zodiac, the place [appears] uneven, thus...[the rest of this folio's foot is a wide blank lower margin, with light foxing and an edge tear at the bottom — not text loss].

[The Fourth Treatise — continued] · [Chapter Five — continued]

[The sun] moves and returns [הולך וחוזר] continually [?: על חבל], position by position [מחנה מחנה], so that its mean position [מתקומה האמש = מתקועה האמש] [...]. It draws a line [אמשיך קו] [...] from its center [?]; and so [וכן] [...] in all its positions [בכל שהיה] [it is] uniform [מתגלגל] along its way [כדרכו]. Know, then [ותדע], that just as [כמו ש] in all its positions it [moves] uniformly along its way [כדרכו], so too at the position [מקום] of the sun's true place [החמה האמת] in everything [בכל]; and we reckon and measure [ושער] the difference [לאחור] [between true and mean] in the manner of [כמו] the depth [העומק].

And now [ועתה]: I shall draw a line [?] [...] from the center of the sun [מרכז החמה] now [עתה], and we measure [ואעמידן] [...] that it is along its path [שהיא על דרכו] [...] of the motions [המהלכות = המעשעות] until [עד] it ascends to the apex [שהוא על] [...] for it makes plain to the heart [שמבריר לבי] that it is the position of the sun [שהוא מקום] [...] and it shall be [ויהיה] the position of the apex [נקודת רחוקה = נקודת המהאלות]; the most-distant point [מהם] [...] is the position of the sun's true place [המקום האמת], when [...] [it was at the position?] [קוה במקום] another [אחר] [...] portion [קנת] of its motion [מעלעלשתו] [...].

The likeness [דמית = דמיון] of the matter [הדומה] [...] and it is [והיה] [...] in the likeness [כדומה] of [...] [?: ל...]; the rule stands [עומד הכלל ...] upon the upright [reckoning] [החותר] [...]. And upon the center [point] [ועל נקודתו] on which it rests [ששטל = שלשתל], it will be the order of the zodiac [סדר המזלות] which it has reached [?]; and you must take care [וצריך]. The center of the sun [מרכז החמה] [is] upon its center-point [על] [מהמסלל = מרכז] from the center of the sun [ואעמיד] [נקודתו]; and we measure [ועל נקודתו] [...] [Lacuna: short run at the column foot, lower margin blank] the operation [המעשה].

[A circular eccentric-model diagram appears at the head of the next folio (p. 180); see below.]

Diagram. A circular eccentric-model figure in brown ink at the upper-left of p. 180. An outer circle (the zodiac sphere / deferent) with radial lines and chords drawn to a displaced interior point (the eccentric center, offset from the center of the world). Several point-letters are marked around the circumference and at the interior crossings; at the resolution available they are not legibly resolvable. No red-ink caption is visible above this figure.

- [Point-letters around the circle and at the interior crossings are present but not legibly resolvable at this resolution.] [?]

[More than 2 labels uncertain]

[On p. 180, body resumes alongside / below the diagram:]

And [the matter is] that [וכש] [...] the center-point [קו...] [it is] uniform along its path [כדרכו = קטות ... מתגלגל], position by position [מחנה], so that its mean position [שמתיקומה האמצע] [...] from one another [...]. And it descends [יורד] [...] the inner [secting line] [החותך] upon the line [...] from the center [מרכז = מהמסלל] in a year [השנה], by the whole [...]. The whole structure [קוטר = the diameter] [...]; for the position [...] of the true [place] [האמת] judges it [צדיו = צדדיו] [...]; for the sign [?] [...] of the whole [...], so that it stands [שהוא] in the depth [בעומק] and on the line of the chord [החותך ... קו], and beneath it [תחתיו]; thus it is uniform [מתגלגל] at the position [לשעת] of the true [place], the position of the true [place].

And now [ועתה]: that you see [כי תראה] [...] the sun moves [הולכת] [...] the whole — that it is the center-point [נקודת] [...] the difference [= שברת] [...] the way of [ונעבר = ונשער] [...] the true [reckoning] [דרך התיקון], in the way [...] of the inner [secting] [החותך] [...] the chord [...] of the order [סדר] of this [...]; so that the depth of the chord [?: קטעת] [...].

The center of the sun [מרכז החמה] descends [יורד] as [its] motion [כמהלכו = כמהלך] [...] of its center-point [מנקודתו] [...] and the difference [...] [or] it ascended [או ירד] from the [...] [or] it descended [או ירד] from the [...] [it is] in the way of the true [reckoning] [על דרך התיקון], and you must measure [ונצריך לשער]; thus the chord [החותך ... קו] was the way [הולך] of the true [place] [...]; the chord of the true [reckoning] [...]; and they likened [וירמו = וידמו] one to another [...]; he said [אמר], the matter [מעשה] [...]; for one of the workers [העובדים] [...].

Its distance [שיעורו = שיעורו] in its motion [בתנועתו = בטכלת], all of it [כלה], without [בלא] difference [שיווי] even [...]; and the other chord [...]; for it is from there [...], from the most-distant [...] uniform; the matter [...] in this; and this is the specifics [הפרטיות].

And [there is yet] more [ועוד]: [...] and the calculation [והחישוב] requires [צריך] the threefold [?:הטל...] [...]; for in everything [כי בכל] [...].

[End of written text on p. 180; wide blank lower margin and torn lower corner — blank, not text loss.]

The Fourth Treatise, Chapter Five (conclusion) — the eccentric solar model

from the degrees whose distances are equal one to another. From this it follows that the [two] arcs of the chord [קשת תלכ] are equal, and that the two angles opposite them [are equal as well], because of the equality of their distance [?:terse construal] within the eccentric [היוצא].

From this [it is established] that the chord [is such] that the eccentric center of the sun [מרכז החמה] is the [more] distant [point], while the center of the world [מרכז העולם] is the nearer; and this is the case [whenever] the sun [is at?] [Lacuna: ~1 word, edge].

The distance of the sun [מרחק החמה] is greater [when measured] from the center of the world than it is when [measured] from its own [eccentric] center; and this is so as long as the sun is [at?] [a span of the orbit].

[Diagram — see fig-p181-1 below; the demonstration refers to its lettered points.]

[Beside the diagram:] ...the eccentric center [מרכז] ... and the [near] point [נקודה קרובה] ... and from this it follows that the distance is greater [when reckoned] from the center of the world. The chord [קו] of point ה and point ז [reaches?] to point [ד/ב], and the ... [Lacuna: ~1 word].

and what is [opposite?] this, [namely] the distance of the sun [is] less [when reckoned] from its own [eccentric] center; the [more] distant point [נקודה רחוקה] [is the apogee], and the world [center] [is the nearer], and the chord of ... from its [own center] [is the lesser].

The distance of the sun, then, is greater [when reckoned] from the center of the world, and is not [greater] from its own center; and this [holds] so long as the sun is in [the upper half of?] [the orbit]; whereas its distance is less [when reckoned]

from its own center [when the sun is in the lower half]. So long as [the sun] is at the nearer point [perigee], its distance is least.

And there is, accordingly [ושד י'ש], [the case] in which the distance is equal [from both centers] — and this is when the sun is at the place where the eccentric and the [path of the orbit?] intersect. [The author here completes the proof that the apparent distance, and hence the apparent motion, of the sun varies according to its position on the eccentric.]

פרק ששי — Chapter Six [the method of computing the sun's correction]

[Body heading, rubricated, mid-folio 88r:] **פרק ששי** — Chapter Six.

The aim of this chapter is to make known the method of computing the sun [תיקון], and its foundations [ויסודות], so that [the computer] may know it.

When you wish to know the place [מקום] of the sun's mean [position] — for the mean [position] is [a known quantity?], and you need it [as the basis] — you must [first] take [the value] from the table[s] [שני שקרים: terse]. And the [mean] place of the sun: for it is [reckoned by?] the equal [mean] distance, and you must take the difference [המרחק] between the center [of the world] and the [eccentric] center, [and] this is the difference [חלוק] that lies between the two centers [מרכזים]. And this is the [span] between [them?] [Lacuna: ~1 word, edge].

between the mean [position] and the true [position] [בין ... המסלול], and that is what you need: namely, the difference [between the two], which [arises] because the center [of the sun's orbit] is not the center of the world. The two distances [are unequal], and the [difference] between them produces the unevenness [of the apparent motion]. [The computer] must, therefore, know first [how to find] the place of the sun's mean motion; thereafter [he finds] the difference, which is the correction [התיקון].

For the difference between the place of the sun's mean [motion] and [its true place] — this is the [solar] equation [or "anomaly"]; and the cause of this is the difference [in distance] that lies between the two centers. And this is the matter [העניין] that we have already explained, and from it [the correction is derived].

[A worked instruction follows — terse:] You should know, first, [the argument]; and the place [מקום] of the sun's mean motion [you find] by [its tabulated value], and [then] you take its difference [from the true place], according to the order [על]

[הסדר]. [The remainder of these lines repeats the rule that the sun's apparent motion is fastest at perigee, slowest at apogee, and even at the mean distances.]

[the sun's] motion is faster [יותר חזק] when it is at the nearer point [perigee] [than the mean], and at the [more] distant point [apogee] it is slower [than the mean]; and at the [two] mean distances its motion is even [שוה], neither faster nor slower [than the mean].

[Closing lines of 88r — terse instructions on the computation:] ...the [computed] place [מקום] ... and [from] the mean degrees [you reckon]; and you must know first the place of the sun's mean motion. The sun's mean place [is found] from the [computed] year [as it stands?], year after year [שנה אחר שנה], [and?] its mean motion proceeds [יתהלך] [as] the sun's mean [position], and its cycle [is] reckoned by quarters [רביע? Lacuna at foot — torn lower corner falls in blank margin, no text loss].

the [mean] value being added [נוסף] one to another; and [the computer] should know that its position [is reckoned] by quarters [רביעי] [?: of the orbit].

[such] that [the sun] is at one place, [reckoned] one from another, and upon the known point [נקודה ידועה]; and so too the place [?: construal]. And were the point [נקודה] to be fixed [קיים], then the mean course [המסלול] would be even [שוה], its course [going] forward [?: חוזר/חוזך].

the path [דרך], and you should reckon the mean; and you should know plainly [תדע בברור] [?: construal].

[such] that there is a near place [מקום קרוב] and [a far place] [?: ועוד]; [the computer] has the value [?: לקו], [namely] that it is thus [שכן].

to know the difference [המרחק] between the two centers [?: construal]; and from this follows the [whole] matter [העניין] [?: construal].

The place where the distances are [equal] [מרחקים]: it is the place [מקום] where [the sun is] at the more distant point [רחוקה]; according to the order [הסדר], from the degrees — and this is the chosen [reckoning] [נזה נבחר].

[Beside the diagram — fig-p182-1:] ...as [in?] the orbit [כמסלול], and you should take the [eccentric] center [Lacuna]; the differences [מרחקות] ... [Lacuna]; this is [the table?] [Lacuna]; ...[such] that the place [מקום] is [near] [קרוב]; and what [is opposite?], the distance [מרחק] [is] far, [reckoned] by [a quantity?] על הסדר.

[Below the diagram:] ...[the sun's] equation [רשם המעלות], and this is the chosen [reckoning?] [נזה נבחר]; ...as [in] the orbit [כמסלול], and you should take a [table?]

of [the?] [Lacuna]; the [tabulated?] differences [למחזורין? terse] ... [Lacuna]; the standing [columns / values?] [העמודים] ... as [shown?]; ...[your reckoning being] one from another, and [you should] know plainly [וידע בברור]; year after year [שנה אחר שנה]; and so the sun's mean motion [is reckoned by?] quarters [רביעי]; the sun's distance [מרחק החמה] is its course [orbit], greatest [at one point] and least [at another?]; and this is the [computation] [Lacuna].

[the sun's] equation [המעלות] [is even] when its [name?/argument] is [at] the [two] mean distances [Lacuna]; and the time [is reckoned] [Lacuna].

[a portion?] [חלק] [reckoned] by quarters [רביעי] [of?] the orbit [מהלך]; the chord [or "argument"] [קשת] [Lacuna] of the mean [motion] [Lacuna], such that the time [is?] [Lacuna]; and the mean course [is even], its course [going] forward; and so its mean [position] [Lacuna].

[such] that the value [is] greater [when reckoned] one way, and [it would be] the time [Lacuna]; the mean [motion] [Lacuna]; the difference [is reckoned by?] [Lacuna] degrees [מעלות]; and [the?] argument [קשת] [Lacuna] is [a known quantity?]; the chord/argument [Lacuna]; ...its [own] course, [going] forward, and so its mean [Lacuna].

[The lines toward the foot continue the same rule, in increasingly elided form:] ... such that the position [נקודה] of the [fixed?] point [קביעה / קבועה? Lacuna], but rather its course [Lacuna], the chord [קו] of ... [Lacuna]; ...it is its course, [going] forward, [reckoned by] the mean degrees [מעלות מעלות]; and afterward [ואחרי כן] thus [is the reckoning] [Lacuna].

[Beside / below the diagram, lower lines — terse worked phrases:] ...already, so that your value [שך? terse] [Lacuna] from the [table]; ...the [tabulated] argument [קשת] [Lacuna] is [a known quantity?], and [you may] [Lacuna]; ...the chord [or "argument"] [קו] is known [ידוע], and you [Lacuna]; ...the table [or "matter"] [Lacuna] of this [is?] from the ... [Lacuna]; ...such that its mean [המסלול] [orbits?] the center [מרכז]; ...it [orbits], and [the sun] revolves [ויסוב] upon the whole [orbit] [על כל]; ...the [more] distant point [רחוקה] is known; ...[it is] known, and so it will be [ויכך תהיה]; ...such that the chord [or "argument"] [Lacuna] is known [ידוע]; [the computer] takes one [tabulated] argument [מרת אחד], [and another].

[The text continues into the following folio; the foot of 88v is blank margin with a torn lower corner falling in the blank margin — no text lost.]

Diagram. An eccentric-solar figure in the upper portion of folio 88r: a circle (the eccentric, *galgal ha-yotzei*) with a vertical diameter and a chord drawn obliquely across the upper part of the field. A short red-ink caption stands at the circle's center. The construction illustrates the proof in Chapter Five that the sun's distance — and therefore its apparent speed — varies with its position on the eccentric, the center of the world and the eccentric center of the sun being the two reference points. Labeled points (read off the figure; cross-checked against the prose):

- כ (top of the circle / apex): upper terminus of the vertical diameter.
- ה (center): a center point (the eccentric center, *merkaz ha-chamah*, or the center of the world).
- ז (just below ה): a second center / reference point.
- ט (foot of the vertical diameter): lower terminus.
- ח (left of circle): point on the circumference.
- א (left of circle, lower): point on the circumference.
- [point at right of circle, label [?]]: terminus of the oblique chord.

Diagram. A second eccentric-solar figure in the lower-left (spine-side) of folio 88v: a circle with two diameters drawn across it (one near-horizontal, one oblique), dividing the field, with short tick-marks/points on the circumference. It accompanies Chapter Six's rule for computing the sun's correction (the difference between mean and true place arising from the offset of the two centers). Labeled points (read off the figure):

- כ (lower portion): point on / near the circumference.
- ה (center region): a center / reference point [?].
- [two further circumference points, labels [?]]: termini of the drawn diameters.

[Most of folio 89r is blank parchment: the leaf carries only a few short lines of text at the foot of the written area, with the upper two-thirds and the lower margin left blank. There is no diagram, figure, or table on this leaf — the surface is bare ruled parchment. The page furniture (photographic scale-bar / black strip on one side) is not part of the manuscript.]

The three legible lines at the foot of folio 89r read:

[?] [so-and-so] estimated/measured in the world[?] ... [the star/body to them, and they varied (וּנִשְׁתַּנּוּ) ... [?] upon it, in its changing[?], and it was found (וּנִמְצָא)...

[Lines 1–3, folio 89r foot: "שיער בעולם ... הכב להם ונשתנו ... עליה בשנותו ונמצא...". The opening word of each line runs into the blank inner margin / is rubbed; the surviving words concern an estimated quantity that "was found" to vary. The connective syntax between the three surviving fragments cannot be construed with confidence — only the isolated phrases above are legible.]

[Remainder of folio 89r: blank parchment.]

[the body is] thick below and curved[?]; ... between [it] and the distance[?] [הרחקה]. And so [וכן] ... [is] thick, prior — not the true [position] [לא אמיתית] ... the [body], upon the arc of its difference [קשת חילופה] [the arc of anomaly] ... it returns [נחזרת]; and the eccentric [והיוצא] [?] was [the position] that is delayed [later, מתאחר], in which there is [שבה יש] ... the distance[?] of the sun [... מרחק [החמה], ... which occurs along the course of its revolution[?] ... its ascents [עלויות], and the distance of the place [ומרחק מקום] ... along the course of the [solar] anomaly [העלה], as [it is] ... at its hour [שעתו]. And now [ועתה] it is what occurs [שיקרה] ... and I say [ואומר] that there is reason to reckon [שיש להשב] ... it [as] in the final treatise [במאמר האחרון] ... which is what occurs [שיקרה], and he will say[?] [ויאמר] ... that the correction of the sun [שתיקון החמה] is reckoned [ערוך/שערור] [?] ... the arc from it [לקשת ממנו] approximately [כקרוב] ... and to make known [ולהודיע] the matter of [בצד] the natures[?] [of the motion] ... that there be [שתהיה] ... [a quantity in months/days — numeral not legibly inked at this point].

the difference [in the sun's place] at each time is known. For when its place was set, the place of the sun was likewise known, [as was] the position [of the sphere] at that time. And the matter is thus: from the figure of this third construction, the lines [are drawn]. This is the line of the difference (the equation line); and its point was known, for it is the center of the degrees. According to the order [of the construction], the place is known by the line. And he completes [the construction] of the figures from the center of the world up to the order [established].

[The text now refers to the lettered points of the diagram below.]

Diagram. A single circle (the eccentric sphere) with a point near its center and chords drawn from a point on the upper circumference down through the interior to points on the lower and right circumference. The construction continues the eccentric-correction figure begun on the previous folio (fig-p183-1). Labels are drawn in faint brown ink and are only partly legible.

- (apex, upper circumference): [?: ג or א]
- (interior, upper-center): [?: ב]

- (center of circle): η [?]
- (lower interior / foot): τ [?]
- (right circumference): [?: small mark, illegible]

[More than 2 labels uncertain]

There is a known point [on the circumference]; and he said: this is the point. Therefore there is a difference between this place and that place, which is known. Concerning the angle [formed] at the point of intersection — that is, this small angle — and the angle of the difference, the place is known. And he said: by means of this small angle, the angle of the difference is known, and it is the known difference. The sun at that time is known, and it stands at a fixed degree.

And he said: by means of this angle, which is a small angle, this is the reckoning. For there is a known difference between them; and the difference is known by [the relation of] the line [drawn from the center], so that the place [is found]. And there is one known [quantity] from which the place [is derived], and the matter is in proportion to it, and so their reckoning [is established]. And further, he gave them [a rule]: that the place of the other [figure] — for it is the length [of the chord] — so that [the computation] returns [?: terse].

And further, he set down [the rule]: the matter of the degrees of the figure proceeds thus, that the length [of the line], the length of the chord — and behold, [it is reckoned] from the place of the difference, [whose] length is known. And [the line] stands by itself — that is, this is the difference between them — and this is the line drawn, the line of the difference.

And concerning [the matter] he said: it is a known [quantity], and the difference is known. By means of it, this [is found]. By the line of the figure, for the place [is found] from the difference, in this figure — known and verified. And he said: from where [is it taken]? For this is the line drawn from the point of intersection of the chord, in this figure, [whose] place is the distance [from] the center of the sun, the place of the difference.

And further: the place of the sun, by its distance — that is, this is the length of the line. So that the difference [is found], the matter of the lines [drawn] in this figure, the difference from every figure proceeds from the figure of this third construction, one verified figure. And by this verified [figure], the procedure of the figures [is set down].

ועתה ["And now"] — it is fitting to verify the angle of the difference of the figure, in every figure, which is the difference. I will explain to you the procedure of the matter.

ועתה ["And now"] — and know the matter of the sun, so that [its place is found] at the time it was. The sun: in every [computation] you should make it, so that it be from [the rule] more [precisely]; and you should add the value [for the tequfah/the entry] at that time. And it [shall] be from the center of the world, its drawing-out and its determination, and you should order it correctly. And the eternal [order] [proceeds] thus, at the time [it was] known...

And know that the matter of the sun at the time it was — the sun in every [computation] that it was, so that it be from [the rule] more [precisely], and you should add the value [for the tequfah/the entry]. And it [shall] be [taken] in the figure correctly, just as it was, [its place] correct, [verified]. And he said: this is so. Likewise the sun [is found], more [precisely], so that it be from [the rule] correctly, the value [for the entry]. And when its [place] was completed, the figures of the sun are these — its place verified at every figure.

the order of the place of the sun by its distance, that is, the order of the figures of the sun, and they are [reckoned] thus. So that you know the place of the sun, you should set its order accurately, just as it was set right correctly, and so [too] the value of [the difference is found], and you should verify it. And there is for it an order, and the difference of the sun [is set] right, like this, [so that] the place of the sun [is found] at the time it was — known.

פרק שביעי [Chapter Seven]

[Body heading, centered:] **פרק שביעי** ["Chapter Seven"], **בביאור קצת החילוק הדק**, ["in explanation of some of the fine difference / the fine correction"].

between the days of the sun in the figures (the tables); and behold this is its measure. And should there be a deficiency [in] the strengthening, it is a benefit thereby; and were it not so — the [computation] of the cycles [would be amiss], and also it holds [?: terse]. And further, [up to] the eternal [reckoning], the way of [setting] it right; and you should set it right [in] doubt — that is, [if] it is doubtful from this [computation], [these] words [are added], in case there be a deficiency, or it returns (wraps around); and behold a doubt [arises] — for this is the time, the sun you should set right.

ועתה ["And now"] — and know that there is in this [matter] a multitude of words (subtleties). For [the heavens] above have not moved, the place, so far as it is

fitting; for this is its measure. And this is the matter [stated] above — that is, this is the difference.

Behold, the way of the matter of the inquirers (the astronomers) in this matter alone: that the sun in the figures (the tables), its difference, by its order — the difference of the sun from itself [is found]. For [their] knowledge of [the time] when the place was completed, and the matter of the place either by itself or by [a known] entry. And [its] reckoning — and the [observers] above, [the order] [is reckoned] thus.

The place of the sun from itself [shifts] — for it adds in the figure from a difference to a difference; and it is in proportion, and is verified at every figure. And in [the difference of] the figures between [observers], two [observations are needed]: in the figure he was, and he set [it] down; and behold he set it down, [its place] verified. And further: the order [proceeds] from one to another; and it is the difference of the sun from itself. And behold, when [there is] a doubt, the sun [must be] determined [?: terse].

He found at the time of one [observation]; this is the difference of the figure itself, and he set it down; and behold, the way of the matter — it is fitting. And from the [difference] the sun [is reckoned], for it [shifts]: at the time of the first it was so, and at the time of the [second] it [was] otherwise, like this. And the difference of the sun from itself [is found], whether the [whole] figure or a deficiency, in the figure [it shifts]. And know that they [the observers are] not equal [in] their figures, for this [reason] — namely [the motion of] the apogee.

And he said: from where [comes] this? And we [explained the matter of] the verification, a known matter, [whose place is reckoned] thus. And he said: the place is one, equal, the figures of the sun, from where [are they taken]?

By [the relation of] one to another — that is, [a single] figure [reckoned] thus. The inquirers — their words [are] thus; and they said [as to whether] there is a verification or a difference. And by means of [this] — this [is found]. He set it down, and it is a benefit, so that the [place is found], correct. And [the difference arises] from [the relation of] one to another, [whether it is] a fixed [point] or a difference; and he set it down. And behold, the place is a known [point]; and behold, the place from itself is more [than nothing] — that is, it adds, at the time of the [later observation], like this.

And behold, this is the matter, the order, for the inquirers in this matter; that they may know [the matter] — they, so that they [be] equal [in] their results, and that there be no doubt. For [the cause of] the doubt [is] the place; that is, [its motion].

And further: there is from one to another — that is, [from] the inquirers, who [differed as to whether the place is] fixed or [moving] — a deficiency; and you should [reckon] it correctly, as it was, that it [be] not in doubt, so that [its place be found] in the end, and you should set it right.

And [the matter] of the [observers], [reckoned] over time; and you should explain the matter, [whether it adds] or [diminishes], either an addition or a deficiency from the sun, an addition [more precisely], at every time — and you should set it right.

And know that the order of one [observation] — that is, [its place] correctly — and behold the difference of the sun, which [arose from the motion]. So that, [if] there be a doubt, the value [is found] in the sun, or [in] its diminution, like this. And likewise, [for] the times it [is set down] from one to another, [whether] an addition or a deficiency from the [place], at every time of the sun, an addition or a deficiency, like this.

[The Fourth Treatise — continuation of Chapter Seven]

[This folio side carries dense, heavily-elided calendrical Hebrew on the precise solar correction. The hand is physically clean and legible glyph-by-glyph under magnification, but the syntax is so compressed (elided subjects and verbs, repeated discrepancy/place/motion/days/correction vocabulary) that continuous English cannot be committed for much of it without invention.]

the place was one place; from a place to a place [מקום מקום מקום].

The sages who calculated [החכמים שחישובו] reached a discrepancy in the places [חילוף במקומות], and they did not [agree?], for the computation is difficult; for at the times of observation [שקיעה], between [one] and the [next], there remained [a remainder].

[Verbatim, construal uncertain:] ... וכדי ... מעשי מהלך ... חילוף היה במקום מקום מהם ... חשבנו למהלך הכוכבים לשם תכלת היה זה ... מהלך הכוכבים ... לשום תכלת היה זה ... מקומיות זה והשקיעה ... משת הריחוק ... יאמר כי יש על כל מחשב ... חברתי האמצעי לשום עת ...

[Construable spans:] They sought to make the motion of the planet [מהלך הכוכב] precise; and the more its remoteness [ריחוק] increased ... The sages of motion, they knew it in their times, and from them they reckoned ... the tables of motion [לוחות המהלך] ... the motion of the sun [מהלך החמה] ...

[Verbatim, construal uncertain:] ... לבין מהלכו בימים מהם... [Gate / display rubric — reads ש-ע-ר in large script, line-break before and after;]
... לחוש לבדי זה בתקון חלקות ... קמתיים ידושים על פי ... ויהפך אותם ויחזרו כדי ... המשך
היה וטעמו היה ... מאשן שזרכרן והימים ... החילוף וסום היה רגע מעלין ... היה לה ריגם
... ליהם לכל תקן ... עליה ולא תשלה פדי ... ושכל זה יאות

[Verbatim, construal uncertain — lower lines:] ... וירע ... שתהיה בה שהות חשבה
מרית האמותר שום בין ... קמתיים כמו שנתבר ... מן חצי שעה או יותר מעש ... משערפתיים
או ינבע אותו מהם הם החוסרים ... זימים האמעשיים שיש בימים קדושה הם ... ולבשעים
צריך המחשב להפך שום ימים ידושה ... רישן ... ובתקן החילוף היה צריך ... החמה האמצעי
...וסף האמ

[Gate / display rubric — reads ש-ע-ר in large script, line-break before and after;]
[Verbatim, construal uncertain — the block following the שער rubric:] ... במדינה
פלונית ונקרא חתיה שכר החמה ... ועל ידי ... בדרך כמאמר האחרין כפי מה שיתבחר לשם
...ונבין ... וגם הראות למי זה עת מועדת שתהיה אחרי ... עתה

the difference [שינוי] ... and the day and the night, the year is reckoned [יחשב] as
the days of [its] sanctification [קידוש] ... the sun's motion ... each in its place.

[Foot of folio, last legible line:] ... ונבין ונדע מקומה ... חרי עת השקר ואילך ...
and we shall understand and know its place ... from the time of the discrepancy
onward." The word read as השקר/השער is uncertain.]

[The Fourth Treatise — conclusion of Chapter Seven]

[As on 91r, dense elided calendrical Hebrew; verbatim transcription with English
only where secure.]

And likewise, when this discrepancy [וכשן זה היה הדין] ... that there be in it a
discrepancy [יאות], and it is reckoned upon [the tables?] [ונחשב על].

[Verbatim, construal uncertain:] ... קרן ... העת שעת ההוא ... בזמן ההוא המשך מעשת
אותו ... האמת של שנתו ונדע מר ... ומה שיהיו ... קרת אותו תקן ... יהיה לא יהיה חלת חמות
... ונקרא אותו חלקי השדרך ... זה חלק ... השדרך היה ... על קת ... המאשר זו יאות
שנהחית ... הנקבץ זו השער היה היה הריחו לכבא זו בלת ... בזמן האמת המוצא ההוא
... מועש להחזיר זמן זמן

[Construable spans:] ...copies / a difference upon the divisions [חלקי] ... the true
[reckoning] [האמת] ... the observer's place ...

Chapter Eight פרק שמיני

On deriving [בהקשת] the majority of the [astronomical] principles [רוב העקרims] and the [calendrical] foundations [והיסודות], for the knowledge of their conduct [מנהג], their tables [תלוכותיה], and the planets.

מקנה תהלוכות היה ... מהמומים ל ולחמה כה ... רוב... [Verbatim, construal uncertain:]
...השכרים והיסודות ... אין לך וחבר זו טווק

והתחיל [And he began — display rubric opening the chapter's exposition]

The east / the sunrise [המזרח], in degrees, day by day; and the world [ובעולם]. And this is from the difference of [the observation?] [וזוה פי מירוקת], like the [difference] of the time ...

[Verbatim, construal uncertain — to foot of folio:] ... למשך ... מעש ... עת ונקרא מעש ... למשך ...
לצד הישוב כדי ... העמלות בלם ונם נכח ... מן ... כדי שידבק אותה שנתבות מאחר ... עוב
... היה ... תהיה ... עתה היה ... עבה המאלה ... תכון תכות משה שנתעלה לבה החמה

[The lower and outer margins of both folio sides are wide and blank — original layout, not damage. A faint sliver of the facing leaf appears at one edge of each page in the scan (ignored, to avoid duplication).]

Fourth Treatise [המאמר הרביעי], Chapter Eight [פרק שמיני]
(continued)

the difference [in motion] there was, and we know that it amounts to [a certain] degrees, and more than [that]. The keeping of the [observation of the] moon, and at the highest point [?: ובעלייה — its variation is by one day, [as] is found in the [tables/computation]. Thus they took up the issue, just as [?]. . . so that the place of the [observed] truth [מקומו האמת] would be [established], [proceeding] from the point of [the moon's position] up to its [true place], the truth of the [matter].

For if it were known to you — when the moon is [in conjunction with], or in opposition to, the sun — the place of its true [position] [מקומו האמת], then it would be [as] in the [tables]. For at the time of the conjunction [חילוף] of the moon, when it is found [in conjunction], it stands [שיעמוד] at the place of its truth; and the difference [חילוף] of the sun, when it is more than [a certain measure]... so too the difference [חילוף] of the sun [is by] degrees [מעלות], like that [of the moon]...

[Rubric, larger hand, mid-line:] **וְשַׁר** [ושער — a Gate-marker;]. The investigation [החקר] of the [matter] was this: that all of the motions [follow upon] the motion of the sun, and according to its motion is the [true] difference... the moon, when its motion is regular [?]; and the variation [חילוף] of the sun and the variation [חילוף] of the moon — both proceed as one; and just as it [the body] is more than [a certain measure]...

The known [motion], when the motion of the sun is [reckoned], it stands at the time of the [observation] of a degree, of [the zodiacal sign]; and we observe the degree of its [position], [the zodiacal] sign, and the [increment of] difference [סדר]; and the moon is at [a degree, sign]; and the difference [חילוף] of the moon, when it is found [in conjunction], it stands at the place of [its true position]...

The investigation [החקר] of the moon's [motion] — the meeting [המצא] of the moon with the sun, and the place at which [the body stands] — [is reckoned] for [its] standing; and at every place [along its] path, the [true] difference is by [a certain amount, reckoned] by degrees, [in a manner] suitable for standing [the reckoning].

[Rubric, larger hand, mid-line:] **וְשַׁר** [ושער — a Gate-marker]. And all is for the verification of the reckoning [לבחון החשבון], so as to fix the center [of the body's motion]...

at the center [מרכז] of the moon [ירח]. And this is set down in a clear demonstration [במשטח חבור]... the universal foundation [היסוד הכולל] of the [body] is broken into [reckoned upon] four [parts]... of the sun, [which] moves upon the [course of the firmament]; more than [a certain measure]... and it is more than [a certain] degree, [in] the deepest [reckoning] of the matter [שעמיקה]; more [degrees] than what [is deepest], the deepest [reckoning] of the matter; for [as for] the moon [?: הלבנה / לבד] and [its] difference, and its [true place]; the moon always [moves] eastward [מזרח]; and Ptolemy [ותלמיס] [established] this...

the place [מקומו] of the truth of the moon, [reckoned by] day; and just as he [Ptolemy] set out the [reckoning], so [too]: it was the magnitude [שיעור] of the sun; and [thus] they said above [למעלה]; and [there] was the truth of the moon, by [the standard of] day, in every...

just as he set down the [reckoning of the] tequfot [התקופות], [so] in their [computation] by the truth of the difference [חילוף]: that their [magnitudes are] of [the zodiacal] sign and degree[s], and the difference [חילוף] of the sun and [its] tequfah [?: ותקופה]; we observe the magnitudes [the sun] traversed, [whether] it

stood [still] or [moved] forward [לעבדיו והוא], and we [reckon] the [number] of those that stand behind [those that] precede [it], at the place of [its standing]; we found [it], and the difference [החילוף] [of] the [matter]...

[a certain measure], and it stands [still], and it is not so [?: ולא שן]; and [it] was [reckoned] of [its] truth, and a brief [statement] of its character [משפטיו] in this [matter]: for the [body] is [found] when [reckoning] the difference of the moon; and it [moves] forward, [reckoned] from each [increment that] precedes [it]; and Ptolemy [תלמיס] [established] the [reckoning] of [its] standing [?].

and the foundation [היסוד] of the matter; and [the body], when its motion [is reckoned], it stands; and Ptolemy [לבטלמיס] for it... the tequfot [התקופות], and [their reckoning] is fixed; and the investigators [החקרים] [did so], and they made [their reckoning] complete [שלם]; just as he set out [שיתבאר] this, [so too] in [the matter of] the tequfot...

[Rubric, larger hand, mid-line:] **ותחיל** [recte: ותתחיל — "and it begins"]. The [reckoning of the] difference [חילוף] of the moon: that it is reckoned from a [certain] place — beginning [the reckoning] of the moon's difference; the [moon] always [moves] eastward [מזרח], being more than [a certain] degree, with the difference [חילוף], so [too] the order [סדר], and so [too] the standing of [its true place]; and the moon, when its motion [is reckoned], stands — and this is its [true] place [תקונו].

And [as for] the difference [חילוף] of the sun: that of the truth of the tequfot [התקופות] is [reckoned] of the center [המרכז], just as we [reckoned] more than... [a certain measure]; the tequfah [התקופה], [reckoned] approximately [בקירוב] [by] nine [תשעה], and we know it; and just as [shown] above: more than the third [השלישית], for [each] one [is] more than... and the difference [חילוף] [is reckoned] from each one; [and] when it [is reckoned, there] is no doubt [אין ספק]; and the order [סדר] of the tequfah [התקופה] is of the [matter] [?: שעירת]; and we [reckon] of [the body's] standing — the regular [motion is reckoned], it does not appear [לא נראה] to us...

just as [with] the sun; and afterward the difference [חילוף], [reckoned] of [its true place]; and we [reckon] the difference of the [body], at [its] standing — and afterward [we reckon] the [true] place...

[Rubric, larger hand, mid-line:] **והעלה** [— "and he raised / brought up (the value)"]. The matter of [the body's true] standing is this: [proceeding] from one to one, until you reckon it all [up to] the [body], so that it stands [reckoned]; the magnitude [שיעור] of the motion of the center [המעלות], and the difference of the

motions [תנועות]; and they are the [true] place [?]; and the [reckoning of the] difference of the motion, [reckoned] from each, the place [of its truth]...

the computation [החשבון]: that it [is reckoned] of [the magnitude/excess] [מהם], that it is so, [only] approximately [בקרוב], up to [the value] that there shall be of it; the magnitude [שיעור] of the motion of the center [המעלות], at the time of the [observation]; and afterward [the reckoning] of [the true] place, by demonstration [במשטח] of the [reckoning of the] motion, the place of the truth [האמת]; the [body's true] place [is] the great motion [reckoned]; and the [reckoning of the] truth was [drawn] from the magnitudes [המעלות], [whereby] it is fixed [חוקק] of the center [סבב מרכז], and we [reckon]...

and the [body], when its motion is reckoned, [is] approximately [בקרוב] just as the order [reckoned]; for it shall be of [the body], that there is no [doubt]; and there is a magnitude [שיעור] of the motion of the [body] [שעיר המעלות]...

[reckoning continues] just as he sets out [שיתבאר]; and it is reckoned, [for] a small [reckoning]...

[Text ends near mid-page; wide blank lower margin — not damage.]

as you said, that this is distant; and from the [reckoning] you understand the matter — that it should be from the investigators [the astronomers]. And so it truly is. From this matter you understand the working of the moon's motion. And likewise you do, and look upon it: the rising of the degree [is] near; and therefore it was called "the cause." [ובזה תתבונן — recte for the rubric below.]

[Larger-hand rubric:] And by this you will understand [ובזה תתבונן] —

— that when you reckon the place of the moon by the table, by the [argument] of its motion, and the equations come out from them, then the place comes out. And the position of the moon [is] in this manner, by it; so that it should be. And likewise, if you wish to reckon it, the place [comes out] and the motions; and you must reckon until you finish it, and so on.

And know that the motion of the moon, when it comes out [in the table], must be reckoned in proportion: when its motion is direct [forward], you add to it; and when it is retrograde, you subtract — by the place reckoned from the tables, and likewise from the [argument of] motion.

—that when there comes out for you a [value] there [in the table], for the [argument of] motion, you take the proportional part between the [tabulated

entries], in this manner; and you must reckon until you complete it. And so you do for the [argument of] motion, so that it may be corrected [verified].

[Larger-hand rubric:] And now [ועתה] —

— know that when the moon is direct [in its motion], why is it reckoned thus? You must add the equation to it, so that it should be corrected. Until what point? Until the proportion of the place and the rising [ascension].

When you reckon for the [argument of] motion what comes out [in the table], it is [established as] the [argument of] motion, the third, small [the small third residue]; and as for its proportion to the place — know that, when the moon is direct, the equation is added, as explained.

[Larger-hand rubric:] The principle [הכלל] —

— and you reckon the place of the moon thus: that when you take the proportional part, you pass over, in this manner, the [argument of] motion; and you must reckon until you complete it [verify it]. And likewise, by the way of the tables, as is fitting, the motion comes out; and the [argument of] motion which they give, its proportion is reckoned — by taking the proportional part of the degree, in the given manner [of interpolation], so that it may be corrected [verified] in this way [recte הדרך].

[Larger-hand rubric, slightly enlarged:] The small [residue], [of] the place [recte הקטן] —

— and you reckon the place, and you find it as the rising [ascension], and it is [established as] the place. The [argument of] motion which they give it — it is its place.

[Larger-hand rubric:] And this [is] the small [residue] [recte הן הקטן] —

— and as for the eras [reigns] that come out [in the chronological tables], so that what comes out of the moon [results]; by the [argument of] its motion, by this [date]. And when the moon is direct in its motion, [in the table] it is [found] direct, and you add it; and when it is retrograde, you subtract it. And it goes upon the path [orbit], the moon [moving] in the zodiac signs, in the given proportion.

—and according to the proportion of the moon — when its motion is as the investigators have said — for the matter of the moon, the [several] motions which they reckoned; and the latitude, in the place, and it is reckoned.

And the reckoning of the moon upon the path [orbit]: that you reckon it by the [argument], so that it may be corrected [verified] for it — the [argument of] the moon's motion when it [is established] by them, established [in the table].

[Larger-hand rubric:] And now [ועתה] —

— know why it is thus: that it should be reckoned in this way. And as for the investigators [the astronomers] in the matter of the place — know its motion is not swift [recte מהיר לא]; [for] the moon. [?: this line is partly elided.]

—so that they pass over [interpolate] in the place of the moon, in this manner, so that it may be made clear [verified]; and according to its proportion it is reckoned, by its place, so that it may be corrected for it.

— you must reckon the moon's place by the path [orbit]; the matter of the moon. So know that, [regarding] the place of the moon — the small [residue], reckoned from the [position] — when the moon is direct, it [moves] forward, and you add it; and when it is retrograde, you subtract it.

And [regarding] the small [residue] that comes out of it: when it is [reckoned] from the [position], when the moon is direct, it [moves] forward; and the latitude — that you reckon its place by the latitude [רחב]. And what comes out of it — the investigators [the astronomers] reckon it, by the moon's [position], by this [argument]; and the moon's [place results]; and when the moon [moves] direct, its place [is reckoned by addition].

—[that] the moon's [position] should be the place to be reckoned; that at times it should be direct, and at times it should not — that is, whether it is direct or retrograde.

And it goes [moves] in this manner: the moon, when its motion is swift or slow in its course. And the moon's motion, more or less, [goes] upon the path of the zodiac signs, in the given proportion; and likewise it [moves] in the signs, [with] the latitude.

And the matter of the moon — its motion is, as the investigators have said, in the matter of the moon: the [several] motions; and the latitude, in the place, and it is reckoned.

And the reckoning of the place, and the calculation upon the path: that you take the proportional part between the [tabulated entries], so that it may be made clear [verified]; and you reckon proportionally in the place of the moon, in the given proportion, so that it may be corrected [verified].

The investigators [the astronomers] reckon the moon, taking the proportional part of the degree, so that it may be made clear for it — when the [position is established] by its given [argument]; and it [the place] is verified.

[Larger-hand rubric:] And now [recte ועתה] —

— know why it is thus: that it should be reckoned thus, so that it [comes out]. Make this [matter]: that the place [should be made clear] in this [manner].

—and as for that which is direct [in the table], the [argument of] the moon's [position], when it [is established] — that it [moves] forward — it is the third [residue], small.

[Marginal note, right margin (smaller, later hand — verbatim, 3 lines):]

[Margin: "המוצא [?] עתה דעת מן המוצא / ועתה [?] ידוע מאמת[?] ל? עוד / נשלם הקפה [?]" — a later-hand gloss on the procedure (apparently: "the [computed value] now — the knowledge from the [computed value] / and now [it is] known from the verification, further / [thus] the circle of revolution is completed"); the bracketed words are not securely legible and require further verification.]

The reckoning [of the moon] in the place: know its proportion, [it being] not swift [recte מהיר] — that it [moves] back [retrograde]; and you pass over in its motion.

—that they pass over [interpolate], around [the table of] the equation, in this manner; and you pass over in this manner, so that it may be made clear for it. And to [reckon] the place [of the moon] —

[Larger-hand rubric:] Upon the circle of revolution [על ההקפה] —

— and the matters that I have explained to you regarding the circle of revolution are [as follows]. And you reckon it, in this manner, so that what comes out for you of the circle of revolution, until it [is], should be reckoned; and as for that which is direct, the [argument of] the circle of revolution, [when] established — that it [moves] forward — it is [established as] direct; and the [argument of] the moon's [position] [moves] like a planet. And the circle of revolution is its [position], the degree that comes up — the [argument of] its motion, [established] from the circle of revolution.

And the [position] of the moon, when it [moves] near [the circle], and that there should be [established] the place; and its equation more than this —

—[that] the [argument of] its motion, the [residue], [reckoned] from the [position]; and there should be reckoned the moon's place, when it [is established]

retrograde]; and the latitude — the [argument of] the circle of revolution — that it [is] forward — it is [the residue of] the circle of revolution.

—and upon the [argument of] the moon, taking the proportional part; and you reckon the degree, its motion; and there should be [established] the place, by the [argument of] the circle of revolution.

[?] —And as for that which comes out there [in the table], for the [argument of] the moon, and that there [is the residue] — that you take the proportional part between the [tabulated entries]; and so know that the circle of revolution, the moon [moving] like a planet —

[Larger-hand rubric:] And the moon [recte וְהִירָח / וִיתוּקָן] —

— is set right [made correct], for it goes back [retrograde] — and the matters [I explained]: that there should be reckoned, upon the circle of revolution, that which is its place. And as for the small [residue]: that you take the proportional part between the [tabulated entries], in this manner, so that it may be made clear; and you reckon proportionally in the [position] of the moon's place, upon the circle of revolution — for the circle of revolution [carries] the moon, [it moving] around its center, [each step].

—and you go around upon the path of the zodiac signs, the moon; and you reckon the latitude, by its given [argument], so that it may be corrected; and so [established], the moon [moves] like a planet [retrograde]. And this is verified for it.

[Larger-hand rubric:] And the small [residue] [recte וְזוֹה הַקָּטָן] —

— [in] the circle of revolution [is] the small [residue]; and so, the [argument of] the moon — that [its position] is [reckoned] from the circle of revolution; and it [moves] like a planet, retrograde. And there comes out for you the [argument of] the moon's place.

[Larger-hand rubric:] The measure of the course of the circle of revolution [recte שִׁיעוֹר מֵהַלֵּךְ הַהִקְפָּה] —

— is this: that it [completes its revolution in] about twelve [12] years and [some] months and a hundred [?: חֲדָשִׁים וּמֵאָה — "twelve years and [some] months and a hundred [days?]"]; the exact tally is partly elided]; renewed, the circle of revolution — that you reckon it in this manner so that it may be corrected for it. And the moon, in the circle of revolution — that you reckon it carefully: in the measure of about a hundred [days], and [some] days; renewed;

and it goes in this manner — for it goes around upon the circle of revolution, until [it returns] to it.

—its [revolution completes] in a hundred-odd days [?]; and it returns, the circle of revolution, in this manner — about [a number of] days, and a quarter, and about a fifth of an hour [ימים ורביע וכמו חומש שעה].

[The Fourth Treatise, Chapter Eight — continued: the moon's true place by means of the circle of the apogee (ההקפה).]

so that the body of the moon is always carried upon it; for, as we explained, it is fixed, going forward and drawing away from the point toward which the moon's course tends. The circle of the apogee corresponds to the mean place; for the ancients (הקדמונים) called it so, and they said that its center is always in motion. The body of the moon revolves upon it just as the other planets revolve; they are alike in this, that the body is carried continuously upon the circle of the apogee in the manner already set out, the motion of each planet having been given on its own. It goes forward direct and turns backward, and the equation (חילוף) is reckoned accordingly.

The center of the moon-circle revolves about the center of the deferent (מרכז), and the body of the moon is carried upon it: it goes forward and turns back, and the equation is reckoned accordingly. So the moon's revolution about this center is like that of the other planets. The distance (מרחק) between the two centers was fixed, and by it the equation is reckoned.

[The remainder of the upper text-block here works through the same construction in dense, allusive phrasing — the motion upon the apogee circle taken by its arc; the equation reckoned by the arc of motion; the distance of the center of the moon-circle from the center of the deferent; and the figure drawn "to make the matter plain to the eye." The argument is continuous and legible, but several clauses are too compressed to construe word-for-word with confidence. [?: dense allusive passage, recurring lunar-model vocabulary read, but the clause-level syntax is not fully resolved here.]]

The center of the moon-circle revolves about the center of the deferent. By the figure that is drawn the equation is reckoned, [the moon going] forward and backward by the arc — and this is the matter. The distance of the center of the moon-circle from the center of the deferent is, as we explained, the basis on which the equation is reckoned.

For this is the equation of the moon, which we mentioned above; and this matter follows its proper order, taken first "at the head" [of the reckoning] as we set it down. So the reading follows the figure before us, by which the equation is reckoned, forward and backward by the arc — and this is it.

And the figure is as drawn: the outer circle is the deferent, whose center revolves; the inner circle is the circle of the apogee, fixed and carried upon it; and the line drawn through it is the line of the moon's mean course, by which the true place is found by the arc. The equation is always taken according to the order of "the head" of the reckoning, and the moon's true place (מקום אמת) is verified by the arc.

[The lower portion of the text-block continues the same construction — the center of the moon-circle moving direct upon the circle of the apogee; the distance of the moon's center from the center of the deferent taken in the setting-down; going forward and turning back, direct and retrograde; the equation according to the order of "the head" of the reckoning, as explained. [?: dense allusive passage; topic and recurring terms read, full clause-by-clause syntax not resolved.]]

[A figure is drawn at the foot of the leaf.]

Diagram. A pen figure of nested concentric circles in light brown ink at the foot of the leaf, illustrating the circle of the apogee carried upon the deferent. An outer circle and two inner concentric circles share a common center; a vertical diameter is ruled through the whole figure from top to bottom (the line of the mean course / line of the apsides). A few single-letter point-labels are placed around the circumference; they are lightly inked and resolve only partially.

- ה [?] (top, where the vertical diameter meets the outer circle): point label
- ט [?] (upper-left, inside the inner circle): point label
- ט [?] (upper-left, on the outer circle): point label
- כ [?] (right side of the outer circle): point label

[The labels are lightly inked and resolve only partially; figure for label recovery.]

[Lower and outer margins of 94r are blank parchment, not damage.]

that it is fixed, moving direct upon the circle of the apogee, the center of the moon-circle revolving about the center of the deferent; and the body of the moon is carried upon it, going forward and turning back; the equation is reckoned by the arc, as in the figure that is drawn; and its distance from the center of the deferent enters into the setting-down.

That it is fixed and carried continuously upon it is the matter we set out: the center of the moon-circle revolves about the center of the deferent, and the equation is by the arc. When the body of the moon is at "the head" of the reckoning, the figure of the apogee is the one before us; moving direct and retrograde, it goes forward and turns back — and the equation is taken accordingly.

[The body of 94v continues to restate the construction with the same recurring vocabulary — the circle of the apogee fixed and carried continuously; the mean course (מהלך) going forward and turning back by the arc; the distance of the center of the moon-circle from the center of the deferent; the equation according to the order of "the head" of the reckoning. The text is continuous and legible, but, like the recto, several clauses are too compressed to render word-for-word. [?: dense allusive passage; recurring lunar-model terms read, clause-level syntax not fully resolved.]]

The distance of the center of the moon-circle from the center of the deferent is the measure between the two centers; the body of the moon is at "the head" of the reckoning, in the figure of the apogee, going forward and turning back; and the moon-circle revolves about its center in motion. The matter we have set down here is this: that the circle of the apogee is fixed and carried continuously, the body of the moon revolving with it, so that they revolve together.

And the point of greatest distance — the apogee, which they called so — [is reckoned thus]: the center of the moon-circle revolves about the center of the deferent, and the body of the moon is upon it; about the figure of the apogee the moon moves in its course; and the distance of the moon's mean course about "the head" of the reckoning is always taken — for when the body of the moon reaches "the head" of the reckoning, the place is found by the arc, as we explained.

The distance of the center of the moon-circle from the center of the deferent, [taken together with] the circle of the apogee through the whole reckoning, and the figure of the apogee, [shows] that it is at "the head" of the reckoning; for that is the moon's true place, reckoned in the setting-down. The center of the moon-circle revolves about its center in motion; this is the matter, as it is written here, taken always according to the order; and the distance of the moon-circle from the center —

[the center] revolves, which is the pillar-point (העמוד) of the apogee — they called the center so — moving continuously; and the apogee circle [completes its

course], as we explained, when the expectation was fulfilled in... [?: the final clause runs to the foot of the leaf and is not fully construed.]

the place of the moon was on the line of mean motion. And the line of mean motion was the line of mean motion [from the center], and the place of the moon was on the line of mean motion. And when the line of mean motion coincided with the line of true motion — that is, when the moon traveled along the line of mean motion — then the moon's course was on the line of mean motion. And when the moon's place lay on the line of true motion, its place was reckoned upon it. So this is the place of the moon.

And the line of mean motion lay on the line of true motion, and its place was upon it. And when the line of mean motion lay [coinciding] with the line of true motion — at the time it fell upon it — then it traveled along it, and the moon traveled the course of mean motion; and the equation and the place coincided, and the moon's place lay upon the line. And when it traveled the place by mean motion, at the time it was [so positioned], these matters were ordered each in its sequence, always.

פרק תשיעי [Chapter Nine]. Returning to the circle of the apogee [ההקפה], let me make plain the equation [חילוף] [arising] from the divergence of the line of mean motion from the line of true motion, and their two places.

From the body [גשם, i.e. center] of the circle of the apogee, which was [set] in such a quantity, and by which it was set right [תקנו] — let me set it right upon them. The matter is that the [body] was set there, and let me return [it to] the circle of the apogee. The reckoning of the circle of the apogee surrounds its center [נקודה], so that the center of the moon's circle, upon the line of mean motion, was a [determined] point; and the center of the circle of the apogee, by the position it knew, its [measure being] such-and-such. So when they reckon it, the center of the moon's circle was upon the circle of the apogee, [its] degree always [fixed]; and so the moon traveled, and so forth [וכן].

[Concerning] the divergence which there is in this matter: it travels and revolves about [its] center, and its course veered off [שעבר] and was reckoned upon it. When it coincided with [the line], it traveled, and at that time it was [on] the line of true motion — and this is the way [direction] of nearness [קירוב, i.e. approach]. And when it had the position of mean motion, it knew that it [moved] forward, being direct. And [there were] days upon the path of [its] degree [מעלה], and it revolved; and so the moon traveled forward until the [inter-]center [distance], and so forth [וכן].

[Lower portion of 95r blank.]

Diagram. A large outer circle (the deferent / circle of the apogee) within which three smaller circles (epicycles / the moon's circle of the apogee in successive positions) are set — one at the upper center, one to the upper right, and one at the lower portion of the figure — connected to a central node by straight construction lines forming a Y/triangular linkage from the center of the deferent. The word ראשונה ("first") is written in brown ink at the center of the figure, captioning this as the first of the chapter's constructions. The point-letters marking the circle positions and intersections are faint single Hebrew letters.

- (apex / upper center): ב [?]
- (upper right circle): ג [?]
- (left circle): ד [?]
- (center node): א [?]
- (lower circle): ה [?]
- (center caption): ראשונה ["first"]

[in its motion] about it [סביבה], the figure [צורה] of the circle of the apogee [differs in] its motion and its revolutions; and the cause of its going forth from the line of mean motion to true motion. And they were set right, so the moon was [positioned]; and the place was set right upon it [תקנו] until its end at the end of [the cycle]. On the [line of] mean motion [of] the circle of the apogee, and the center of [the figure], there was [a position]; the figure of the circle of the apogee revolves about its center, [its degree] always [fixed].

[The matter] was that the circle of the apogee, at the time it is in its [place], was the time it [lay] upon the [center of] the moon's circle — and so its course veered off [the line]. And so when it [coincided], the moon was [there]. By the way [direction] of nearness [approach], the [center of] the moon's circle was upon the line of true motion, [and so was its] place. And when [the line of] true motion lay [coinciding with the line], its place [was reckoned] upon it; and so when the moon's circle [diverged] from its course at the end of this time, then [what follows].

If [from] the line of mean motion to true motion they were retarded [נתאחרו], and they coincided, until the point — then in this way the circle of the apogee [had] its place set right and was reckoned upon it; the matter being [that] its [center] [lay] there, and [its] mean motion [was] from its [center] until [its] point.

Returning: at the time [the circle of the apogee] is [in] its [place], and the [body] fell upon it — here are their places, the [line of] true motion [diverging] from [the line of] mean motion. And [where] the place of mean motion [diverges] from the [center], by the way of the [line of] true motion upon the circle of the apogee — this divergence is the [position], the figure of the circle of the apogee [traveling] along it. So the moon traveled, like the sun; for there is a divergence [in] the moon's circle which traveled along it, veering off [the line], and [its] place was reckoned upon it. So this is the circle of the apogee, [its] course veering off it; and the moon's place [is] upon the line of true motion, [and so is its] place. So when [the line of] true motion lay [coinciding with the line], it traveled; and when the moon's circle [diverged] from [its] course at the end of this time, then [what follows].

[The matter] was that the circle of the apogee, at the time it is in its [place], traveled forward — for here [the line of] mean motion [was] from the [center] until [its] point. And so [in] the way [direction] of nearness [approach], the position of mean motion knew that it [moved] forward; and so when the place of the circle of the apogee was the place of the moon's circle, the equation and the place coincided as they [had] said; and likewise their [two] places [were] reckoned, the figure of the circle of the apogee veering off it. And the moon traveled; for there is a divergence [in] the moon's circle, that it travels along it veering off the line, and [its] place was reckoned upon it. And so it traveled, veering off the line of mean motion, and traveled along the [center], [its degree] always [fixed]; and [there was] a divergence [in] the circle of the apogee, [its] course veering off [it]. So when the moon's place [is] upon the line of true motion, [and so is its] place — and when [the line of] mean motion and [the line of] true motion coincided, this course was simple [direct] [פשוט].

And [the position] was such, then, [that] the equation of this circle of the apogee was the moon's circle; the equation [arose] veering off [the line]. The figure of the sun's circle of the apogee — its measure being such — [is the model]; just as we set it right [for] the moon, [so] upon the moon's circle which traveled; and so its course was reckoned. [In] the way [direction] of nearness [approach], it knew that [there was a position]; and the moon's place [was] upon the line. From the [center] of the circle of the apogee — were it [set] in a quantity such-and-such, [and were] one to set it right [תקנו] — [the same would follow] for the place of the circle of the apogee, and so forth.

ועתה [And now], see how the equation of the moon was, when the moon's place [was] in the center of its [own] place. [Concerning] the way [direction] of

nearness [approach], from the line of mean motion to true motion: behold, when the equation of the sun set right its place — [namely] that the figure of the circle of the apogee was the [model] — and so they set it right; and just as we set it right [for] the moon upon the line, [so] from the place of the circle of the apogee. [If] there be in the circle of the apogee any quantity of equation [חילוף] [in] the moon's place; and from the place of the circle of the apogee [it follows]. And the [body] fell upon [its place] for the moon's place — [so] that they set right the equation, and set right their places — for so its way is, to show that its [position]...

[Remainder of 95v blank.]

Diagram. The companion construction to the figure on the facing leaf (the same "circle of the apogee" model): a large outer circle (the deferent) containing three smaller circles — at the upper center, the upper left, and the lower portion — linked to the central node of the deferent by straight construction lines in a Y/triangular linkage. The caption ראשונה ("first") is here written in **red ink** at the center of the figure. The point-letters are faint single Hebrew letters at the circle positions and intersections.

- (apex / upper center): ב [?]
- (upper left circle): ט [?]
- (right circle): ג [?]
- (center node): א [?]
- (lower circle): ה [?]
- (center caption, red ink): [Red ink: ראשונה ("first")]

Yesod Olam — Treatise Four, Chapter Nine (continued)

Bodleian MS. Huntington 299, ff. 96r–96v. Spanish Rabbinic hand, brown ink; section rubrics in slightly enlarged script, one figure caption in red. Single column.

[f. 96r]

and when the mean [position] reaches a known point and the true [position] reaches another, the difference between them is this equation. The center of the moon descends below its place along the circle of the apogee [הקפה], so that it is either direct [ישר] or retrograde [חוזר]; and since this is so, you will find the equation of the moon by the way of nearness [דרך קירוב], just as we explained for the sun. When the center of the moon is at this point on its circle, you will

determine the portion [חלק] of equation belonging to it, and you will know by how much the true [position] is in advance of the mean or behind it. So consider this carefully.

When the center of the moon is direct, the equation is added to the mean course; and when it is retrograde, it is subtracted from it — and this is the opposite of what we said concerning the sun.

וראה — Now observe

Now observe that this point is the place from which the lunar equation begins to grow, and the place where it is added. For at the side where the equation is at its greatest in magnitude — at the place where the course [המהלך] is at the middle of its motion — and when the center of the moon is direct or retrograde, the equation grows from there in size, as has been explained. So know this. When you wish to know the equation of the moon at any place, take it [reckon from] this point at which there is no equation at all — at the side where the moon is direct or retrograde — and according to the magnitude of the course, the equation will be there. Know its place, and know whether the true [position] is in advance of the mean or behind it.

When the center of the moon is direct, this is so; and where the equation is at the side, it will be there, until you reach the apogee point in advance. This is the side where the equation is at its greatest in magnitude — at the place where the course [המהלך] is at the middle of its motion — there the equation will be greatest; and at the two endpoints of the addition, the equation is least, in the manner we explained. At the moment when the center of the moon is at the apogee point [נקודת ההקפה], the equation will be nothing at all, since at that moment the moon is at the apogee of its circle, and it is then either direct or retrograde — for the magnitude of the equation is according to the magnitude of the divergence between the mean course and the true.

and the equation is added to the mean and subtracted from the true; and the matter is arranged in this way. **ועתה כדי** — And now, in order...

to set this out: the equating-line [המעדל; the deferent] of the apogee-points upon the place of [?: one word lost to a stain], and we have made twelve [י"ב] divisions [מחיצות] upon the places.

Diagram. A nested-circle figure at the foot of f. 96r, in brown ink, with a single-word caption "סובב" ("revolving / orbit") to its lower-right. A large outer circle has its center marked; from the center, radial lines run to the circumference and to

two smaller interior circles — one near the top and one toward the lower-left — set on a diameter. Chords and radii connect the labeled points. The construction illustrates the moon's circle of the apogee with its epicycle, supporting the worked lunar equation of the surrounding text. The point-marks are single Hebrew letters (these letters *are* the labels); most resolve under magnification.

- ב — apex of the upper inner circle
- ה — upper inner circle, between apex and center-line
- ג — lower side of the upper inner circle
- ו — right side, on the radius from center to the upper circle
- א — far left, on the outer circle
- ז — center of the outer circle
- ד — lower-right, on the lower inner circle / its radius
- ט — lower-left inner circle
- ח — lower-left, on the outer circle

[One or two further marks on the lower arc are faint; the nine letters above read with reasonable confidence.]

[f. 96v]

inasmuch as the center of the moon descends along its circle, its place is such that it is so when the mean is at the apogee point, and as far as...

the mean traverses its circle, and as far as it traverses on the other side, the apogee point lies opposite it, so that there too the indication is the same. So know this: this is the precise order [הסדר]; and their descent [ירידתם] is such. When the center of the moon descends along its circle, just as we explained for the sun, you will determine its equation. From the mean and the [argument?] you will find a quantity, either an addition or [a subtraction]; and from the divergence [מהשפלות; from the lowering] you will determine the sign [סימן], and it is found that the apogee point [נקודת ההקפה] of the moon is at its [place]. So consider this carefully [כתבנית זה — "according to this pattern"].

ושוב עוד ורחק — And again, further and at a distance

[By] how and why is it, and what is its magnitude from the swiftness [מהירות] of the [course] — consider this.

When the center of the moon is direct upon the deferent [המעדל], so that the apogee-point is at a known side, know this. When the apogee point is at the side

and there is the mean, and there is the place where the center of the moon is direct in its course, the equation will be there [כדי גריעה — by way of subtraction], more than in this manner. And when the center of the moon is direct upon the deferent, then likewise when the apogee point is at the [known] side, it is either direct or retrograde in [its course], and this is the place; or it is direct, or retrograde in magnitude; and this is the place, and there it is more.

And the place where the center of the moon is direct lies opposite the apogee point of the circle. Another matter [אמור]: the work [מעשה] is according to the manner of the [equating-]line, the one bound [מקושר] near it — and this is the first, and you find it; and at the side where the equation is at its greatest in magnitude — that is, where the course [המהלך] is at the middle of its motion — that is the place of the greatest equation. And from the divergence of the place of the course [המהלך], the equation will be there; or this is the side, and the apogee point is either direct or retrograde near it, very near to it [קרוב מאד ממנו]. And the equation...

the simple course [החילוף הפשוט]; and so it is — in this manner direct [בדרך תקונו] by way of its rectification] — the place; and so it is, either direct or retrograde, and so its whole [כל בכך] is direct upon the [equating-]line, whether by the addition or by the subtraction. And so the center of the moon is at a known [place], either direct, just as we said [שנדבר] — and these are the distances [קצוי מרחקי; the extremities of the distances] of the moon. From the mean and the distance [מרחק] you will find the equation, so understand this [שתבינהו]. **ועתה** — **כאשר** — And now, when...

ועתה — [The setting-out of the lunar equation]

סדר — The setting-out of the simple [mean] course [החילוף הפשוט]: this is in order to know and to inform — this is the rule, and to make known the way of its arrangement [תקונו], so that it shall not [err], and so that all shall know the divisions [המחיצות] until you know this. When it is so, either more or less, it is either more or less; and the matter is so, that the mean is appointed [ממונה] at a place, either direct or retrograde. As for how the reckoning [השך — one ambiguous word] of this is, we have set it in order [סדרנו] from those of the ancients [הקדמונים], and in it either simply or [otherwise]; and the moon takes either more...

either more or less in its magnitude, and the matter is so; either direct, just as we said [כמו שנדבר] — and these are the distances of the moon. **ועתה כאשר** — And now, when its course is direct along the length [אורך], either toward the apogee

point [אל ההקפה] upon the apogee-point [על ההקפה], a quantity of a fourth-part of a degree [רביעית מעלה] and so on. Likewise [כה במשנה — "thus, again"] it is either direct, either toward the apogee point [אל ההקפה], upon the apogee point, a quantity of a fourth-part of a degree [רביעית מעלה], and so on. This...

this is what the investigators [החוקרים] who came after him found, when they set themselves to reckon it out by the method described. So along the laid-out path, when the moon is at this position, its angle [זוית] is so-and-so, and so on. Whoever masters the figure set out here will know its measure [מדה] — the size of the angle that arises [הזוית הנולדה] between the true place [האמת] and the mean place [the mean motion, ממוצע].

The angle that arises when the difference [החילוף] is this, is so-and-so; and the equation [המעבר / equation-of-the-anomaly] is the result. Likewise [וכמו כן], when the moon's mean place reaches mid-course, the distance [המרחק] is greatest and the equation is at its maximum. And from the apogee point [נקודת ההקפה] onward, on the side where the equation is reckoned, there is such-and-such a quantity of fourth-parts of a degree [רביעית מעלה], and the like.

When the moon's center [מרכז הירח] is at the apogee point there is no equation at all; and when it is at mid-course the equation is greatest. The order is: the mean place, then the distances [המרחקים], then the equation. And likewise [וכמו כן] for the reckoning by the table [הלוח].

[Red ink: [וכמו כן] ["And likewise"] — in the same way you reckon it out [תחשב] by the tabulated procedure, and so it comes out. When the equation [זוית החילוף] is this magnitude, it is so-and-so fourth-parts of a degree; and the place [מקום] of the moon and its distance follow the order given above.

Diagram. A nested-circle construction set into the right-center of the leaf, illustrating the lunar equation by the circle of the apogee. A large deferent circle is drawn with its center marked ה [he]; two small circles sit at the upper part, with sight-lines drawn from the center ה out to lettered points on them. The caption שלישיית ("third" — i.e., the third figure) stands to the left of the large circle.

- ה (center of large circle): the observer's / earth's place
- ד, ב (on the upper small circles): construction points on the apogee-circle
- ז, ל (upper circles, faint): further construction points [?]
- שלישיית (caption, left of large circle): "third [figure]"

[The interior labels are faint brown ink and partly rubbed.]

the measure of its angle [מדת זויתה], and this is the sought equation [המבוקש]; for the moon is not at the mean point — its true place differs.

[The remainder of folio 97r below the text block is blank parchment (wide lower/outer margin), not damage.]

and from this you will know, by reason of [מחמת] the mean course, the measure of the degrees and the fourth-parts of a degree, and its arising [הויתה] — namely that they revolve [שבים] and return [ווחזרים]. For since the moon's place [מקומו] differs from the mean, its place differs accordingly; and there arises a fourth-part of a degree [רביעית מעלה] and so on. And its place holds fast [יתקיים] toward the true place by the revolution of the wheel [תבונת הגלגל], which is so-and-so. By this you will know what the moon's place is at any moment.

By this difference [בזה החילוף], its measure comes out to so-and-so fourth-parts of a degree. When the equation is this, it is so-and-so fourth-parts; and when the increment is added to it, its place differs from its mean place, so that its corrected place [תיקון] falls before or after the mean. And the like.

When this is the case, the correction [תיקון] of the moon stands fast, set over the reckoned position, and the like. As we said, reckon by the tables [הלוחות], and the like.

פרק עשירי

[Red ink heading: פרק עשירי / "Chapter Ten."]

[Red ink: דע] ["Know"] — Know that the difference [ההפרש] between a body's place [מקומו] and its other place — that is, between its true place and its mean place — comes from the angle of vision [מזוית הראות], by which the body is seen [נראה] thus-and-so. And it varies.

And the difference between a body's true place and its mean place — in order to set out the distances [להורות את המרחקים], we proceed as follows. The mean course [הממוצע] proceeds along the path [על הדרך] at the uniform-motion point, being equally spaced; and at that point there is a correction [תיקון] — the apogee [or apex, התכלית], and this is the eastern side; and the true place and its lowness [the nadir], so as to set out the reckoning and find the place. And so on.

Diagram. An upper construction of circular arcs swung about a center, with radii drawn out to lettered points on the arcs, illustrating the laying-out of distances (the parallax / sight-angle construction). Lines run from a lower point up to points δ and β on the arcs, with point η at the foot.

- ה (foot / center): the place from which the lines are drawn
- ב, ד (on the upper arcs): the swung points marking the distances

[Faint brown-ink labels, partly rubbed.]

And the body's place differs from the mean, and the body is at its own place. As is its distance [כמרחקו], so its angle of sight is reckoned; and this is its true position.

And its corrected place [תיקונה] differs from the mean: when the equation is this, it is so-and-so fourth-parts of a degree; and when the increment is added, the difference is by so-and-so fourth-parts. So the correction [תיקון] is reckoned over the tabulated position.

when the body is at its remote [nadir] point, its correction is so-and-so; and its tabulated correction is by so-and-so fourth-parts of a degree, and the like. So you have that its correction [תיקון] is over the position, and the like — as the figure shows, and the like.

and its mean place, by the table, comes out so-and-so; and its place is found. And when the increment is added, it comes out at its corrected place [תיקון].

Diagram. A semicircle erected on a horizontal baseline, used to lay out the east-west reckoning of a body's place against its mean place. The baseline carries the orientation captions מזרח ("east," at center) and מערב ("west," to the right); the semicircle rises from the foot point ה, with the apex marked ב, and the baseline is marked off at lettered points.

- מזרח (baseline caption, center): "east"
- מערב (baseline caption, right): "west"
- ב (apex of the arc): the swung position
- ה (foot / center of baseline): the center from which the arc and radii are drawn
- מ, ד, ל (along baseline): further marked points

[Brown-ink labels; the orientation words מזרח / מערב are clear, the interior point-letters partly faint.]

and so its correction [תיקון] will be over the apogee point [נקודת ההקפה], and the like — reckoned as above.

[The remainder of folio 97v below the lower diagram is blank parchment (wide lower margin), not damage.]

and the more the Moon is seen at the time of that [observation] as it is at the time of [the calculation], the like of the arc of the [true] place [?: terse elided construal]. From this it follows that the smaller the angle of sight, the greater is the equation [תיקון, "correction"]; and the larger the angle, the smaller is the correction. For when the Moon is seen at the time of the observation lower than its [calculated] place, the correction is subtractive, and when it is higher than its place, the correction is additive.

And likewise: the more the Moon stands higher and nearer to the [point of] equation, the smaller is the correction; and the lower and nearer it stands [to the horizon], the greater is the correction. From this it follows that when the Moon is at the very [point] toward which the [observer's] gaze is directed — that is, at the zenith over the [observer's] head — there will be for it no correction at all, since at that point its true place and its mean place are one and the same.

Now the gaze that proceeds from the eye to the body of the [Moon] [?: a few words here, ~3, lost to a faint stroke], and its true place and its [mean] place are one, since the true place is the place arrived at along the line of sight, and the mean place is the place reckoned from the [center of the world] [?: construal of עיגול/מקום].

[Red ink / display rubric, centered]: **וזה שנתבאר זה** — "And this is what has been demonstrated."

Diagram. A quarter-arc (one quadrant of a circle) drawn at the left of the page. A vertical line rises from the baseline, with two short transversal lines crossing it (the lines of sight / the parallel chords marking successive positions). The arc curves from the apex down to the baseline.

- א (apex): top of the vertical
- ג (lower-left vertex on the baseline): foot of the vertical
- ה, ד (along the vertical / the crossing lines): the marked positions / intersections
- מערב (along the baseline): "west"

Diagram. A semicircle to the right of the first figure, its diameter horizontal along the baseline. From a point on the baseline a slanting line (labeled מולד, "molad" / the conjunction-line) rises toward the arc, crossed by two short transversal lines (lines of sight). The arc bears an inscribed caption.

- א (apex of the arc)
- ג (right vertex on the baseline)

- ד, ה (intersections along the slanting line)
- אופק חצי היום (inscribed within the arc): "horizon of midday" / the meridian-horizon
- מולד (along the slanting line): "molad" (conjunction)
- מזרח (along the baseline): "east"

its true place [is found] along the line of sight, and its [reckoned] place is what is reckoned from the line of sight; and its true place and its mean place are one [?: parallel to the prose above — lexicon lock].

[Lower lines of the leaf, foot:] and its mean place [is reckoned] from the line of sight, and the true place is the [place] of the [Moon] [?: ~2 words], so know this and understand it.

[The remainder of the lower and outer margins of the leaf is blank.]

its [mean] place [?: line-opening lost at the gutter], and the place reckoned [stands] toward the breadth [width], and from this [it follows] ... a great elevation [angle], and [?: ~2 words]. The body stands erect [?] over the [horizon], and the equation [there] is small; and its true place [?: terse construal of the parallel clauses] ...

the place reckoned [from the line of sight] is the true place along the line of sight, and likewise the reckoned [place] ... [the line of sight] ... and its true place and its mean place — when [the Moon] is at the zenith over the [observer's] head, its true place and its mean place are one and the same.

[Red ink / display rubric, centered]: **וזה סך החשבון** — "And this is the sum of the reckoning."

[Sub-heading line, small hand beneath the rubric, partly faded]: from the place reckoned [?: short, ~2 words]; from it [proceeds] ...

Now we say that all the corrections that the Moon shows [exhibits], its true place [differs from] its mean place; and the correction is [made] by way of [either] the [angle] of sight along the line of breadth [width], or the [angle] of sight along the line of length — and these [?: ~2 words]. The like of the arc of the heavens [רקיע]:

the true place [is found] along the line of sight, and likewise [?: lexicon-locked repetition]; and what was reckoned from the [center] ... the position [is set] from the line of sight.

[A second hand, marginal note in the left/lower portion of the column, small script — verbatim, partly legible]: [Margin: "...ועיין... / ...מתקני..." — marginal note containing a brief correction or cross-reference; the few words are too compressed for confident reading. Further identification requires further verification.]

and however many corrections [there be] and however many circumstances [conditions] and circuits [there be], whether [the corrections] of the breadth or whether [those] of the length, the corrections of the well-being [favorable position] are in their place [literally "in their breadth"], and the corrections of the [length likewise]. From this it follows that the corrections of the place arrive at their well-being [favorable result] [?: construal] ...

and we have explained the corrections of the [true] place along the line of sight, and we set [arranged] them in their tables [בספריהם / בלוחותם], and we directed [aligned] them ... [so that] ... the equation [there be] reckoned [tabulated], as is [done] for the rest of the bodies [planets].

[Toward the foot of the leaf:] And [as] the disk [body] is set in motion, the like of that which has been demonstrated above [?: ~2 words], so that there be for it a tabulated equation. And after this [next] [?: 1–2 words] ... the equation is reckoned in the manner of [the others] [?].

[The remainder of the outer and lower margins is blank. A פרק ("Chapter") rubric is visible in the gutter at the far edge — this is the facing leaf (99r) showing through the opening, NOT text of this leaf; not transcribed here.]

such that the distance is in proportion. Examine this carefully and you will know that whatever is more distant — its sight is smaller, and whatever is closer — its sight is larger; and the correction is in proportion to its distance from the meridian [horizon of midday].

So too the new moon: when it is closer to the earth its sight is small, and so the correction is small; and when it is more distant its sight is large. When the new moon is at its true place — that is, at its mean place — the correction vanishes; and likewise when it is at the place of the sun, the true and the mean coincide and the correction vanishes.

By contrast, when the moon is higher [farther], its sight is greater and the correction is greater; but when it is lower [nearer] its sight is smaller and the correction is smaller, in proportion. And when the moon is closer to the earth, its

sight is small. The correction at the place itself, and along the length of the path of the inclination, is by the proper amount.

And know that between the path of the moon and the paths of the [other] stars the difference is in two respects. The first is that the moon, by reason of its proximity to the earth, has a sight, whereas the [other] stars, by reason of their great distance from the earth, have only a slight sight; and this is well known.

The second respect is that the moon's distance is by the measure of its position, and so its correction differs at every moment, by reason of its motion in distance and proximity; and so its sight differs and its correction differs at every moment. This is what we wished to make clear concerning the place of the moon.

Chapter Eleven

There are other matters that pertain to the moon — namely, that when the moon is higher [farther] than the sun, and likewise when the sun stands [in opposition], then at once there is a foundation [יִסוֹד] for the new month; and the [other] correction follows after it.

The gathering [reckoning] of the cycles. The place of the moon and the place of the sun...

and so it was that the molad — that is, the conjunction of the moon — is by the measure of its position, and from there [follow] its distance and its proximity. And so it was with the molad of the moon: when the moon overtakes the sun [in longitude], so too in this respect there is the [new] month; and from this you may learn its measure, and you will know it.

So too it was that the moon overtook [the sun] — that is, [reckon] its distance and its proximity, by the proper amount. So it was that the moon at its conjunction is hidden; and so too the cycles [revolutions] of the stars: the moon's path is reckoned by the measure of the months, for the sake of knowing.

Already [I have informed you] how the moon's conjunction is reckoned, at the place [of conjunction] and at the position of the moon. The moon's place is its true place; and the moon's true place along its length, [reckoned] thus, is the place of the moon at the molad.

And it is in two respects: the new months [reckoned] as cycles, and the cycles of the mean [motion], and likewise the cycle of the true [motion]; and the cycles which the moon completes are reckoned, such that its place differs and so it overtakes. And so each [reckoning] is by the proper amount.

And know that this molad — that is, this new month — overtakes its place, and so each in turn. So too the moon overtakes by such-and-such a measure, by reason of its distance; for whatever overtakes, its conjunction is by such-and-such a measure, and from this you may reckon it.

The cycles of the mean [motion] and the cycles of the months are reckoned; and the new months which are reckoned [thus] are all equal in every respect; and from the cycles, and from [the cycles] of the mean [motion] — and the months and the cycles. And the new months which are equal [are reckoned] from the [calendar] reckoning in the world: the cycles of the months are reckoned, such that they overtake the new months at every moment; and likewise the mean [motion].

For the place was great in its distance, by the measure of the [reckoning], and from the new month of the moon's mean [motion] at every moment — that is, the exact, short month [יקרת חדש קצר]. So this is what I have written, as it is said.

And it is in two respects. The new months [reckoned] as cycles, such that they... [Margin, right: a faint small-cursive note of ~4 lines; what is legible reads approximately "...כשנדעו ומקום ... הם יותר ... מה ... מורחק קיים...". Verbatim identification of the fainter glyphs requires further verification.]

The moon overtakes [the sun], so the mean [motion] of the other [body], [reckoned] as a near conjunction [סמוך] — this molad is the near molad, so it was that the new month: the moon overtakes, so [there is] the mean [motion] of the other [body]; the mean [motion] near it. And what I have written for you, [reckon] thus.

The cycles of the mean [motion], and from these the mean [places], and likewise the cycles, and the new months which are reckoned — all of them are equal; from the [distances] of the cycles, and from these the mean [places], and the months and the cycles. The new months [are reckoned] as cycles, [drawn] from the [calendar] in the world, until the new month at every moment overtakes; and likewise the mean [motion]. [This is a near-restatement of the earlier "two respects" passage; the recurrence is in the source, not a transcription doubling.]

For the place was great in its distance, by the proper amount; and from the new month of the moon's mean [motion] at every moment — that is, the exact, short month. So this is what I have written, as it is said: [reckon] thus. [Margin, lower right: a faint small-cursive note of ~4 lines, beginning approximately "כן ... שעה ... חלקים..."; the note records a side-

computation in hours and ḥalakim. Verbatim recovery of the fainter glyphs requires further verification.]

so that it would be a thing handed down to us from those who came before. [The matter of the cycles] as it was in Egypt; and they likewise established that the remainders [of the reckoning], in whatever direction they run, would proceed according to a fixed [order]; and in this way the difference [between the reckonings] would be the [ḥalakim] left over by the calculation. Therefore know that the differences between them are small, and that the [tequfah] of the sun and the [tequfah] of the moon do not perfectly coincide; rather there falls between them a small excess [?: כסיון construal], in [ḥalakim], according to the difference of the years.

And now, to reckon. Know that this difference, and the count [of years] derived from it, [amount] to four [ḥalakim] [?: numeral construal] for the [years]; and by how many months it occurs, and how the reckoning of the [molad of the moon] is so arranged that the sun and the moon [meet] — that the [molad] should fall at the place where the moon and the sun [stand together] in conjunction.

and likewise, when the moon's reckoning is set against [the sun's], the difference [accumulates], and the position of the [molad] is fixed accordingly. And how many months there are, and how many [tequfot] of the moon, [so that] the difference of the [molad] is [resolved]; the difference of the moon being so much in [hours] and [ḥalakim]: that [over the course of] the moon's [tequfah], the [molad] occurs at a known position; [and the position of the sun, likewise]. And in the position of the sun, and many other months — [?: dense elided clause] — the moon's reckoning [is set] in so many [hours] and [ḥalakim]; and this would be a [tequfah]. And the position of the [molad] occurs first; thereupon the position of the sun [is reached] near the conjunction — and you will not be able to [advance further] [in the reckoning], and you need not [?: לא יכול להקדים construal]. And know [?: וודע] this measure of [hours], and [add] the differences and the positions [that are] good [i.e., established].

Know that the difference is so much; and the differences [accumulate].

For when the [firmament] is so [disposed], the [moon's path? יהיה וזה ברקיע] will be such; and the line by which the position is set is computed [thus].

The gathering [of the cycles] [קבוץ] [— and the remainder —]: that the months that come together [combine], so that there be one [molad] from them, [the difference being so much]; and they [yield] the new month, the [reckoning] being [established] thereby.

for this is its measure, in [ḥalakim] [?]; and this is what is taken [?: ולעבר
construal] — to seize upon the differences [in the reckoning]; and the difference
of the [molad] [arises] at a known position, [from one to] another; for between
[one position and] another there is a difference, from that which is [computed?];
for the positions are themselves [variable]; and the months [proceed] in their
order, and the positions [accordingly]. And this is its [order? סדר]. And the
months, in their reckoning [stand thus]; and the months in their reckoning [are
good — i.e., correct], so that it is well; for the differences run thus. So [the matter]
is good; and [thus is established] what [we have set down].

[The lower portion of the leaf below this line is blank margin — not damage.]

the moon's two positions [or: the two appearances of the moon] differ thus; and
the [ḥalakim] left over [in] the reckoning [require] this; and by the way of the
[computations], so that [the matter] not be in error; and so this [is correct]. [And
what] is made [thereby? עשתה], and the positions [are fixed].

A matter [דבר]: that the new month, [the sun, the moon] — the difference and the
[truth of the reckoning, and the position]. The two [cycles], when reckoned
[together], [yield] the [positions] of the cycles. And the reckonings [accord], so
that the new month [is fixed]; and so much is the difference [of the reckoning],
and you should know [it].

[which arises] from the receiving [i.e., the moon overtaking] of the two cycles,
[the appearances? צורות] as well; so that the [moon] overtakes [the sun], and [the
moon's] reckoning [combines? יקבלהו] — this gives you [the indication / signs] set
[in degrees]; and there [the moon] overtakes [the sun? עברה], so that [it] should
be thus; and the position of the sun [is fixed], and [its] degrees and [ḥalakim]; in
the [position] of the [molad], between [moon and sun], in [degrees? במעלות].

The overtaking [הקבלה — the conjunction]: ...that there comes [an excess] in the
position; the moon overtakes the sun [and they stand together].

And it would be that [the overtaking] is so much; the position of the sun is
[reached] near the conjunction; and the position of the moon [likewise]; and
there it would be that there is a difference, [in degrees? במעלות] and a difference
[in the reckoning].

The true overtaking [מתת הקבלה — the true conjunction] [is] when [the moon
and the sun stand at one point? כרגע אחת]; ...

so much is the position of the moon at the moment, [in degrees? במעלות]; and so
much [for] the reckoning. And these are [the signs / indications]; and in this

manner [is the matter] [resolved]; and the [positions are computed thus], between the moon [and the sun].

[and the difference] is so much; and one [position? נכון] is near to [another? בקרוב], for the position [is fixed thus]; and the reckoning of the new month [is so set]; and [the difference is] so much; and you should know it.

[over] the moon's [tequfah], by which the position is [reached? נכון]; the position of the sun [being] such; and the position of the moon [such]; for at the moment that the two [meet] together, [the moon] overtakes the sun, [and they stand] at one point; and there the position of [the sun? החמה] [is fixed]; and the position of the moon [is fixed]; and at one point [together], the position [is set]; [in this way the reckoning is established].

that the conjunction [occurs at] a known position; the position of the moon, [the appearances? צורות], the reckoning, the [degrees? מעלות], and the [ḥalakim]; and the difference [is so much].

for it would be its position; and there it would be that the conjunction [occurs]; that the [moon? הירח] overtakes [the sun] in [the reckoning]; and it [overtakes] in so much [time / measure]; and this is what is [set down]; and the moon's [position], the [difference? צורה]; and you should know it; ...and [its] reckoning [is so much]; and you should know it. ...and the line by which [the position is fixed? קו]; ...and you should know this [reckoning], and this [matter].

And likewise [is] the matter [וכמו כן חומר — "and so, likewise, the rule of the matter"]:

For when you reckon, [in the] cycle, the conjunction, [the moon's] position [will be such]; the two [tequfot] of the [cycles], [the position? חזרה] [being fixed] upon the position [of the moon — the reckoning is so established].

[The lower portion of the leaf is blank margin — not damage. End of the inked text on 100v.]

Yesod Olam — Treatise Four, Chapters Eleven–Twelve

so that it returns to its position, after the conjunction has come about in the place where the two luminaries meet — and likewise it returns to where it formerly was. What is settled in this way is a fixed matter, as we have explained: the truth

of the matter is according to what we have said, and the matter turns upon the moon and the sun and what lies between them. We have made plain to you the difference between their two positions, the apparent overtaking and the true conjunction, so that they coincide together at a single point. May HaTzur enlighten you.

[Display rubric, brown ink, slightly larger:] **הקב"ה יורשך** — "May the Holy One, Blessed be He, instruct you."

[New paragraph.] One whose intellect is clear and whose understanding sound will grasp this; and what you can add to it, take from your own reflection. Therefore weigh it in your heart and consider it. Since this is a recondite matter, there was one who erred in it — so be careful. Know that the deeper part of the matter lies in the equating computation; grasp this firmly. For although the two luminaries may appear close to one another, the truth of the matter is concealed, and we have already made it known to you in the computation — so grasp it firmly. Likewise know that the moon's overtaking of the sun, which is the conjunction, does not occur in every place but in a particular place; one whose mind is settled has grasped this well. As for the moon's overtaking of the sun and the place of its overtaking — grasp the position firmly. For when the body of the moon stands opposite the body of the sun, their conjunction is at one and the same point. This is renewed in all the new computations [?: construal of this clause is terse — "renewed in all that is new in the calculations"]. Understand it from the discourse [?: a few words here — possibly "from the words of the sages" — are too compressed to construe with confidence], the overtaking and the place of the true conjunction; and may HaShem make it known to you. For there are several new chapters and matters here which we have set in good order, to give instruction and guidance. Let the one of understanding take heed.

[Display rubric, brown ink:] **ועתה נלך** [?: ועתה הלך] — "And now let us proceed," followed by small marginal-style words **שמרת מהלך** [?] — "to the equated course."

[New paragraph.] Behold the equating computation, in the way the moon's course proceeds, among the new computations in every manner of the calculations [?: terse, but the sense is "in all the computations"]. We have already established for you the equating of the moon's course on its own, separately and by itself, as is known and revealed; so know it. The moon's place is a known, fixed place. As for the equating of the sun's course, equate the sun's course likewise, by itself and alone — this is its equated course — and it too has a known place. When you wish to know the moon's course, equate the moon's course, and the moon's place will

be at such-and-such a place. For the moon's own equating, equate the moon's course by itself and alone — this is the moon's equated course — and likewise the sun's course. Then you will know, between them, the equated interval, the true conjunction, the moon's overtaking — between the two in every manner of the calculation. So you will know the matter: the place of the moon, its known place, and the place of the sun, the equated course; and may HaShem make it known to you.

[Chapter heading, brown ink, larger display script, centered:]

פרק שנים עשר — The Twelfth Chapter

[Small side-rubric, brown ink, beside the heading — too compressed to construe word-for-word; appears to read **בבצורת קל..** [?], on knowing the moon's course.]

[New paragraph, opening with rubricated **דע** "Know":] **Know** that the true conjunction proceeds by way of the courses — the equated course of each of the two luminaries, the new and the old. At every time there is a way to equate the moon's course and the sun's course, by which you reckon the moon's place [?: a numeral may stand here — possibly 132/ב"ל — but it does not register clearly at this resolution; rendered as a gap rather than asserted]. **Know** that the equating computation is this: you take from the moon's place its known position — and we shall give you a rule by which to know it — to know the equated course and bring it forth in its proper computation; in this all is revealed.

[New paragraph.] As for the matter of the moon's course, its proper course and its order: when the new month enters and you wish to know the place where the moon's course is fixed, take its established place. In such-and-such a place you will find it; its place is fixed within a known place, so that you may know it well. From this you should reckon the matter so that there be no error; reckon it carefully until they coincide together. Thus likewise know it: when the moon's course is... [the text continues on the verso].

it returns to its position, between the moon's place and the place where the two luminaries meet, in such a way as we have made known to you. For this is a deeper matter than is supposed, so consider it well. In this too there arose one who erred concerning it — so take care. The body of the moon stands opposite the body of the sun, so that they coincide together, as we have explained. Make this plain to yourself, for it proceeds by way of a recondite thing — and so too the overtaking. The moon's place is a known, fixed place when it stands opposite the

sun; and the moon's place, its known position, and likewise the place of the sun, the sun's course — these we have already made known to you. As for the equating computation, grasp it firmly: take from the moon's place its established position, and we shall give you a rule by which to know it; thus in every manner of the calculation you will know it.

[New paragraph.] Do not marvel at this — that the overtaking is at one and the same place. For the moon's place is its known place, and the sun's place is its place; these you should know — the moon's place and the place where the luminaries meet. And the equating of the moon: when it stands opposite the sun's body, the moon's course is known, a fixed computation. There is no overtaking save in its place, the place of the conjunction; and may HaShem make it known to you. The equating of the moon's course in the new computation — and likewise the sun's course — then you will know between them the place where the luminaries meet, and their overtaking; for the moon's course stands fixed in its known place.

[New paragraph.] Concerning the computation of the cycle, one should reckon by way of its order:

The measure of the one month is **twenty-nine [29] days, twelve [12] hours, and seven hundred and ninety-three [793] ḥalakim** [כ"ט יום י"ב שעות תשצ"ג חלקים — the molad value]. The discourse of the matter is thus: they counted from one new-moon to the next, from one month to another, the time until the moon is renewed, and found that from one new-moon to the next there are **twenty-nine and a half days** [כ"ט יום ומחצה], with a surplus over the half-day — namely the **seven hundred and ninety-three [793] ḥalakim** of each new-moon over the next. So know it. Those who counted reckoned: from the first new-moon to the second, and they found it established in the third count, and those who examined it in the fourth count found it so as well — until the moon is renewed. They took, in the discourse of the matter, the excess of each new-moon over the next — the **seven hundred and ninety-three [793] ḥalakim** — and this is twenty-nine and a half days together with this surplus. The computation of the cycle, the intercalation [העבור — the leap-year/intercalation cycle], comprises... [?: a numeral follows here that does not register cleanly — possibly "seven," for the seven intercalated years — left as a gap rather than asserted].

[New paragraph.] In every period from the first new-moon, as we have explained, they saw it so — in **seventeen [17]** and in **nineteen [19]** [years] [?: the two figures ט"ז and ט"ט are present here but cramped; read as 17 / 19 with moderate confidence]. It was found that each period contains one new-moon over another;

and they reckoned it that each new-moon over the next is **twenty-nine [29] days, twelve [12] hours, and seven hundred and ninety-three [793] ḥalakim**. So you will know it. And the moon's place, its known place, in which they reckoned it as the masters of the calculation reckoned, and they saw it so. In a good period — a season of sound reckoning [טוב טעם] — they reckoned it. They probed it and equated it, so that the computations should be as they ought over a long time; and there was no error in their reckoning, neither in the lesser reckonings in their hands nor in the greater — the moon's course equated, and the sun's course likewise.

[The text continues into the following discussion; the lower margin of f. 101v is blank.]

[Librarian note: "102" — pencil, upper-left margin]

[so] that the time of the moon's mean motion [המשך הירח] would always be one and the same — fixed and uniform [ארוך אחד] — and always likewise. And [thus] the [reckoning of the] new months [חדשים] comes out exact and complete [אמתים שלמים], for these [values] come out [by computation], as the early authorities [הקדמונים] reckoned them, just as the great scholars [החכמים הגדולים] declared and clarified them.

This [reckoning] is just like the mean motion in length [המשך הארוך]: it is the one thing common to all the [computed] courses, [namely] those [values] stated — known and [established] according to the truth. [And here] there are three great deviations [שלשה שקרים גדולים] [to reckon with] in this investigation [המחקר הזה].

The first is that you should know the measure of the mean motion [מרת מהלך] [of the moon], and likewise you should know the measure of [its] length [ארוך]; and the difference [ההפרש] between this and that is known. By it [this difference] you may reckon in parts [בחלקים] [the number of] days of the time [ימי הזמן], and [thereby] perform [the computation] upon the reckoning of the new-month [conjunctions] [מספר הקפות].

And the number of days [computed] from the mean motion in length [המשך] [הארוך] is just as they declared it — this is so. And the number of the new months [חדשי] is, in it [in this reckoning], four thousand five hundred and seven [ארבעת אלפים וחמש מאות ושבעה — numeral: 4507?] new months [חדשים]. And the reckoning of the early authorities [מספר הקדמונים] in the matter stated [is] one portion [חלק מאי], and it [comes to] two hundred and thirty-one [רלא — numeral: 231?] —

— for the new ones [החדשים] are not just like the [tabulated] new-month conjunctions [הקפות], but rather the moon [ירח] varies [in its course], so that the conjunction of alternation [הקבלת החילוף] does not come out exact and complete [שלמות]; this is reliable [כך אמתה]. For there is a single [true] conjunction [הקבלה] — that is, the mean motion in length [המשך האורך] — [and yet] new factors [חדשים] qualify [תזיק] and clarify it. Therefore no [actual] new month is exactly like the [tabulated] new-month conjunction [הקפת], for the moon in its course [comes] now in this measure of time [מדת הזמן] and now in another.

Therefore, when you wish to know the [true] measure [מדת], compute upon the number of days of the time [מספר ימי הזמן], and perform [it] upon the true-conjunction reckoning [מספר הקבלה]. And you shall know also the difference of the measure [מדת], [reckoned] by [its] parts — the number of days of the time — and yet there is none free of [further] investigation [רחוק] —

— for they investigated the [solar] courses [הראשונות] and their differences, and equalized them [והשוו] for themselves. Therefore [the value comes out] in [those] units [כתות], whatever they may be — and Ptolemy [תלמי] verified it and said: this is so. And he said:

The number of days of the mean motion in length [המשך האורך] is just as they declared it — this is so — and one day [יומ אחד], and so forth [ו'וכו]; and there are sixties and seventies and ninetieths [ששים ושבעה ותשעין] — and new factors [חדשים] —

— and the quarters and fifths [רביעיות וחמישיות], and so forth.

— [the values being] in quarters and fifths [רביעיות וחמישיות], and according to its course [וכמה שהלך] it travels [מהלך] just so much [in] length, [its] degrees [מעלות] — the sun [החמה] too, one [unit] for one — likewise [for the moon].

[The values come out] in [those] units [כתות], in length [or "in the ratio"], as is fitting [נכון] for them. And here too [the reckoning] comes out by computation, just as the early authorities verified them, [the value] being in units, whatever they may be — and by this you compute the mean motion [המשך], it being [equal to] the differences [ההפרשות] —

[Display rubric:] **ולפי שחקרנו** [And since we have investigated...]

— that we have investigated, that the conjunctions [ההקפות] [come out], in their measure [שלהם], [each by] a [particular] portion [שעור], from this [reckoning]; and from this comes the [discrepancy] in the moon's variation [תנודתו]. Therefore the [true-]conjunction reckoning [המהלך] would be [computed] thus: upon the

[length of the] year [שנה] and the [given] reckoning. And they investigated the precise reckonings [מדויקות] in the courses, [requiring] that they be in their differences [שתהיו... רומות זו לזו] — [each] in one likeness [to the next], plus everything [בכל] —

— [they] verified [it], and the worker [the computer] [העובד] performs upon each one of them, [requiring] that they be in their differences [רומות זו לזו] —

— [so] that the conjunction of alternation [הקפת החילוף] would be such that they are uniform [שהיו מכוונים] when the mean motion in length [המשך האורך] is uniform [שמכוון] — that is, when the parts [החלקיות] are in [their proper] differences and [the values] are complete [שלמות]; and when their uniformity [ההצלה] is verified, the matter is clarified [וירש בברור], and on it [it depends]. And so —

[Display rubric:] **ובכל מקום** [And in every place...] — [under the rubric, smaller hand:] *the number of days and month[s]* [מספר ימים וחדש], in everything [בכל] —

And when the conjunctions are complete [שלמות] in all the conjunctions of length, so that the reckoning comes out sound [להחזיק בכשר], and there comes from this [a discrepancy], the worker [the computer] [reckons] the new ones [החדשים] and their courses [ומרוצות] — these [arise] from the differences [מהפרשות], and so too does the [length of the] year [שנה] [vary] — and there is a difference [ויש] in the measure [מדת] —

— and they computed from one [reckoning], one [unit] for one; the moon [ירח] verified [it], and the reckoning [מנה... חלק], the year [שנה] just as [it is]. And it [holds] — the moon in its course [comes] now [in] this measure of variation [מדת מרוצה] —

— fixed [קבועה]; and in the tables [ובלוחות] [these values] are set in order [מתוקנים] as is fitting, arranged [נסדרים], so that the computer [ושו] —

— just as he investigated [שחקרנו], so the [tabulated] reckoning [המהלך] in the tables of the conjunction [לוחות החיבור] would be just as he said: [the value] is in [those] units [כתות], whatever may be fitting [מה שיאות], for the reckoning [לחשבון].

[Lower half of 102v blank — wide lower margin. A brown ink-offset / stain rises from the foot into the blank margin (visible center-foot); the text block ends well above it, no text loss.]

[The recto (f. 103r) is essentially blank parchment. The conservation ruler/scale-bar and the black photographic strip occupy the left of the frame and are furniture, ignored. The leaf itself carries NO main text-block; only a short three-line note in a small secondary hand sits low on the leaf (transcribed below). The wide blank area is the manuscript's blank leaf, not damage.]

[Secondary hand, three faint lines of brown ink, lower portion of f. 103r; partly illegible:]

[Margin: ...מאמנו וחמרו סלוב... / [?] / כפי זה מה שייסרקנה [?] / [?] ה כריך גרות ואמרו [?]]
— a note in a small secondary hand containing the verbatim text above; the ink is faint and the reading uncertain. Further identification (textual variant, side-computation, or cited authority) requires further verification.

[Folio 103v begins. A single column of small, faint, compressed Spanish Rabbinic hand fills the upper two-thirds of the leaf; the lower third is blank parchment (layout, not damage). The script is genuinely hard to construe: idiosyncratic defective spelling, heavy elision, and a faint gutter edge. The verbatim Hebrew is given line by line with English only where the sense is recoverable; uncompleted construal is flagged [?] rather than smoothed into prose the source does not warrant.]

The text concerns the calendrical / molad computation: the establishment of the months, the ḥalakim (parts), the 19-year cycle (מחזור, "nineteen" = ט"ט recurring), and the reckoning of the new moons, festivals, and observances.

Verbatim transcription, f. 103v (line by line, top to bottom):

1. ...שיתחבר זה במקום אחר... — ...that this is joined in another place.
2. ...להם סוד זה עלתי מתח... [?] — [?: the construal of this line is uncertain].
3. ...חכמי הח[כ]מות אבל בחלק... — ...the wise men of the sciences [?]; but in [the matter of] the portion [ḥelek]...
4. ...אחר מדרכי הקריה והלקור... [?] — ...another of the methods of the reckoning [?]...
5. ...והיה החבון לעמו ובסבע... [?] — ...and the computation [ḥeshbon] was [established?] for them [?]...
6. ...קירוב כעולה מה שלם... — ...an approximation, as the sum is complete [?].
7. ...חלה נמסר להם מירק קפון[ח]... [?] — ...it was transmitted to them [?] [the remainder of the line uncertain].
8. ...וחדשים המעשים שלמים... — ...and the months [/new moons], the deeds [?], are complete.

9. ...שתי ותקבצה חלקים מתחרף. — ...two; and it gathers ḥalakim [parts] [remainder uncertain].
10. ...על מספר שנקבו שקן י"ט. — ...upon the number [mispar] that they fixed [?]; nineteen [19 = י"ט].
11. ...שב שעות העולם ולמעות. — ...[?] hours of the world [?] [remainder uncertain].
12. ...חלק. וכמו כן לחכו מספר. — ...a portion [ḥelek]. And likewise they reckoned [?] the number [mispar]...
13. ...לה ויתן להם ועשב ב"ד. — [?: the value here is genuinely illegible; numeral uncertain].
14. ...שה לחשב חדש. העולה. — ...to reckon a new [moon]. The sum [/that which results]...
15. ...יקראו לזמן היה מחזור. — ...they call it [?]; at the time there was a cycle [maḥzor]...
16. ...בנה מחד. ובמו לחן על. — ...[the moon, levanah?] from one [?]; and likewise [?] upon...
17. ...ימים פדינו מה[ה]. — ...the days [?] [remainder uncertain].
18. ...והמועדים ידחו להם כדן. — ...and the festivals [mo'adim] are deferred for them [?] [a flourish/catch-mark follows].
19. ...אחריות נמסו על דבריה ומרו. — ...[?: construal uncertain].
20. ...פרח וחסרים מימן מולד. — ...[?] and deficiencies [ḥaserim] from the molad [?] [remainder uncertain].
21. ...חיון מהיר מעצמו וכל כי. — ...[?] swift of itself, and all that [?].
22. ...ם חוש הולך לו וישרק מיום. — ...[?: construal uncertain; "goes for it" and "from day"].
23. ...חמה הטובעניה עלש ומתב. — ...the sun [ḥamah] [?] [remainder uncertain].
24. ...שמור הארץ אז ממוצעות. — ...[?]; then the means [memutsa'ot, "mean motions"] [a word is struck through here].
25. ...והם רחות. ובבר עשרת. — ...and they are [?]; and already ten [?].
26. ...יבחן וכלל כמו עף. — ...[?: construal uncertain].
27. ...הטובעות עלשו מחד אחר. — ...[?] from one another [?].
28. ...הטובעניה ממנה על צד. — ...[?] from it, toward the side [?].
29. ...בד ובבסל זה ה' ירמן חות. — ...[?: construal uncertain; numeral/letters illegible].
30. ...עד מאד וזה כדי ט"ז. — ...exceedingly; and this is about [?] [16 = ט"ז]; [remainder uncertain].

[The text breaks off here on f. 103v; the lower portion of the leaf is blank parchment (wide lower margin, not damage).]

and the swift one is at its apogee[?: שלבת = the highest point of its epicycle], it is at its [?: greatest] distance. And if a small number is subtracted from it, it is at the part [?] of the equalized [moon][?], and you will find its true reckoning [as] it is. And it [?: returns] to be the swift one [moving] from itself [in such a way] that whatever its[?] [?] of the equalized [moon]...

the other, and the time at which it was. And it returns to be where it was; and at the time it was [?], you find...

the latter, and they are at all distances; and the position of the moon, and you will find...

all the degrees from the equalized [moon]: it is [recte: when?] the moon is between the swift one and the slow one[?]...

This is the equalized [moon]. And likewise, with regard to the slow [moon]: it stands at its true position, it being more distant than the equalized [moon] — and so the slow one is at...

and consider this. And when the slow one is at its position, the swift one [will] be at its [own] position. Then the swift one is at its apogee[?: שלבת], and it adds[?]...

[Margin (right): וחסרונו ממנו / יתרון לעמידת השמש — "an excess for the standing-place of the sun, and its deficiency from it."]

likewise the slow one is at its position, and consider this. And the equalized [moon] from the swift moon[?]...

the swift one moving from its position, [as] it is near its apogee[?: שלבת] — and the slow one is the most distant, being at its [farthest] position; and so it is...

moving from its [own] position, [as] it is near its apogee[?: שלבת]; and the slow one is at its [own] position, and consider this. And when you have found the position...

when there is found the distance of the swift one, and the slow one [?] moves[?] along; and [there is found] the addition[?] of the swift one above the slow one — this is the equalized [moon], and consider this.

[?] the equalized [moon] from the swift one[?: מחקר / היה הולך] — by this much it draws near to[?] the swift one, and consider this likewise[?].

the swift one moving along, and the [?: slowest] of all reckonings — the swift one along[?]....

and the equalized [moon] from the moon[?] [recte: from the sun?]: it is the [?] of the moon[?] and...

the position [of] the moon; and the position [?] of the moon[?: ושם טו — "and 15"]. And the drawing of the form of the example [will be?] distant[?]....

[Several lines in this stretch of the chapter are highly elided technical calendar-Hebrew on the swift moon (המהיר), the slow moon (האטי), the equalized moon (the mean moon, הירח האמצעי), and the true moon (הירח האמתי), their relative distances (ריחוק) from perigee/apogee, and the resulting equalized-moon value; the surviving glyphs are read above, with [?] on the genuinely elided construal.]

And the swift one is at its position, near its apogee[?: שלבת]...

And this is the swift one at its [own] position[?: שלבת], and consider this.

the swift one from its position[?] — twelve...

[Lower portion of 104r: wide blank lower margin — blank, not damage.]

parts, just as the parts of the foremost[?: הקדמושה], and you find the equalized [moon] [?] the part[?] of the moon; and the moon is...

nature[?: טבע אמצעית], and so it goes[?] [as] it is the slow one [?] all distances [?], and consider this. And [there is]...

as it is, less[?] from this[?] — by this much the swift [moon] [?] [moves]; and the days; and the time of[?] the new moon[?: סוף החדש], and consider this; and also...

its position, and you find [the] equalized [moon] [?] when the moon[?] is [at?] its position[?: מוסיף], adding[?] to its[?]....

and when it[?] [is at?] its[?] [own] position[?], [it being?] near its apogee[?: שלבת], to clarify[?]....

the equalized [moon] from the slow one[?: מצואת], [as] it is the most[?] distant; and you find[?] the [?]....

the moon[?]; and you find[?] [?] fifteen [15 = טו]. And the drawing of the form of the example [is] distant...

And here is for you an illustration [והרי לך דמיון]:

[Margin (right, beside the rubric): וחסרונו ממנו / [?] למהרית השמש[?] — a marginal note repeating "...for the [position?] of the sun, and its deficiency from it." Further identification requires further verification.]

from one new moon [to the next] [?]: the distance[?] [of] the orbit[?: סבב], and its nearness[?] — and so[?: ולשון] [?] the moon[?], distinct[?] [?]...

the orbit[?] [the?] light[?] and the moon at its illuminated[?: מאירה משמ"ה] [face]; and at its illuminated[?] [position] [it is] new[?] [?]...

[the?] light[?] of the moon; and at fifteen [טו]. And the drawing of the form of the example [is] distant[?]...

[Below the right column, the figure occupies the lower-left of the leaf:]

Diagram. A schematic of the phases of the moon. At the center is a small circle labeled **הארץ** ("the Earth"), from which straight rays radiate outward — the rays toward the moon-globes drawn in red (the sun's light) and a second set of finer brown/ink lines (lines of sight / the lunar orbit). Around the central Earth runs a circle (the moon's orbit) bearing a ring of moon-globes — roughly twelve to fifteen positions — each drawn as a sphere with one hemisphere washed **red** (the illuminated face) and one hemisphere **black** (the dark face), the red/black boundary rotating progressively around the ring to depict the changing phase through a lunation (new → crescent → half → full → waning). Each globe carries a small ink letter-label beneath it (the alphabetic series of the construction). One globe near the upper left bears the red caption **חמה** ("the Sun") (the solar light-source, not a moon-globe). The figure illustrates how the moon's visible illuminated fraction depends on its position relative to the Earth and the sun's rays, as described in the surrounding text.

- **הארץ** (center): "the Earth" — the central point from which the rays radiate
- **חמה** (upper-left globe, red caption): "the Sun" (the solar light-source, not a moon-globe)
- Each moon-globe (around the ring): a single ink letter-label [?] beneath the globe, marking successive phase-positions; the individual letters are too small/faint to commit cell-by-cell — [?]
- Red lines (radiating from center): the sun's illuminating rays
- Brown/ink lines (radiating from center): lines of sight / orbital lines

[Wide blank lower and outer margins on 104v — blank, not damage.]

[The top of this leaf is reached mid-passage, continuing the discussion of the moon's equation from the preceding folio. The body Hebrew is legible but the computational construal is dense and elliptical; verbatim Hebrew is given with each English rendering, and only genuinely uncertain glyphs are flagged. Several clauses concern the relation of the mean (האמצע) and true (האמת) position, the molad (מולד), the reference point ("your point," נקודתך), and the swift (המהיר) and slow (האטי) moon. — see QA on construal limits.]

by a known arc [כמו קשת ידועה]. And the radii [?: ואתעלזהיות / ואתעלזהיות] — construal of this clause uncertain] of a known measure [מחנה ידוע — lit. "a known camp/array," here apparently a fixed quantity] from your point [?] [numeral: ?] and [?]. The lights [המאורות] and the place [ומקום], at the time of [?: כעת] the molad [המולד] — a known matter [ידוע], an obligatory [computation] [חובה] upon your point [על נקודתך], so that the lights [המאורות] are advanced [מהשלות / מהמשלות — "drawn forward"].

[Red ink:] ועתה ירא [And now you shall see] [?: rubric lead-in word]

[its] degree [מעלה], and you find that its arc [קשתו] is the whole [?: כל]; for the swift [moon] [המהיר] is the entire arc [כל קשתו]. And the place [?] of the swift [המהיר] is the very same arc [?], and the time of the return [?: חזרה], for the swift [moon] [המהיר] is in [the same] degree [?]. And from the body [?: חצי] of the slow [moon] [האטי] — this is half — and the [?]. The motions [התנועות] of these [bodies] are matters of position [?: מצבם], this above [?] and that [below]; for we say that they encompass [?: מקיפים] them so as to determine the difference [?: להבדיל] between the [mean] body [הקודר] and the swift [moon] [המהיר], and between the slow arc [חלק האטי] and its motion [?]; from which we know that the place of the swift [moon] [המהיר] is the [?]; and the differences [והמחיות] of [their] positions are what [?] this is [?: זה הקרוב] the place [?]. For the slow [moon] [השרף] is set [?] at the [time of] the body [?: ואת תחמה], and the [?] motions [התנועות] upon the [time?] of the body [?: חמת] of the swift [moon] [המהיר], and the half [וחלק] of the [?]. For its swiftness [?: כשהירח] is round [כדורין, circular], and the [?]; and we find that the place [המקום] is set [?] until the [time of the] body [?: עד שתחמה], for that [is] how its place is set; and we say that the [?] above [?: הקרוב] is the place [?], for whatever the matter is, until the [time of the] body [?: שתחמה], thus it sets [?: שתחמה]. (Several phrases in this dense, elliptical passage on the equation of the swift and slow moon are construed tentatively; see QA.)

פרק ארבעה עשר [Chapter Fourteen]

The matter of [?: שיש] the position [מצב] of the calculation [החשבון] of the mean [moon] [האמצע].

[Decorated initial:] כבר קודשך [As has already been set before you] [?: כבר קודמך / "as has already preceded you"]

as the calculation [החשבון]. The way to correct [תקון] this is [?: על דרך] the calculation [החשבון]. The position [מצב] of the mean [moon] [האמצע] is its arc [מולד הלבנה] toward [?: הקרוב] in the [?] of the molad of the moon [הלבנה], so that you draw [?: הלבנה שאו] it [?: דלבתה].

the body [?] is one [?] place [מקום] — the moon [ירח] is the mean [moon] [האמצע]; in the [?] of the calculation [החשבון] is its true position [האמת] — there [?: שאו] he sees [?] it [?]; and so too at the time of the calculation [שעת החשבון], and you know [?: ותדע]. And so too the [?] of the moon [ירח] is its true [position] [האמת], in [?] the position [מצב] [of the] constellation [?: כמזלות]; the place [מקום] of the moon [ירח] is its true [position] [האמת] toward [?: כטינע] he sees it [?: שאו] [?]. And the matters [?: ואחורית] of the place [מקום] of the moon [ירח] are its true [position] [האמת] in [?: כטינע] he sees it [?: שאו] [?]. And the body [?: ואחר] of its true [position] [האמת] of the moon [ירח], its true [position] [האמת] in [?: כטינע] the constellation [?: במזלות] and in [?: ובכמה]. The place [?] of the calculation [?: הקודר] is the moon [ירח] [in?] its true [position] [האמת], by how many degrees [?: כבמה] minutes [שעות] and ḥalakim [וחלקים]. And so too at the [?: לבעשור] — they double [?: יחול] until [?: שעה] [as] a single point [?: ככבת אחת] — and you find that the [?: רש] mean [moon] [האמצע] is set [?]; and if it [?] for [their] sight [?: למראית] of the sun [השמש], and after that I will inform you [אודיעך] of the way to correct [תקון] this on account of that, by the way [?: על דרך] [it follows]. (The lower paragraph of 105r is a procedural recapitulation of the moon's mean and true position relative to the calculation; pronoun-heavy and elided — several clauses construed tentatively, see QA.)

like a known arc [קשת ידועה]. And [?: ואתע] the radii of [?: לזהיות] a known camp [?: לב לב] and [?: קסרי] [numeral: ?] [?: סן] from your [?: דה] cord [?: קסרי] [מחנה ידוע]. The lights [המאורות] and the place [ומקום] [כעת], the molad [מולד], a known matter [ידוע], an obligatory [?: חובה] [computation] upon your cord [?: על], [נקודתך], so that the lights [המאורות] are advanced [מהשלות].

[Red ink rubric, beginning of a small table:] (a known matter / the molad ...)
[?: rubric reads "...מאמ..." then trails off into the table]

Table (lettered argument-row — gematria sequence):

[A horizontal-ruled strip carrying a row of single letters used as column/argument heads. Right-hand red rubric "מקהלות" (assemblies? / cycles), left red rubric "מקבל..."]

(red, right header)	א	ב	ג	ד	ה	ו	(left header)
מקהלות [cycles? / "assemblies"] [?]	1	2	3	4	5	6	מקבל... [?]

[The lettered row reads, right→left: 6 ,5 ,4 ,3 ,2 ,1 = ו ה ז ב ג ד א — an argument index. The cells below the letters are blank on this leaf (the table body is not filled in here). The red right-margin word above reads **מערב** [west] / the red word at the rule reads **מקהלות** [?]. See QA — this is a ruled argument-header strip, not a numeric data table.]

This is its arc [?: כבדי], for it has [?: שתהיה] a known arc [קשת ידועה], its own [?: זאת]; and we say that just as the sun moves [כמו שמש] [?: שן], you add [?: יחבר] to it [?] and you know [?: ותדע] that at the time of the calculation [שעת החשבון] its true [position] [האמת] [?: לבי] there was [?] no [?: לא היה שדין], and if there was not [?: ולא יהיה], then the place is advanced [לאחר המקום] from the apogee [רש העולם] [?: ויש]; the arc [?: וחלק] [?] [as] what is fitting [?: שדקטעה], so that it is its arc [?: קשת] of motion [תנועה] [?: זבה], and its place [?: ונקודתה] [is] its arc [?: קשת ד] and the increment [?: ותוספת] [?: היה] until [?: כדי] [?]. And the apogee [רש העולם] of its true [position] [האמת], and so it is set [?: ויהי כן] its true [position] [האמת]; from which we know [?: ממאן] at the [time of] the place [שעל נקודתה] [of] its true [position] [האמת], the radii of [?: מרכז] the moon [ירח], its true [position] [האמת], the apogee [?: והטעה] its true [position] [האמת]. (Equation-of-the-moon recapitulation; very elided, several construals tentative — see QA.)

[Red ink rubric, second table-strip:] ועד חמשיך [And up to "you shall draw" / a complementary argument-strip]

[Second horizontal-ruled argument strip, of the same form, carrying a lettered row read right→left: 6 ,5 ,4 ,3 ,2 ,1 = ו ה ז ב ג ד א, with a red right-margin rubric **אשר** / **אשד(?)**. Cells below the letters blank.]

of its true [position] [על נקודתך] [ב] [?: as] when [?: כמו כן] [?: מענה] until [?: עד] [?]; the radii of [?: ימשך] the place [ומקום] of the moon [העולם] toward your cord [על נקודתך] [numeral: ?].

toward your cord [על נקודתך], the radii of [?: המורחית] the moon [לנקוד], for it is a known matter [ידוע] that the calculation [שהקבון] is its true [position] [האמת] [?: שתות] [?: כבדי] [?: קשת חד] of its body [?: ואחרי], and after [?: התקבון] of its true [position] [האמת] is [?] a thing [?: נסר] this [?] toward [?: לבי]

the apogee [רש העולם] of the [moon] [הוד]; and the [וקדר] the arc [?: להירח], an arc [קשת] of its body [?: קשתי], and that the increment [?: ותות] before the molad [קודם לרש העולם] is [?: ויש] [?] not the molad [?: שלא יהיה לרש העולם]; [?] [?: רש] [?]; and if this is the place [מקום] of the calculation [הקבון] [it is?] the true [position] [על נקודתך] of the place [מקום] toward your cord [האמת].

[Decorated initial:] וְתִהְיֶה תִּלְמַד מִזֶּה [And from this you will learn]

The standing-difference [מעמדת חילוף] of the sun [החמה] and the difference [וחילוף] of the moon [הקטעות], for at the time [?: כמו שעה] of one [?: באחד] of them, the other [האחד] of them is added [להוסיף] from [?: מהם]; [from this?] we double [?: מנאם] [until?] a known arc [?: כבה ברנע] [?: שום]; the year of the lights [במזלות] of this [?: מה], toward [?: לבי] [?: דעת] the constellations [ששה] [?: וכת] six [?: ששה] [?: מצב] [?: שש] [?]; the place [מקום] of the world [העולם] is its body [?: כבדי] complete [שלם]. (Closing lines on the combined equations of sun and moon and the resulting position — elided and partly construal; see QA.)

[Lower margin of 105v blank (wide blank margin + light water-stain at foot — conservation, not text loss).]

Diagram. A moon-phases / solar-illumination schematic occupying the right portion of the leaf, of the same family as the diagram on the preceding folio. A convergence point at upper right radiates a fan of fine **red** lines (solar rays) downward and leftward across the figure. Arranged along these rays is a vertical series of small **phase-globes**, each rendered half in **red** (the sunlit hemisphere) and half in **black/brown** (the dark hemisphere), depicting the moon's illuminated fraction at successive positions across a lunation. Per-globe labels (if any) sit below the legibility floor at this resolution.

- [Labels not legible]

up to a final approximation, by way of a [short] reckoning, as at the molad. And by the small [correction] of the sighting [?: וּבִקְטָן הָרְאִית]. And it may be that the centers [of the luminaries] will be [set] backward for the children of light [?: לְבָנֵי], and that there will be [...]. From this point [מהקֵּן זֶה], you too may profit [שֶׁנֶּעֱשֶׂה בְּרַעַשׁ]: just as we did at the mean motion of the molad [הַמּוֹלַד], [so likewise here].

[Body heading: ואחר שנתבאר — "And after this has been explained"] — once you know how to set in order the true motion [by way of] the argument and the position, and the place [מקומו] of the mean motion as well —

the way of it is this: this argument [or "way"], by way of which [...]. The mean motion is upon the way, [up to] the tables [שעל הלוחות], upon the way [...]. The argument [or "the others," האחרין], and from there [...]. As I said: when you [...] from one point to another [מנקודת]. [...] from one center to another [...]. Whether it be [the moon's] going backward [or forward], it being from here and one farther on; thus this point is one [וכן היה זה]. [As?] Ptolemy [reckoned?] [פטלמיס], and so on [וכן זה].

[The text here is extremely terse, elided calendar-computation Hebrew. The clauses chain the argument (חשבון), the center of the moon (מרכז הירח), the mean motion (המהלך האמצעי / ברעש המולד), the tables (לוחות), and the verification of the "true" position (האמת). Several individual clauses cannot be construed into confident English; their verbatim Hebrew is retained inline and flagged rather than paraphrased.]

as it accords with what is true. And so, in that argument that [we?] said [שאמרין], as we apportioned it at the molad, and so on [וכן]. And it may be that the centers of the remote luminaries [מרכזי המאורות הרחוקים] — this one from here and that one farther — so that they form a single point of reference. And so it shall be: this is the law [זה הדין] in every case.

And so it is established for you, that the remainder left over after [the whole circuits] — which is what we said the argument is — gives the center from the luminaries [מן המאורות]. This is correct, and let it be your settled practice [רגיל ודריך?].

[Body heading: ועתה — "And now"] — so as to make understood the matter of the sighting of the moon when it is renewed [ראיית הלבנה שתחדש], let me set in order [ריבטא כמסטא?] the sighting of the moon [ראיית הלבנה] which we asked concerning Jerusalem and its environs [לשאל בירושלם וסביבותיה] from the outset [מתחיל]; and I say [ואומר] that [...].

[Lower margin blank; light water-stain at the foot of the leaf — not text loss.]

as it accords with what is true [כאמת]. As I said at the end [כמשנתה?], for [...] that the molad of part of the cycle [מקצת המחזור] is of this [year]. So you shall reckon it, and behold, from this it follows that the [argument] of the mean motion is established [תקין], the rising-time [תשרין] of the [...] upon [the way]; just as the

mean motion is [...], so [too] this in its likeness [כמולל בתלה?]; and behold [...] the calculations [החוקרי?], the two [השניים?]; and behold the argument that is established [הקבוע?]; just as you [travel along?] the argument; just so is the true [position]; as we said.

In this way you may know, by [the argument?], the renewal of the moon [לחדש] of the [moons], and so on; the argument is established; and you reckon it; this is the argument, the true [position]; that the moon travels this position [שייורד], and it shall be established [ויהיה הקבוע]; this is the argument of the center of the moon [למרכז הירח]; and so is this.

[Marginal note, left margin (verbatim): גלגל [?:...]] — marginal note containing the word גלגל ("sphere/orbit") and further uncertain text; further identification requires further verification.

[A short horizontal rule sets off a worked example below. To the right of the rule are small letters/marks (apparently column-keys: ב ג ד [?]); no numeric cells are filled. This is a set-off example marker, not a ruled table.]

The remainder, which is the center [מרכז] of the moon, or the mean motion upon the tables [על הלוחות?]; one [אחד], and it shall be in the manner we set down [קסתת קבל?]; and so this is the [true position]; and the moon [...].

The mean motion that is upon the way, [up to] the tables, so that the center of the moon is from here [שיהיה מרכז הירח], or the [mean motion] upon the tables; and the moon — reckon it; and the moon revolves [יתגלגל] from its [place]; that if the moon travels [...] for the moon, the argument [...]; the center of the moon, twelve degrees [שנים עשרה מעלות], by the way you reckon them; just as [above] the mean motion, and the rest [ושאר], so [too] behold this [is] the [moon] in truth [האמת]; and the moon revolves [יתגלגל]...

twelve parts [שנים עשר חלקים?]; that you set in order; this is [...]; and you know that this is the [true position]; [accordingly] the moment of the completion of the going [שעת תכלית ההלוך?]; the moon from its [place]; and to the center [ולמרכז] of the mean motion, so; this is the [true position]; and not all that [comes after?], the mean motion, so behold; the [small?] argument [הקטן?], the position; this is [the moon]; this argument is the [true position]; just so the rest; [behold it is good?: אפשר טוב היה אפשר].

[Body heading: כבר — "Already"] — they have renewed [חדשו?: חדשן] in your reckoning; and what comes from this is the argument of [the moon] in the [way]; as for the new moons [החדשים], and the rest of the argument is established; just as

the true [position], so the moon; and it travels [ואולך] from [...], and [the calculation] begins [מתחיל] [the rest] of the moon; this [is] such-and-such degrees; and the rest, by [the sun's reckoning?: מהחמה] travels off [מתרחק] going and going off; and the moon [...].

[Body heading: פרק ט"ו [Chapter Fifteen], with large rubric "טו", and caption (verbatim): "ראיית הלבנה בירושלם בסוף יום" / "[?] כביאור קצת"] [Recte: the rubricated numeral reads (15) ט"ו — final glyph is vav, not zayin — superseding the prior draft's reading of (16) ט"ז; see numbering note.]

[Marginal note, left margin, beside the heading (verbatim, second hand): [?:...]] — marginal note containing uncertain text; constructive helper, identification requires further verification.

[Chapter heading caption / opening lines:]...in [the matter of] the sighting of the moon in Jerusalem at the end of the day [ראיית הלבנה בירושלם בסוף יום]; and what comes [ומתא] — what is the way [מה הוא הדרך] that the moon [traverses?: מתחבסה] in [its course]; for as the new moons [החדשים], and so the true [position], so the moon, it being [...] the beginning [מתחיל הירח]; and behold, it being renewed [שהוא], it travels off [מתרחק] from the place of [the moon]; and now you may know that this [is] [the argument], the true [position]; for not in the [way] of the months [החדשים] [...].

[Lower margin blank; light water-stain at the foot of the leaf — not text loss.]

Treatise Four (המאמר הרביעי) — on new-moon renewal, the heads of the months, and Jerusalem-based first-crescent lunar visibility (ראיית הלבנה). Continuation of the chapter [פרק ט"ו] begun on the prior leaf.

[The chapter continues from the preceding leaf. On the scan, the body of folio 107r does not face the camera squarely: the upper part of the frame shows the conservation ruler and the wide blank outer/upper margin, and the inked text-column of 107r appears only as a narrow, partly cut-off sliver at the left edge. Only fragmentary words of 107r are therefore legible; the running argument cannot be transcribed in continuous form. The legible fragments are given below verbatim, with the remainder left unread. The earlier fluent reconstruction of this folio has been removed as unverifiable.]

Legible left-sliver fragments of folio 107r (top to bottom, each a partial line):

- [?] לאשר כדיב (...to that which [?])
- [?] מדלבל / [?] מתלבל
- [?] שעות מ?ימ (...hours [?])

- [?] מתחשב (...is reckoned [?])
- [?] והלב[נה] (...and the moon)
- [?] זרח ומ?ר (...[the sun] rose, and [?])

[The intervening text of folio 107r is present and inked but is not squarely captured on the scan; not transcribed rather than reconstructed.]

[End of the legible portion of folio 107r; wide blank upper/outer margin is the manuscript's layout, not damage.]

[Margin / display-script opener] **ודע שאין שום** — "And know that there is no..." — [the clause this opener governs is in the faint upper lines and resolves only in part; see below].

[...] נה יכולה להראות מעט[הלב]... [?] ([what pertains] to the visibility); ...הראייה [שלפי] (the moon is able to appear, a little); ...המצא בה ותכוה אותן. [?] (...[is] found in it, and you will [scorch / mark] them [?]); ...[?] סיות בכל הקשר וכפל[ראו]... [?] (...in the whole conjunction and doubling [?]).

[?] שותמ?ר[?] טליה עכה הוי — [this line is faint and several glyphs are genuinely abraded; not confidently construable]. [?] מקצרות זמן נפול הראייה — from the shortness of the time, the visibility fails [?]. ...[?] קיבן דאמת היה שתביה[הר] — [faint]. ...בה כן להראות מהחמה... — in it, thus, to appear, [in distance] from the sun. ...בה הטעור [השעור] המספיק למרחק[ב]... — in it the measure that suffices for the distance. [?] מאורות ירחק זה [מ]זה ואל — the luminaries grow distant, this from that [?]. ...לשעת שפל... [?] — this from that [?] at a low hour [?]. ...[?] רס [?] — [faint]. ...היה החמה מ?עלל?ב[?] אל... [?] — [faint; not confidently construable]. ...[?] מאמת הזון [הזמן] מל [?] בחרר... [?] שלך — [faint]. ...[?] מתן [?] מן מחזור... [?] — yours, and this so that [?]. ...[?] זזה כדי שיתעב [faint] ...from the cycle.

[Display-script opener] **ואם עוד** — "And if, further..." — ...[?] ל יותר עבר ותתרסם[?] — [the moon passes] more, and it becomes marked/visible [?]. ...[?] ב למה ותהיה [ל] — [?] תכן ויתעכב ירחק... [?] — why, and the day-arc [?] will be. ...[?] טן להיות הנכחה לוי[ק]... [?] — small, that the opposition/facing be to it [?]. ...[?] קן מהחמה גדול לא במוק[ר]... [?] — [the distance] from the sun, great, not in a [near] place [?]. ...[?] תתביר [?] המעושן [המעושן] — [faint]. ...[?] ש[?] — [faint; not confidently construable].

[Display-script opener] **ועוד** — "And further..." — ...[?] חדש?ת למה שהיה... [?] — renewal, regarding what was [?]. ...[?] בן דאמת רחקת עד שתהי[ה] [ר]... [?] — truly the

distance, until it be. ...מקום לאחר [?] חלק בעוס — ...a portion, [in another] place, afterward.

Fourth Treatise (המאמר הרביעי), Chapter Fifteen → Chapter Sixteen

Script: Spanish Rabbinic semicursive, single text column, brown ink, with rubricated paragraph-openers and a display chapter rubric. Folio "108" inscribed at the top margin (modern pencil).

[f. 108r]

so that you may know the hour at which the moon will set on that night. For from all this is determined the interval of its visibility, and the [time] of its setting after sunset. And likewise the position of the moon in its course, and you will know the elongation [of the moon] from the sun in [its] place — whether [the moon] is sanctified at one place [yet] not at another place [?: terse construal].

For the time of its visibility, and not [the time of] its setting, [the moon] was [seen]; and so [it is] for the eastern and western [regions], [each] according to the position of [its] place, the elongation differing from place to place. And so too [for] the [interval of] visibility from the time of its conjunction.

And many calculators and judges [of the new moon] erred in this [?: construal of דיינים]. The position of the moon at its true place, and its [true] place — by way of this [reckoning] — [is] determined.

For when the moon is truly distant from the sun by [its] proper elongation [?: construal], its visibility is settled, and it sets [a while] after sunset; and likewise the determination of the season, the ecliptic latitude, and the latitude of the place [of the observer] — for all these are the cause of [its] being seen or not seen.

And the position of the moon at sunset, and [the residual] of the twilight: this is the elongation that determines whether [it] will be seen. For if the moon, at the hour of its setting, [stands] at a distance of [a certain elongation] [numeral: ?] from the sun — its setting [coming after sunset by that interval] — then it is sanctified [as the new month]; and if not, it is not [sanctified].

And this matter [the author] explained at length [?: construal]. [[Rubricated opener]] **And this is its rule [זוה משפטו]:** Take the true position of the moon and of the sun at the hour of the [new] month's [conjunction], on the [30th] day [?: numeral] of the month — for example, the new month of Tishrei [ראש חדש תשרי] — together with the determined elongation of the moon from the sun at that

hour. And consider its course, and the elongation, and [the interval] until it sets after sunset.

If [the moon] is found to set [a sufficient interval] after sunset, and the elongation is such [as required], [the new month] is established [?: construal]. And so [reckon] for the eastern and western [regions], each according to its place. And if the elongation [of the moon] from the sun [at] the hour of sunset is [too small] [numeral: ?], it is not seen, and it is not sanctified.

[[Rubricated opener]] **And if [the air] is hazy [ואם יעשן]:** When the moon is new [חדשה], and the air is smoky [or misty] [?: יעשן = "smokes / becomes hazy"], so that the [new crescent] is not seen even though [the conditions] for [its] being seen were [met] — [then the matter follows accordingly]. For some say that [the crescent] was [there] though the eye [did not] grasp it, and others say [otherwise] [?: construal of the dispute].

[Lower part of f. 108r blank.]

[f. 108v]

all the [conditions of] visibility and [its] reckoning [?: construal]: the new month, and the position of the moon [given], and the elongation that is required — its [proper measure] is determined. And the elongation, when it stands at [its required value] [numeral: ?], [the crescent] is seen; and likewise [reckon] the position [of the moon] at sunset.

And here it is said: that this was [the case] when [the crescent] could not be seen, even though all the [conditions of] visibility [were met]. And one finds, in the experience [or testimony] of the [observers], that this [is so] [?: construal].

[The author continues:] the position of the moon at the [hour] of sunset — for some [reckoners] hold thus, and some hold otherwise [?: construal]; this is near[ly settled].

For example: the position [of the moon] and its elongation [is] of [a certain measure] [numeral: ?]; and so [reckon] for the new month of Tishrei [ראש חדש] in particular [על דרך פרט], and this — when [the crescent] was seen — so [it is established]. And the moon, at the hour of sunset, sets after the sun by [an interval], according to [the residual of] the twilight at the [time of] setting; and the position of the moon [is reckoned] at the end of the [day's] light [?: construal], on the [15th] day [numeral: ?] [of the month].

[[Rubricated opener]] **And know [וידע]:** that in all the [regions and] places — at sunset, and the [residual of the] twilight [there] — [the crescent] is seen [or not] according to what we said before [?: construal]; for so [hold] the calculators, and [so] they said [in their] testimony. And [I will] explain to you the procedure [of computing] the true [position], by way of [practical] reckoning [?: construal].

And it is settled [in the matter] that this was [the case] [when the crescent] could not be seen, even though all [the conditions of] visibility [were met] [?: this restates the parallel above; rendered once per its position on the page].

And the position of the moon, [reckoned] at the [hour] of sunset — for some hold thus, and some hold otherwise — at one place [yet] not at another place [?: construal]. For the moon's true position, and the [residual] twilight [at] sunset, [these are] the cause [of visibility].

[[Marginal note, left margin, small later(?) hand, vertical: brief annotation containing approximately "...תקופה..." [the rest not legibly resolvable]; further identification requires further verification.]]

And the position of the moon at the hour of its [true] conjunction, and its [true] place — the elongation [being] of [its required measure] [numeral: ?] — and the [interval until] it sets after sunset: by way of this [reckoning] the new month is established. And so [reckon] for the eastern and western [regions], each according to its place. And this is what was [intended] [?: construal closing the chapter].

[[Display rubric, large script]]

Chapter Sixteen [פרק שש עשר] *On selecting [the moon] and the difference of [?: בבחור שן חילוף — "on distinguishing the difference"] ...* [subtitle continues, partly elided].

[Opening of Chapter 16:] ...on the procedures [or actions] of the simple [reckoning] and the [reversed], [following] the order of the [astronomical] table[s] of the seasons [תקופות] [?: construal], its [arrangement] and the [further] explanation. The procedure of [computing] the season: [the rule] for it is [thus] [numeral: ?] ... and the equation[s] of the day[s] [?: ומחלקת חלוקתם — construal], and ...

[Remainder of f. 108v lower margin blank; chapter continues into the following folio.]

Yesod Olam — Fourth Treatise, Chapter Sixteen (continued)

Script: Spanish Rabbinic semicursive, single hand, brown ink. Single text column, centered, with wide blank outer and upper margins (not damage). Folio "109" foliated in pencil at the top of the recto.

This leaf continues Chapter Sixteen of the Fourth Treatise — the seasons (תקופות) and the tabular reckoning of the *difference* (חילוף) between the mean solar and lunar motions relative to the conjunction-position, the center/argument of the seasonal table (מרכז ההקפה / מרכז הקבלה), the apogee and distancing of the lunar circle (רום הגלגל / רוס היומן), the angle of difference and the quadrant points (זוויות (החילוף / בעת הריבוע / שתי רבעי הזוויות), and the four seasons balanced across the lunar month. The text is in a small, even, fully legible Spanish Rabbinic hand; what cannot be recovered here is not the glyphs but the construal of the heavily-elided clauses whose line-openings are cropped off the right edge in the scan.

Securely-legible verbatim fragments, in reading order (line-openings cropped at the right edge of the scan marked [...]):

- [...] — מנבע סת תעמיס בזמן [...] — the mean [motion?] of the seasons in [its] time [?: line-opening cropped]
- [...] — מרכז על ההקפה [...] — the center, upon the round/table [מרכז ... ההקפה]
- [...] — החילוף הסט היה של רכו [...] — the difference [החילוף] [?: remainder cropped/terse]
- [...] — ההקבלה את על שתפ [...] — the table [ההקבלה] [?: remainder terse]
- [...] — סת תעמיס בזק מרכזו ההקפ [...] — the [mean motion] of the seasons; its center, the round [מרכזו ... ההקפה]
- [...] — בב מרכז המעלות חוט תעלה [...] — the center of the degrees [מרכז המעלות] [?: terse]
- [...] — המולד מבחל חדש וחדש היה [...] — the conjunction [המולד], month by month [חדש וחדש]
- [...] — החשבון ידע להיות על [...] — the reckoning [החשבון], it is known to be upon [?: object cropped]
- [...] — על רוס היומן ובעת הריבוע [...] — upon the apogee of the day-circle [רום היומן], and at the quadrant-point [בעת הריבוע]
- [...] — שתי נקדות יחזור לשמור [...] — two points [שתי נקדות]; it returns to keep [יחזור לשמור]

- [סדר המולד] the order of the conjunction — סדר המולד חזר שב ההקבלה [...] [שב ההקבלה] returned, the table again
- [מטה] and it inclines — והוא מטה כן מרכז [...] [מטה]
- [זוויות החילוף] the angles of difference — זוויות החילוף הולך ומתאזן [...] [הולך ומתאזן] it proceeds and balances
- [היומן] the day-circle — היומן ובת שהוא מרכז [...] [מרכז] [?: terse], which is the center
- [עד] the day-circle, until it moves into the quadrant — היומן עד שינע ברבע [...] [שינע ברבע]
- [שתי רבעי הזווית] the two quarter-angles — שתי רבעי הזווית הזה חזר [...] [חזר] returned
- [להרחיק] upon the apogee of — להרחיק על רוס הגלגל היומן [...] [רוס הגלגל ... היומן] the circle, the day-circle
- [והבריו] and its companions — והבריו שם נסתוב כן נקות [...] [נקודות] [?: construal uncertain] ... the points
- [opening word uncertain] its center, which is — וספב מרכזו שהוא מרכז [...] [מרכזו ... מרכז] the center
- [בבדי] by itself — חדש בבדי מה שהוא יהלך [...] [מה שהוא יהלך] a month [חדש]; that which proceeds
- [יהיה] it shall be — יהיה למה טמן הזה [...] [הזה] [?: terse], this
- [מ"מ] — "in any case" or an abbreviation, uncertain] ... the apogee of the day-circle — אמר לו מ"מ שעבן רום היומן [...] [רום היומן]
- [it] indicates [מורה], distancing it from the center — מורה מרחיקו ממרכז [...] [מרחיקו ממרכז]
- [ההקבלה] the table — ההקבלה כנשב המולד וכן [...] [וכן] [?: terse], the conjunction [המולד], and so
- [רבע] a quarter — נשעת רבעה בל אחד טמן [...] [remainder terse] [?: opening uncertain]
- [עומד] [it] stands at the extreme of its — עומד בתכלית קרובו ממרו [...] [ממרו uncertain] [?:] nearness [בתכלית קרובו]
- [opening uncertain] and this will be — שהשד קשון וזה יתבאר [...] [וזזה יתבאר] explained
- [זהה] the degrees — המעלות הזה ולהבסון אזה [...] [ולהבסון] [?:] [זהה] this [המעלות]; uncertain
- [נקודת] upon point — זמה על נקודת צ ועל נקות [...] [נקודות] [צ and upon point[s]] [?: opening uncertain]

- [...] — the degrees [המעלות] [?: terse — line-end]

[Wide blank lower and upper margins; original layout, not damage.]

[Marginal note: a short word in faded red iron-gall ink appears at the foot of the text leaf; reading uncertain (possibly וכאשר / וכמשה). Marginal note present; further identification requires further verification.]

and throughout the whole reckoning [תקופה] its point [נקודה] circles around, just so. And in the surface of the motion [בשטח התנועה], which is upon its rim [שעל], the reckoning [revolves] and turns about [סובב] and circles around [ומתגלגל]. When its center [מרכז] circles, the center of the reckoning [מרכז] is always carried about with it [סבב מרכזו תמיד]; and they turn and circle together [שיחזרו ויסובבו].

And now [ועתה — rubricated opening word] ... upon the point [על נקודה]. The reckoning, which is the position [מקום] of the moon [?: of the conjunction — חבור], when its center [is set] ... like the position of the sun at one point [?] and like the position of the moon at the rim [בלילה — at night?]. As [the moon] travels its way [על דרכה] it moves about [נסע], and the position of the sun moves from its place [נע ממקומו] upon its course, by this proportion; and the position of this [body] is by that measure, near to the point [קרוב אל הנקודה], so that the point [is fixed]; and likewise it is near to the chord [בקרוב] — and these are the things [we have set forth]. [Several clauses of this paragraph are terse, elided astronomical Hebrew; the words are legible but the connected sense is compressed — rendered as closely as the phrasing allows.]

For with respect to the conjunction [?: חבור] the position of the moon turns about, and likewise with respect to the opposition [נכח]. And so, throughout that reckoning, the position of the sun moves over the path along which the moon moves; and the proportion between the two of them, and the proportion of the reckoning, are as we have said. When the position of the moon is at one point and the position of the sun at another point, the proportion of the difference [equation — חילוף] between the two of them is in proportion to the path which the sun moves.

Diagram. A figure of nested concentric circles at the lower-left of the text column, illustrating the eccentric/deferent construction for the seasonal reckoning. A small sun-symbol is marked at the common center, from which radial lines run out to lettered points on the circumferences. Two small-script captions sit above and at the lower left of the figure, naming the circles; single-letter point-labels are placed around the rim.

- (center): a small marked body-symbol (sun-mark) with radial lines drawn from it
- (above the figure, two-line caption): עגולת היוצאת ["the eccentric circle"] / עגולת ה [?] [second line partly rubbed]
- (lower-left, caption): עגולת הקטנה ["the small circle"] [?] ["the circle of the reckoning"]
- (within, marked region): ראשונה ["first"]
- (rim, lower): ב
- (rim, right): ג [?]
- (rim, upper): ד [?]
- (rim, left): ה [?]

For the proportion of the difference [equation] is by the heart [center — לב] which is near to it, by which [its parts run]; and so they all run in order [וכן יחזרו]. By the measure of the distance of the center [מרכז] of the reckoning is the position [of the sun?]. As [the moon] travels its way it moves about [נסע], and the position of the sun moves from its place along the path of the reckoning, the proportion being as before. The position of this [body] is by this proportion, near to the point [נקודה], so that the point [is fixed]; and likewise it is near to the chord [בקרב] — and these are the things we have set forth. [The clause-chain here is the same compressed seasonal-reckoning argument; legible throughout, terse in its connectives.]

[its parts] coming to be at one point, and likewise [for the opposite]. And he said: just so in this reckoning, when its swiftness [מהירותה] comes to be at one point, so too the swiftness, by this measure, in due order [שבכל זמן]. The proportion is by the swiftness [מהירות] of the reckoning, as the swiftness of the moon goes over the surface of the motion [שטח התנועה]. When its center [מרכזה] turns about and [the moon] turns back upon itself [חוזר בעצמו], so it goes [תהיה מהלך].

The proportion is from the swiftness [מהירות] of the reckoning by the moon, [reckoned] for this whole [span], by the measure of the distance of the center [מרכז] of the reckoning. The swiftness of the reckoning by the moon is counted [נמנה]; the position is at one point and the moon at another point, [so that] the proportion of the difference between them is by the measure of the distance, returning by itself [חוזר בעצמו] — so it goes. For the difference [שנוי] is this; and its order, and the order of the reckoning [סדר התקופה], is by the measure, until it has gone round and there is to it ... the swiftness [מהירות], as it is.

By the measure of the distance is the center [מרכז] of the reckoning for the tables [לוחות], so as to set them straight [לתקנם], because [thus] it is. By this — to make known to you [להודיע] the measure for [each] place [למקום], and to make it known to you in all the arrangement [בכל סדור] — the center [מרכז] of the reckoning revolves and draws near to the center of the signs [zodiac], as he set forth. Around its center it returns [חוזר], and [the position] is straightened, and there will be a difference of position [נקודה].

And he said: just so in this reckoning, when there is a difference of motion [שנוי], then there is a difference between the position of the moon and the place where the reckoning revolves and draws near to the center [of the signs], in proportion to the position of the signs. By the measure there is for it a path, and this is the path of the difference [שנוי החילוף — the path the difference/equation makes]; for it [is] near.

The center [מרכז] of the reckoning descends [יורד] ... of the season [תקופה] when they are set in order [כשהם בסדר], by ...; and there will be a difference [שנוי]. For in the reckoning its position [is by] the measure [מרכז], and there is a difference of position; and the moon goes [והולך], and the proportion of the moon is as we said [דמות הלבנה]... [The foot of this folio side is a continuous, compressed clause-chain of the same seasonal-reckoning argument — legible cursive with no ink loss, but several of its connectives are too elliptical to construe with full confidence, and are rendered as closely as the phrasing supports; ellipses mark genuinely unconstruable joins, not lost ink.]

[The discussion continues; the chapter is not yet completed on this folio side.]

Fourth Treatise (המאמר הרביעי), Chapter Sixteen (פרק שש עשר) — continued.

The seasonal reckoning (תקופות) and its geometric construction: the angle of the difference (חילוף / equation), the co-revolving deferent-center (מרכז), and the figures of the concentric circles.

the line of this [chord], [marked] ג"ז, in the manner [shown]. Angle ב"ד-ק"ד is the angle of the difference [חילוף]; [it stands] either at the time of the conjunction [מולד] or at the time of the [astronomical] opposition [ההקבלה האמיתית], and angle ע"ה-ד is the difference [equation] of the portion [מנת] proper to the place [position], as we showed in [the case of] the quadrature [רביע]. And it [the difference] will be from angle ב"ד, its diameter; and the demonstration [ראיה] for this is fine [valid]. Now extend it [the line] ל until the angle of the difference [חילוף] becomes such as is required for the position [מעמד], so that you may know the difference for [any] place [position].

Thus, when angle ϵ -ה-ד is the difference, and the moon's mean motion [מהלך] is so much, [the figure resolves] just as we showed in the quadrature; and so it is [also] for the time of the [solar] world [year] and for the time of [each] season [תקופה]. And angle ϵ -ה-ד is the difference of the position [מנת עה], its [proper] difference for the position [מעמד], in the manner that we set [it] out in the quadrature; for the centers [מרכזים] are revolving [סובבים], and behold, this is right [נכון].

And [as for] the difference [חילוף]: it [is determined] from the apogee [רום] and downward [ירידה], that is, the angle of the difference is set [up] from the apogee, and [the moon] descends [from there]; [the line] is the difference. And just as we said, the difference is so much, and angle ϵ -ה-ד is the difference of this [position].

[a fuller passage follows, set lower on the page, beginning a new explanation:]

And he explained this: the mean motion [מהלך] — its difference is the difference of the position — is [taken] near the apogee [רום], in the manner that he taught, just as it stands; and Ptolemy [בטלמיס] taught it [thus], and his statement is right [valid].

[The construction:] when the [mean] motions [revolutions, רבועים] are equal [or: in quadrature], so that the deferent's center [מרכז] was so much, and its distance [from] so much — observe [מדע] how far it [the planet/moon] is [מרחק] near to it [the center], the place [position] being corrected [המתוקן] for that day; this [is so] when the difference [חילוף] is from the apogee [רום], its descent [ירידה] being the difference, in the manner that we set it out [in the figure]. The mean motion [מהלך] is taught: [the moon's] position, its mean motion being so much.

When the apogee [רום] and the difference [חילוף] are [combined], the position is corrected [המתוקן], so [that you] know its difference [חילוף] near the apogee [רום], its descent being the difference; therefore the position [מקום] is corrected, and behold it is so much. And one corrects from the apogee the descent [ירידה] of the difference, in the manner we set out, until [the line] becomes [the corrected motion], so that the apogee is so much, and the descent of the difference is so much...

And he explained this: how much it [the equation] is near to it [the position]; and [say] that, of [these] revolutions [period?], the apogee [רום] was so much [a distance], and the descent [מורד] of the difference was [from there]; the position is corrected for that day [as] so much, and the descent [ירידה] of the difference [חילוף] is so much. And the corrected motion [reading] for that day is so much. Then they said that the mean motion [מהלך] is so much, and a difference [חילוף] is

the descent [or: a difference is the matter spoken of]; and behold, the place [מקום] is corrected [המתוקן] for the [new] moon [לחדש], its difference [חילוף] being so much.

[the lines continue with worked phrasings of the same template: the apogee, the descent of the difference, and the corrected position for "the fifth [day] of the month of Tammuz" [ביום החמישי לחדש תמוז] — a worked example of a season's date.]

and the [mean] motions are taught: a position [reading] near to it; the revolution[s] [רבועים] being so much, in the manner [shown]; and behold, the mean motion of the deferent's center [מרכז], the corrected [reckoning] returning [חוזרת], is wholly upon the point [marked נקודת מ / the reference point], as set out.

Diagram. A geometric figure of two overlapping circles drawn in brown ink in the center-right of the page, with a vertical diameter line running top-to-bottom. A small upper circle is set tangent to (overlapping) a larger lower circle; the vertical line is the common diameter, running from the apex of the small circle down through the intersection to the foot of the large circle, modelling the angle of the difference (חילוף) between the deferent-center and the reckoning circle described in the prose. The point-letters along the diameter are legible under magnification. A brown-ink caption-word [תקופה, "season"] stands beside the figure (somewhat faint).

- ב (upper, at the apex of the small circle / top of the vertical diameter)
- ד (at the intersection of the small and large circles, on the diameter)
- ו (at the foot of the diameter, within the large circle)

and [as for] the case where the deferent-center [מרכזו / its center of revolution] was so much: [the planet/moon] was [taken] from its difference [מחילתו] at the time of the season [שעת הריס — recte: שעת התקופה (?), "the time of the season"; or שעת הראיה, "the time of observation"] [?]. This was the figure [התורה] set out, [as] explained for the matter of the [solar] world [year]; and [the line] was [drawn] at the time of [the moon's] portion [חלקו]. [The moon's] mean motion at the season [or: at observation] was its issuing-point [מוצא], and behold, within [the figure] is a point so much [a given amount] [marked off] by [the chord] — angle [so-and-so].

near the apogee [רום], its position being so much [a given amount]; the corrected motion [reading] was its issuing-point [מוצא], the place [מקום] being [corrected]; [and we computed] how far [the planet] is, from the apogee, its distance [מרחק]

so much, near to it. And the position [נקודה] is corrected [for] so much, in [the manner of] its quadrature [בכדי], angle [so-and-so].

The figure [התורה] [stands] thus, [as] set out, at the time [of the season]: it is corrected [מתוקן]; and the apogee [רום] [combined] with the descent [or: with the position] is the difference [חילוף] of the position [מנה], near the apogee. [Read off] from it [the figure] how much it [the equation] is, near to it [the position], in the manner [shown]; and behold, [it] is so much; therefore [the result is] right [נכון]. And one corrects, from the apogee, the descent [ירידה] of the difference, until the [corrected] position [comes out], in the manner that we set out.

[The diagram is referenced here:] The figure [shown] is for the season [התקופה], its revolution [reckoning] being so much, as [the lines] issue from the center [מרכז] of the [reckoning] circle; and [the chords] are drawn from a single point [נקודה אחת] upon the circumference, in the manner [shown]; and behold, the lines [קוים] of the difference [חילוף] meet [issue] from one point, and they enclose the angles [זוויות] of the difference.

Diagram. A geometric figure in brown ink occupying the upper-middle of the verso's text area: a large circle with a vertical diameter, a small circle tangent at its top-left (sharing the upper part of the diameter), and a third small circle low on the diameter. From a single point high on the diameter, a sheaf of several straight oblique lines fans down and left across the large circle to points spaced around its lower-left arc — the "lines of the difference issuing from one point" described in the prose, marking the several angles of the difference (זוויות החילוף). The diameter-endpoint labels are legible under magnification; the several fan-endpoint labels on the lower-left arc are single faded letters and are not securely read. A red-ink caption-word [Red ink: שנית, "second" — i.e. the second figure] stands beside the figure.

- ב (apex, top of the vertical diameter)
- ג (at the fan's vertex, high on the diameter)
- ו (at the foot of the diameter, within the lower small circle)
- the fan endpoints on the lower-left arc (several): single faded letters [?]

[the closing paragraph, set below the figure:]

Thus was the force [תוקף] and the issuing [מוצא] of the matter [or: the resolution, הדין], just as we set out [שתרך — recte: שתארך(?)] this in the figure [or: in the table], the one that serves [העובד] for the difference of the elevation [חילוף העלוי]. And the season [העובר/the [solar] world(?)] [?] — its difference [חילוף] [reads off] by the table [העלוי / by the elevation]; so it is corrected [מתוקן], and behold it is

right [נכון], in the manner [shown]; and the corrected motions [תנועות] [stand] continually [תמיד], just as we set out; and [the line] issues toward [it] [ויתחבר לה] — thus is the corrected point [נקודת המתוקן].

the season, that it [the position] is so much. Once that is known, it is easy to derive what we require: the corrected position for each place and each season. And in this way the matter is established and verified for you. The difference [חילוק] between the mean position and the true position is here a known quantity.

And since the angle of the difference at the point of conjunction was found—as you saw above—and the descent of the difference from the apogee was likewise found, the corrected position is therefore known. And the figure of this is the figure that we set out, in which the deferent-centers revolve together one with another. So too the line of the apogee and the line of the descent, each of them, is a known straight line; and therefore the corrected position is known.

The remainder of the angle, then—that is, the angle that remains of the whole—is the angle of the true position. And the side opposite the apogee, and the side that completes [the triangle], each of them is a known line; and from them the corrected position of the moon [ירח] is derived. For this reason the true position differs from the mean position by the measure of this difference, neither more nor less.

[Diagram region — lower portion of 112r]

Diagram. A geometric figure occupying the lower portion of folio 112r: a large circle (the deferent / containing orb) with a smaller circle set within it toward the lower-left (the epicycle), a diameter line drawn obliquely across the large circle from upper-right toward lower-left, with marked point-letters along it, and a small triangle constructed at the inner circle. The labels are faint brown ink.

- ב (upper-right terminus of the diameter line on the great circle)
- ג (center of the great circle, where the diameter is marked)
- ה (lower-left, at the inner/small circle)
- [Two further point-letters at the small circle and on the triangle are too faint to read with confidence — [?]]

[The construction in the prose above names the points along the line of apogee and the line of descent; the figure illustrates the angle of difference and the two sides of the difference-triangle. More than two labels are uncertain here]

Now this is the figure of the season—that is, the figure of the difference, set forth so that you may grasp the matter to the eye [literally "see it"]: the apogee, the descent, and the corrected position, as we explained.

this same matter is in the figure, [namely] that it is so. The corrected position is therefore a known quantity, and likewise the remainder [of the arc]. And from this and from this [from both] the figure of the difference is composed, and it is verified for you in the figures of the cycles [המחזורות]; for this matter recurs through the cycles in like manner.

The mean motion, then, is one thing, and the true motion another; and so too the corrected position is another. As for the centers [המרכזים]—it is known that they revolve, so that they fall sometimes here and sometimes there. And in the figure of the season it is the case that this angle is at such-and-such a place, neither more nor less. And every one of them [the angles], when the [arc] subtended by it is a known quantity, then its position is also a known quantity.

In order that the tables of the seasons [לוחות העונות] should be ordered each according to its kind [למינו], and the matter be made plain [ידיע], proceed thus: take so much, [enter] into the tables, and what comes out is the figure—and this is a known matter. And know that this figure is of the position, and the figure of the season [תמונת העונה] is so-and-so, and the moon [ירח] [enters] into it, and so it is.

And after [ואחר] we have set this out, the figure of the moon [ירח] in the cycles is what was explained above; and this is the corrected [position]. It is the distance of its center [מרחק מרכזו], the moon [ירח] from them [ממאתם, i.e. from the [centers]]; it is the length [אורך] of so-and-so degrees [מעלות]. The season [is] fixed [קבוע], so much; the figures of the cycles, each one apart, [give] its [position]; [each] according to the apogee and the descent, the corrected. And this is the figure of the difference; and the descent and the apogee, that one [are] so. So that you may learn the seasonal computations [תקופות / חשבונות] through the [foregoing] chapters, as we explained—you will be able through them [to compute], and you will find it [the result] sound and exact [נכוחות ומדויקות], so that...

[Large diagram — lower two-thirds of 112v]

Diagram. A large system of concentric circles representing the orbs of the sun, occupying the lower two-thirds of the leaf. A vertical diameter divides the figure; an oblique diameter line runs from the upper-right (labeled ב) through the center (labeled ג) to a small epicycle at the lower-left. A small filled red disc sits on the lower portion of the diameter (the body—sun/luminary). A small circle (the epicycle, "the small ה sphere") is drawn at the lower-left with internal chords

forming a triangle and a point labeled ה. The circular bands are captioned in faint brown ink with the names of the orbs; the red disc bears a faint label.

- ב (terminus of the oblique diameter, upper-right of the great circle)
- ג (center of the figure, at the crossing of the diameters)
- ה (at the small epicycle, lower-left)
- Outer band (top): עקמומיות הגלגל היוצא מרכז וגלגל הסבוב — "the eccentricity of the deferent (the eccentric orb) and of the epicyclic orb [gilgal ha-sibbu]"
- Band below it: עקמומיות הגלגל הכוללת לגלגל החמה — "the eccentricity of the containing orb of the orb of the sun"
- Inner band: הגלגל הנושא תנועת גלגל היום — "the orb that carries the motion of the daily orb [gilgal ha-yom]"
- Right-side band: הגלגל הכוללת תנועת גלגל היום [?] — "the containing orb of the motion of the daily orb"
- Lower band (left): הגלגל היומי דומה [?: read as "the body / structure"] נבונה — "...the daily orb resembling the circle of the sun"
- Bottom band: גלגל היומי נושא הגלגל היוצא מרכז [מעגל החמה] — "the daily orb carries the eccentric orb [the circle of the sun]"
- Small epicycle (lower-left): גלגל הה קטן — "the small ה orb [the epicycle]"; with a label גלגל הסבוב — "the epicyclic orb"
- Red disc: faint label in the red ink reading חמה [the sun] — the disc is the solar body; the glyphs are rubbed but legible as חמה

[More than two diagram labels are uncertain]

Fourth Treatise (המאמר הרביעי), continuing — **Chapter Seventeen**, on the eclipses of the two luminaries (לקות המאורות).

פרק שבעה עשר — Chapter Seventeen

(Folio 113r — single column, medium brown-ink Spanish Rabbinic hand. The chapter opens with a display rubric **פרק שבעה עשר** ("Chapter Seventeen"), inked larger at the head of the column, and runs as a full, legible prose column treating the eclipse [לקות] of the two luminaries — the geometry of how one body comes to obscure another, the conditions under which the sun is eclipsed, and the division of the eclipse-types. The hand is legible glyph-by-glyph; the register is compressed calendar-astronomy prose. Technical nouns are committed; only genuinely illegible glyphs are flagged.)

The eclipse of the two luminaries [ללקות המאורות] arises from the position [ממעמד] of the two of them, when they stand [ועשן סמ] along a known line. And we have already explained [וביארנו] in what preceded — by way of [על דרך] their being set in order [תקונם] — by what means [על פי] the eclipses [לקות] come about, and the matters [העניינים] bound up with [בתלויים ב] this; and we have made known [והודיענו] that each [שכל אחד] of the two luminaries [המאורות] may be eclipsed [בלקות], and the eclipse [לקות] of this one differs [?] from the eclipse [מלקות] of that one [?].

And this is the cause [וזוה הסבה] and the reason [והטעם] by which [שבדרך] they are set in order [תקונם], according to [על פי] their motions [תנועותם]; for the one [מן האחר] which is eclipsed [מתלקה] differs [?] from the other [ב] in its eclipse [בלקות]. And this we have already explained [וביארנו] above [וזוה כבר ביארנו] by way of [בדרך] what is plainer [?], and we have made known [והודיענו] that the eclipse [שלקות] of the moon [הירח] and the eclipse [ולקות] of the sun [החמה] differ [?] one from the other.

[?: a clause of about a line, ink locally compressed at line-heads, treating the standing of one body opposite the other along the line of the orb — committed only at the noun level: the body [הגוף], opposite [נכח], the line [וקו], known [ידועה].]

And it is obliged [ומחויב] that the sun be eclipsed [שתלקה החמה] when the moon [כשהירח] stands [?] beneath it [תחתיה], between [בין] our eye [עינינו] and between [ובין] the body of the sun [גוף החמה]; for then it is obscured [שיתכסה] from us, in whole or in part [?], and that obscuring [וההכסות] is its eclipse [לקותה]. And the eclipse of the moon [ולקות הירח] is when [כשתהיה] the Earth [הארץ] stands [?] between [בין] the sun [החמה] and between [ובין] the moon [הירח], so that the shadow of the Earth [צל הארץ] falls upon it [?], and it is darkened [?].

[?: one short clause, locally abraded — committed at noun level: the shadow [הצל], the cone [?], the moon [הירח].]

And now [ועתה] [?] we shall make known [נודיע] [?] the divisions of the eclipses [חלקות הלקות] — committed as "the divisions of the eclipses"; the two leading words [?]. Below the prose stands the shadow-cone eclipse diagram.

Diagram. A shadow-cone eclipse figure occupying the lower part of folio 113v. Nested concentric circles (the orbs) are drawn around a common center. A tall dark shadow-cone (a long black/brown wedge, apex pointing downward) runs along the vertical axis; at its apex, inside a small circle, is the Earth (הארץ). Below, a large red disc is the body of the Sun (גוף החמה); two straight lines run from the

solar disc up the flanks of the cone (the bounding rays of the shadow). Orb-name labels are written along the concentric arcs. Brown ink with a red wash on the solar disc.

- (caption, above the figure): גלגל חמה — "orb of the sun"
- (small circle at the cone's apex): הארץ — "the Earth" [apex glyph ambiguous הירח / הארץ; committed as הארץ on context (Earth at the cone's apex casting the shadow), but flagged [?]]
- (large red disc, below): גוף החמה — "the body of the Sun"
- (outer arc): גלגל המזלות — "the orb of the zodiac" (outermost concentric arc)
- (arcs flanking the cone, brown, reading along them): גלגל[?] — orb-name labels written along the inner concentric arcs; each appears to read גלגל ה... ("orb of the ...") but the individual orb-names are not resolvable at this resolution [?]

(The lower margin of 113v below the diagram is blank — normal layout, not damage. The facing-leaf sliver at the gutter is ignored.)

and it is for this reason that the southern [point] is the one above. And likewise we have already explained to you the position of the moon, so that the difference between it and the sun shall be a known quantity. From this it follows that the moon will be in such-and-such a configuration, and the eclipse will be near. From this you will further understand that the moon's reckoning is close [to that of the sun], and from this it is clear that the eclipse of the sun occurs at the conjunction [molad], while the eclipse of the moon occurs at the opposition. The reason is as we have explained: the moon receives its light from the sun, and when the earth comes between them the moon is darkened.

The closer the moon stands to the [line of the] node — whether the ascending node [ראש] or the descending node [זנב] — the greater is the latitude [מרחב] of the eclipse; and the farther it is from the node, the smaller the latitude of the eclipse, until [a point is reached] where there is no eclipse at all. For when the moon stands at the node, there is an eclipse, and when it has departed from the node by such-and-such a distance, the eclipse ceases. The descending node behaves likewise, so that this too is a known [boundary].

The remoteness [of the moon from the node] is, accordingly, the cause of [the variation in] the eclipse: the greater the latitude, the smaller the eclipse; and the lesser the latitude, the greater the eclipse [צל, "shadow"]. We are obliged to compute it, and it follows that the [magnitude of the] eclipse is according to the

latitude of the moon at the time of the opposition. So you have the rule: the latitude is in one direction, and the [resulting] eclipse is found accordingly — and this is well established.

Behold, I have laid out for you all that is needed concerning eclipses; and what remains [for you to know] you must now consider:

❖ **And now I will come** ❖

[the passage continues:] ...and explain to you the reckoning of the eclipse and how it is to be found. There is, then, a reckoning of the [solar] eclipse, for which they have laid down a method, so as to teach it. And know that the [magnitude of the] eclipse is according to the disposition [of the moon], and it is reckoned as follows: [take] the surfaces [שטוחות — "surfaces / planes"], and from them the position of the moon, and the degree of its latitude in [the relevant] direction. And consider these [matters], whether toward the ascending node or the descending node, in order to find the position of the planet.

And [reckon] from the [degree of the] eclipse upward; and the difference between them [you shall apply], and the others after it. And if you have found the position of the moon's eclipse to be such-and-such, then it follows that the whole of [the moon] is in eclipse, and the reckoning is correspondingly greater — that is, whatever the moon's position may be, and you will know its magnitude. From the [degree of] eclipse, the latitude of the moon is itself a known quantity, until you have it; so proceed, and reckon in this way.

And [reckon] from the latitude of the moon and the latitude of the [reference], so as to teach the reckoning, and the [resulting] eclipse follows:

❖ **The latitude of the moon** ❖ [Display-ink rubric: עולת הירח — lemma]

This is what you find regarding its measure:

❖ **The latitude of the sun** ❖ [Display-ink rubric: עולת לחמה — lemma, parallel to the preceding one]

[the text continues:] ...two separate [luminaries] in the reckoning, each in its own proper place. And it comes about, in the reckoning of the eclipse — namely the [computed] latitude — ten hours [עשרה שעות, a duration]. And [by] the [method of the] true [latitude], from the distance of the [moon's] center [from the node], thus [proceed].

The latitude is reckoned in the computation, roughly an hour at a time, at the moment of the opposition, by [the rule of] the true [latitude]. The [distance of the]

node, when it is at such-and-such a remove, and likewise when the center of the moon's latitude...

is in such-and-such a configuration, in this manner — [the points] כב and כן [being so positioned] — then the center of the moon's latitude lies toward the south of the moon, and the line drawn between [the points] is the מרטיק [transliterated technical term — the diameter line; identification uncertain], so that it shall be [as required]. And in order to [find] the distance, the latitude and the [computed value] are brought together for the moon's eclipse. This is the [measure of] latitude that this eclipse has, [derived] from the moon's latitude when it inclines [toward the node], and so it is established. The latitude of the moon is thus determined.

And it follows from this that the moon's eclipse is such [as described]: this is its form and its matter [צורתה וחומר], namely that the center [of latitude] be [as stated]. This is a first principle, [taken] from the [moon's] course along its inclined path, [as it moves] far along its course. The moon's shadow, the moon's eclipse — in the [matter of the] eclipse, this is the limit.

Diagram. A figure of the eclipse geometry, occupying the left-center of the page. It shows three circles linked by long curved arcs (the inclined orbital path of the moon and the line of nodes):

- Upper circle: a circle with a dark, ink-filled center bearing a small interior point-mark — one luminary (the sun, or the earth as shadow-source).
- Middle circle: a circle with a dark crescent shading on one side and a point-letter beside it — the moon partially entering the shadow (a partial eclipse), with a reference letter marking the limb.
- Lower portion: two adjacent/overlapping small circles, one carrying a quartered cross-mark — a further stage of the moon along its path.
- A long arc sweeps from the upper circle down through the middle and lower circles, representing the moon's inclined path relative to the line of the nodes.

The interior point-labels are small, faint brown-ink letters and are not securely legible at this resolution.

[More than two labels flagged [?]]

[the prose resumes below the figure:] ...the moon's eclipse. And when it stands thus, the moon's center is [as described] at the time of the opposition. The latitude of the moon, indeed, in the reckoning of the eclipse, will be greater or smaller. So

know that the moon's center, in its motion, will be [thus]; and likewise, when [the moon's center is] in [such-and-such] direction, the eclipse varies. Whether the moon's eclipse is [partial], [reckon] from the law of opposition, and [reckon] from all that we have explained: the latitude of the moon's center governs the eclipse. And when the center of the moon's eclipse stands thus, and its latitude is [as stated], we have [now] explained it:

∴ **And now, here, arise** ∴ [Display-ink rubric: ועתה כא ועמד — display-hand lemma; "כא" = "here/thus," ועמד = "and stand/arise"; not a numbered chapter heading]

[the passage continues:] ...[to] nullify the corruption [נבלה]; observe it. And he said: for we have already reckoned the latitude of the moon's eclipse, when it stands at the [limit of] the moon's latitude [argument — אלפסון הירח, Arabic al-...: "the argument / element of latitude"] and [departs from] the argument of the moon's latitude. As it was in the latitude, so is the [resulting figure]; this [argument] is found. As it was in the latitude, so from it we know that [the points] ו and כ [are so positioned]. And [reckon] the moon's eclipse and its full magnitude, and this is what is required for the moon's eclipse, [reckoned] from the law [of opposition]; and likewise the node is near.

And from this [follows] the magnitude of the eclipse, [taken] from the argument of latitude, according to the reckoning of the Sages [החכמים]: that where there is no opposition [near the node], there is no eclipse. And the eclipse of the moon's latitude — the [foremost] reckoning of the Sages — [holds that] the difference between them is such-and-such: that it is in the reckoning of opposition, just as it is in latitude. And [when] the moon's eclipse and its center lie outside the place [of the node], upon the point of opposition, it follows by nature that the moon shall then be [eclipsed], thus. And by this labour [טורח] of the eclipse, the eclipse is reckoned.

for it follows necessarily that the moon's body will be the same distance from the line of the zodiac [the ecliptic] at the moment of conjunction, and the [magnitude of the] eclipse will be proportional to that distance. Therefore, when the moon stands at the node [זנב or ראש], its latitude [מרחב] from the ecliptic is nil, and then it will be fully eclipsed; and the closer it lies to the node, the greater its eclipse; and the farther from it, the smaller. [?: this clause construes a dense elided computation]

And just as we determined the moon's [latitude] from the ecliptic at the moment of conjunction, so too we determine it at the moment of opposition [הקבלה]; and

from it we know the magnitude of its eclipse. For the magnitude of the eclipse is in proportion to its latitude, just as we explained regarding the eclipse of the sun.

When you wish to know whether the moon will be eclipsed and the magnitude of its eclipse, take the moon's argument of latitude [אלפסון] at the moment of opposition, and from it derive the moon's true latitude [מרחב]. If [the latitude] is nil, then [the moon] stands at one of the two nodes [the ascending node, ראש, or the descending node, זנב], and it will be totally eclipsed [?: construal of the elided protasis]. And the more its latitude increases, the smaller will be its eclipse, until its latitude reaches the bound [גבול] at which it is no longer eclipsed at all.

And the cause of this is that the moon's body is small relative to the body of the earth, while the body of the earth is large; so the cone of shadow [צל] which the earth casts is conical [תבניתו כתבנית הקדקוד — its form is the form of a cone/apex], its base toward the earth and its apex [קדקוד] tapering away from it [the earth, toward the side opposite the sun]. And the moon, when it enters within this shadow, is eclipsed, for the sun's light is screened from it by the interposition of the earth. [?: long construal of the shadow-cone description]

And the path [ודרך] of inquiry [חקירת] into the eclipse of the moon is in this manner: [lemma rubric in the body]

We have already explained that the moon's distance from the earth is greater than [or: such that], and its distance [from us] is variable, since at one time it is at its apogee [רום] and at another at its perigee [שפל]; and likewise the sun [varies in distance]. So the magnitude of the earth's shadow [צל] differs accordingly [?: construal]: when the sun is at its apogee its shadow is one size, and when the sun is at its perigee [its shadow is] another. [?: this comparative pair construes an elided computation]

And just as we determined the magnitude of the [solar] eclipse, so too here [for the moon]: we examine the moon's true latitude and its argument of latitude [אלפסון], and from them we know whether it will be eclipsed and by how much. [?: construal]

[Red/heading-script rubric, larger hand: "חזון הלקות" — "The Vision/Diagram of the Eclipse"] [?: rubric reading; could be חזון הירח, "The Aspect of the Moon"]

Diagram. A schematic of the lunar (and the earth's-shadow) geometry, drawn across the lower third of the leaf. A long, gently curved line runs left-to-right across the figure (the moon's inclined path / line of nodes against the ecliptic). Along it sit a row of circles: at the upper left and upper center two small circles

each captioned **ירח** ("moon"); to the right a third small circle, also **ירח**, partly filled with a dark blot (the moon within the shadow / an eclipsed disk). Below them sit three larger circles, two of them labeled **עגלה האופן** ("the wheel of the orb" / the epicycle-wheel) and one (leftmost) labeled **עגלה הח[ופן]** [?: label partly cut]. At the right end a large, heavily inked black disk with a small star/cross at its center represents the earth (or the earth's shadow body), with lines radiating to the moon-circles. A vertical stroke at the far left connects the upper moon-circle down to its wheel.

- **ירח** (upper left): "moon"
- **ירח** (upper center): "moon"
- **ירח** (upper right, blotted): "moon" [within the shadow]
- **עגלה האופן** (lower center): "the wheel of the orb / epicycle-wheel"
- **עגלה האופן** (lower right): "the wheel of the orb / epicycle-wheel"
- **עגלה הח[ופן]** (lower left): [?: label partly trimmed]
- **ה** (beneath two of the lower circles): point-label "ה"
- Large black disk (far right): the earth / earth's shadow [unlabeled or label illegible within the ink]

[Two lines of body text continue beneath the diagram:]

the [shadow] of the earth was such-and-such [?: numeral/quantity not legible — elided], it being [conical], its apex [tapering] away [?: construal]; and the moon, when it stood within it [the shadow], was eclipsed, and its light was screened by [the interposition of the earth] [?: construal of the closing clause].

[The lower portion of folio 115r is blank margin — not damage.]

it returns to the same magnitude, and at [the moment of] opposition [the moon] is eclipsed, in such measure as it stands distant [from the node] [?: construal]; and there will be for it [an eclipse] proportioned to its latitude [מרחב]. [?: construal of the opening clause, which continues the sentence carried over from the recto]

For if its distance [from the node] is small, then it stands near [the node], and its latitude is small, and its eclipse is great; and conversely [ובהפך], the greater the distance, the smaller [the eclipse], until [the moon] no longer is eclipsed at all. And the reckoning of this proceeds just as we explained regarding the [solar] eclipse [?: construal].

And [for] the moon's true latitude [מרחב] at the moment of opposition, we take its argument of latitude [אלפסון], and from it we derive the moon's true latitude, and then we know the magnitude of its eclipse, just as we determined the magnitude

of the [solar] eclipse at the moment of conjunction. [?: construal of this iterative computational sentence]

And the argument of latitude [אלפסון] is the [arc] from the [ascending] node [ראש] reckoned in the direction of the [moon's] motion [?: construal of the definition].

It has already been explained to you regarding the moon's true latitude [?]; and you should know that the magnitude of the eclipse is in proportion to the latitude, and likewise the [duration of the eclipse is in proportion to] its [the moon's] passage through the shadow [צל], from the moment it begins to enter the shadow until it wholly emerges from it [?: long construal of the duration clause].

And the cause of this is that the [breadth of the] shadow [צל] is greater [at one configuration] than another, according as the sun is at its apogee [רום] or at its perigee [שפל]; for when the sun is at its apogee the shadow is longer, reaching the moon's sphere at a greater breadth, and when [the sun is] at its perigee [the shadow is shorter] [?: construal of the apogee/perigee comparative]. And from this it follows that the moon's eclipse, at one [time], is total, and at another only partial, even though its latitude be one and the same [?: construal].

And the moon, when its distance [from the node] is small, its body lies wholly within the shadow [צל], and it is eclipsed totally; but when its distance is great, only a part of it enters the shadow, and it is eclipsed only in part. [?: construal of this distance/totality pairing]

It is therefore possible that the moon be eclipsed and that it not be possible [for the sun to be eclipsed at that same molad-period], and the converse; for the [conditions of the two eclipses] differ [?: construal of the comparative possibility-clause].

And the magnitude [of the eclipse] is reckoned in "digits" [parts of the disk]: the whole diameter of the moon is divided into twelve parts, and the magnitude of the eclipse is stated as so-many of those twelve parts [?: construal — "twelve" read but the surrounding fractions elided]. [?: numeral context — the divisor reads $12 = \text{י"ב}$]

And just as we determined the magnitude of the [moon's] eclipse, so too [we determine] its duration: from the argument of latitude [אלפסון] and the true latitude [מרחב], by [computation], reckoning the time the moon takes to traverse the shadow [צל] [?: construal of the duration computation].

And now [ועתה] I shall come to explain to you the manner of [computing] the eclipse [?: lemma — the rubric "ועתה" opens a new computational lemma, not a new chapter]

the place [מקום] of the [luminary] and the [argument], and between them the [arc of] eclipse [?: construal of the opening of the new lemma]; and you must know that all this [proceeds] by means of the [astronomical] tables [לוחות], and we shall explain, God willing, in [the chapter / treatise on] the tables, how [these quantities] are derived. And the moon's true latitude [מרחב] at the moment of opposition, [taken] from the argument of latitude [אלפסון], [yields] the magnitude of the eclipse; and [if] it is impossible [for the moon to be eclipsed], then there is no eclipse at all, and so it will be... [?: the lemma continues; final clauses construed from an elided procedural passage]

[The lower portion of folio 115v is blank margin — not damage. The chapter (פרק) עשר (שבעה) continues beyond this leaf; no פרק י"ח rubric appears in this opening.]

Isaac Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484). Sephardic semicursive, single column, brown ink. = folios 116r–116v.

[The text continues the close of Chapter Seventeen of the fourth treatise, on the magnitude of a lunar eclipse as a function of the moon's ecliptic latitude (מרחב) and its distance from the true syzygy-point. The discourse passes from the magnitude of obscuration to the apparent size of the lunar body — which varies with apogee (רום) and perigee (שפל) — to the duration of the eclipse measured in time and in degrees, and closes with the transition-lemma to the table-computation that follows.]

and this distance will be measured by the distance of the place of the true [syzygy] from the point of opposition. For the obscuration is in proportion to the [moon's] ecliptic latitude [מרחב — ecliptic latitude] at the moment of opposition, and in proportion to the latitude that it has [at that moment] — whether less or more, by the amount of the moon's [latitude].

We have already explained this in what preceded, and it has been recorded [in the discourse of the tables]. So know it.

Know, then, the magnitudes of the eclipses according to their latitudes. When its latitude is small, the obscuration is small; and when its latitude is great, the obscuration is great. And this holds when the moon's latitude does not exceed a certain measure of degrees — for [beyond that] no part of the moon's body is eclipsed at all, since its whole body passes outside the shadow [צל — shadow] and there is no eclipse.

When the latitude is such that the moon's body enters the shadow only in part, the eclipse is partial — that is, part of the moon is eclipsed and part remains uneclipsed. But when the latitude is such that the moon's whole body enters the shadow, the eclipse is total, and the whole of the moon's body is obscured, since its whole body is within the shadow.

Therefore the eclipses fall into two kinds: total eclipses, in which the whole body is obscured, and partial eclipses, in which part is obscured and part remains. The boundary between them is the latitude at which the moon's body just touches the edge of the shadow [?: "edge" renders שפתו, "its lip"]; from there inward the eclipse begins.

[Display lemma:] And know that the eclipse is greater or smaller also according to the moon's own apparent size. For the moon is not always of one apparent magnitude: when it is at its apogee [רום — apogee] it appears smaller, and when it is at its perigee [שפל — perigee] it appears larger, since [at perigee] it is nearer to us. So its apparent body is now larger and now smaller, by a small amount [?: minutes of the lunar disk], and accordingly the magnitude of the eclipse differs somewhat — for a given depth of immersion in the shadow obscures a larger fraction of a small disk than of a large one.

[Margin: 116r, primary hand, 3 lines — "...for the partial [eclipse] is according to the latitude ... and when its latitude is as it is ... the oblique line [אלכסון — the oblique/cross-line] that arises from the difference ..."] [?: a constructive helper relating the partial eclipse to the latitude; the central words are abraded.]

[Display lemma:] And after [this has been treated], [we turn] to the duration of the eclipse — that is, the length of time from its beginning to its end, which is measured both in time and in the degrees [of the moon's motion]. For during the eclipse the moon traverses a certain arc of its path, and the time of that traversal is the duration of the eclipse.

The duration is longer when the immersion in the shadow is greater and the moon's motion is slower, and it is shorter when the immersion is smaller and the motion is swifter. All of this is set out in the discourse of the tables [לוחות — tables], and you will find it there. So know it.

[Display lemma:] And know that the passage of the [moon's] center [מרכז] through the shadow, and likewise the half of it [the half-duration, from first contact to mid-eclipse], you may compute by the tables. The time from the beginning of the eclipse until the middle is the [half-]duration, and the time from the middle until the end is equal to it [?: the symmetry of the two halves]. The

discourse of the tables makes this plain, as Ptolemy [תלמיס — Ptolemy] set it down.

the eclipses, and their measure, will come out [from the computation]. For the first of them is the [moon's] motion [reckoned] from the [time of] opposition; and you will find that the second of them is reckoned in degrees [?: שיתרקע, construal uncertain — possibly "what is laid out / displayed" in the table], so that the duration of the eclipse [is known]. And this is according to the depth of immersion in the shadow.

So the magnitude of the obscuration and its duration are bound together: when the latitude is small the obscuration is small and the duration short, and when the latitude is great the obscuration is great and the duration long — up to the limit at which the whole body is obscured. The matter is as we explained it above.

And the apparent body of the moon, as we said, is now larger and now smaller, and this difference too enters into the reckoning of the eclipse, since the magnitude is reckoned relative to the moon's apparent disk. Reflect on this.

The obscuration, then, is reckoned thus: when the moon enters the shadow at its first contact, that is the beginning; and the depth to which the center [מרכז] of the moon's body penetrates the shadow determines the greatest magnitude of the obscuration at mid-eclipse [?: the clause is elided]. The magnitudes of the digits [of obscuration] are reckoned according to the portion of the body that is covered.

And know that the measure of obscuration, at any given depth of immersion, is greater for the small disk and smaller for the large disk — which is what we said above: that the apparent size of the moon enters into the magnitude of the eclipse.

The discourse of the preparation [for the computation], its arrangement, and the reckoning of the eclipse from the tables — all of it will be set out, and the matter made plain in what follows, as Ptolemy [תלמיס — Ptolemy] set it down and as is recorded in the discourse of the tables. So know all of this. **This concludes [the matter]**. [?: the closing word כשבמו is uncertain.]

[Display lemma:] And after it has been explained [ואחר שנתבאר] — that the [moon's] center [מרכז], when it is at the [computed] point, is the true place, that this is the [proper] reckoning of the matter [?], that the moon's apparent magnitude differs, and the duration with it, and the measure of the eclipse —

after all this has been treated, [we proceed] to the discourse of the preparation, which is the foundation for the computation of the eclipses from the tables.

[Foot rubric, enlarged primary hand:] **The Discourse of the Preparation** [מאמר ההכנה — the Discourse of the Preparation].

And the matter of this preparation [is now to be set out]: how the moon [enters the shadow as described]. And here is its form, for viewing [לראות צורתו למראית] — "and here is its form for you, to be seen".

[The remainder of folio 116v is blank parchment. The figure promised by "here is its form" is not drawn on this leaf — no diagram appears in the wide blank space below the rubric; the figure follows on a later folio.]

in the eastward direction it would be near the center, and its [observed] position would be as the eye observes it; and the position [we obtain] from the calculation is the true one. Now this matter that I have set before you in this figure is correct only when the luminary lies upon the zenith of the heads [i.e., directly overhead], for then the line of sight and the line of the calculation are one and the same; but when the luminary is removed from the zenith of the heads toward one of the horizons, the two lines diverge.

Diagram. A tall, narrow funnel-shaped figure formed by straight rays drawn from a single point at the bottom (the eye / center of vision) up to a wide arc at the top. Two red arcs cross the figure: a broad arc near the top and a smaller arc below it, partway down. The rays fan out from the apex through the lower (smaller) arc and continue to the upper (broader) arc, representing how the same body subtends a smaller apparent size when farther from the eye and a larger one when nearer, and the divergence of the visual ray from the line of true position.

- Top arc (broad, red): **הדבר** — "the body" [the luminary's true disk]
- Label above the top arc: **הפרחה** — "the swelling / spreading-out" [the apparent enlargement; from פרח, to burgeon/spread]
- Upper cone, vertical label along the right ray: **לאמת מצב הירח** — "for the true position of the moon"
- Middle arc (smaller, red), marked with the letter **ה**
- Lower-left slanting ray, vertical label: **[?] לאמת מ[צב]** — "for the true po[sition] ..." [lower portion of the label fades into the ray]
- Lower-right slanting ray, vertical label: **[?] השמש [?]** — apparently "...the sun..." [partly legible]

- Apex (bottom point), marked א, with the label מרכז שן הראיה — "the center of the line of sight"

The eye does observe the body, but it does not perceive its true position; rather it perceives only its appearance and the apparent removal of one [body] from another. Hence its position will be larger or smaller than its [true] measure according to the matter we set before you. And this is what we wished [to show]. Concerning the visual ray and the line of true position, the eye does not perceive the difference between them except by a great [distance], for the matter is fine and subtle.

[The text continues at the foot of the page; the lower margin is blank.]

and concerning the matter we set before you, behold this: the [whole] order has been arranged for you in the manner we have arranged it, and you should not depart from it, neither adding to it nor diminishing from it, neither in the [matter of the] sun nor in the moon nor in the rest of the things, so that you may know ... the order that I have set before you, in order that ...it preserves the order, and each thing in its own way; for all of them have one and the same root, as we have explained.

and you should know that this proportion is uniform [the same] for you in the eastward direction, namely that it is as we have explained. And the distances of the heads [poles/nodes] from each other are as we explained above. In that very [computation] there is for you the eclipse of the moon and the magnitude of its eclipse, since the body is near the [true] place, and the body of the moon itself [is near]; for it is near it. And the magnitude [of the eclipse] and the place [where] it is to be eclipsed — there is for you in this [a way] to know what the eclipse [will be] in the magnitudes, namely the proportions [?] one to another.

Now know that this matter is correct only when the body of the moon is at the head [node], so that it is observed in front of [opposite] the sun, and when it is removed from the head, you must subtract this much from the magnitude of the eclipse. The two lines [of sight and of true position] diverge from one another, and the apparent removal [parallax] of one from the other [must be reckoned], for the matter is fine and subtle. So preserve [it], and arrange [it] in order, in the manner we have set before you, and do not depart from it, neither adding nor diminishing.

[Display rubric:] וְעִמָּהּ [And with it]... לֹא [not]...

This matter [holds] only when the moon was at the head [node], so that it was observed [exactly] opposite [the sun]; but were it removed from the head, you would subtract this much from the magnitude of the eclipse. [And it was] the apparent position [parallax], in the manner that it appears to the eye; and the body in its [own] place — there is for you to subtract from the magnitude of the eclipse this much. For the two lines diverge, and the apparent removal of one from the other [enters in]. And we have already explained this matter at length, [setting] in order before you what we have set before you, so as to instruct you in the things [needed]. And this is what we wished [to convey].

[Display rubric:] וְכִי לְבַד [And indeed / But only]...

that this is for you, and you will know the manner of the eclipse and its order, by way of the proportion that we set before you. And know that the moon, in the eastward direction, [varies] in its appearance from day to day, and from this [comes] the difference in the magnitude of the eclipse and the order of the eclipse; for the moon, in the eastward direction, [stands] in its true appearance, and its appearance changes, and the body changes, and the heart [center] of the moon together with its appearance and the body that it [the eye] perceives — the appearance of the moon is correct. And know that the appearance is this: by way of the [great] distance, [the eclipse appears] close [small], and it is correct in its measure. And the moon, in the eastward direction...

[The remainder of the lower portion of the leaf is blank.]

The lunar eclipse [לְקוֹי הַיָּרֵחַ] runs in the firmament according to the moon's course — from east to west and from west [to east] — and the body of the moon [is reckoned] at its place [בְּמִקְוָמָהּ], from the place at the close [סוּף] of one cycle to the place at the close of the next, between [one] place [and another].

According to the moment of [its passage through] the firmament, when the body of the moon stands at such-and-such a point, then when the orb [גִּלְגַּל] is corrected and [the body] has ascended [וְעֵלָה], it is gathered up [נִקְבָּץ] — and at that moment the moon [stands] at its place. In this way [the reckoning] returns and repeats.

If the moon is farther [from the node], its eclipsed part is greater [יָתֵר]; and if it is nearer, its eclipsed part is less. So whether the body of the moon is above or below [its mean place], its position is reckoned from this.

These are the degrees of the moon to the south or to the north [of the ecliptic], [taken] from these new [values]. Thus is the magnitude of the eclipse determined — from these arcs [קשתות] and from the distance, by the new reckoning.

When the body of the moon stands at its place at the node [בראש], the eclipsed part of its body is [now] greater, [now] less, and one subtracts [ויוחסר] from it accordingly. Whatever its place, the body of the moon turns and returns [in its course], and in this way it [comes] near the node where it is set. Until both [reckonings agree] — these are the new [values]. So:

When the moon stands at its place at the node, its body is set [as described]. The farther the body of the moon stands at a distance [from the node], the greater its [eclipsed] part.

Between the molad [the conjunction] and the true [position] they correct it by addition and subtraction, and the part [is reckoned] accordingly.

When the moon is at its eclipse [ליקות הירח], everything is gathered together [נקבץ]. So in the eclipse of the moon all is done according to the tables of the figures [לוחות הצורות], [each] at its place.

Likewise, day by day, [reckon] by the tables of the figures — its molad from it, and the magnitude.

The eclipse of the sun [ליקות החמה] is by the reckoning of the [moon's] removal [parallax], in this same manner. In peace [בשלום].

And so the lunar eclipse is fully laid out [?: the clause is abbreviated — כדי התלבה — בחקלמים(?)].

[Displayed colophon closing the Fourth Treatise, in a larger hand:] והנה נקרית — "And here [the discourse] is called the chance/occurrence [?: מקרת אבע uncertain], inasmuch as the obligation of the poet [המשורר, i.e. the author] requires it... to expound [לך]."

[The final three lines of the colophon are written in a larger, displayed hand. Their last words (מ[?]טן לדרוס / ל[?]ך) are abbreviated and partly rubbed. The remainder of the leaf below is blank (light foxing, conservation, not text loss). End of the Fourth Treatise.]

Diagram. A solar-eclipse construction. At the foot is a circle (the earth), labeled ארץ ("earth") across its midline, with a small letter א(?) at its apex. A red disk (the sun), labeled עין החמה ("the disk of the sun") across its midline, stands above. Two

pencils of straight sight-lines descend from the sun's edges, cross, and pass a small dark disk (the moon, labeled ג, with a second point-letter ט legibly inked beside it) set between sun and earth, the tangent rays meeting the earth's rim. An oblique two-word label beside the crossing names the line of sight.

- (red disk): עין החמה — "the disk of the sun"
- (small dark disk, mid-figure): ג — the moon's body
- (beside the dark moon-disk): ט — a second point-letter
- (lower circle, midline): ארץ — "earth"
- (lower circle, apex): ט[?]
- (oblique side-label, left): ה... לזיה [?] / a two-word line-of-sight label — not securely read

Diagram. A lunar-eclipse construction showing the earth's shadow-cone. A long dark cone (the earth's shadow) tapers upward to a point; its tip bears an oblique two-word label (גלגל הירח / גלגל היומי — the spheres). Within the cone sit two red disks (the moon at two positions as it passes through the shadow). At the base of the cone the earth (ארץ) sits at the center of two concentric circles; the inner ring is labeled גלגל הירח ("the sphere of the moon") and the outer ring גלגל היומי ("the diurnal sphere"). Below, a red disk (the sun), labeled עין החמה, sends rays up past the earth to generate the shadow-cone.

- (cone tip, oblique): גלגל הירח / גלגל היומי [?] — labels of the shadow's apex region
- (two red disks within cone): the moon at two positions
- (central white disk): ארץ — "earth"
- (inner ring label): גלגל הירח [?] — "the sphere of the moon"
- (outer ring label, curved): גלגל היומי [?] — "the diurnal sphere"
- (bottom red disk): עין החמה — "the disk of the sun"

[More than two labels in each figure are flagged [?].]

Prose (below the diagrams)

These [sight-lines] run by the distance from the earth, [each] from its line: from it the disk of the sun [appears] the smaller, because the sun stands at a great distance — [so its body] is small [in appearance]. As for the body of the moon, which is near, its line is reckoned thus. So at the moment of the molad of the moon, when [the moon is] near, [its body appears] cold/dark קור — all according to its place.

The figure [צורת] of the disk of the sun, and the moon's body, [run from] their sources [מקורות], and [the line] continues [וממשיך] [its course].

[A terse line on the threefold reckoning:] three [things] from which, as much as is required; and one says that the sun [stands thus].

By the reckoning of [their] distance — this was the cause [seen] in the reckoning of the position; likewise from the sun.

[The remainder of folio 118v is blank — wide blank lower margin, with light foxing/staining (conservation, not text loss).]

[The leaf opens mid-sentence, continuing the eclipse-discourse from the prior leaf.]...its distance and its longitude, as we have explained. And likewise the eclipse [לקות] of the moon, when it is concealed [נסתר], the position [המקום] is concealed [or: the place is hidden]. It does not catch [light] [לא לקה]; and accordingly the position [המקום] is removed [נעתק], and the place [המקום] is [found]. [The reckoning here is terse and elliptical; the running construal is uncertain.] So [reckon] the measure that you require — that is, when the moon has a [given] measure, that you may know how much you require for it. [?: the close of the clause is compressed.]

And the position [המצב] of the moon's body — in its concealment it is visible [נראה], and so we have considered it. And accordingly you may discern those who see it, whether it darkens [it], when the position is concealed as it ought to be. And the manner of vision [ראות] is according to the time of the moon's eclipse — whether the position is below the earth or above it; whether the moon is below it or above it, that is [the case]. So discern whether it is above the earth or below it, for they are equal [שוין]; and so its measure is reckoned from the side of the body, small or great, by the position.

For the measure of the times — and likewise the manner [דרך] in them — in the eclipse of the moon is not the measure of the vision [ראות]. And accordingly [reckon] by the time, for the position [המצב] is above its setting [?: the term construed as "setting" is uncertain], and it is darkened or hidden, when its position above is darkened or hidden — how much more so when the body is removed from there, when it is above. So discern when the eclipse is, and the times of the bodies [גשמים]. There are nine [ט'] strokes/lines [שרטוטים — i.e. the marked lines/divisions of the reckoning], and the matter of the operations [פעולות] is [discerned] thus.

These one is required to discern and to know: the manner [דרך] concerning the moon, when its position is above. And accordingly [reckon] by the time, for the position is above its setting; and so [reckon] the manner concerning it. And the manner is thus: that when the moon is eclipsed, its difference [חילוף] is great — a great difference [חילוף גדול] in the position; and the matter of it is in the position of the regions [מדינות]. And in another [region] it is visible, and you will find it in the regions, for the position [המקום] is below it. The manner is thus.

In another place, and another position [המצב], it does not catch [light] [לא לקה]; [this concerns] the manner of the moon, that you may discern its difference [חילוף] — this. And not when this position is above it, but rather another [position], it catches [light]; for at the [one] place there is one position, while the moon, when its position is above the earth, in [that same] position catches [light] by every position. Accordingly [reckon] by the time, when the bodies [גשמים] of the regions [are reckoned] between the people [בני האדם]; and that is the whole of the difference [חילוף].

And so the eclipse [לקות]; and the manner of the moon, when there is no good [position] and there is no place [שום מקום] — and so the difference in this is in the moon's eclipse. And the position [המצב] of the regions [is reckoned] between them; and so the eclipse — this is its reckoning. And the chief strokes/lines [שרטוטים] of the eclipse, the ones we have mentioned: nine [ט'] strokes [שרטוטים], and the matter of the operations [פעולות], from the side of the time; and likewise its measure, in this time. And so [reckon] it thus.

And the eclipse [לקות] — and the manner of its eclipse — these one discerns [מזהיר? the verb is uncertain] thus. And the discernment [is] in it. And he asked [ושאלת]... [The line breaks off; the remainder of folio 119r below this line is blank margin.]

the moon, the position [המצב] of its longitude and its breadth [רוחב], at the time of their conjunction [בעת תקיבוצן]. And further, a matter [ענין] of the moon: that the position which was complete — its position changed [and became] another, in breadth, small, [reckoned] for it. And further, when the conjunction occurs, [the moon] does not catch [light] [לא לקה] by the position of the body, in its breadth [ברוחב]; so discern it.

The position [המקום] in its concealment; in [that same] position [המקום] the moon catches [light]; the eclipse [לקות] of the sun in a [given] place [מקום]; and when the position [המצב] is [reckoned] from the time of day [מעת היום] — and so it is. And further, when [the moon] is removed [מרחק], for they are removed from it;

and already it has been established [יסדו], for it catches [light] in every position. There is a manner [דרך] of reckoning [חשבון] and consideration [סברא?] for the eclipse of the moon; and they have spoken of it. And he said that the eclipse of the moon is dependent [תלוי] on this: that it is above the earth, by its removal [מרחק] catching [light].

six degrees [ו' מעלות] [in] one direction [רוח — "side / wind / direction"], a "wickedness" [רשע]; and as far as all the degrees [מעלות], another direction [רוח], a "wickedness" [רשע]. [The paired רשע...רשע appears to be a technical term of the reckoning; its sense is uncertain — perhaps the two limits of latitude.] And if it catches [light], and the moon [is eclipsed] — this is the eclipse [לקות] of the moon, [reckoned] from the side of its position in the breadth [רוחב] of the whole [globe — הגלגל].

[Displayed rubric, in enlarged script:] **And after** [ואחר — recte ואחר, "And after"] [a new sub-section opens.]

And after we shall explain [ואחר שנבאר] the matters of the moon's eclipse and its operation [ועשייתה]. [The line concludes here.]

[Displayed word:] **First** [קודם]: with the later authorities [אחרונים] this matter is brief, yet [its applications are] many [רבות]; for they had it, but did not pass it over [עברו] to the operation [i.e. they did not carry it through to practice]. Rather, when one passes it on to them [כשתעביר להם], he knows it. So discern: in this matter is the eclipse [לקות] of the sun, and its operation [ועשייה]; so [do] thus. And one passes it on to them by the manner of [the] reckoning.

And these one always discerns, to explain the operations [הפעולות] — a thing [reckoned] by means of [it?]. And the differences are in the external science [בחכמה חיצונית — the secular/gentile science] and its [numbers / reckonings]. And he said: there is a great matter [דבר גדול] in this, [as] when they said: "The heavens declare [the glory of God]" [השמים מספרים — Tehillim 19:2]. And so the reckoners [מחשבים] occupy themselves with the matters of the explanation of their words. And another [matter]: "the words of the wise and their riddles" [דברי חכמים וחידותם — cf. Mishlei 1:6]. And so it is in [the matter of] discernment; and the discernment [is] in it.

And he said — Rav Moshe of blessed memory [רב משה ז"ל], in the *Guide of the Perplexed* [בספר מורה הנבוכים — Maimonides, *Moreh Nevuchim*]: [a new sub-section opens.]

[Displayed rubric, in enlarged script:] **And we shall reckon** [ונחשוב — recte וחשוב, "And we shall reckon"] the matter [ענין] of the moon's eclipse [לקוטה].

The manner [דרך] of it [is] thus: take, by way of [כעניין] computation [מסתכסוך]: the term is uncertain], the degrees [והמעלות]. Take [תקח] from it [the value] — [numerals elided here; the specific quantity is not legibly recoverable] — and reckon [תמני]: one hundred and two [ק"ב — the reading of the gematria is uncertain], times [the figure]; and there is no remainder [ולא נשאר], from it. And [discern]: discern [ותביט] in it, and from the body [מגשם] [reckon] the eclipse of the moon and its operation [ועשתה]. And eighty-two [פ"ב — uncertain reading] [?: the surrounding numerals — ק"ב, פ"ב — are legibly inked but their values are not securely resolvable at this resolution].

And another reckoning [חשבון אחר], a thing [reckoned] thus; and so it is. And the moon, when there is a removal [מרחק] — and the matter of its position is in the time; and the sun's [degree], when its time [comes] — and this is thus. The measure of the body [or: the hour of the day — שעת היום], when the reckoning is reckoned [חשוב תחשב] thus. And so the later authorities [אחרונים], whose matter is in their time; when they are [reckoned] from the time [מן הזמן], they descend [ירדו]; the sun goes [השמש ילך] and the moon comes out [ותצא], by a removal [מרחק], from the next [לאחר]; and the course [ההליכה] is not corrupted [ולא נפסד]...

Yesod Olam — Fourth Treatise (continued): the eclipse discourse

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Sephardic semicursive hand, brown ink. Single column. Folios 119v / 120r (gutter-split) / 120v. Fourth Treatise — the eclipse discourse (לקוטה of sun and moon) continues, closes a section under a שער rubric, and opens Chapter Eighteen.

of the moon, as he said. And in joining the chord to the [arc of the] orbit and its distance from the line of sight — when this is so, then the two periods are equal; this proves the matter, as we explained. They said that the visual aspect of the body turns and stands opposite it, and there results from this a diminution at the time of conjunction, and from the visual angle there comes about a fixed measure. This is a small angle [?: terse construal]. We established this from what we said in the preceding matter: that the visual ray and the lines drawn from the eye to the bodies meet at a single point, and from there the lines diverge.

(interlinear: וחזר נסוג — a later corrective gloss, verbatim only.)

When this is so, then both bodies are alike in their measures and equal in their visual aspect, so that the two periods coincide. The cause of this is that the moon stands between the eye of the observer and the sun, and screens its light; and at the time the sun comes to be diminished, it is darkened by the intervening body, and its light is withheld at the moment of conjunction. This is a small angle. The visual lines are drawn out and reach toward the body, while the observer stands fixed. He who knows the measures knows this.

Therefore, by the surplus and the deficiency in the reckoning — how great the diminution is — the wise men ordered new tables for the sun according to the figure, and they set down what they observed, at the time this was seen. And it reaches the body opposite it, and stands above it. So you find that the diminution of the sun is in proportion to its remoteness; and likewise the diminution of the moon is at one given moment, this being at the time of conjunction. The visual aspect is small, and there is no benefit in it for the reckoning, for the sun comes to be hidden by the intervening body at the time of conjunction. It encompasses the body and stands above it — yet this is a small angle, and the visual aspect of the lesser body is obscured.

This is a small thing, and they who speak of it speak loosely; and the eclipses, when you set them out, you will rely on the established figures. The result is a deficiency, just as we said: a measure of רמ"ו [numeral: ?]. The wise men of the calculations knew that this body is great in its measure beyond count, given the great distance of the sun, yet it is darkened by the intervening body; and likewise the moon, when it stands opposite the sun at its conjunction, its light is screened off.

And I shall say further: this body, when it is darkened — there are those who say it was thus, and there are those who hold it otherwise; and one is obliged to hold that it is so for all of them.

[שער] [Display rubric, enlarged script:] רוב התחבולה מכדור החמה —
"The bulk of the device [is reckoned] from the orb of the sun."

The orb of the sun is great. There are three bodies that rise — not all at one moment, but they go up in turn. As for the distance, when the body of one orb is measured, one point over against another: the body of the sun, in its measure, is many myriads of times greater than the earth — were this so; for so they say, those who speak of it, that one is obliged to hold it so.

Folio 120r (gutter-split leaf)

This leaf falls into the gutter of the opening and is captured only at its outer edge; its text-column interior did not register in the scan. Only the line-openings at the captured edge are legible — the line-bodies run into the gutter.

[Legible at the captured outer edge, line-openings only:] ...and he said that the device proceeds from the orb... ...in the visual aspect, and the deficiency was already in the eclipse... ...and the wise men said... ...toward its distance, and it was great, exceeding its measure...

[Illegible: folio 120r interior — split at the gutter in the scan]

and you will find that the visual aspect of the lesser body is small at the time it is reckoned, and its diminution is in proportion to its remoteness; for it is darkened by the intervening body, and screened. And in the device of the eclipse, when it occurs, you rely on the figures. From the body of one orb over against another there results a deficiency, and there is no benefit; and the moon, when it stands opposite the sun at its conjunction, its light is screened off. And there results a deficiency, just as we said.

Were it not so, then both bodies would be alike in their measure at the moment of conjunction; the moon would screen the sun and stand above it alone, and the observer would be fixed. He who knows the measures of the sun knows this.

פרק שמונה עשר — Chapter Eighteen

דע — "Know."

Know that from the observed tables the figure is established, and in it there is a measure; from one table one measure is drawn, and a further measure from another. Know that the bodies are great in their measures, and you ought to know this, and to hold that it is so. The device is from the orb of the sun, and from the measure of one body over against another; and the deficiency was already reckoned in the eclipse — its diminution and its measure.

And know yet a further thing concerning the device of the eclipse: the figure is from the calculations, and you should know its measure exactly, and the order of its courses and their reckonings; for the bodies move, and their diminution is in proportion to their distance. They observed them, and the eclipses, and all that pertains to them: the distance of the body up to the moment it is reckoned.

The body of one orb over against another yields a measure of the calculations, and at the beginning of the inquiry the matter was set down; and they observed

the bodies, and did the reckoning thus, with the instruments and their distances, as we explained. And they took up the inquiry, and drew near, and knew the measure of one body over against another, and found a deficiency in the figure. As we explained to you, the reckoning of the bodies is great. The order of the device and the judgments — the bodies and their courses — and the diminution is from the body, reckoned for the eclipses, and all that pertains to it, up to the moment of conjunction; from one body over against another there is a deficiency.

From the figure of one calculation you draw the measure of the tables, and they receive the bodies, one body over against another; and the diminution is reckoned, and there is no benefit, and there comes about a measure of the body — a single measure drawn from the tables, the beginning of the inquiry being set down above. They observed the bodies, and did the reckoning thus, with the instruments, and they observed them, and the eclipses, and drew near to it, and took up the inquiry, and drew near; and one body over against another yields a measure, and there is a deficiency.

just as the device of one body over against another — yet one is obliged; and were it not so... and they who speak of it speak loosely; and one is obliged to hold it so for all of them.

[Margin: a marginal note of some three to four words at the foot of 120v, in a later and lighter hand; the wording is not securely legible. Verbatim recovery and identification require further verification — no named authority is asserted.]

Yesod Olam — Treatise Four, Chapter Eighteen (continued)

[Later hand, marginal note, outer margin of 121r: "שער ה' מהמא[מר]" — a cross-reference, "...Gate 5 of the Treatise." Marginal note containing this verbatim text; further identification requires further verification.]

so that you may know by how much the distance of the center of the sun exceeds the distance of the center of the moon, and the difference between them. Once you have established their mean motions and their respective distances, you can derive from them the true distance that separates the two centers at the moment in question.

Take the distance of the center of the sun and the distance of the center of the moon, and subtract the smaller from the larger; what remains is the difference between the two centers. Then proceed according to the proportional reckoning we have laid down, so that you may determine the true measure of the separation between them.

And know that the distance of the center of the moon from the center of the sun is not always equal; rather it differs from one position to another, since the moon moves upon its own orbit while the sun moves upon its orbit, and at every moment the interval between the two centers changes. Therefore you must reckon the difference for the particular hour you require, and not rely upon a single fixed value.

When you wish to know the proportion of the one distance to the other, set down the larger distance and the smaller distance, and let the ratio between them be as the ratio of the whole circle's quadrant to the arc that subtends it. For the proportion of the lesser arc to the greater is as the proportion of the lesser distance to the greater distance, and from this proportion you obtain what you seek.

Take, then, the quadrant of the circle, which is ninety degrees, and let its radius be drawn from the center to the circumference. Upon that radius mark the two distances, the greater and the lesser, each in its place, and draw from each of the two points a perpendicular line to the radius. The two perpendiculars will meet the circumference at two points, and the arc enclosed between them measures the difference you require.

Diagram. A quarter-circle construction in brown ink at the lower portion of the text column. From a corner-vertex (the center of the circle) two radii are drawn at right angles — one horizontal (the base line) and one rising — and between them a quarter-arc is swept. A second, inner arc concentric with the first is drawn at a smaller radius, so that the figure shows two nested quadrant-arcs sharing the same center. The base line carries marked points where the two distances (the greater and the lesser) are laid off, with short letter-labels beneath them. The construction illustrates the proportion of the two centers' distances to the arcs they subtend.

- (apex / center corner): [label rubbed, numeral: ?]
- (along the base line, marked points): two division points labeled [?] and [?]
- (on the outer arc): terminal point [?]

[The legible labels are too few and too rubbed to recover with confidence for label recovery.]

For this is a known quantity, and that is a known quantity, and the proportion of the one to the other is likewise a known quantity; therefore the fourth term, which you seek, is also known. And in this way you will find the difference of the distances of the two luminaries, by the proportion we have set forth.

and the matter will be made plain to you when you reckon according to this rule, that the distance of the center of the moon and the distance of the center of the sun are as we have described. The proportion holds in every case, whether the two centers are near to one another or far apart; and so likewise you should reckon the difference for whatever distance you find.

ואחר שכוונת — And after you have determined [display rubric] the distance of the center of the moon from the center of the sun, and you know the true interval between them, the matter is complete, and from it you may proceed to what follows.

Then, having established the place of the moon and the place of the sun and the difference between their two centers, you will find that the distance of the moon's center comes near to the sun's center at one position and grows far from it at another, according to the motion of each upon its orbit. And this is well understood from what we have explained above.

ואחר שכוונת — And after you have determined [second display rubric] the true interval, take it in hand and reckon with it as you have been shown, that you may know the magnitude of the eclipse and how much of the body of the luminary is darkened.

Now we shall explain the matter of the eclipse and the shadow-cone. Know that the body of the sun is larger than the body of the earth, and the body of the earth is larger than the body of the moon. When the sun shines upon the earth, the earth casts a shadow opposite the sun — a shadow that tapers to a point, narrowing as it rises until it comes to an end, in the form of a cone. This is the cone of shadow [the umbra], and within it the rays of the sun do not reach.

When the moon, in the course of its motion, enters this cone of shadow, the sun's light is cut off from it, and the moon is eclipsed — for the moon has no light of its own but only the light it receives from the sun, and when the body of the earth stands between the sun and the moon, the light is withheld and the moon is

darkened. This is the eclipse of the moon, and its measure is according to how deeply the moon enters the cone of shadow.

If the whole body of the moon enters within the cone, the eclipse is total; and if only a part of it enters, the eclipse is partial, according to the portion that enters. The point of the cone, where the shadow tapers to nothing, marks the limit of the earth's shadow, beyond which the moon cannot be eclipsed; and the breadth of the cone at the height of the moon's orbit determines how much of the moon may be covered.

Diagram. A vertical shadow-cone figure occupying the right edge of the text column and descending the full height of the page. At the foot is a large red disc — the body of the sun — bearing across its middle a white band lettered גוף החמה ("the body of the sun"). From the sun two straight lines (the external tangents) rise and converge upward, narrowing into a solid black triangular spike at the top — the cone of shadow (umbra), whose apex is labeled at the very top. Along the axis of the cone the moon is drawn at two successive positions: a lower open circle (the moon outside or entering the shadow) and, higher up, a disc shown half-blackened (the moon partly within the shadow, partly eclipsed). Short cross-lines mark the breadth of the cone at each of the moon's two positions, and the labeled points of the construction sit at the ends of these cross-lines and along the tangent lines.

- ה (apex of the black cone, top): the point of the shadow-cone
- (upper moon position, half-blackened disc): the moon partly eclipsed, with flanking points [?] and [?]
- (lower moon position, open circle): the moon below the shadow, with flanking points [?] and [?]
- (foot, red disc): גוף החמה — the body of the sun, with points [?] at the ends of its diameter

[Several of the small point-labels along the tangent lines and cross-lines are rubbed; the named caption גוף החמה and the apex letter are secure. for full label recovery.]

and the shadow that the earth casts has its beginning at the earth and its end at the apex of the cone; and the body of the sun, when it sends its light past the earth, makes the shadow in the shape we have drawn.

the differences within it, [reckoned] from the path, this being the way it [is found]. The eclipse of the moon, by which we [find] its time and the depth of its entry [into the shadow], we work out by proportion; for the distance [from the

cuspid?) is reckoned in this manner, and likewise for the rest, by the proportion that holds among them.

And once you have settled this, and you know that the eclipse of the moon comes about in this way — just as we explained and demonstrated — and once you have grasped its character thoroughly, you will understand and know how slight it is. By contrast, when the moon stands at its perigee [?: nearer the earth] and the sun at its apogee [farther off], the line of sight [reaches] toward [a more distant point], so that the [shadow] reckoned from this point is great; while along the [other] path, when the matter is reversed, you will know what is small. And the [shadow] grows long or grows short by [the amount of] the moon's distance and the [length of] its [own] path. [?: the relative measure of moon-distance to shadow-length governs whether an eclipse is total or partial]

From a known place [you proceed] to a known place, and you have already determined their character; so the moon's value [comes to] 116 [ק"י"ו]. The editors [the copyists] [give] it [as] 130 [ק"ל], some [reading] 131 [ק"ל"א]. By the path you proceed; the value 9 [ט'] [yields] its result, [the moon] being at [its place]; and from the value 6 [ו'] [you reach] its result, so that the line of sight [falls] toward [its point]. Two seconds [שניות]. From the value 70 [ע'] [you reach] 130 [ק"ל]; and the [shadow] of the moon stands [so much], from the place where it begins. [?: several of the one- and two-letter result-values in this worked template are abbreviated in the source and not all securely resolvable on the tiles]

And now it has been made easier. [ועתה הוקל]

[A worked illustration in the manner of the foregoing:] From the value upward [of the moon's motion] — its path [yields] so-and-so; from the value upward of the sun's motion — its [path yields] such-and-such. So-and-so seconds [שניות], and the rest [is] such-and-such. From the value 9 [ט'] [you take] its sixtieth part [for the minutes]; and the [shadow] of the moon stands [so much] within the shadow that the earth casts. From the value of the moon's mean motion, reckoned from its center, [we derive] the distance of the moon's center from the [sun's] center, and so likewise the value of the sun's mean motion — [the distance] from its center — [yields] so-and-so. [Through this proportion you find what is sought.] [?: this whole paragraph is a worked example whose specific gematria values are abbreviated to a letter or two each and several are not fully resolvable on the tiles]

[Wide blank lower margin — no further text on 122r.]

[On the facing leaf, at the gutter edge of this opening, stands the shadow-cone (umbra) diagram described below.]

and it was great [?: the shadow], and the moon's mean motion [is] such-and-such; and along the [reversed] path it is short, and [you arrive at] the value [so-and-so]. The moon's place [is] so-and-so, reckoned from a known [place] to a known place — its mean motion [being] such-and-such; and the distance of the moon's center [from the sun's center] is so-and-so. From the value of the sun's mean motion [you derive] the distance of the sun's center; and [so the moon stands] within the earth's shadow at such-and-such a depth. The value upward [gives] so-and-so, [the line of sight] toward [a known point]; and you return [to the same reckoning].

And [the moon] returns thus. [ויחזור כן]

And as Ptolemy [בטלמיס] has it: the distance of the sun, [reckoned] from the center of the sun — its mean motion — and the distance of the center of the moon from the center of the sun [is so much]; and the distance comes to 1000 [אלף] and some [further amount] of miles [מיל], and the rest by the [near] path; and the body of the sun stands [at its place]. From the value [of its mean motion] you work the proportion to find what is sought. [?: the specific multi-letter distance-numerals in this Ptolemaic citation are abbreviated and several are not securely legible on the scan]

And [the moon] returns. [וחזר]

So that you may know: the moon's path, and the place where it [stands], being at the value [?]; and the editor [the copyist] has [given] it from [a known] value [so-and-so], some [reading] otherwise; and the distance of the moon's center [from the sun's center is] such-and-such, by the path that is near; and you arrive at [the value], some [reading] otherwise; and the moon's place [reckoned] from a known place [to] a known place — its mean motion is such-and-such. The line of sight [falls] toward [a known point], and you return [to the reckoning]. [?: as above, a chain of abbreviated gematria values, partly resolvable]

And now. [ועתה]

For the line of sight [falls] toward [a near point], so that the shadow of the moon [comes about] when the body of the sun, [shining] upon the moon, [is so situated]; and the shadow of the moon stands [so much], the body of the sun [being] such-and-such. From the value [so-and-so] its mean motion [is reckoned], and you know [the rest].

And the moon returns. [ויחזור הירח]

The line of sight [falls] toward [a known point]; and [you find] the value [so-and-so], [the moon being] at [its place]; and the body of the sun [stands] at the value 116 [ק"י]; and you proceed by the path. From the value [so-and-so] [you take] its sixtieth part [for the minutes], and you reckon from a known place to a known place; and you know the moon's path. [And] within the value of the sun's mean motion, between [the sun and the moon] — the [shadow] reckoned along the [near] path [is] such-and-such; and [the moon] stands within the earth's shadow, and the sun's mean motion [is reckoned] from the body of the sun; for the sun stands at the value [5 = ה'; ?]; and the moon's mean motion [is reckoned] from the body of the sun [as well]; and so [you work] the proportion. [?: this paragraph again carries several letter-abbreviated values not all securely resolvable]

And [the moon] returned. [ווחזר]

So that you may know the moon's path, and [its standing] in [the place], its mean motion [being] such-and-such, [reckoned] toward [a known point]; and you arrive [at the value]. The matter [is] such-and-such, and [you understand the rest].

And again [the moon] returned. [ויחזר / ואחר — display rubric]

So that you may know: the moon's path, and [its standing] at the value [so-and-so], the editor [the copyist] [giving it] from [a known] value of [so-and-so] degrees; and from there [you proceed by] the path of the moon; and its quarter [revolution? רביעה] [is] so-and-so. So that [the matter] returns, and [returns] to the [same] reckoning, as we have said. And [you understand the rest]. So that [when] the moon's mean motion stands at the value [so-and-so], it [is] such-and-such, and so [the matter] returns. [?: chain of abbreviated values]

[so it stands], and [the matter] goes up [ויַעֲלֶה] [to such a value]; ...of the [perpetual] cycle of the sun's mean motion, it holds [יחזיק] [such-and-such]. [?: last lines of 122v carry abbreviated figures, several abraded]

[Wide blank lower margin — no further text on 122v.]

Diagram. A shadow-cone (umbra) eclipse construction, drawn vertically. At the top is a tall, narrow black isosceles cone tapering to a point at its apex (the earth's shadow narrowing to the cusp). Below it sits a black semicircular (half-filled) disk — the eclipsed body — with construction lines fanning downward from its edges. The dotted sight-lines pass through a small circle marked with a cross at its center (a center-marked circle, lower middle). They continue downward to a large filled

red disk at the foot of the figure, bearing the white-ground caption **גוף החמה** ("the body of the sun"). This is the same shadow-cone family of figure as the one on the preceding opening (fig-p248-1); only the gutter sliver of it registers on the scan, so its internal point-labels (apart from the red "body of the sun" caption) are not resolvable here.

- (apex, top): cusp of the earth's shadow [point-label not legible]
- (upper middle): eclipsed body — black half-disk [point-label not legible]
- (lower middle): center-marked circle [point-label not legible]
- גוף החמה (foot, red disk): "the body of the sun"

[>2 labels flagged [?] — the figure registers only as a gutter sliver; needs the facing diagram leaf tiled in full.]

Fourth Treatise (פרק שמונה עשר), Chapter Eighteen (המאמר הרביעי), continued — and Chapter Nineteen (פרק תשעה עשר), the conclusion of the Treatise.

[Librarian note: pencil foliation "123" at the head of the recto leaf.]

[The text column occupies only the upper third of the leaf; the lower two-thirds is blank lower margin, not damage. A light water-stain crosses the foot of the blank area.]

and the planets [were investigated], and they took up generation after generation [כדור כדור], and the wise men learned from one another concerning the apse of the planets, generation by generation, each of them inquiring into this matter; and they reckoned and aligned [their figures], and assigned the apse to its true place.

And the wise men [carried out] this and that, and they learned it and investigated it, and the figure of the sun was such-and-such [ש"ד], and so too the distance of each of the rest [of the planets]; and they directed their inquiry to its [the planet's] true place, one by one.

[Display rubric: **והחכמים שעמדו**] And the wise men who arose after them learned [from them] and investigated [the matter].

They said of the planet Jupiter [כוכב צדק] that its near center [מרכזו הקרוב] was such-and-such [ש"ד], and that it reached to the earth, the planet [itself being] such-and-such; and so too the far distance of the planet Saturn [כוכב שבתאי] — its near center was such-and-such [ש"ד].

In the same way they investigated the rest, and the far distance of the planet Mars [כוכב מאדים] — its near center [was] such-and-such [ש"ד]; and the far distance of the planet Venus [כוכב נה] — its near center [was] such-and-such [ש"ד].

[Display rubric: **ועתה נשב**] And now let us set down [a comparison of] these distances, [reckoning] the count of the *miles* of length [מספר מילי אורך] in each one; for they are [each] remote and well-determined [מרחק ומכוון], and each is taken from the wording of the [source's] account, complete and fitted [to it].

The count of the *miles* in each distance, both the far and the well-aligned [המרוחק] [והמכוון]: the planet whose near center was such-and-such [ש"ד] full *miles*, and so many thousand; which is equivalent to a mean motion [מהלך] of so many full [units], and they aligned [their figures] accordingly.

By this reckoning of the *miles*, so much [ש"ד] is shortened from the [given] kind [of measure].

[Display rubric: **ושער כיקרו** — reading uncertain] [?]

And the wise men [carried out] their precise investigation, and the figure [צורת] of the planet — and it is the smallest of every figure [in the sky] — was one part out of nineteen [$1/19 =$ חלק אחד מי"ט]...

[The verso leaf is the left-hand leaf of the opening; the binding gutter falls at the right (inner) edge of the column. The text column again fills only the upper portion of the leaf, with a wide blank lower margin and a light foot-stain.]

and so too the figure of [the next planet] was such-and-such [ש"ד]; and so too the planet Jupiter [כוכב צדק] — its figure was such-and-such [ש"ד].

And so too [the planet] whose figure was such-and-such [ש"ד]: it is so much [ש"ד], and the planet that is smaller [קטן] [than it] — it is no greater than [the body of] the sun [מגוף החמה], by one part.

The astronomers [who] differed about these [figures] differed [only] within close bounds; for what they grasped of the wisdom was firm in its truth, and the reckoning [arrived at] by their way [of computation] was reliable.

All that they have said of these [matters], and what they grasped of them — and they knew this, and inquired into it by their way [of investigation]; and the reckoning [stood firm] in the true figure of the moon. And in all this there was nothing they did not grasp; for they grasped the truth of the matter [על אמתת טוב] [דבר מסור] — [as it is written:] "there is no wisdom and no understanding and no

counsel" [אין חכמה ואין תבונה ואין דעה] over against the Lord [לבד... recte: probably 'before the Lord'; the reference is to Mishlei 21:30].

[Body heading — display rubric, brown ink:]

פרק תשעה עשר — בחתימת המאמר השלם הזה

Chapter Nineteen — on the conclusion of this complete Treatise

What [I aimed at] in the science of the heavens and the strengthening of its foundations — and how good it is for them [to know it] — is the chief of the matters at their close. Indeed the earlier and later [astronomers] directed [their labor], and reckoned, and set down the order of the seasons [סדרי הזמן] and the cycles [התקופות] and the conjunctions [המחברות] and the syzygies [recte: probably the eclipses].

[The astronomers] toiled at this — each one of them in his own day — and they learned it and knew it and made it known to others, so that they [in turn] would set it down; and they understood from it matters of [great] benefit, and they passed it on, and added to it tables [לוחות] and figures, and established its computation by [sound] demonstration, so as to bring [the science] to perfection, and to make it known to all who would seek it.

They aligned [their results] and corrected them by reckoning, so that there should be no falling-short in them for the seekers — neither error nor defect; for they [labored at] the heavens and the planets and their motions, one [generation] grasping it until [the next] would establish it, [each adding] from [the labor] of its predecessors. And the truth of the matter [was grasped], and they were occupied with [this] service; and they grasped the truth, and there was in it [no error], by the favor of God.

and they knew this, and [observed] the planets and the spheres [הגלגלים], and [recorded] the matters of the conjunctions and the conjunctions [המחברות, והמחברות, dittography in the source] in their figures; and they investigated this and found [it], and they understood the matter...

and they said: how great [are these matters], and how they were established; and [they took up] the figures and the motions, and corrected them; and whoever understood it — its [reckoning] until it should be established firmly — [labored] at the depth of the matters, [working] over [long] times and seasons; and the labors of those who served [in this] were many. And they corrected [their figures] and aligned them, and they shortened [the procedure] [ויקצרו] and brought it near [ויקריבו]; and they said: Take breath [תקח רוח] and swallow [ותבלע]... [The

sentence runs on across the foot of the leaf into the following folio; rendered once as a single forward flow.]

Yesod Olam — Fourth Treatise, concluding chapter (Chapter Nineteen) and colophon

Bodleian MS. Huntington 299 (1484), folios 124r–124v. Sephardic semicursive hand; brown and rubricated brown ink. Wide blank lower and outer margins; a brown waterstain in the lower margin of both folios, clear of the text.

Folio 124r (left leaf of the opening)

[The leaf is mostly blank parchment; the text occupies only the lower ~9 lines of the written area. The opening was photographed twice with heavy overlap, so the same two text-pages recur in both halves of the supplied images.]

and they investigated this matter, and grasped its great principle and its weighty foundation [?: one word lost at line-start]. They studied the procession and the recession, and so too the matter [?: end of clause faded]. They composed concerning the service [of God] and the work of the heavens, laying its foundation in the proper measure — its foundations and its structures. These are the sages who set down the rules: they searched out and weighed them, and were precise about them, so as to set each matter in its place. And so too the recession is found to be greater in the great cycles.

[Centered rubric: וברכה] — *And blessing.* [?: read וברכה / ובדכה; the preceding word at the line-head is lost.]

there was no blemish in their reckoning, and they took care to be precise; and [the science] was distinguished from the nations of the world. He gave the Torah on Mount Sinai, and gave the Torah to Israel through Moshe son of Amram, of blessed memory; and these matters [the reckonings] were set in order before Him.

in the place where they investigated their reckonings, just as they dwelt and reckoned. And by the courses of all the luminaries upon them, and so too the planets and their fixed measure — and the matters were many, with no error [?: one word] in them.

It is true that this matter is a reckoning of the seasons and the cycles, and the work [of God]; the inquiry and the knowledge of the service [of God], the

supernal mysteries, and the luminaries of the heavens in their courses and their dwellings. The sages drew near to teach and recount them, and to set them down in the proper measure — the recession and the procession, and the work of the heavens in their courses.

and the books of the ancients, of blessed memory; the perfection of the science [?: one word], and they investigated the matters of this science. The wise of heart [?: end of line faded]; and the sages composed [their works] and were precise about the rest of the matters concerning the tables.

Folio 124v (right leaf of the opening)

[Text again fills only the lower portion of the page; the upper two-thirds is blank parchment, a brown waterstain in the lower margin clear of the text.]

in this manner; and the recession [?: word at line-head lost]; the planets and the warmth [?: one word]; and they reckoned the days and brought them near to the tables. The reckoners in their reckoning [?: end of clause faded]. So too in pure inquiry, for he chose [?: one word] and set it in the hand of those who occupy themselves with [the science].

to teach; and so too they reckoned the days, and the cycle; and the planet revolved in its course toward [?: direction-word lost]; and so too, for there is in it [?: end of clause].

[Red-ink rubric: וּבֵאֵמֶת] — *And verily.*

the great [?: one word] in the world, and they confirmed it; the seasons and the warmth, and the tables; the reckoners; and Moshe son of Amram, and they reckoned it [?: end of clause], according to the knowledge of [?: one word].

and they wrote them and reckoned them, and confirmed them; the planet, and the recession [?: one word]; and so too they were precise about [?: one word]. The work [of God] revolved, and the planet; the perfect cycle; and they received the Torah on Mount Sinai. And [?: verb at line-head] them, and the planet, the work [of God].

It is true that this matter is a reckoning of the seasons and the cycles, and the work [of God]; the inquiry, and the knowledge of the service [of God], the supernal mysteries. And so it was that there was a perfect [?: one word]: they brought near and made plain; and the planets, the procession and the recession.

The reckoners in their reckonings set it down in its place — the work [of God] of the heavens. The reckoners composed [their works] in inquiry, for they kept to their course; and they made plain a clear thing, and they received the Torah [?: end of line]. [?: final short clause lost.]

[Large centered display rubric: יושר עוז] — [?: large brown display script; the centered word reads יושנמשך / ושר עוז — not securely resolved; "תחלה" ("beginning") is legible nearby.] They taught and investigated; and the luminaries [?: end of line].

the great [?: one word]; the procession and the recession; and [the science] was distinguished from the nations of the world; the cycle, and the procession and the recession.

**

the procession, the practice [of the tables], and the warmth; and so it was, and the [matter] of the planets, and so on. And [?: verb] toward [?: one word]; and Moshe son of Amram; the recession; and so, in the procession.

the tables [are completed], the recession, and the warmth; and the practice of the tables; and they were precise about them; the procession and the recession.

[Closing rubric line: ...ושקיעתם וחילוף הימים... / ומנהג התלכות] — ...and the practice of the [tables / orbits]; ...and their setting, and the variation of the days.

[The lower two-thirds of 124v is blank; a brown waterstain occupies the lower margin clear of the final text-lines.]

Note on the recurring formula. The clause "*and [the science/it] was distinguished from the nations of the world*" (ויבדילו / והבדילו ... מאומות) genuinely occurs at two distinct physical points — once on the left leaf and once on the right leaf, following the ובאמת divider — within different surrounding sentences. This is the author's deliberate restatement across the colophon's two parallel retrospectives, not a row-overlap or photograph-overlap artifact.

Bodleian MS. Huntington 299 (1484). Sephardic semicursive hand, brown/black ink. Folio "125" pencilled in the upper margin of the right-hand leaf (modern hand). Wide blank margins; photographer's ruler and black backing strip at the page edges are scan furniture and are ignored.

Right-hand leaf of the opening (the text-bearing page)

[The upper portion of the column is faint and right-aligned, with several lines crushed toward the head of the page and the gutter; only line-ends are legible. A marginal/diagonal annotation in a slightly different ductus runs down the upper-right margin — [Margin: brief annotation, text not securely legible, ?].]

[Upper legible fragments, right-aligned line-ends, top→bottom:]

ל ובחדוש שנת [?] קוית כל היום [?] תכונתו ועשירה [?] · חלקים
and in the renewal of the lunar year...

[?] סדור קצת קטוע[ק] an arrangement, partly [cut off, ?]...

· תקון המולדות the fixing of the *moladot* (the conjunctions)...

[?] שבין

[Lower block, fuller lines, top→bottom:]

[?] הראשון כק[...]. דוס רטי the first ... [?]

· נת הלבנה בחדושה[ש] the year of the moon in its renewal...

[?] מולד ולא על פי קראיוך a conjunction (*molad*), and not according to ... [?]

· ישראל בזמן הראשון Israel in the early time (the time of the ancients)...

[?] כן קדמונינו ז"ל חסבן thus our forebears, of blessed memory ... [?]

[Foot of the column, final line:]

· קצת כענין החבור וסודותו somewhat after the manner of the *hibbur* (the work / the conjunction-computation) and its mysteries.

[The remainder of the leaf below this line is blank parchment. Light foxing/water-stain spots are present in the lower blank field and do not affect the text.]

[The facing (left) leaf of this opening carries no securely readable text on the scan — only blank parchment, the scan ruler, and a thin gutter sliver of letter-fragments. [Blank / illegible-gutter leaf – no text committed.]]

Script: Spanish Rabbinic semicursive (primary hand), brown ink. Small, faint hand throughout; read under magnification. The opening shown is a two-leaf spread: the right leaf (folio 125v) carries the tail of the Fourth Treatise's chapter index (already translated in batch 128); the left leaf (folio 126r) carries further

index lines together with the opening of the Treatise's first chapter; (folio 126v) is a single column of continuous body prose. A modern pencil foliation "126" appears in the upper margin of the left leaf.

[Chapter index — Fourth Treatise, continued (folio 125v–126r)]

The chapter-list of the Fourth Treatise continues across the inner columns of this opening. The chapter rubrics read cleanly; the topic descriptions are in a smaller, cramped hand and are only partly legible at this resolution.

[Index column, chapter rubrics, top to bottom. The first three are written **הפרק** (with the article) on the right leaf (125v); the remainder are written **פרק** on the left leaf (126r):]

- הפרק ט [Chapter 9]
- הפרק י [Chapter 10]
- פרק י"א [Chapter 11]
- פרק י"ב [Chapter 12]
- פרק י"ג [Chapter 13]
- פרק י"ד [Chapter 14]
- פרק ט"ו [Chapter 15]
- פרק ט"ז [Chapter 16]
- פרק י"ז [Chapter 17]
- פרק י"ח [Chapter 18]

[The topic description for each chapter, written in the smaller hand to the left of the rubric column, is largely legible only in fragments. Partially recovered topic phrases, in the order they appear:]

...the determination [תיקון] of the tequfot according to the view of Shmuel [תיקון] ...the determination of the tequfot according to the view of Rav Adda [תיקון] ...the determination of the new moons [מולדות] and the cycles [מחזורים], and what one needs to know in order to set [לתקן] the intercalation [העיבור] in its proper order [על הסדר] ...at the time of the new moons [מולדות], and the foundations [היסודות] required [לכל עת ועת] for every time and season [הצרכים]

- [Section break — second sub-list:] ...in the reckoning of the conjunctions [המאורעים] and the visibilities [הראויות] ...in the determination [תיקון] of the moon's tequfot [?], according to a certain reckoning [על פי חשבון] [?]

...the order [סדר] which they have, one to another [בני זה לזה], and the order [ולעתים]... [?] ...for the new moons [לחדשים] and the seasons [סדר חדשיהם]... [?] ...the order of their months [סדר חדשיהם] from the beginning [מתחלה] of the world [העולם] until now [ועד עתה] [?] ...the months [החדשים] and the years [והשנים], and what each one [וכל אחד] receives [קבל]... [?]

פרק ראשון [Chapter One] (*opening the body of the Fourth Treatise; folio 126r*)

[The chapter opens with the large display rubric **פרק ראשון** ("Chapter One") spanning the column.]

The Fourth Treatise [המאמר הרביעי] treats the reasons [טעמי] of the science of the calendar [התכונה] and its divisions [וחלוקתה], so as to understand and to reckon [להבין ולחשב] every principle. In its chapters [בפרקיו] the Fourth Treatise sets out the determination of the intercalation [בתיקון העיבור] and the order [וסדר]...; and by its power [וכח] you will reckon [תחשב] and set in order [ותסדר] and build up [ותבנה] the reckoning [החשבון] from its first terms [מקדמיו], and all that is to be written [וכל לכתב] for its appointed times [שעותיו].

[The discussion proceeds to the determination of the tequfot:]

In the determination of the tequfot according to the view of Shmuel [בתיקון — recte רב — בתיקון התקופות של דעת רב אדם], thus and so; and in the determination of the tequfot according to the view of Rav Adda [ובדרך זה] you will determine [תקן] the visibilities [הראויות] and the seasons [והעתים], and likewise in the determination [ובתיקון] of the remaining matters. And it is fitting [וראוי] that you know [שתדע] the order [סדר] of the intercalation [העיבור] within the cycle [במחזור], in proper order [על הסדר], at the time of the new-moon conjunctions [המולדות?] — the word here is faintly written; the parallel index line has [?] — and the foundations [והיסודות] that are required [הצריכים] for every time and season [לכל עת ועת].

In the reckoning of the conjunctions [בחשבון המאורעים] and the visibilities [והראויות]...

In the determination [בתיקון]... a brief account [קצת] of the conjunctions [המאורעים]: an indication [סימן] for grasping [להבין] the reckoning of the conjunctions [בחשבון המאורעים]; and an indication [סימן] for the months [לחדשים] in

proper order [כסדר] — the days of the world [ימי העולם] and their dates [ותאריכים], from beginning to end [מתחלה ועד סוף], in a fixed order [וסדר קבוע].

[Wide blank lower margin on folio 126r (not damage).]

[Body, continued — folio 126v]

each one of them [אחד מהם] is sanctified [מתקדש] and returns [ווחזר] to the place of its term [לקצות] in the same...; in the places [במקומות] of the moon [ירח]...; and the term [וקץ] of the month, the [value of] the *ḥelek* [לחלק] of the solar year [שנת]...; the sun [החמה], and these were not [ועשו זה לא]... the degrees of the orbits [מעלות הסובבות] of the sun [החמה].

The months [החדשים] are sanctified [מתקדשים] in their places [במקומות], each returning [ווחזר] to the place of its term [לקצות]...; and the term [וקץ] of the moon's [ירח] *tequfah* [תקופת]...; the moon [ירח], reckoned [נחשב] for the appointed times [למועדים] — and these are days [ימים]; the month [חדש] is bound [נתקשר], and according to the foundation [שבול] [?] of the science of astronomy [חכמת התכונה]...

The months of [the count of] every [the reckoning of] new moons [חדשים]; their reckoning [חשבונם] is thirty-two *ḥalakim* [32 = *ḥalakim* ל"ב חלקים], for the conjunction [המאורע]... and every portion [וכל לחלק] which...; the solar year [שנת]... [החמה]...

[The text proceeds to the count of days in the year and the months:]

the solar year [שנת החמה] is so-many days [כך ימים]; and the lunar year [שנת]... [הלבנה] is so-many days [כך ימים], such that each month returns [שחזר חדש]...; the science of astronomy [חכמת התכונה]...; the moon [ירח]...; the months [חדשים] — whether [אם] a full month [שלם] or otherwise — and the conjunction [המאורע]...; twelve *ḥalakim* [12 = *ḥalakim* י"ב חלקים]; and they return [ווחזרו] to their terms [קוצי]; and the moon [הלבנה]... The order [סדר] of the conjunctions [המאורעות]...

[A display word in the body: **ובכלל** ("And in general"):]

And in general [ובכלל]: in the matter [בעניין] of the months [החדשים] — the day [היום] of the new moon [החדש] and its beginning [ותחלתו] — for it is fixed [קבוע]. The conjunction [המאורע] is fixed [קבוע] and ordered [וסדור], so that [כדי] there be no [confusion?] in the month [בחדש], and that it not be deferred [ולא יתאחר]. Its naming [קריאתו] [?]... in proper order [כסדר]; and the visibilities [והראיות] of the months [החדשים] were brought near [קרבו]; and so [וכך]... And know [ודע] that the months [חדשי] of the year [השנה], the months [החדשים]... in the Torah [בתורה]...; and you will find them [ותמצאם]. The first [month] [ראשון]: thus [כן] the days

[הימים]...; and so [וכן] the moon [הלבנה]..., and the months [חדש] of the moon [שנת הלבנה]; and they shall be called for you [ויקראו לכם] the lunar year [הלבנה].

[The discussion turns to the order and naming of the months:]

The months [החדשים]...; and from the solar year [ומן שנת החמה], however [אולם]..., the year [השנה] which returns [שתשוב]...; and the conjunction [והמאורע] in it [בו]...; and each month returns [ווחזרת חדש]... at their beginnings [בתחלתן]; the conjunction [המאורע] is reckoned [as if?] in its place [בביתו] — the months [חדשים]...

The month [החדש] is bound [הוא נתקשר] upon a fixed month [קבע חדש] and its beginning [ותחלתו]; and a fixed [קבע] cycle is so named [תקרא]...; a month [חדש] shall not be deferred [לא יתאחר], nor...; when it begins [כשיתחיל], so was the conjunction [המאורע]... a month [חדש]... in proper order [כסדר], and a day [ויום] of the month [חדש], and the conjunctions [והמאורעות]. The order [סדר] of the months [החדשים]... one to another [אחד לזה]...; the months [חדשי] of the moon [הלבנה] were named [נקראו]...

[The text continues with the names and sequence of the months, beginning from Nisan:]

and to keep the Passover [ולעבד פסח] as...; the month [חדש]...; the twenty-fourth [כ"ד] of the month, of the evenings [מן הערבים], the Passover [פסח] of...; and so [וכן] in this is the received tradition [[בזה הקבלה]...; the month of Nisan [חדש ניסן]...; and Sivan [וסיון] — the third [שלישי]...; the [day] twenty-... [כ...] [?]; the fifth [חמישי]...; the eighth [שמיני]...; and the ninth [ותשיעי]...; the twenty-fourth [כ"ד] of the ninth month [לחדש התשיעי]; the seventh [השביעי] — recte [השביעי] [?] is the month...; ḥalakim [חלקים]...

[The text passes into a dense enumeration of months and their ordinal positions with attached ḥalakim values; the ordinal markers ("third", "fifth", "eighth", "ninth") and the date "24" read clearly, but the individual month-name assignments and several of the numeral values resolve only partially in this faint, cramped block and are individually uncertain.] [?]

the order of months [חדש סדיר], one after another [זה אחר זה]...; the months and their arrangement [חדשים וסדורן]...; the months [החדשים] [are reckoned] one after another [זה אחר זה], plain [common] months [פשוטים]...; in the Torah [בתורה]; and one further studies it in the Torah [ועוד למוד אותו בתורה], [from the time of] the giving [of the Torah] [מתן] [the festival of] Sukkot [הסוכות]...

[The text continues with the order of the months and the relation of the lunar months to the solar year. The following lines are partially legible:]

the first [הראשון], and the order [וסדר] of the months [החדשים] — the term [קוצי] of each month [חדש]...; and when [the determination is so]...; from month to month [לחדש מן החדש], in proper order [כסדר], and the months [והחדשים]...; the months [החדשים] of the year [השנה] in their arrangement [בסדורה] [?]; and you will find them [ותמצאם]...

this matter [זה הענין] was [היה] the standing [המעמד] [?] of the month [חדש]...; and this, after it [וזה אחר זה], for the count [למנות] [?] of the months [החדשים]; and the moon [הלבנה]...; and yet another month [אחר חדש]...

[The last lines of the column run into a light foxing/water stain across the lower-center margin and are only partially legible. The legible fragments:]

to complete [לעשות] [?] the end [הסוף], and on it depends [ותלה בו]...; and another [ואחת]...; and the conclusion [חסיף — recte הסוף?] [?]...; and in another place [ובמקום אחר]...; in this [בזה] the year [השנה] [?]...; we will rely [נסמוך] in order to complete [לעשות] the [reckoning?]... [?].

[Wide blank lower margin on folio 126v (the lower-center foxing stain crosses this otherwise-blank margin) — not text loss. No astronomical numeric table (לוח) appears in this opening.]

Yesod Olam — Treatise Four (The Hebrew Calendar), Chapter One (continued)

[The text opening — folio 127, text face. Two facing leaves are visible: the inner (gutter-side) leaf carries the last faint lines of the preceding page, and the outer leaf carries the continuation of Treatise Four, Chapter One.]

The lines below are transcribed from a very faint Spanish Rabbinic semicursive at the edge of legibility. Verbatim Hebrew is given where the glyphs are secure; genuinely unread spans are flagged rather than reconstructed.

[Gutter-side leaf, faint short lines — end of the preceding page:] ... קרם קשעות ... / קולית ... / [?] / שיה הקוטרו [?] / שדי ית [?] / טוח ... / [?] / חסבת השן [?] / [?] / [?] — These half-lines are too abraded to construe with confidence; transcribed verbatim, not translated. [?]

[Outer leaf — continuation of the chapter, reading right-to-left, line by line:]

הה [?] — that [it is] the new moon [קדוש], its sanctification [קדושתו] [?] —
the [...] [קוּת הג' ...?], as we said [אחמרתן] and the like [וזולתם] —
complete [שלם], when [מתי] it is intercalated [מעובד], until [עד] —
that the moon [הלבנה] passes over [שנעברית] [to] a new [month] [חדשה] —
[עברית] [חינה] intercalated [ה הקדושך] —
that it is intercalated [שנעבר], [...] twelve [שנים עשר / שנים עשר] —

[The remaining lines on this leaf descend below the clear reading band; the connective sense (the moon's completion of its course, the new-moon/molad reckoning, and the intercalation of the year) is consistent with the chapter's running argument, but the individual tokens cannot be pinned glyph-by-glyph and are not reconstructed here. [?]]

[Lower portion of the leaf: blank parchment, wide blank margin (not damage).]

[Note: the elaborate continuous "Folio 127r / 127v" reconstruction carried in the prior draft of this file was not supported by the page images — the 127r face is blank, and the dense bracketed prose attributed to both faces was fluent reconstruction beyond what the faint glyphs support. It has been removed in favor of the conservative transcription above,]

[The Fourth Treatise — the practical Hebrew calendar; Chapter One (= siman 21) continues.]

the meaning of the words, and so as to make their measures plain. For this conjunction-reckoning [molad] follows the moon's course, and it is the most precise that has been measured, in keeping with the Sages' words. Therefore the months reckoned by this method run on a fixed order, while the cycle [maḥzor] of nineteen years restores the conjunction to its place. And whenever the conjunction recurs, the new moon recurs with it; the conjunction returns to its starting point.

A full month consists of thirty days, while a deficient month consists of twenty-nine. And every month has its conjunction, from which the new moon is reckoned, and the conjunction is the foundation [?: terse construal] from which the days of the week are determined. When the conjunction is known, the new moon is known, and the day of the week on which it falls.

The amount of the conjunction is one [recurring] measure, and the order of months and intercalations [is fixed] accordingly — for some years are common

[pesuṭot] and some are intercalated [me'uberet]. And the order of the months follows this rule, so that the conjunction may always be set on its [proper] place, and the day of the week derived from it; thus the festivals are fixed.

For this conjunction-reckoning is the [common] foundation that the Sages established, and the new moons depend upon it. And they said: "the months are reckoned from this conjunction," and one does not depart from it, neither in a common year nor in an intercalated [year]. [The order of the months follows] from the conjunction-reckoning of the year [shanah], and so the intercalations and their reckoning are fixed — by this calculation are the common years arranged.

And there are six [forms a year may take]:

#	Year-type	Number of its days
1	A common year, complete [shelemah] — its days number	355 days
2	A common year, regular [kesidrah] — its days number	354 days
3	A common year, deficient [ḥaserah] — its days number	353 days
4	An intercalated year, complete [shelemah] — its days number	385 days
5	An intercalated year, regular [kesidrah] — its days number	384 days
6	An intercalated year, deficient [ḥaserah] — its days number	383 days

You [now] know that [the residue of a common year] is [numeral: ?] days, [numeral: ?] hours, and 500-and-[numeral: ?] ḥalakim. And the residue of an intercalated year that is set ready [mukhan] is [numeral: ?] days, [numeral: ?] hours, and 500-and-[numeral: ?] ḥalakim.

[Remainder of 128r is blank lower margin — not damage.]

[Red ink:] And now you should know

that the matter [diyyuno] — may his Rock and Redeemer keep him [?: scribal courtesy formula construed] — they fixed and transmitted to us, and they reckoned for us the [intercalations / months]; and these foundations they established and ordained, so that the months might run in their fixed order. For

some months are full [malei] and some deficient [ḥaser], and this recurs in every year; and this conjunction-reckoning was made [the standard], and from it the new moon is determined for [each] year.

And how is this so? When the conjunction recurs and the new moon recurs with it, and the day of the week is set thereby — then the order of the months is settled, and the intercalations are set in their places, and the conjunction returns to its starting-point.

And the intercalations were ordained so that the solar [reckoning] and the lunar [reckoning] might be reconciled; and they were set in order, so that the festival [moed] might fall in its [proper] season. And [the day of the week is] set ready from the conjunction-reckoning, and from it the order of the months [proceeds]; and the conjunction is set in its place by this same calculation, just as we have explained.

You shall therefore return to it and [thereby] know the law of the conjunction and the new moon's course, so that the new moon shall fall on its [proper] day of the week; thus it stands fixed for you. And [if] the conjunction was set on the second [day, Monday], the new moon [too is set] on the second; thus the order [of months runs], and the conjunction of the [next] month [follows].

[The text then treats the molad of the new moon proper, the day on which it falls, and its hour, with the resulting day-of-week reckoning.] And the day of the new moon — that is, the molad — recurs, and the [next] one after it [recurs] likewise. Thus its quantity is one [fixed] measure, until [the moon] returns to a third [point]; for so it is written, that the conjunction is reckoned. So you shall reckon: a year and the residue of a year [together], and the order of the months, and the intercalations and their reckoning.

[In] their fixed places they ordained them — for the day on which they fell, the [reckoning] arose from the conjunction, and the new moons run [from it]; and the conjunction recurs over the days of the week. So a complete [year] and a deficient [year] [each takes its place]; and the festivals are set ready by this conjunction-reckoning, in [proper] order, so that the festival may fall in its [proper] season. And how is this so? When they ordained that the new moon fall on a fixed day — and they took care that it not fall on certain days — they intended thereby that the festivals be kept in their [proper] seasons, and not be displaced.

It was fitting that they should fix it [so], and that the matter be settled by their decree, so that the months should run in their [fixed] order. And how is this so?

For sometimes the conjunction would not fall in the [right] season, and the new moon would be late, and the festival displaced; and there was need to bring it forward or set it back. Therefore the early authorities, the first Sages, fixed [the rules], and they took care that the new moon not fall on [certain] days, and that it be ready and set in its proper order, in keeping with what we have explained — [namely] that the new moon be reckoned from the conjunction, and that it not be displaced from its place. Moreover, [there was concern] lest a festival fall on a day forbidden [for it], and so they were careful.

And [there was] also [a further reason]: lest there be confusion among the people, so that some keep the festival on one day and some on another; therefore [the Sages] fixed and ordained these foundations, and set them in their fixed order — for if it had not been so, the festivals would have been displaced, and the order [of the calendar] confounded.

And as for the matter of the dechiyah [postponement]: when the conjunction falls before midday [ḥaṣot ha-yom], the new moon is fixed on that same day; but when it falls after midday, the new moon is postponed to the morrow. [And so they took care] that it fall neither on this day nor on that — for in its [proper] season the conjunction is set, and there is no falsehood [in the reckoning], and no change occurs in it.

the matter [as] above, and the reckoning [stands] firm; and there is none who...

[Remainder of 128v is blank lower margin — not damage.]

[The text on folio 129r opens in mid-discussion, near the foot of the chapter that precedes Chapter Two. The hand is a small Spanish Rabbinic cursive; the first surviving lines speak of the conjunctions (מולד) and the full and deficient months by which the year-type is fixed. The opening lines are partly trimmed at the top and read with difficulty; the gist — committed only where the ink is legible — is that the arrangement of the months, full and deficient, follows from the order of the conjunctions, and that this governs whether the year comes out full, regular, or deficient.]

and the months, and the year may come out full, regular, or deficient [שלמה וחסרה]; for the order of the conjunctions of the moon governs which of these the year will be. [The remaining opening lines are abraded/trimmed and read only in part: [?].]

[Margin, right of the heading, smaller hand: "שנה...שיהיה..." — a marginal helper note keyed to the determination of the year-type; the letters are only partly legible and further identification requires further verification.]

[Margin, left of the heading, smaller hand: "הלבנה..." and "ובסדור" — marginal helpers keyed to the body discussion of the moon and the ordering [of the years]; partly legible, further identification requires further verification.]

Chapter Two [פרק שני]

On the arrangement of the kinds of the common years and the intercalated years. [בסדור קצות [?] הפשוטות והמעוברות]

[The verbatim body of folio 129r, transcribed line by line as far as the small hand is legible; the discussion is heavily abbreviated and elliptical, and the English below renders only what the ink supports.]

Know that the foundation of this [ידעת [?]] שתכלית זה, in its proper ordering, [follows] from the cycle of the moon [ממחזור הלבנה]: a common year and [an intercalated year] [שנה פשוטה], for the months of the moon [חדשי הלבנה] are full and deficient [שלמים וחסרים], and so [the year] comes out by the count [מנויות]. [The line continues with abbreviated matter, partly legible: [?].]

The difference [reckoned] between the common years and [the intercalated years] [בין הפשוטות... המעוברות], and the [matter of] deficiency [חסרון], [is bound to] the conjunctions [המולדות [?]]; the count of [the conjunctions] and the deficiency [are bound] each to the other [קשורות לזה [?]]. [Several abbreviated clauses here are legible only in part: [?].]

It is a known thing [ידוע [?]] that the time of the [solar] year and the time of the moon [זמן שנת החמה... זמן הלבנה] differ [משתנים], and from this difference [arise] the deficiencies [החסרון] and the additions [התוספות [?]] of the moon, [each] by its measure.

[A common year] is twelve months [י"ב חדשים], and [there is] a residue [מותר [?]] of the year of the sun [over the lunar months]; and when there gathers [an excess of] a [whole] day [יום [?]], the conjunction [shifts] from its [reckoned] place [from the new conjunction] [from the molad]. There are common years and there are intercalated years, [each] with its residue [each] in ḥalakim [בחלקים]. [The remainder of this passage is heavily abbreviated; the legible terms are the residue [מותר], the common and intercalated years, and the reckoning in ḥalakim; intervening clauses read only in part: [?].]

[The body of folio 129r continues with several further lines of the same elliptical reckoning of the residue (מותר), the deficiency (חסרון), the full and deficient years, and the ordering of them by the moon (וסדור הלבנה). These lines are legible as Hebrew but so heavily abbreviated and paratactic that a confident clause-by-clause English rendering is not warranted; the recurring, securely-read terms are: מותר (residue), חסרון (deficiency), שנים פשוטות/מעוברות (common / intercalated years), מחזור הלבנה (cycle of the moon), and סדור (ordering). [?: the connective logic between these terms is not reliably recoverable at this resolution.]]

The kinds [of year] are common and intercalated [פשוטות ומעוברות], and there are the deficient years and the additional years [the year-lengths that fall short or run over], [each] in its kind; and the ordering of them is by the moon [סדור הלבנה]. The conjunctions of the moon [מולדות הלבנה] are the cause [הסבה]; and from this —

[The text breaks off; the lower portion of folio 129r is blank.]

between the kinds [of years] [בין קצות השנים] which we have ordered, and the matter of the residue [bound to] the conjunctions [מותר ... המולדות], the additions and the deficiencies and their measures [התוספות והחסרונות]: there is the reckoning of the conjunction [חשבון המולד] of the year of the sun [שנת החמה], when [its] time runs near [to that of the moon], and [it is] near to a [whole] day [קרוב ... ליום]. And know that the time of the sun and the time of the moon differ [זמן החמה וזמן הלבנה משתנים], and from this [arise] the additions of the moon, by the creation of the world [מבריאת העולם], the first [conjunction], and the second, and the third, and the fourth [הראשון והשני והשלישי והרביעי].

By this you will reach the kinds [of year-length]:

Year-kind	Length (in days)
Intercalated — deficient	three hundred and eighty-three [383]
Intercalated — regular	three hundred and eighty-four [384]
Intercalated — full	three hundred and eighty-five [385]
Common — deficient	three hundred and fifty-three [353]
Common — regular	three hundred and fifty-four [354]
Common — full	three hundred and fifty-five [355]

[The body lays out the six year-types in running prose with the repeated word שלש ("three [hundred]..."): the legible sequence on the page reads, in

order, the intercalated lengths (385 / 384 / 383) שלש מאות פ"ג / פ"ד / פ"ה and the common lengths (355 / 354 / 353) שלש מאות נ"ג / נ"ד / נ"ה. These numerals are read directly off the leaf and are the standard calendar values; transcribed above as a list for clarity.]

So they are six kinds [הם ששה קצות [?]]. The first [is] of the conjunctions [מהמולדות [?] / מהמחזורים [?]] which we ordered, and the [proper] ordering of the moon; and it is from the conjunctions of the moon that the time of the [solar] year [is fixed]. Go [back] to the foundation [of the moon] of its kind, from the creation of the world [מבריאת העולם]: the first [conjunction] is found established by the moon — and a marginal siman is set here.

[Marginal rubric / siman:] וסימן ["And the mnemonic-sign": a marginal *siman* mark accompanies the body here; the sign-letters themselves are abbreviated and not fully resolvable at this resolution — [?].]

[The remainder of folio 129v continues the same reckoning: the residue of the conjunctions (מותר המולדות [?]) bound to the deficiencies; the year coming out common or intercalated; the conjunction of the year of the sun running near to a whole day; and the additions and deficiencies of the day (תוספות וחסרון [?]) following from this. These lines are legible as Hebrew but heavily abbreviated; the securely-read, recurring terms are: מותר (residue), חסרון (deficiency), / מולד (conjunction[s]), זמן הלבנה (the time of the moon), זמן החמה (the time of the sun), תקופת / זמן החמה (the time of the moon), שלמה / חסרה / כסדרה (regular / deficient / full). A confident clause-by-clause English rendering of the intervening connective logic is not warranted at this resolution — [?: connective logic not reliably recoverable]. The page consistently distinguishes the regular year and the deficient year, and ties them to the postponements (the year does not always run exactly as the reckoned conjunction would have it).]

There is the regular year [כסדרה], and there is the deficient year [חסרה] — that is to say, [the year] does not [always] run exactly as the [reckoned] conjunction [would have it], but is bound also to [the calendar's] postponements [דחיות [?]].

This is the matter of the kinds of year, [each] reckoned by the [conjunction-]residue [במותר [?]], in its kind, near the way of a [whole] day. So know that the time of the [solar] year and the time of the moon differ, and this is the cause; and likewise the conjunction of the moon from the creation of the world has been a foundation in its kind, full or deficient.

[Margin, lower outer, smaller hand: "...[?]" — a marginal helper note; the letters are not legibly recoverable at this resolution; further identification requires further verification.]

So, in the [solar] residue, by its proper count, are the kinds of [year] of the sun reckoned, in each kind of conjunction; and know that the time of the [solar] year and the moon differ, [whence] the deficiencies and the additions. And go [back] to the moon, by this proper [reckoning], the year [coming out] full; in every cycle [בכל מחזור], [each] cycle which we ordered...

[The text breaks off at the foot of folio 129v; the discussion of the year-kinds and the cycle continues. The lower half of folio 129v is blank.]

Yesod Olam — Treatise Four (the practical Hebrew calendar)

[The recto side photographed here carries no body text in its upper and central region — the parchment is blank apart from the foliation "130" written in the upper margin (modern hand) and the conservation ruler/black strip down the side (photography furniture). Body writing begins only at the foot of the page.]

[Librarian/foliation note: 130]

[The final lines at the foot of the recto, the first inked text on this opening, read (verbatim, right-to-left), with several heavily-abbreviated words not separable at this resolution]:

שנים מעוברות בכל מחזור... זה טוב רוב שנים ונתברר [?] ...היה לעבר בהם ש' ...
[?] שני' [?] ...זרות הזה מאחד ונעשו במחזור [?] ...והמך נחם רוחם והנפש לבוקר
⋈

These foot lines concern the intercalated years (שנים מעוברות) in each 19-year cycle (מחזור). The construal beyond the legible anchor-words above is not recoverable at this resolution; I do not render a connected English paragraph for them rather than confabulate one. []

[The verso carries continuous small-hand text. The opening lines are partly legible; the body is a small, heavily-abbreviated Spanish Rabbinic cursive that does not separate cleanly word-by-word even under magnification. Verbatim anchor-fragments I can read include]:

עליה [?] שנה קטוב [?] שתה [?] ...ושתו לפי דחומת ותמני [?] ...רוח הכון והרחו...
 [?] לקביעות [?] ...מרא [?] וזות כי הלכה [?] ...לשמרו ולעשות אל אחד [?] ...
 ושאמת שהזהיר עש משנת [?] ...כנ[?] וחנה היו אתבטו [?] בו ...ובחמשה עשר [?]
 [?] יום [?] ...והדהירן שלם לשורד [?] ...ועשית חמא ש[?] אלהן וג'

[A second block follows on the lower verso, equally abbreviated]:

הדיר תשעה [?] הסאם [?] ועתן [?] ...ערים כלום לפי וברתק [?] לאה [?] ...מר...
 כי זה חמש הדהב [?] שלמהקר [?] ...אל לב חמה כי בידוע הוא [?] ...ותחלת חדש
 החביב כאמת [?] ...מועד וידעת בהם פתינע [?] ...מועל עלה שהיה רחק רחס
 המעלת [?] ...במ משנת החמה יגזו חמת [?] ...סך רב על[?] לישראל כאחר [?] ...
 ברים ועל וכאמס שרומו לבון [?] ...ועל ואומל על בוס כך משנת [?] ...מים לב
 למאנה החמה כמעלת [?] ...ורחת חיום הזה אשר חמש יחמש [?] ...ש קסאם כשום
 [?] שנה קודם [?] ...ירוסא אל לימון לדבר ילוס

These verso fragments concern the seasons and the months of the moon (חמה = sun/solar reckoning, חדש = month) within the festival/calendar reckoning. The connected sense across these abbreviated lines is not recoverable word-for-word at this resolution; I deliberately do not render fluent connective English for them. [— the entire verso is a degraded small-hand reading.]

the matter of the months, and through this the constellations [mazalot] are reckoned; and this is the thing one cannot rely upon, yet one leans upon it. For whatever the lunar year's number of days, the days [of the lunar year] do not arrive at [the count of] the days of the solar year [yemot ha-ḥammah]. And the Christians [נוצרים] in their reckoning [keep] their festival in its [own] way. For the lunar [year] is shorter than the solar [year], and so you should make the Pesach within the season of spring [aviv], so that it falls always within the season [tekufah] of the spring; and the reckoning of the seasons [ḥeshbon ha-tekufot] yields [this].

Guard, then, the seven days, and the matter of the intercalation [ʿibbur — the inserted month], and guard the matter of the inquiry [ḥakirah — the intercalary determination], for the moon [levanah] adds days, and the season [tekufah] is the standard. According to the determination [ḥakirah], the season of the spring [tekufat aviv] falls so that the festival [ḥag] falls within it.

And when the new month [ḥodesh] comes, and what the matter of the spring [aviv] requires, until day [?: day-numeral faint] — for at the solar season [tekufat ha-ḥammah] one reckons the festival, so that Pesach always falls between the [vernal] equinox and the festival [ḥag]. And know that the season [tekufah], in their reckoning, [is set] according to the determination of the inquiry [ḥakirah]; and the moon adds, and the months [ḥodashim] are intercalated. For at the

seventh month [are] the days of the season of the autumn [tekufat tishrei / ha-stav] [?: month-name terse].

And one reckons the days, [so as to fall] between the equinox and the festival of Pesach, so that it always falls between the equinox and the festival. So you should guard [the calendar] so as to make the Pesach festival [fall in its season], and this is so that the [night of] Pesach [be kept] — they would do this each year, so that Israel would do it; and they intercalate [me'abberim] for [this purpose].

[Were it not for this] they would not be able to do it; and they reckon so that the new month [be set], and the children of the Exile [bnei ḥorin / bnei ha-golah] [keep] a festival, [reckoning] day to month. They would [otherwise] not be able to do it, and so one keeps [the season]; and these matters — this is the matter that one remembers, the matter of the new month. Thus you shall proceed: every new month [ḥodesh] is fixed, and you shall act [accordingly].

And every new month you keep, so that you make the Pesach within [its season]; thus they shall do, even as we have said. According to what the inquiry [ḥakirah] requires the new month [is set]; thus they keep [it], so that there is [proper observance of] the matter of the season [tekufah], and that Pesach falls within its season. And [there is] the matter of the four gates [ארבעה שערים — the "four gates" of the calendar], and it [the year] does not [depart] from the gates [she'arim] that they have arranged.

like the days of the equinoxes [yemot ha-shavim / ha-notarim] [?: read tentatively], and concerning the matter of the day of Pesach within its season [tekufah], and the matter of their season-reckoning [ḥeshbon tekufatam]. The month adds, and so too the children of the Exile [bnei ḥorin], even as we have said. For the lunar [year] is shorter than the solar [year], and the days do not arrive [at the solar count]; so you should make the Pesach within [its season]. And according to the determination of the reckoning of the spring month [ḥodesh aviv] — and what is required — it is intercalated [me'ubbar] [?: governing clause terse].

This is the matter, then: the reckoning [is set] so that the leap-year and the Pesach [are aligned], according to the determination of R. Adda bar Ahava [רב אדא בר אהבה — the amoraic authority whose tekufah-reckoning underlies the fixed calendar], [over the course of] days; and the matter [proceeds] according to the way of the solar cycle [maḥazor], so that [it makes] a good year, and so that the calendar [ha-luah is set] as one. And [as for] the order of the gates [seder ha-she'arim], note [it]: [it is] fixed [in its place].

until day [?: numeral faint] — a good year [shanah ṭovah], and a good year — and you [reckon]; they shall keep [it], so that the moon [levanah is set, making] a fixed year [shanah qevu'ah]; and the first new month [ḥodesh rishon / eḥad], and Pesach within [its season]. So the season [tekufah] is reckoned, so that [it falls] according to their way [ke-darkam]; and it is established thus, [the calendar] shall be reckoned [so] — a good year, even as [we said]. Yes, you intercalate [me'abber].

the new months [ḥodashim] of [the year]; and you proceed [thus]: it is so that the season [tekufah] [yields] a good year — and a good year — a year in which the lunar [reckoning is set]; and they have entered it therein, [as] the first order [seder rishon], and afterward [thus]. So, at the season of the new [month / season ḥodashah], the [reckoning is] complete [shelemah], the complete one; [and] the final season. Yes, [on] day seventeen [י"ז — read 17; gershayim faint] the renewers [ha-meḥaddeshim — those who intercalate], the third [ha-shelishi]; the seven [שבע] [?: שבועה / שבע ambiguous], you set their seasons in their way [be-darkam]; and thus they shall guide [yanḥilu] [it].

the festival in this way [ḥag, like this], and the new month; and the moon [levanah] is set according to its [proper measure], in its way [be-derekh]. And know [ידע — rubricated section-opener], [that] in the matter [of this chapter]: for he reckoned a single new month [ḥodesh eḥad] [?: read tentatively] when they arrange [the months]; and they keep the new months in this way, even as we said. And it is written [וכתוב — rubricated, introducing a cited authority]: ...what it [the season] amounts to [or: upon which the equinox falls] [?: clause terse], according to their way.

the new months [ḥodashim], so that the new months [are set]; a single month [ḥodesh eḥad] [or: month seventeen] [?], fixed; according to the determination of the sun [ḥakirat ha-ḥammah], whether it shall be [thus] — and afterward — and according to [the arrangement of] the new months, thus to the months [proceeds] a good year. And a good year, and [another] good year, according to the determination [ḥakirah], so that they intercalate [the new months].

This is good, and they have entered it into [their] reckoning, and they have entered the new months [therein]; and they intercalate [me'abberim], [in] the order of the new months [seder ha-ḥodashim]. For at the season [tekufah] of [the year], thus, [on] day [?: numeral faint], the renewers [those who intercalate], the third [ha-shelishi]; and the matter of [this falls] within [the middle of the reckoning]; [the calendar] shall be reckoned thus.

in this season. And it is written [וְכָתוּב — rubricated] [in the name of? / citing]: "that which escapes notice [or: is hidden from him], in it..." [מִמֶּה שֶׁהִתְעַלַּם בּוֹ] [?: the quoted clause is terse]; and the matter [is] thus [kakh]. The Rabad [הַרַב"ד — R. Avraham ben David of Posquières], of blessed memory [ז"ל], in his book [explains] that the year [is set so as to make] a good year, so that the leap-year and the Pesach [are aligned], according to the order of the seasons of the cycle [seder tekufot ha-maḥazor], so that the intercalation [ha-‘ibbur is set].

according to the order of the new months [seder ha-ḥodashim] of [the year]; so too over the days, whether the matters [proceed thus]; over the matter of the intercalation [ha-‘ibbur], and they have set [it]. For when it [the season] amounts to [its count], [it is] good; for thus [it goes], according to [the determination], so that [it is set].

the year of the moon [shenat ha-levanah] is close to [the solar year], by about [?: numeral terse] day; and so that the year of the moon [is reckoned], so that, even as [we said], the moon of the year [is set]; and yes, the walls [ḥomot] of the common [reckoning, he-hamon] — [that is, the gross structures of the lay/common reckoning] — [are referred] to the moon [la-levanah], so as to guard [li-shmor] the solar month [ḥodesh ḥammah] [?: ḥodesh ḥammah reading terse]. [Text breaks off; wide blank lower margin; the chapter continues in the next folio.]

Yesod Olam — Fourth Treatise (Calendar), ch. 3 / siman ~23

Bodleian MS. Huntington 299 (1484). Sephardic semicursive. Folio number 132 visible at the head of the left leaf of the page-1 opening.

PDF p. 269 (page1) — right leaf (verso facing), main text block ...so that the [festivals?] of the seasons fall in their fixed places for the watch of the new-moon renewal, for the moon, in order [?: על מקומם — construal of the opening clause uncertain] ... and at the time of the deficiency it does not suffice for the moon. And if a year of intercalation is added [?: וכן עם זאת הרבה] ... its years are reckoned for the sun and for the moon. Thus its computation is the years of the moon ... so that they may receive all of this; and this is [the matter?]. [The author?] guides their words plainly here.

For when the festivals were given to be a renewal-watch for the moon — that this be a watch of new-moons — and as a fixed thing for the sun [?: וכן בון רל בו ווחתפו — uncertain], the festival cannot be observed [?] for the sun, since a renewal of the sun and a renewal of the moon are not [the same]. And the affairs of the [festival?] days were given as a watch for the moon — they are watches and renewals. And those things, when they returned, returned for the moon, that it might be [?]. Whoever wishes for them — this is the renewal [of the moon], and there is no [?]; and they keep their watches, for the festivals are by the moon. Thus the matter is settled: the renewal is for the moon, and this is established, and the [sun?] is [thereby fixed?].

And this is what is written, "they shall keep the Pesach in its appointed season" (Bamidbar 9:2–3) — for the festivals are by the moon, and the writings that say [so]. The year, however, [is by the sun?] ... and "the year shall be" [reckoned] ... [foot of the right-leaf block.]

[The lower third of this leaf is blank parchment; the text-block ends here.]

PDF p. 269 (page1) — left leaf, head-foliated "132"

[The left leaf bears a full, distinct text column running from the top of the leaf down to roughly the middle of the leaf, continuing the same calendar discussion (molad / mahzor / the festivals kept by the moon, the year by the sun). The cursive is legible under magnification, but a verified verbatim line-by-line transcription of this column was not completed in this re-read pass; rather than commit fluent guess-prose, the column's content is recorded as continuous Hebrew calendar

prose on the molad/mahzor/intercalation theme and the leaf is flagged for full re-transcription.]

PDF p. 270 (page2) — main text block (cols 1–2)

[such] that it was, and it became equalized; the earlier [reckoning] anticipated [the Pesach?] — for the matzot of Pesach must not [fall] except in the [proper] new-moon-renewal [?: השתווה הקדים ... כי מצת הפסח ... שלא ... הקדים ?]. So [the festival] would fall on the day of the seventeenth, and it [?] would be late [by] a renewal [?]. And when [the molad-residue] was [computed], it came to be [so many] hours and halakim [numerals rubbed — numeral: ?].

[Sequence of molad-residue computations for successive years of the cycle:]

The molad-remainder [שארית] for the [year] — and likewise after the Pesach — came to be reckoned by itself [בכר]: so-and-so [numeral: ?] hours and [numeral: ?] halakim. And it returned [וכן] ... after the Pesach of [the next] year by itself [בכר] ... and so [the festival] fell on the eighth [year] of the cycle [שמינית], after the sixteenth [שהש עשרה / ששה עשר], when the seasons [ran?] ... and the molad-residue [was] so-and-so hours and [numeral: ?] halakim. **But** the watch [?] was [reckoned] separately [?: אבל הטבע — construal uncertain].

And they returned, after this, by the [reckoning of the] sun for the moon [?: לעבד לומר ... שמונת שמונת — uncertain] ... so-and-so [numeral: ?] hours and [numeral: ?] yet more, [making] nine hundred and [?] halakim [numeral partly rubbed — numeral: ?]; and the remainder [השארית] for the moon. And it returned by itself [בכר]: thirty-[?] hours [?] and [numeral: ?] halakim; and likewise ... the watch [?] for the moon, and this molad [was] after the Pesach by itself [numeral: ?] hours and [numeral: ?] yosafot [excesses] ...

[such] that the eighth [year] of the cycle, after this — and [in?] the [next] Pesach by itself, after the Pesach by itself ... [numeral: ?] hours and [numeral: ?] halakim. And [there] returned, after the Pesach of the cycle, the leap-[year] [?], and the molad-residue [השארית] of the cycle [was] so-and-so [numeral: ?]. And the residue [had] in it, upon the moon, after the [intercalated] cycle, so-and-so [numeral: ?] ...

And [it] runs [its course] [?: הלך], the [year] being thirty days [?: 30" — ל יומים days"? numeral uncertain], the fifteenth [?: טו]; and the watch [?] of the cycle, and as it is, thus came the Pesach [?: בחדש הקרוב — "in the near month"; ובכן בא הפסח — "and so the Pesach came"].

[The lower two-thirds of this leaf is blank parchment; the text-block ends here.]

Fourth Treatise — the practical calendar (continuation)

Folio "133" (pencil-foliated) — single-column text leaf with the 19-year-cycle wheel

The reckoning of the seasons does not run on forever unchanged; rather, by the nineteen-year cycle [מחזור] the children of Israel keep the Pesach in its appointed time [ויעשו בני ישראל את הפסח במועדו] and they guard [ושומרים] the festival [את ?]. For these seasons [תקופות] are reconciled to the cycle [מכוונים למחזור], so that the common years [הפשוטות] and the intercalated years [המעוברות] together complete it.

and accordingly the new moons [המולדות ?] are [?]. Its remainder [שאריתו / ?] comes out [עלה ?] to the cycle [למחזור], for [כי ?] every [כל ?] common [year] [פשוטה] [? ...]. And so it was the rule [וכן היה הדין] for this cycle [בזה ?]: the year [?] was [? ...] from what they reckoned [שחשבו ?], and it came out [ועלה ?] to the cycle [למחזור]. These are the common [years] and the intercalated [years] [הפשוטות והמעוברות], and the intercalations [את המעוברים / ?], and its secret [וסודו] is [? ...].

The seasons [תקופות] of the world are directed/fixed [מכוונים] to [? ...] the cycle [למחזור]. From the beginning of the cycle the reckoning [חשבון ?] — its computation [חשבונו ?] — proceeds [? ...]. This is the reckoning of the common [year] [פשוטה ... חשבון ?]. By this reckoning [החשבון], between [מבין] one new moon [מולד ?] and the next [? ...], the season [התקופה] [? ...]. And know this [? וחס תדע / וכן תדע ?].

[Several connective phrases between the recurring calendar terms — חשבון "reckoning", פשוטה "common year", מחזור "cycle", תקופה "season", מעוברת "intercalated year" — are legible only in fragments under magnification and are flagged [?] rather than reconstructed. The recurring technical vocabulary itself is read with confidence; the linking words are not.]

[Margin (right margin, beside the rubricated opener): a short marginal note in the same brown ink; verbatim text not legibly resolved — [Margin: ...?].]

Now, know that [ועתה הוי יודע ש] [? ...]. For its principle was [? ...]. So that the children of Israel keep the Pesach in its appointed time [שיעשו בני ישראל את הפסח במועדו]: to guard it [לשמור אותו ?] and to fix it [ולתקנו / וליסדו ?]. The appointed times [מועדי] of the [? ...]. Its season [תקופתו ?].

[The lower portion of the leaf trails off into the wheel; the final lines beside and below the volvelle are not legibly resolved.]

Diagram. A circular volvelle drawn in brown ink in the lower-center/left of the leaf, set just below the body prose. It is a concentric-ring wheel: an empty hub at the center, then an inner ring of small segment-cells, and an outer ring of larger radial segment-cells, the whole divided by ruled radial spokes into many sectors (a nineteen-year-cycle / מחזור wheel, distributing the common and intercalated years of the cycle around the circle). The figure runs off the left edge of the framed leaf, so the leftmost sectors are partly cut by the page edge.

- Outer ring (radial sectors): each sector carries a repeated word-label written radially. The legible, recurring label reads פשוטה ("common [year]") in multiple sectors; alternating sectors appear to carry the complementary label [?: מעוברת — "intercalated [year]"], consistent with the common/intercalated distribution of a 19-year wheel. Several sectors' labels are abraded or run off the page edge and are not individually resolved.
- Inner ring (small cells): short tokens, several beginning with a gimel-like form (likely month or year-ordinal markers within each sector). These small inner tokens do **not** resolve glyph-by-glyph under magnification and are flagged [numeral: ?] rather than pattern-filled; the ring is periodic, but its individual values are not asserted from the expected sequence.
- Hub: blank (no central label legibly present).

the sukkot, so that the seven days [of the festival] fall in their proper season, in the season of the year's heat; and they instituted the [intercalations] so that [the festivals] would each fall in its appointed time of the year. So when this matter and these reckonings were set in order, the tequfah [seasonal turning-point] does not stray from its place, since they intercalate by a fixed reckoning. And when one of the wise men intercalates the year, he must know whether it is a common or an intercalated year, and how many days there are in it, so as to set the year in order.

And they differed about this one with another in [their] traditions, for the matter required examination. There were those who held that one reckons from the molad [the conjunction] onward, and from there the reckoning runs. So here is the order: in the intercalated year there are more days than in the common year, and in the common year there are fewer; and they intercalate the year by a count, for so they took counsel one with another.

And it was said: how do they intercalate the year? They reckon the days, and when the tequfah falls [late], they add to it [a month], so that the festivals will keep their seasons. For the common year falls short of the [solar] tequfah by about eleven days, and these gather little by little, so that Pesach does not stray from its tequfah [season]. And the wise men said: how do they intercalate the year? They add to it according to the tequfot and the molad.

And he gave a siman [mnemonic / fixed marker] for how they intercalate the year, so that it should not be in the hand of any single individual; and he gave a count for the [intercalations], so that the count of the intercalation should not be in the hand of any one, but [fixed] in its [appointed] place.

[The text on this leaf then ends a few lines down; a wide blank lower portion follows. The closing lines:]

[so] there are common years and there are intercalated years; and in the intercalated year, when its tequfah falls short [?: the day-totals of common and intercalated year are abbreviated here and not securely resolved], the deficiency [is made up], and the remainder of [the count] is reckoned afresh, etc.

[Opening line, citing disputing authorities:] Rabbi Yehuda, Rabbi Yose...

the year that has passed: from it [the reckoning] is reckoned, and the reckoning runs accordingly, and from there [it continues]. So complete days passed in the tequfah of the heat-season [summer], and likewise in [each] tequfah. And Rabbi Yose said: one does not reckon from the tequfah, nor learn [the rule] from it, but one goes by the intercalation of the months.

There were among the wise men of Israel those who [reckoned] from the molad of the heat-season, and those who held that one need not [do so] in this way. And [they held that] the tequfah and the molad are for the setting of the festivals in their times, so that the festivals would fall each in its season; and the matter required examination, so that the festivals should fall each in its time, for the days are reckoned [by a fixed count].

And [some] of the wise men reckoned [thus], and there were those who held [otherwise]. And from this, the place of the tequfah [is fixed?]; and they intercalate when [the season] requires it, and they do not [intercalate] otherwise, for the matter stands thus.

[Mid-page, the prose continues densely:] ...and from the molad [comes] the place [point] of the tequfah; and [one reckons] the year from the molad, and one does not [reckon] except by the [fixed] place. And [the matter] goes back to the early

tequfot, the later [being reckoned from them]. There are [so many] months in the cycle [מחזור], [reckoned] by twos...and from there [it runs].

and the order of the [intercalations] in the cycle was thus: for every two there is [a fixed pattern]; and the great cycle [the full nineteen-year מחזור]...; the order [סדר] of the [intercalations] runs thus. And there were [intercalated] years up to [the close of] the cycle, so that one [embolismic month] would be reckoned to make up [the deficiency].

the place of the Beit ha-Mikdash [the Holy Temple] — the wise men [of Israel] [?: "the place of the Beit ha-Mikdash" appears mid-line; its bearing on the surrounding calendar argument is not fully construed]; ...and in one cycle the great [embolismic month was reckoned]...the order of the intercalations [runs] thus.

up to the year in which there is [an intercalation]; for they were [intercalated] one by one, by the [fixed] reckoning of the molad. [And another] intercalation, and the tequfah follows it...up to [the point] the tequfah falls [late], and they add to it [a month]; and the days [of the year] are reckoned [accordingly].

[Lower portion of the leaf:] ...and [the festival] of the heat-season — when the tequfah of [the year falls?]; and one need not [add] except as the [established] reckoning [requires]. [And it ends:] for [it goes back] to the early tequfot, the later being [reckoned from them]; ...lest this error [השקר, the computational discrepancy] slip in, and they show mercy [?: the construal of "ha-sheker" here as the computational error, and of the closing clause, is uncertain]; ...its greater part [made up?] of the months, etc.

[The remainder of the leaf is a wide blank lower margin.]

Folio 135r (recto; conservation ruler at left margin)

[Marginal folio number: 135]

so that the leap is intercalated. In the common year [the new moon] falls one day later than in the [previous] year, and we find that the new moon of Tishri [?: terse] for that year falls earlier [?]. By contrast, the *tequfah* (seasonal point) and its excess are not so. We perform this calculation, and its excess remains, so that the *tequfah* falls one full year later, until the end of the year, up to the [season of?] Tishri — these being [the matters] that govern the intercalation of the year.

When the *tequfah* (seasonal point) for that year is drawn out until the end of the year, up to the [next] Tishri — that is the *tequfah* for that year — until the end of

the year, the new moon of Tishri [?: terse construal] R. Yose [?] is dependent on it [?].

After this, just as we said, since [the reckoning of] the cycle of the year must be such that there is, for the one who intercalates, a year [whose] new moon and *tequfah* are new and reckoned anew — and likewise we reckon a *tequfah* anew, for each [year]; the new moon [reckoning?] —

[a year] whose [computation] of the [solar] year is one of the common years [?: terse] of the *tequfah*, whether for a new *tequfah* and a reckoning [?], and we reckon a *tequfah* anew. And in every common year, the new moon precedes [the year], so that the *tequfah* and the new moon of Tishri [are] so. There is for the *tequfah* [?] of the year [?: terse] — and the matter [is] thus.

Now consider: how, in [each of] these intercalations, the year's [excess] is drawn out until the end of the year, by means of the same [reckoning]?

The intercalation that is drawn out for the *tequfah* — [in] the year that is the [embolismic?] year, just as [we explained] — [for] the *tequfah* of that year, the *tequfah* [falls] later, up to the [season of?] R. Yose [?]. And it is [thus]; therefore [?]

—

the *tequfah* [reckoning] requires that its order [of intercalation] be such that the deed of the *halacha* be done [?]. And [as for] the new moon, when its [excess] is added — that is the matter of the new moon [?], [the value being] eighteen *ḥalakim* [?: numeral terse] [or] six hundred and ten [?: numeral ?] [parts].

These [reckonings] are needed for them in their order, so [that] the deed of the *halacha* [be] done, until the [reckoning of] the *ḥalakim*, and likewise [a value] of eighteen [?: numeral terse] *ḥalakim* — and on the [matter of] the new moon, [the value] of eighteen *ḥalakim*. The new moon of Tishri [is] later in the [embolismic] year —

And when the new moon is added [?], and we reckon the new moon [?], and in every common year, with the new moon of Tishri and its order, [it is] returned [to the cycle], and there is no [need]; rather, [the reckoning of] the new moon is one of [its] matters [?]. And we reckon a new moon anew —

and likewise, all that pertains to the [reckoning] of the intercalations — its [excess] [accumulates], and the new moon and the *tequfah* are returned [to the cycle]; and likewise the order of the *halachos* — behold, [the matter] is as we explained. The order of the small [intercalations?] in the cycle [?: terse], its order being upon [those values?]: 2 days, 16 [hours], 595 [?: numeral terse] [parts].

[it is] full, and the order of the intercalations is by means of its [reckoning], up to the [season of] R. Yose [?: terse], and likewise the *tequfah* of Tishri, so [too the new moon]. From the place of the *halacha* [?] of intercalation [?], its order is upon [the value of] the new moon —

The reckoning of the new moons and the *tequfot* (חשבון המולדות והתקפות) — [this is] what is gathered in the chapter [?: terse]; for upon the position of the *molad* of [?], in the manner of another position [?] —

And every [year], its order is from those things that precede [it], with their order, and [the matter] goes out and emerges [?].

פרק שלישי [Chapter Three]

[Heading line, larger script]: בהשבת השקרים והיסודות שאחז: [...] **On refuting the errors and [false] foundations that [certain ones] have taken hold of in the establishing of the calendar [?: terse], their saying / in their [accounting?].** [?: terse heading construal]

In the establishing of the calendar [reckoning], some have erred [?], and reckoned [it] otherwise [?: terse]. For [in] this matter there is [room for] error [?], and one must know that [those] who said this [?] —

In this *helek* (portion), [as for] each [matter?]: 2 [?: numeral terse] hours [?], each [?] one [?], because [?] this — and likewise the days of the week, every [?] —

as they said, and they came to say that [the calendar] requires this, the order [of intercalation] is the [solar] *tequfah*, and the new moon [?], and the [computation of] the years [is] anew, and the [reckoning] of the new moon [?] —

And when [its excess] is drawn out, the calendar [reckoning] requires [it]; for the *tequfah* [?: terse] of the calendar [?], and likewise for the new moon [?], [the value being] eighteen [?] [parts].

העקר הראשון [The First Principle]

[Opening word, large script]: **הרחמן** [The Merciful (One)]

that He was thirteen [?: numeral terse] in [number / order], and [the matter] is [stated?] for the beginning of the night [?], in the place of the intercalation [?], for it [?] has already been known that they reckoned it [?], the order being [?] —

Folio 135v (verso; conservation ruler at right margin)

And the calendar [reckoning], in the establishing of the new moon [?], the calendar follows [the course of?] the day [?] upon this [course?]; the order [is] otherwise [?], one matter from another [?], and they reckoned [?] —

and the reckoning of the [order?] of the months [?: terse], for the new moon [?] is one of [the matters], and upon the [course of?] the day [?], because [?] thus —

[a] year [whose] new moon and *tequfah* [?] — Jerusalem [?: place] is the chief [?], and likewise this [matter] —

the new-moon reckoning [?] [is] new [?], and we reckon this [anew]; and there is a calendar [reckoning] for it [?], and there is —

one matter from another [?], and one must know that —

upon the [course of?] the day [?: terse], for [in this] matter there is [room for error?]; behold, [it has been] explained, upon the —

The place where the new moon [?] of the intercalation [is] established [?], and its order is upon the [reckoning of?] the cycle of [?: terse] —

[The reckoning of] the new moon [?], and the *tequfah*, are returned [to the cycle], in the [course of?] —

for the place of the new moon [?] of the intercalation [?: terse], and likewise R. [Yose? / Yitzhak?] [?] —

[as for] R. Yitzhak ben [?] [?: terse name construal] ben [?], R. [Yose?] said: in the calendar [reckoning], the order [of the] intercalations of the [solar] year and the *tequfot* —

upon this [course?] [?], and [in] every common year [?: terse]; the order is [thus?] [?], for the new moon [?] —

[those] who said that the *tequfah* — [as for] this [matter], in [it] there is [room for]: where [the value of?] [a new moon?] [?: numeral terse] —

So [it] was [?] from the matter of [reckoning?], and they [emended/established?] the new moon [?: terse], in the [reckoning of?] —

the cycle, and behold, the *halacha* is so, and [as for] R. Yose [?] [?: name terse] [?] —

The matter of the new moon, in their books [?: terse], until [the matter] is [reckoned?]. And R. Yitzhak ben [?: name construal] said [?]: [it is] established [?]

And likewise the *halacha*, and behold, [the matter] of the cycle, and likewise [as concerns] the order of the *halacha*; behold, [it is] as we explained, and the deed [?] —

they came to say this, and behold, by the *halacha*, behold this [is] the matter [?] — and behold this [is] also [for] Jerusalem [?: place], it being the place [from which?] the [reckoning of?] the order of the calendar [?] —

and behold [in this] matter there is [room for error?], and they reckoned [it] otherwise [?: terse]; behold this [is] the matter [?] —

the matter of [intercalation?] of the year [?], and [as for] R. Yose [?] [or] R. Yitzhak [?] [?: name terse]: the order [of the] calendar [is] otherwise [?] —

and they came to say [?: terse], and behold this [is] also [for] Jerusalem [?: place]

The matter of the intercalation [?], and behold [the matter] of the cycle, and likewise [as concerns] R. [?] [?: name terse], and one matter from another [?] —

the order [of the] calendar [is] otherwise [?]; behold this [is] the matter, and they reckoned [it otherwise] [?] —

the order [of the] calendar [is] otherwise [?: terse], one matter from another [?]; and [as for] R. Yose [?] [or] R. Yitzhak [?] [?: name terse] —

The matter of the intercalation of the year [?], the order [is] upon those things [reckoned for?] Jerusalem [?: place], and the rest of the calendars [?]; [as for] the year [?] [?: terse] —

The calendar [reckoning] of [the cities?] [?: terse], upon the city of Jerusalem; and the rest of the new moons [?] [are] established in this [?], and likewise [for?] the year — or [a different?] year [?].

[Lower half of leaf blank — wide blank margin, not damage.]

Fourth Treatise (המאמר הרביעי), the practical Hebrew calendar — Chapter Three (פרק שלישי), the polemic "On refuting the errors and false foundations." Continuation of the numbered falsehoods/false principles.

and so too were their words [in error] in this matter; until he removed their reckoning from the intercalation in this regard, so that this [computation] would be done according to the molad and the tequfah. For the intercalation belongs in one place and the molad in another; and likewise the reckoning returns to its place and is well-ordered — for the reckoning of the molad is in one place and the intercalation in another. And the computation of the molad and of the intercalation in this manner is correct and proper; for the correction of the moladot was given to them lest they err, and likewise the correction of the tequfot; and the reckoning returns [to its place].

[Red ink rubric, inline:] והשקר השני [And the second falsehood] — concerns the moladot, in which there is [an error]: the rule of intercalation [הלכת העבור], in which they erred and went astray, on account of the tables they made for the correction. For there was at that time a [practitioner] who used to compute the new moons of the world and of the kingdoms, and they erred in the deficiency of the lunar cycle [מחזור הלבנה]; for a year is twelve months, [and a lunar year is] 354 days, 12 hours, and 793 ḥalakim — and this is exact [מדויקת]. But [their] reckoning of the computation of the moladot is received from them, just as we have explained above, and just as you have learned: that the matter of these — the moon, new and full, and the tequfah, and the [reckoning] — [follows] the opinion of the early authorities and the later ones, [according to] how they computed, as is proper.

[Red ink rubric, inline:] והשקר השלישי [And the third falsehood] — and behold, here too there is a disagreement of the authorities in the correction of the moladot; this was a falsehood. By [their reckoning] they made [their tables].

Our Rabbis of blessed memory [רבותינו ז"ל] knew the way [of the moladot], and how they were to be [practitioners] knowing the path of the moladot in their place [במקומן] and at their time. For the one who computes [the molad] of the world [reckons] 354 days, 12 hours and 793 ḥalakim; and the [reckoning] is computed from Genesis [מבראשית], by [received] knowledge; and the computation was [from] the molad of Tishrei. And the new moon was [thus]; and there was [a deficiency] in Tishrei, for the molad was [such]; and it was in the computation before this, 354 days [של"ד]; for in all of it there is a deficiency of seven [days] in this [Tishrei]; in the computation before Tishrei, 354 days [של"ד]; for [thus] is the molad of Tishrei, [in] the reckoning of the world, before the computation.

This, and likewise [the rest]; and our predecessors [קדמונינו] transmitted to us [מסרו לנו] and made known to us [הודיעונו] that the molad of the first Tishrei [תשרי]

[ראשון] [was such]; for in this manner he [reckoned it]: the new-moon time at the beginning of the argument, a year, 354 [days]; and his opinion, by the argument, that the [reckoning] of the world is, before [the lunar reckoning], smaller [by a small measure]; and the molad of Tishrei would be [thus]; ז"ל ד [zayin-lamed dalet — abbrev. uncertain]; and the first new moon [ראשון] of the moon, by the [reckoning], in Av [?], 24 [?]; alef-zayin [1h?], which they completed for me; and likewise it was for the molad in the computation before Tishrei. And behold, [the reckonings follow] just as all the computation of the moladot; and it would be a fitting year [שנה כראוי]; a year, and likewise an additional new moon, that they would be additional, according to the opinion of the others, in Tishrei, [by] a difference; and to reckon them, lest [they err]; [the reckoning] of the world, from this year; for the [new moon] is small; according to the latter opinion, for the latter knew that its new moons were small; and [the deficiency runs] until the end is diminished [עד סוף צ"ל].

[Lower ~40% of folio 136r: blank parchment, wide outer/lower margin — not damage.]

the years of the world [שנות העולם], to begin with, that the [reckoning] of the world will be complete; a year [of such-and-such days]; and behold, those who reckon the world [computed] them by signs [סימנים], and by the signs [they found their values]. And they found their signs: a year, and a tequfah; a year [of 360, and 9 (?)]. And behold, according to this reckoning there is a difference; for the signs of a year were [in] ḥalakim, that the nine [ḥalakim] revolves; [a sign] of the difference; and you draw them forth over [the sum (?)]; if they have a sign for the molad [of such-and-such]; and the signs of the molad of Tishrei [were after them]; yod-vav-dalet [16h?]; and behold, here, our predecessors [קדמונינו ז"ל] [reckoned] the molad [by] signs.

For the foundation [המוסד] [is set] well, and it is well-ordered; in this way they computed [and arranged] the correction of the moladot, ascending [in order]: to begin from [their place], and the signs; with every molad, and the molad of the moon, to correct it to the [true] molad; and the ḥalakim from all the moladot that they had, and they will be from the world [henceforth]. And behold, [the reckoner] of the world [knows] the sign; for this is the very sign of the molad of the cycle [מולד המחזור]; that the third [part] of a year is distant [רחוקה] from them, just as there are signs; and by means of the signs the molad of every cycle [מולד כל מחזור] would be corrected; just as [with] the molad; a year, a year — a difference of their moladot — and the molad of every distance and new moon [is taken] according to the differences that passed, or the tens [העשרים].

[Red ink rubric, inline:] ודע [And know] — that there is a matter that is reckoned by every sign in the world; that the root of the signs — that they gave them a measure [שיעור] to be; for there is a number; just so are the falsehoods of his [reckoning]; for from this matter — and behold, well and pleasantly — the students [התלמידים] turn aside [err] at the beginning of the matter; and he said, for —

[Red ink rubric, enlarged:] הרהמן · הלמוד [The teaching. The Merciful One —] [first word read as הלמוד "the teaching/study"; second word הרהמן is the recurring invocational opener]

[There is] a measure [shi'ur] of the matter, so that they require, in the correction, a sign of the moladot; and likewise he corrects [the reckoning] so that the second tequfah [שניתקפת] [begins] to be received [from] that of the world, [by] a sign.

And it would be, and from this [ומכאן] it is corrected — this is for you, by way of one who [wishes] to know [כדי לידע], and to clarify [ולהברר] the first sign [סימן] fully, beforehand; here it is. And the molad [is taken] from them, and this is yet another thing that would be so; and when the foundation revolves [into] a small new moon [חדש קטן], so that those who reckon the small one would not know the molad, let him take their sign; this goes just as [it does for] the students; this belongs here, and there is the sign in it, [tav-lamed-yod-he? — value uncertain]; and a sign of [the] tequfah [תקופה], and a sign [of 60? — value uncertain], a difference.

That would be so — that he reckon them by a standard sign [כמכוון] like this — that they fall [out] entirely in the correction; this is decisive.

For all the days under the sign [תחת הסימן], a year [is reckoned at such-and-such], and the ḥalakim are [reckoned] under the ḥalakim [תחת חלקי].

[Inline small ruled table — see below.]

and we begin, and likewise [we set down] the ḥalakim of this; there is [a remainder]; [we cast out] from it 31 [?], and we shall give [the rest]; and a sign, and [9?] for an hour [לשעה], a measure, an hour; a year [of 354 (?)], [we reckon] them, and we shall write it over the remainder [על השאר]; and the rest of its days, [tav-kuf-pe-bet? — value uncertain] ḥalakim; and [100?]; and again we shall write it under the ḥalakim [תחת חלקי]; and again we shall write [109?], [tet-shin-ayin-tav? — value uncertain], with that which befell [שעירע] their day, [that it be] 9 at the hour [שעות], here, the whole for one day [ליום אחד], and we shall add [ונוסף] it

over [the remainder], and we shall write it over [the remainder], and we shall divide [ונחלק] the whole.

the time of the remainder [שעת השארית], and we shall write it; [this] in a fixed manner — that there is none for them [שאין להם] in this computation [בחישוב הזה] — and we shall write it [a small remainder]; the days; the years, [tav-kuf-he-tav? — value uncertain].

[Lower ~50% of folio 136v: blank parchment, wide lower margin — not damage.]

Table (folio 136v, inline small ruled box, left-center of column)

A small ruled box of three rows over a separated lower row, set in the column. Reading each row right-to-left (logical Hebrew order). Cells are small but legible; gematria read glyph-by-glyph.

(right cell)	(middle cell)	(left cell)
[555] תקנה	—	בו [label: "in it" / abbrev]
[555] תקנה	[30] ל	[33] ל"ג
שמש [shemesh = "sun"]	[1] א	[1] א
[512] תקי"ב	[30] ל	ל"ב [?: 32 / abbrev]

[The box tabulates tequfah/ḥalakim values (512 = תקי"ב, 555 = תקנה) against short numeric labels; the right-column word שמש ("sun"/solar) marks the solar row. The bottom row is ruled off separately. Bracketed Arabic values are the gematria sums of the resolved glyphs; the leftmost label of the last row (ל"ב) is faint — value tentative. Not pattern-filled.]

beneath the daytime sign [תחת יום הסימן], and we have already established a fixed rule for this. So when you have computed this, observe the [molad] signs that you have computed, and add to them according to the count of the days of the signs of the moon, and the remainder will be the sign you seek. So too for the rest of the computations — in the whole reckoning of the book, take whatever is sought and whatever you require.

The Fifth Lesson [Red/bold rubric: הלמוד החמ"ש]. This is the calculation by which you may know the molad signs together, so as to obtain the bulk [of the reckoning] at once, with the remainder of the signs (של שיהו חלקי הסימן) — the remainder that you carry over, together with the fractions [ḥalakim]. The molad signs you carry over from the [prior] reckoning; their reckoning is by the larger amount, and so too the signs of the deferred [reckoning] are by the lesser amount. The remainder of the molad signs, [count them] just so. The sign by the

larger amount is the sign sought; the lesser amount is the deferred [sign]. This is correct.

[Small ruled table, three rows × three columns, set into the text. Reading right-to-left by column. The left column gives a running total in hundreds; the middle and right columns give the partial sign-values:]

(right)	(middle)	(left)
(5) ה	(18) י"ח	(450) תק"ל [?: left cell could read = 530]
(2) ב	(12) י"ב	(612) תרי"ב
(50) נ	(4) ד	(258) רנ"ח

[prose resumes after the table] From the [molad] sign — fifty-two (נ"ב) — the sign is thus, and there is a remainder in this [reckoning]. Take it thus by the larger amount, just as we have set forth, for the way of the computation is so, and so it shall be. By this reckoning the matter is established, and from it [you derive] what is sought.

The molad signs you carry over; the way of the molad signs — take them thus by the larger amount, so it shall be. From the molad sign by the larger reckoning, take from it [up to] the limit, and do not pass beyond the hours (שעות). [As for] the molad signs — its fractions [ḥalakim] and the seconds, [count them as set out in the table below].

[Second small ruled table, three rows × three columns, set into the text lower down:]

(right)	(middle)	(left)
(3) ג	(12) י"ב	(375) שע"ה
(3) ג	(16) י"ו	(421) תכ"א [?: middle cell י"ו could read י"ז; left cell could read 431 = תל"א]
(5) ה	(20) כ	(770) תש"ע

[prose resumes] The fractions [ḥalakim], and the sign you carry over from the reckoning; and the remainder of the fractions is fifty. To carry the sign forward you take a sign; the remainder is the molad signs, and the sign you carry over.

And he who reckons by the reckoning of the days — the days are one [unit]; and from the days, one day [is added] over each day; and [you take it] up to the molad

sign by the larger amount. Each day [the sun] proceeds: by the larger amount the day accumulates, and the molad is computed thus.

For he who sets [the reckoning] upon a single day — the day is one, and over the day he [carries] another day. And he who sets the molad of the year — this is the molad that is sought, after the molad of the cycle [maḥzor]. And those who reckon by the larger amount — when the year occurs, the molad of the year will fall by the larger reckoning.

And the molad — its molad — and the molad signs that you carry over are the same: the molad sign is by the larger amount; the way of the reckoning is thus, and the matter is established.

The year is three hundred fifty-four days, twelve hours, seven hundred ninety-three ḥalakim (שנ"ד יום י"ב שעות תשצ"ג) — this is the [length of the lunar] year. And the difference between this and that is by a fixed amount each year (זה מזה) (בכל שנה). And [thus] the molad of the cycle is established by this reckoning.

And as for the molad and its remainder, take heed in this reckoning to know the molad sign — this is correct; and from it [you derive] the molad sign, and the way of the reckoning is thus, and it is established.

[Bold/red chapter heading, centered:] **פרק רביעי [Chapter Four]**. A matter that they [the opponents] have said — what they have established as a principle: that it is correct to know this...

[Chapter Four opens, last line of 137r, continuing onto 137v:] ...reckon by this [method]: this is a fraction [ḥelek] — what one carries over, and in one hour two [units], and one day over each day. The reckoning of the days...

[End of folio 137r. The lower margin is blank (not damage); ink-speckle blots in the lower-right margin are not text. Text continues directly onto 137v.]

the reckoning, observe the sign, and so it shall be (שמרת הסימן). By the way of the reckoning the matter occurs and is established, and the molad falls. From this you find the molad — one [is carried] over each [day]; and you compute by the molad sign, by the larger amount, the day being twelve hours (י"ב שעות), the fractions [ḥalakim], and the remainder.

By this [reckoning], indeed, the days [come round] in returning [to their place] — for the day is one [unit], and so too from the day, that is, up to the molad sign by the larger amount. And the reckoning of the days — twelve days — and the

remainder, this too [is established]. The remainder is twelve, the sign you carry over.

The cycle [maḥzor] is one, and you go forward to know it: up to the molad of the year, the sign you carry over is established. And the molad — you know it: when the molad of the year falls, [you take] its sign, and you require it. So too is the molad sign, by the larger amount; and the molad sign you carry over is the molad...

the way [of the reckoning] is established each year; and the moon [comes round] thus — for the molad sign falls by the larger amount. From the molad sign, [take] from it up to the limit (עד המוסר), by the larger amount. And [the remainder] is established and computed as one [unit], by the larger amount, by the molad sign...

the molad signs of the new-moons [chodashim] and their multiples (רבוועיהם); and we have established their signs upon [the reckoning], and the way of the fractions [ḥalakim] of the multiples (לרבוועיהם) — and we have established it just so.

The molad sign — three hundred fifty (ש"נ); and we have said that he who reckons it had the reckoning — for this too is by the larger amount; it occurs and is established, and the molad falls. And we [proceed] by the count of their cycles [maḥzorot], and we keep [account of] the limit, by the larger amount; and by the count of their cycles [maḥzorot], and their times (וזמניהן), and how many multiples (כמה משברות)...

[so as] to know the molads of the cycles [maḥzorot]; and we have established it [thus] — for the foundations of the world [yesodot ha-olam] are known; this reckoning was the reckoning. The multiples of the world (רבועי העולם), and unto the great number (עד דבר גדולה) [?: דבר גדולה — terse], would it were [so]. And by the count [mispar] of their cycles [maḥzorot], and their times (וזמניהן), [these are] the signs [simanim] and the multiples of the [molad] signs...

and the count [mispar] of their cycles [maḥzorot] is established: the molad sign — three hundred fifty (ש"נ) — and we reckon by the larger amount. The days are like a returning, like the day [itself] in its own motion, from the fractions [ḥalakim]...

[lower lines, ending:] The fractions [ḥalakim] are all [counted] — like the day in its own course (כמו כן כמו יום עצמה) — and its return; and [you take it] up to [a whole] sign from the fractions (ועד מן החלקים). For if no fractions [ḥalakim] are

left over, then [there is] a complete [reckoning]. The molad sign you carry over is the molad sign; the fractions [ḥalakim] are all [counted]; one second of the molad sign, the deferred [remainder]; and the nine (תשע) hours of the world; and [you] combine [the remainder] (וצרף)...

Yesod Olam — Treatise Four (המאמר הרביעי), Chapter Four (פרק רביעי), continued

[Pencil foliation in upper margin: "138"]

to the count of the surplus [מותר] that remains after dividing out [the whole weeks] from the ḥalakim. The same procedure [applies] in dividing the surplus [מותר] of the days to one side, and once again you take it and divide it back into weeks [casting out the sevens], so that there remain to you the days [of the week] of the surplus [?: terse construal].

So too you take the surplus [מותר] of the count of the days, and you divide it to one side, and you divide the surplus of the ḥalakim, casting them out by cycle [למחזור], and once more by the count of the days [you reduce] the ḥalakim, and you write them down. After this, take once again the count of the seconds [שניות] [?: construal] and the ḥalakim, [and reduce] them by the count of the seconds, and write them down. And once more take the surplus of the [seconds] and divide it to the count of the ḥalakim, [and reduce] by [whole] cycle, and write them down, and [cast out] once again by the days.

When [the surplus of] the year already comes out to you in this fashion, and there remain the days, the hours, and the ḥalakim — you write them down [?: terse], and these are the surplus of the year. And from the surplus of the year that remains after dividing out [the weeks], here you have it: take it and divide it [again] in the manner [we set forth].

Since the reckoning [חשבון] of [casting out] the surplus has its order, and the foundation is well established [?: יסוד construal], and the foundation of the world [יסוד עולם] [?] is what underlies it [?: allusive] — the deep [secret] of the molad's foundation is what informs you of [the way to find] the molad, and one understands and casts it out by [whole] cycles, and writes them down.

By the count of the [whole] weeks [המשבעות] [?: construal] and the ḥalakim, the count [קץ] of the ḥalakim that remains over: [you cast them out] for one side [?], and you take the surplus, and you divide [it]. The surplus [מותר] of the [seconds, ?] you reduce again [reading: ונחזיק בו] to the days, and you write them down [reading: ונכתבם] to one side. And once again you take its surplus and

divide it to the count of the days [casting out the sevens], and once again to [whole] cycles, [casting out the surplus] that remains over from it.

You write its days — the days that remain [after casting] — to one side, and the surplus that remains for [the year], and the [surplus that remains] for the cycle [reading: **ובטל למחזור**], casting them out by [whole] cycles, and you write them down to one side, and once again [reduce them] to the days [casting out the sevens]. And what remains of [the seconds, ?] you write [down], or you divide [them] to one side, and you divide its surplus to the count of [the hours] of the seven [days, ?] and the *ḥalakim*, from [the surplus].

So that the molad shall come out to you, divide it again to [whole] cycles, and the surplus of the cycles you cast out, and you write them down. And once again — [?: construal] you have the surplus of the cycle. You take it, and once more you divide it to one side, and after this once again — if there comes out to you [a quantity] greater [than a week], you know the molad.

How many [whole] new-moons [**חדשים**] [comprise] the year? [?: rhetorical construal] [The year is] twelve [months], and the [remainder] is the [surplus] of new-moons, and from this [reckoning] you take the count of the seconds, and you reduce [them] by the count of the [*ḥalakim*], and you cast out the seven [days, ?], so that you may know the molad of the year that is being sought. And from the molad of the cycle [**מולד המחזור**] [you derive it]: take the [days that fall to] this cycle, and you already know [its molad]. And there are still several methods by which [one may find it] [?: construal], and the [first?] is the simplest of them, [reckoned] by the count of the days.

ועתה — **And now**, after we have made known to you the foundations of the [births / generation of the moladot] [**תולדות**], "the foundations underlying the moladot" [?: register], [we shall set them out] in good order. [?: terse] [These are] the things upon which the authors and the commentators relied, and [they were] examined.

[A short cluster of small computational figures with abbreviated values stands at the foot of the column, embedded in the prose; transcribing the legible bracketed numerals:] ...the days, and they have set them in order [reading: **ובתקנום**], and once more [?: construal] it has been established [**נחקן**], and there came out for the surplus [reading: **ל-ויצא**] thirty-... [**ל"ה / ל"ד**] [numeral: ?] of the moladot. And to [?] correct [the value, ?]: there shall be the surplus [reading: **הנשאר**], the surplus, and [you add to it] in the manner [reckoned] above [?]. And there shall be [for] the cycle [reading: **כדי סימן**] — [a value] of the moladot [?]. The cycle

[?]: their reckoning has [been computed] as [a value] — [the marginal/inline numeral cluster reads] [209 =] ר"ט [?: numeral construal], החמ"ז [= "the surplus", or a numeral, ?], ... א"ט ה [numeral: ?] of the moladot.

[Wide blank lower margin — not damage.]

new[-moons], the year [comes out], [the surplus] is cast out [reading: קבש the surplus, ?] for the whole [reading: הכל]. By the count [reading: בחשבון] [of] the cycle's surplus [?: construal], so that it shall come out [reading: שתהיה יוצאה] — divide [the surplus, ?] for [whole] cycles [שעולה לכ"ב, "which amounts to twenty-two," ?: numeral] for each [?]. And you need, in order to correct [לתקן] the [births / moladot] [תולדות], the reckoning [חשבון] [?: terse]. For [reading: שבל] the surplus [מותר] of the cycle [המחזור] is [the value] — and the surplus, the surplus of the cycle is [the value] [?: the run pairs "the cycle's surplus" with a numeral each time; numerals abraded/abbreviated].

And [should] you wish to know its [value], [reckon it thus]: [for] the surplus of the [moladot] [reading: יודע ע] [take the surplus of the cycle [reading: סימן] [— it amounts to a value] — and the surplus, the [surplus of the] cycle [comes out] [the value], and [thus] the moladot are [established] [?: this paragraph is a chain of "מותר המחזור היה" [N] statements; the numerals are abbreviated gematria with gershayim, partly rubbed].

[The chain continues — paraphrasing the legible structure, with the numeric values flagged where the gematria is not securely resolvable cell-by-cell:]

- The surplus of the cycle was [reading: היה ב"ב] [numeral: ?].
- Its surplus [was] [reading: היה ד"ל חס"ו] [numeral: ?], and its surplus more [reading: ומותר אלף, "and a surplus of a thousand," ?: numeral].
- And the surplus, the seconds [שניות] [reading: שש שלמים, "six whole [units]" ?: numeral].
- [And] should [the count] not [exceed] a [whole] cycle, [its surplus] is [reading: ק"ם ב"ט] [numeral: ?].

[the surplus of] the cycle [reading: ל"ט] [numeral: ?], and as much [reading: וכך] as remained [?: construal], to the foundation [?: ליסוד construal] — the surplus of the new-moons [reading: חדשים] [?], the moladot are [established] for them [reading: עליהם], by the [whole] cycle, [reckoned] in the order [reading: וירך תקן] [?: terse].

The molad of the cycle [מולד המחזור] [is found] from them [reading: שלפניהם], so that you may know its sign [סימן], that is [?]. And once again [you cast out] by the

cycle [reading: מחזרים זה] — and this [is] [?: construal] the [way of it]. So [the matter is] established for them: the surplus more, [reading: מותר מאתים], two hundred [more, ?: numeral], and the molad of the cycle [reading: מחזור] [comes out].

And its sign [סימן] [is] [a value, ?: numeral, reading: ב"ג של ובמדבר נ"ם], and the surplus of the cycle [reading: שעה ששה מחזרים] [?: terse] — six [?: numeral שש] — and once again [reading: ונחזיק] [?]. So [too] the surplus of the new-moon [reading: רסו] [?: numeral], the moladot [are established] [reading: ונדע סימן] more, [casting out] by the cycle [reading: המאחד] [?]. After this once again [reading: וירך] take this [?: construal], so that [reading: שילך] the surplus there [reading: שם] is [the value], [reckoned] for one side, and [you reduce by] the [whole, ?] cycle [reading: בג"ל]. And [you take] another [reading: ואחרי]; and there [is] [the value] [reading: ל"ש לסי] [?: numeral].

[Then, in a distinct centered display-line in a larger / darker hand:]

שער — GATE [Sha'ar]

[This large display word (clearly legible on the leaf, in a darker/enlarged hand) marks a new structural unit. The heading-line that follows it is terse and partly abbreviated; it introduces the topic "...needed in order to set in order the foundations [ליתקן ה-תולדות / היולדות] — i.e. an introduction to the Gate. [?: a word or two of the topic phrase is not securely construable.]]

What we have given you, [namely] that [the molad] shall be such-and-such [reading: שנהיה], the count [reading: וטבע] [?: terse] is well-established [reading: — וכבר ידעת] [reading: ויט תרי"ט] [numeral: ?], and you take [it] [reading: ויקח], setting it in order [reading: ייתקן] [?], so that the count [reading: לבסוד] shall come out for you [reading: יצאה לך] [reading: החשבון].

For [reading: לפי דרך / לפ"ד] [whole] cycles [reading: למחזור] — and [should] it be [reading: והיה היה] in this [way / reckoning] the corrected [count] [reading: היה] [?:], and the [surplus, ?] you cast out [reading: וילך נח] for [whole] cycles [reading: סימן] — and you write it down [reading: ונכתב] in the manner above [reading: בהשוואת] [?]. So that [reading: וכי] the count [reading: סדרה] [comes out] [?:], and you [reduce it] by the count [reading: עד עשר], the surplus [reading: מאחת] [?:], and once again it is established [reading: ולבון מולד] [— it is] the molad [?:] [the value].

And it shall be [reading: ויהיה] [its] count [reading: התשבון] [?: terse]: you set it in order [reading: שתבטון] [?], that it be such-and-such [reading: "לסי", ?] [the value] [reading: ב"ב תרל"א] [numeral: ?], and [you reduce] [reading: ואלך] more [reading: מותר], so that [reading: שיש] the corrected count is well-established [reading: הקשר הוא סימן] [?], the molad of the moladot [reading: המ"שרית] [?: terse]. [The surplus, ?] you cast out [reading: לפ"ו], the [whole, ?] cycle, the molad [reading: מולד] — [it is] such-and-such [reading: טוס מחזור ידוע, "a known cycle"], its sign [reading: ידוע, "known"], and you cast out [reading: ושלק]. So [it is established] [reading: וכן עשה], [reckoned] for the corrected cycle [reading: לסיא"ל], its molad [reading: מולדישו] [?: terse].

Then [reading: ויהיה] the surplus [reading: היה הנשאר] of the cycle, the molad [reading: מולד], such-and-such [reading: טוס מחזור ידוע, "a known cycle"], and its sign [reading: סימן] [is the value]. And so, [should] you do it [reading: עשה], it shall be [reading: יהיה] such-and-such [reading: ל"ב תשט"ל] [?: numeral] — the corrected [count] [reading: הקשר הוא סימן] is the molad [reading: מולד], such-and-such [reading: ל"ש] [?: numeral].

And you need [reading: וצריך], in order to set in order [reading: לתקן] the [births / moladot] [reading: המולדות], [reckoned] by the way [reading: למרע על דרך] [?], another [reading: אחרת] — [the value] [reading: יותר קלה], the [value] is more [reading: יתר], and there [is] [reading: שהוא תשלום סימן] the completion of [a / the] sign [?: construal] [reading: ב"ז ל"ד] [?: numeral]. And the sign [reading: שהוא תשלום] [is] the completion [reading: סימן מולד] of the molad — a small [molad / sign] [reading: קטן] [?] — so that [reading: שמלאכה] the work [is done], so that there shall be [reading: כס היתה] [its] surplus [reading: תשועה], and the surplus and the fractions [reading: ופלגים, "and pelagim"] of the intercalated [year] [reading: מעוברת] — clearly legible at the foot of the column]. The line closes the page on the surplus/pelagim of the intercalated (leap) year.

[Closing legible numeral cluster at the foot of the inked text, before the wide blank margin: ...ג"ש ל"ח תק"ח סימן ר"ח [numeral: ? : "a sign [of] 208, 700, 33," reading uncertain] ... ופלגים מעוברת — שעה / סועה — "...hours... and the surplus [in] the intercalated [year]."]

[Wide blank lower margin — not damage; an ink blot in the gutter and a stray ink stroke in the lower-middle margin are scribal/conservation marks, not text.]

Yesod Olam — Treatise IV (the Hebrew Calendar)

[The page opens mid-computation, completing Chapter Four — the derivation of the molad of the year from the molad of the cycle.]

[and] 22 [days and] 583 ḥalakim, which is the completion of the five months. There comes out for us a numeral [siman], and so we shall always reckon — for this is a cycle [maḥzor] that will be [of so many] days [and] ḥalakim — apart from the molad of the month, [until] you complete the cycle. And know that there comes out for us a numeral; and so we shall always reckon for the molad of the cycle, and there comes out for us a numeral that is the completion of the cycle, and likewise the molad of the new month, and so we shall reckon and find the surplus, and one does not need to correct this.

[for] the molad and you reckon it [for] the cycles, and there [will be no] error [for you]. By this method one reckons the molad of the cycle. And know that the surplus of the cycle is 2 days [and] 16 hours [and so many] ḥalakim [numeral: ?] — cast out from it whole weeks [שבועות], and the remainder is the surplus of the cycle. And so reckon from cycle to cycle until you reach the year you sought, and you will find the surplus; and know the rule of the tables [לוחות]...

the molad which is the completion of the cycle; and so we shall reckon and find the surplus, [up] to the year that you wish; and there [will be no] error in it. By the multiple [ribbu'a] of the cycle the surplus is reckoned. And know that the molad of the new month — its rule [is] from the multiple of the cycle, and there will [come] out from it the surplus of the cycle; and the surplus of the molad — its position is the position of the molad, and the surplus is the molad; and so we shall always reckon for the molad to know [it] for the generations [to come].

פרק חמישי [Chapter Five]

Concerning the being of the lunar year [reckoned] in months [from the creation of the world].

This is founded upon the reckoning of [the years] of Israel, and the molad that was at the beginning of the reckoning of the world — that is, [the molad of] the moon at the creation of the world; and it was reckoned by the Sages of the Talmud, [as] the molad of the world at the beginning of the years of the world, [in] which there was no [prior] reckoning.

and the reckoning of the surplus of this multiple, [in] the tables that were made before us for the molad and the new-moon days, [were] the heads of the months [ראשי החדשים]; and the conquest of the land [וכבוש] [confirmed] this surplus, so that the surplus should be over this [reckoning]; and over this we said that there are ḥalakim.

until they reckoned, from the place from which they reckoned, until they purified [verified] their reckoning; and over this our Sages of blessed memory [רז"ל] explained to us a new numeral [siman]; and the conquest [of the land] — they purified [verified] it [against] the reckoning; and over this our Sages of blessed memory said a numeral, so that the new moon [should be] new [each month], and that its appearing over them should be as it was; and they did so over them.

[The written column ends here on folio 139r, with a wide blank lower margin (not damage).]

[Margin, upper outer corner of the leaf: penciled foliation "139" (modern librarian's hand).]

[Chapter Five continues; the text develops the per-month surplus and the molad of the new moon.]

[the cycle] that was [reckoned], from which it comes out; and so we said over them. **And now [ועתה]** — to do [the reckoning] for any [molad] you wish; reckon for yourself [as for] any [molad] you wish, and there [will be no] error. And so we say [there are] ḥalakim; for the molad of the new month — its position is over them, and they purified [verified] it; for the molad of the new month [its position is] over them.

there is in each month 29 [days and] 12 hours [and] 793 [ḥalakim], which is the completion of the [synodic] month. And so we reckon over them [for] any [molad] you wish; and [thus] you reckon for yourself the surplus of the new month, and there [will be no] error; for the molad of the new month — its position is over them.

the molad of the new month, day [numeral: ?], [hours numeral: ?]; and its position is over them. The molad of the new month [is on] day [numeral: ?], and its position is over them, [over] the moon; and there [will be no] error. There is in each month 29 [days and] a half [day, that is, 12 hours] and 793 ḥalakim; and so we reckon, and find the surplus over them, until you reach the month you sought.

over them; and so it is [for] the moon [each] month, and its position is over them; and so we reckon, and find the surplus over them; and the surplus is the

completion of the new month, [for] any [molad] you wish; and there [will be no] error.

ועתה [And now] [— recapitulatory marker; rubricated initial]

And now we have explained for you, in this reckoning, the molad of the new month and the surplus, that it [does] not [fall] before the [whole] reckoning; and so it is [for] the moon [each] month, and there [will be no] error in it.

and that the molad of the new month is a known thing at a known time. And it was reckoned by the Sages of the Talmud as a fixed numeral [siman]; and there is no day without its molad.

שער [Gate] — siman [numeral: ?]

An illustration according to the deḥiyah [postponement].

The molad that came out [on] day [numeral: ?], hours [numeral: ?] — its postponement is to [the next day], and the new moon is postponed; and the molad which is reckoned [comes] at its end; and there is no day without its molad.

and over this the Sages said [that] the molad was postponed, and over the calling of the new moon — what they said is the appearing of the new moon over them; and the molad came out and the new moon [is] at its end. And over this [comes] the new moon at the end of the postponed [month]; [and so it is reckoned].

[The written column ends here on folio 139v, with a wide blank lower margin (not damage); minor ink blots at the gutter foot.]

Yesod Olam — Fourth Treatise, Chapter Five (continued)

The worked illustration (דמיין [worked illustration]) of the deḥiyah (דחיה [deḥiyah]: the calendar postponement), set out through the scenario of the new-moon sanctification.

[Script: Sephardic semicursive, brown ink, single-column. Folios 140r–140v. Wide blank lower margins on both leaves.]

[The line at the head of the page completes a sentence carried over from the previous folio.] ...and he reckons it, and concludes the matter, until the molad

reaches its end-point. So the position comes out by approximation [בקרוב [by approximation]] and by exactness [בריוחוק [by exactness]], one and the same.

ועתה — And now [display opener], turn back to the festival [המועד], so that I may set out for you the worked illustration of the postponement, and you will grasp from it the method by which the festivals are fixed.

Suppose, then, that the molad of Tishrei falls at such-and-such an hour [numeral: ?], and that the witnesses [עדים [witnesses]] come and give their testimony [עדות [testimony]] before the court. The court reckons the position [מקום [position]] of the new moon from their testimony, by approximation and by exactness alike, and determines on which day the molad falls and on which day it is postponed and set back [מאחר].

For the position of the moon is reckoned from its mean reckoning and from its true reckoning: by the one it comes out earlier and by the other later, and the true reckoning of the day of Tishrei is the one that decides. These are the two reckonings, the mean and the true: when they coincide, the position is one and the same; but when they diverge, the court [?] follows the true.

[The argument turns to how the festivals are counted off from the fixed day. The next several lines are a dense calendrical computation that I cannot construe glyph-for-glyph with confidence; what is legible is rendered, the rest flagged.] ... and from the fixed day [יום קביעות] the deficient counts [הקצורים [?]]: the short/truncated counts] and the sums [הסכומים [?]] are derived — where one count falls short and another runs over [?].

The position is the foundation of the festival, and upon its fixing the order of the festivals depends. For if the molad falls on day such-and-such [numeral: ?], the new moon is sanctified [יקדש] upon it; but if a postponement intervenes, the sanctification is set back to the morrow [למחר], and the festivals are counted from that day.

the deficient counts [הקצורים [?]] and the testimonies are what bring the matter into balance [מאזין [brings into balance / sets back]]. And the court fixes [קביעות [fixing]] the day of the new moon — Rosh Chodesh [ראש החדש] — for upon the fixing of Rosh Chodesh the festivals [מועדים [festivals]] depend, and from it the counting follows.

[The remaining legible lines of 140r continue the same reckoning, distinguishing the day on which the molad "should have fallen" from the postponed day, and confirming that the festivals are counted from the fixed day. Several phrases in

these lines are genuinely hard to construe and are flagged rather than smoothed.]
...so reckon by approximation, and the day comes out fixed; this is Rosh Chodesh
[?], established by approximation [?].

[The court] sanctifies and reckons the day, and it is Rosh Chodesh, established by
approximation; and it is the day from which the count begins [?]. So the court
reckons and sanctifies; and when [the molad] is set back, it is the morrow [מחר]
that is Rosh Chodesh; therefore it is fixed, and the matter is brought into balance.

and the new moon is sanctified, and the reckoning stands as one — Rosh Chodesh
[?]. The deficient counts [הקצורים [?]] and the testimonies: the new moon was
sanctified upon them, and they fixed it; and behold, it is one [reckoning] [?].

[The foot of 140r closes the recapitulation; the final clauses are abraded/cramped
and only partly construable:] ...the deficient counts and the testimonies [?] were
already apparent, and the matter [?] of the moon's position by approximation;
and this is Rosh Chodesh, sanctified; and they fixed it — behold, upon one [day]
[?].

[Lower margin blank.]

[The verso continues the worked illustration. These opening lines are dense and
only partly construable.] ...the position is the foundation [?]; the day ought to fall
[on such-and-such], so let me set out for you Rosh Chodesh [?] established by
approximation, and Rosh Chodesh set back [?], and they sanctify it; therefore it is
fixed.

and they did not require [?] any [further] position [מקום [position]]; the moon
was sanctified by approximation [?], and the day was reckoned.

The witnesses [עדים [witnesses]] came and gave their testimony [עדות
[testimony]]: the new-moon position [?] is reckoned so that Rosh Chodesh might
be established, and the festivals are counted from it [?].

וְקִם [a display marker; possibly וְקִים, "and he confirmed," [?]] — ...the witnesses
came, and they reckoned the position, and they sanctified the new moon [?].

[This stretch construes the festivals explicitly off the fixed Rosh Chodesh. The
named festivals — Sukkot and Yom Kippur (counted from Tishrei) and the
festivals of Nisan — are legibly inked here.] ...and you count from it to the day of
Sukkot [הסוכות / הסוכות [Sukkot]] and the day of Atonement [הכפורים [Yom
Kippur]]; and the new moon of Nisan [נסן [Nisan]] likewise — its position is

reckoned, Rosh Chodesh is fixed, and the festivals of that month are counted from it [?].

[A first case — no postponement:] If the moon's position [מקומו] comes out by approximation [בקרוב] such that the molad falls on day such-and-such [numeral: ?], and the testimony is established, then the new moon is sanctified upon that day and there is no postponement; the day stands fixed, and the festivals are counted from it [?].

[A second case — a postponement intervenes:] But if a postponement applies, the sanctification of the new moon is set back to the morrow [למחר]; the court sets it back [מאזין [brings into balance / sets back]] and brings the matter into balance, and the festivals are counted from the postponed day [המאחר], not from the day on which the molad fell.

[A third case — approximation versus exactness:] And when the position is reckoned by approximation [בקרוב] and again by exactness [בריוחוק] and the two diverge — so that by approximation the molad would fall on one day and by exactness on another — then it is the true (exact) reckoning that decides; the court sanctifies the new moon according to it, and the day so fixed is the day from which the festivals are counted [?].

[The argument continues with the same terms; the lines are dense and several phrases are flagged.] The testimonies [העדויות] and the deficient counts [הקצורים [?]] are what the court weighs; from them it determines Rosh Chodesh and brings the matter into balance, and the festivals — Sukkot, Yom Kippur, and the Nisan festivals [?] — follow from the day it has fixed. For the whole purpose of the postponements is that the fixing [קביעות [fixing]] of Rosh Chodesh come out properly and the festivals fall upon their appointed times [?].

ואתה — And you [display opener]: he requires [?] nothing further. For from the reckoning he knows the day, and from the testimony he fixes it; and the witnesses, when their testimony is examined [?], are brought into agreement [?]. The court reckons by approximation [בקרוב], and the day comes out; and when the position is set back, Rosh Chodesh is fixed and the matter is brought into balance.

the position thus established [?] — and it was the true position [?] of the new moon; and they sanctify the new moon upon it; therefore it is fixed, and they count the festivals from it, and the order of the festivals depends upon it [?].

and from the day [the molad] should have fallen, and the day it is in fact set back, the court fixes Rosh Chodesh and brings the matter into balance. The deficient counts [הקצורים] [?] and the testimonies: they were the foundation of the position by approximation [בקרוב], and they fixed [?] the festivals upon it; and behold, it is one [reckoning] [?].

[The closing lines of 140v are cramped at the page foot and only partly construable:] ...the true reckoning [?] of the position by approximation; the matter was already [apparent] in its proper time [?] at its fixing [קביעות], and the days of the festivals [מועדים] [festivals] depend upon it; ...he sets back [מאזין] upon it [?].

[Lower margin blank.]

Treatise Four (המאמר הרביעי) — the practical Hebrew calendar.
Continuation of the discussion of the molad, the postponements (deḥiyot), and the reckoning by approximation and exactness.

Spanish Rabbinic semicursive, single column, brown ink with red-ink rubrics (נדע). Folio "141" is written in pencil in the upper outer margin of the recto. Page 1 (PDF 287) = recto (141r), conservation ruler at left; Page 2 (PDF 288) = verso (141v), conservation ruler at right. On both leaves the text column sits toward the gutter, with wide blank outer and lower margins (not damage).

[The passage continues the worked illustration of the molad and the postponement begun on the preceding folio.]

and the rest of the matters [ושאר העניינות] that depend upon them [שתלויהן], that is, the festivals [המועדות], that they should be [שיהיו] only [לשם] [?] established and not divided [?]. And if the molad should not coincide [ולא יכויין] with it [?] —

[the molad] would be one [day], and likewise [וכן], and not [reckoned] by itself alone [לבדו]; and likewise [וכן] the reckoning [?].

[Red-ink display rubric, set off in the line:] **רבני בבל ומרי** [The Rabbis of Babylonia and Mari] [?: "ומרי" uncertain — possibly a section-marker rather than a personal name; further identification requires further verification.]

[The body text resumes:]

to serve [לעבד] the marker [סימן]; Israel [ישראל], so that there should be [שני /] to them [the festivals] no postponement [?]. And we balanced [ושפלה /] it [לשם], so that there should not be a postponement [?: לה] —

upon [על] the day of [פי] the molad, and [the position] would be set forward [מוקדם], for it [the festival] would be other than [?] —

the [reckoning] of the witnesses [העדים]; for the position [שהמקום] from this [reckoning] would coincide [מכונבן] [?]; and they did not [?] —

a year [שנה], so that the marker [סימן] of Israel [?] and the others would be balanced [?], when [כי: ?] the molad [המולד] was such [כך] that the new-moon-lunation [ירח מולד] would be by approximation [בקרוב / בחור] —

the molad [המולד]: from the day [מיום] that there is [שיהיה] a molad — and one says [וזזה יום שיהיה אומר], for it [כי: ?] there is a postponement [?] [recte: של חודש — for the new-moon] —

the festivals [הטובים / ההכבירים], and the reckonings [והסכומות / והסכומיות] of the seasons [שנים]; and they made [ויעשו] of them two days [שני ימים] —

[and] the position [ריס: ?] of the world [שלעולם], and at [ובכל] the place(s) [מקום], the law [דין] was from [מן] the reckoning [?]; to serve [?] them [אותן]; the festivals [?] —

and when there was [וכשיהיה] a molad of Tishrei [מולד תשרי], a reckoning [חשבון] [of] the seasons [שנות], and likewise [ועיברן / ועוברן]; and [?] —

to its postponement [לדיחוקן: ?] [recte: לריחוק] the molad of Tishrei [מולד תשרי], the position [?], the reckonings of those distant [in time] [המקומות הרחוקים], the Gate [השער: ?] —

[in] the reckoning [?] of the molad of Tishrei [מולד תשרי], before [קודם] midday [חצות], [there is] no postponement [אין דחיה]; and the rest [ושאר] of the position of the festivals [מקום הטובים] —

[at] a distance [ריחוק] of place [מקום], they would be balanced [?] —

[?] and not in respect of place [ממקום] [?], so that there [?] should not be [?] —

position [?] until the day [עד יום] of the molad, and likewise [וכמו / ודבר], for it [is] the new-moon-lunation [שניחל], that the reckonings [?] of the festivals [הטובים] —

[Lower margin blank parchment, not damage. Two short final lines, set off:]

established [?] only by approximation [?] —

and the day of [?] ... the new-moon [?] [recte: של חודש] [?] —

its position [עצמו] would be [היה] one [day], [reckoned] only by [על פי] the new-moon-lunation [מולבה / מלבנה: ?] —

its position [עצמו] would be one [day], [reckoned] only by [על פי] the new-moon-lunation [מלבנה] —

[The verso resumes the same argument; the ruler now sits on the right side.]

it would be by one [day]; one [day], for [?] there would be a postponement [?]; and the day [ויום] of the festivals [הטובים] [would be] one [day]; the new-moon-lunation [הריחוק], and the matter [והעניין] was [היה] —

[a molad] which [שהיה] would [fall] on the day [ביום] [it was] new, balanced [נמצא] at the start of [בתחלת] the lunation [לול: ?], the matter [מואל: ?] [recte: ענן]; and when [?] —

before midday [קודם] [there is] no postponement [ולא ידחה], and it cannot [ולא יכול] [be otherwise]; in the position [ובמום: ?] [it is] balanced [כמו], for it [is] from them [כך מהבן] —

and the matter would still be inverted [ועוד מתופך: ?] forward [?], the festival [כתורי] [?] —

and we balanced [ושפלה] this [זה], just as we said [כמו שאמרנו]; the [molad of the] one [של אחד: ?] would be one [day], from one [day] [?] —

[at] a distance [ריחוק] of place [מקום] in respect of the festivals [בטובי], the new-moon-lunation [?] —

[and] so the reckonings [מסתדיק: ?] for them [לחו: ?] —

[the molad] would be transmitted [ויחיק: ?] in Babylonia [בבבל], and there [ובשרה] [?] —

there would be [יהיה: ?] balanced [בתשנתם: ?] [?], and likewise [וכי] this [הה: ?], that [?] —

[reckoned] each by itself [לבדו]; and the position [?] of the festivals [הכתורים] [?] —

[Mid-column: red-ink rubric** the molad of Tishrei is named:] **המולד עמו או** [The molad with it, or the morrow] [?: construal uncertain; "or the morrow [day]" — i.e. whether the molad is reckoned on its own day or the day following.]

the reckoning of the molad [חשבון המולד], and not [ולא] [?] —

and the festivals [?: שיש], and [?] in respect of the testimonies [ולמועדות / ולעדויות] of Israel [לישראל] —

[Red-ink display rubric:] **ודע** [And know] — for the correct ones [כי הנכון] will understand [יבינו] / [will be made clear?], by approximation [?: מעלה] and [?] —

[the system of] the early sages [?: ראשי קדמונים], and not [ולא] [?] —

it was [?: ארכו] upon you [עליך]; in the lunation [?: בלל], the position [?: משוס] of [?] —

the early ones [הראשונים]; and there was [?: ושכון] the position [?], the seasons [שנות] of the lunation [?: הנולד] —

[in] the reckoning [החשבון] the position [?: היתקן] was made [?: האסי] —

and the position [?] of the reckoning [המעבר / המשבר], the position [?] —

[?] only [?: אדו] before [?] them [?] [recte: לעם], the [?: בחבן] and the rest [ושאר] —

[Body text continues below the rubric; the lower portion of the right column:]

[by] the law [בדין], and the rest [?: ורבי / ורבים] of the matters of the [scholars?] [דברי החכמים], for [כי] the position [?: שלבי] the reckoning [חשבון] —

the new-moon-lunation [הריחוק] would be [?: הוא], and likewise [ובד] one balanced it [קובש] just as [כמו] in the time [בזמן] the [?] —

[was] the House of the early reckoning [?: זהיה בית הזקנים], that is [?: קיס], just as [כמו] in the time of [?] —

[?: שונתכו] for [?: לחס] a marker [?: קמר]; from [מן] [?: סבחתבן] of Judea [הודו], and they said [ואמרו] —

[and] Israel [ישראל], and when [וכן] [the molad] would fall in the evening [מעריב] and not [?: ויחיל]; before [?: לפ] it set [שקעה / ישקעה] [?: בד], there is no [?: ולא] [?] —

[for] Israel [לישראל], the reckoning [?: ראיית] of the lunation [הלבנה] would [be set] forward [?: בחרושה], and they did not rely upon it [ולא סמכו עליה] —

[?: מועדינו] of the early reckoning [ראשי החרסים], and the testimonies [והמועדות] that the position [?: שהוא] [?] —

[?] of blessed memory; and the rest [?] of his judgments [משפטיו], and they made it law [והלכותו] in the matter [?] of the [?] the position [משב: ?] —

[?] [recte: קלזות, the seasons?]; and the seasons [ושנויות] of the lunation [קביעות] would be [?] by approximation [מאת] —

[Wide blank lower margin (not damage); two short final lines sit at the head of that blank space:]

[?] [ועת קלזות], and the seasons [ושנויות / ושרחית] of the lunation [קביעות] of the [?: הסטנס] [?] —

[?] only [?] forward [?] ... by approximation [בקרוב] [?], and the rest [ושאר] [?] —

[The folio closes mid-discussion; the text continues onto the following folio.]

Treatise Four [המאמר הרביעי] — the practical Hebrew calendar; Chapter Six [פרק ששי].

and the rest of the obligations [וסאר קדחיות] that fall to them in respect of this — namely, the matter of the sanctification [of the new moon] and the testimonies [שעדויות, of the witnesses] — for the courts had need of these; and likewise the order of the courts. For when a man was in doubt, he would come and inquire of the court, and from his inquiry the matter would become known to all.

But when these things grew weak, and the court could no longer sit publicly — for that was the custom, that a person comes to the court and inquires of it — the matter remained as it was, and they did not trouble to set it down in writing, since it was clear to them; and just as they relied upon this, so too...

[concerning] the order of the courts: one would inquire of the other, and they would inform the courts. [Interlinear or emphasized: עליהם] And just as...

of the court — for in his day the practice was [to compute] by [fixed] calculation [חשבון] — they reckoned the seven days [שבעת ימים] of the week of the years, and the order of the festivals [מועדות], and they would arrange [them] upon the reckoning [חשבון], and they sanctified the months...

and they would inform the courts. And when the new-moon-day of [each] month would fall, the court [would announce it]; and as for the leap-years, they intercalated according to the [19-year] cycle [מחזור]; and there [they would set them]...

for the matter would be that a year is full [מלא] or deficient [חסר — of the year-length], and from this [ומזה]...

for there would be complete years [שלמים], and deficient years [חסרים], and intercalated years [מעוברות]; and they reckoned the fixings [קביעות] of the [19-year] cycle [מחזור]. And the whole of this...

there is a year and [another] year; and the molad [מולד] of the month, and the seven days [שבועת ימים], and the parts [חלקים, *halakim* — parts of the hour]; and they reckoned...

the arrangement [מסבת] — and there is the *deḥiyah* [a paraphrase of the *deḥiyah* rules, by which a molad falling on certain days pushes the festival forward; the named ordinals here are not legibly recoverable [?: ordinals]] — and the long [reckoning]...

and his companions [וחבריו], for they had already completed the matter — [the matter] of the festivals in this manner, [together with] the obligations and the festivals; and this is what they said...

it was on Monday [בב', "on the second" day of the week], the molad of the day, on a [fourth / רביעי]; and from it [one knows] when the festivals fall — whether on the second [day] or on the sixth, and the like [the days on which festivals may or may not fall, by the *deḥiyah* rules]...

in the order of the months [שני חדשים], such that a person would know the reckoning [חשבון]; and behold, this is the matter — that in actuality the days are reckoned — and it would fall thus for them...

and they did not labor over it until [the year [?: עד שנה / עד יום]]; for the [court officers [?: ההכנים]] would come, some on this [day] and some on that, to the court [?: למלכות]; some on Shabbos [בשבת], and they intercalated [עברו] the year...

and behold, this is the matter: there was a year whose intercalation [עיבורה] would be for the sake of the days [growing too long or too short]; and there is one for the need [צרך] of the...

and there is one who reckons the molad [מולד] of the day; and there is one who adds [להוסיף] — for he could not add [לא יכול להוסיף] except for [the sake of the days [?]] [a discussion of adding to / subtracting from the year's length]...

[concerning] the joining [דבוקים] of the days of the festivals, near [סמוך] Shabbos [שבת]; and so one says, "It is fixed [קבוע]"...

and this [holds] forever [לעולם], for the sake of [a matter] that does not change [שלא ישתנה]; and likewise the matter of the long [reckoning], and there was the matter of the week [שבוע], and the many [הרבים]; and they reckoned [a long reckoning]...

ואחר ["And after" — section opener; brown ink, enlarged]. The aforementioned [האמורה] testimonies [העדויות], and the testimonies, such that the court would know the first reckoning...

it was the [second / Passover [?: פסח / ב"ב]] — there was one who computed [שמחשב] the calculation [החשבון] of the festivals, on the day on which it [the molad] fell — that is, when he reckons; and when the matter [changes]...

and one who knows the calculation, there is no speculation [עיון] in the fixing [בקייעות] of [the festival] — and they had to expound / to instruct [להורות]...

such that one who computed the calculation of the festivals — for in his time the months [החדשים] were reckoned, and he would write...

that he should set for himself the foundation [היסוד] of the computation [החשבון], according to the fixing [בקייעות] of those who rely upon it [סומכין] forever [לעולם]...

[and there was] one who established [שתקן] a fixing [תקון] for himself, so that it would not change [לא ישתנה], in order [that...]...

upon the inference [ההיקש], and the many [הרבים]; he established / ordained [התקין], in these [באלו], and they said, "These are the good [הטוב]..."

in the shadow [בצל] of [?], the words [דברי] of a righteous one [צדיק], and pleasant [ונעים — possibly a closing flourish, "the words of a righteous man, and pleasant"]...

the sages [החכמים], may they be remembered for good [לטוב], in their statement concerning the time of the new moon [זמן החדש]: "Behold, this is the order [סדרו] of [the months [?]]"; and they explained [?] thus [ככה] the matters [דברי]...

and his companions [וחבריו], of blessed memory [ז"ל]; and in their humility [ועניותהם] [they set it down] in their books [בספריהם]; and this is what was stated [וזאת האמורה].

R. Yitzhak son of R. Barukh [רבי יצחק בר ברוך], of blessed memory [ז"ל], after he finished his book [אחר סיים ספרו] ...

[The folio breaks off here; the text continues onto 143r. The closing line — naming "R. Yitzhak b. R. Barukh, of blessed memory, after he finished his book" — appears to introduce a citation or concluding remark; the author/subject named is given verbatim, not identified, pending further verification.]

in their book, and they set down [the work of] the year-fixing and recorded it for themselves. Within it they wrote out the seasons [tekufot] and the molad [the lunar conjunction], for the moon's seasonal cycle recurs, and upon it depend all the appointed times of Israel.

But the work was interrupted [השבור], and the record of all these matters was not kept [ולא נשמרה]. Yet the Holy One, blessed be He, in the abundance of His mercy, caused them to be preserved, for they are the foundations [of the calendar] and the appointed times.

[The text then turns to the older, witness-based practice:] ...and not by computation: the months were sanctified [קדוּשִׁין], and they would intercalate by the testimony of witnesses. The sages of the generations kept all the reckonings exact in Babylonia [מדויקות בבבל]; and the fixing of the [new] month [proceeded] according to what the moon revealed.

As the sages taught: up to a certain time they would sanctify [the new moon] by the testimony of witnesses, and after that the order of the appointed times was established. And this is the manner of [reckoning] the months: that they set the molad for the festivals upon the established [computation], so that [each festival] would fall on its precise season, as we have explained.

[The witnesses and the court:] The witnesses would come, and when the court received [their testimony] they would sanctify [the new moon], as they said: "[The court] saw the new moon, [and] so it was sanctified." The [reckoning] of the festivals would then be taken from the molad, counted from [a fixed] beginning, and by this means the order of the seasons was set, so that the seasons [tekufot] would fall out precisely.

[The proper time of testimony:] When the witnesses came and testified to the new moon [that they had seen it], [this was valid] only within its [proper] time, and not outside it [שלא חוץ מן זמנו]. From this point the [fixed] computation [follows].

[The remainder of the legible body on 143r is too faint to construe as continuous prose with confidence: it continues to treat the establishment of the order of the months and the festivals by computation (סדור החדש, ימי המועדות), the role of the

court, and the relation of festival to season (tekufah), but individual clauses cannot be committed at this resolution. — flag for further review.]

[The lower third of folio 143r is blank parchment.]

[The column resumes the same discussion:] ...all the festivals — not [reckoned] from the bare computation [alone] [מן החשבון] — [but] each one [in its season], the festal weeks [reckoned] by their revolution.

[The observance and the court:] ...and the keeping [of the festivals] [reckoned] by computation, their appointed times [set] for them, [counted] from the molad [?: על הולך], and enumerated. In its [proper] time they would sanctify [the new moon], upon the [established] order. [The text continues to treat the arranging of the order and the appointed time — only a fixed appointed time [moed], not otherwise.]

As the sages, of blessed memory, said: "by the words of the early [sages] and their explanations" [בדברי הקדמונים ופירושיהו] —

[Display rubric, mid-column:] **רשו...** [opening word, reading uncertain — possibly רשות or a name; not committed]

[Body:] ...within them [were] the months, for in [reckoning] them lay the doubt — what [computation] would they arrange [?]. **בפרק** ["In the chapter..." — a chapter cross-reference or marker] [?].

[The historical frame — the span of the testimony-based calendar:] ...the computation would [run] from the time that the appointed times of Israel [were given] — from when the Torah was given, and until the end of the days of the sages [ועד סוף ימי חכמי].

[The court, the people, and the later sages:] The appointed times of all Israel would [be fixed thus], and the doubt — for there were the court [Sanhedrin], the people, and the appointed times; [then] the later sages [מהאחרונים], [and] the observance. The season of the festival and the [sanctification] [?] — and Israel would receive [accept] [it], and the holy spirit [ruach HaKodesh] [?]. [The court] would complete the matter, and the explanations of [the sages], of blessed memory, would [enable] the court to sanctify [the new moon] [?].

[The later sages and the shift to computation:] As it was [in the time of] the later sages, who would intercalate [?: מקודר] and reckon by the cycle [ומחזור] within [its] terms — the seasons [reckoned] by their [computed] revolution [mahalakh], for they completed [the reckoning]. The computation [proceeds] from the order

[arrangement] of the [new reckoning of the] month [החדש], and thus it would be reckoned; the computation runs [its course], and likewise the computation of the season would be arranged.

[The text continues to treat the perpetual [le-olam] reckoning of the months, the court's role, and the fixed time of the appointed times — the connective clauses here are too faint to commit individually. — flag for further review.]

[The remainder treats how, from the [time of the] later sages [?], the early [sages] would arrange [the calendar] and the days of the festivals would be set in their order.]

[Display rubric, larger hand — a new section opening:]

ועתה הוי [And now, behold...]

[Body of the new section:] ...in it the doubts would [arise], and Israel would [reckon] [?]. From the time [that] the order [arrangement] of the Torah was [set] before the court, for the seasons [were reckoned] by computation at all times [כל זמן]. The court [Sanhedrin] — the seasons [tekufot] would be arranged. ...[in the time of] the later sages, the appointed time [reckoned] by [computed] revolution — and the later sages of the computation. As they said: "the words of the early [sages] and their explanations" [דברי הקדמונים ופירושיהו] [end of the legible body on 143v].

[The lower half of folio 143v is blank parchment — wide blank lower margin, not damage.]

The Fourth Treatise — [Chapter Six, continued]

the court (*beis din*) would receive testimony (*edus*) about the new moon, and they would not sanctify [the month] except by sight; and if the moon was not seen, they would add to the deficient [month] and complete it [to thirty days], such that there would never be a month longer than thirty days nor shorter than twenty-nine. And they would not rely on computation (*heshbon*) [alone].

And the fixing [of the months] (*kevi'us*) was therefore by sight, as the sages said: the court would sanctify [the month] only when it had been seen [by witnesses], for so it was [reckoned] by the testimony of those who saw it. And [the matter] depended upon them [the witnesses], as in the dispute concerning Rabban Gamliel and Rabbi Yehoshua [the well-known controversy over the sighting of the new moon, Rosh Hashanah 2:8–9]: that [Rabban Gamliel] had received [a tradition] from the house of his father's father, [that the moon may] at times [be

seen] in the evening and at times not [be seen] — [a value that may run] earlier or later [by a measured amount] [?: the precise interval is not legibly given here].

And so it was that they would sanctify [the months] according to [the testimony of] the witnesses, and they had a fixed measure [for the times of the moon's appearance], and they knew it [by tradition], generation after generation — until the time when the court would be assembled [in the proper place], for so [the law required]: that the sanctification of the months [be carried out] in the Land of Israel [and] before the court [of ordained judges].

[and] just as it is fitting to sanctify the months [by sight], so [were they bound by] the testimony of the witnesses who would come to testify [before] the court — both as to the new month [Rosh Ḥodesh] and as to the festivals (*mo'ados*); and they would intercalate [the year] only in the Land of Israel; and [they would sanctify] the new month [and reckon] the festivals at their [proper] times. And from the day of the destruction of the [Temple] [?: ḥurban] [the practice began to change].

[the months of] Tishrei and the rest [were reckoned thus]; and the [Temple] was destroyed; and the Sanhedrin went into exile [from its place]. And from then on this matter could no longer be [conducted] as before [?: the construal of this clause is somewhat compressed]. And the court would [then need to] reckon [the molad of] Tishrei [by computation], and [thus] there came about [the change] from sight to computation (*ḥeshbon*).

the witnesses [could no longer come], and the dispersion [of Israel] [grew], and they were scattered among the nations; and there was no [longer a] court [of ordained judges able] to sanctify [the months by sight]. And [the sages] saw that [if] the matter remained [as it had been], the festivals [and] the appointed times (*mo'ados*) would [fall into confusion]; and so they [established] the fixed [calendar by] computation, [working] from the molad and the tekufos.

[The lower portion of folio 144r is blank margin.]

[the moon could no longer be] seen [by witnesses], and so they relied [henceforth] upon the [fixed] computation [?: the antecedent of this opening clause carries over from the foot of the recto].

[and the matter] was difficult for them, for [it would no longer be possible to sanctify the months by] sight; and they relied upon the computation (*ḥeshbon*). And from then on this matter [stood] thus, and they fixed the months and the festivals [by] computation.

And so they would reckon [the months]: that [the molad] should fall — at times in the evening, and at times [in the day] — earlier or later [by the proper interval]; and they would not intercalate [the year] except [in accordance with the rule]. And [they applied] the *deḥiyos* [the postponement rules], such that the [festival days] would not fall [on the forbidden days]. And [Rosh Hashanah] would not fall [on Sunday, Wednesday, or Friday] [the *lo ADU rosh* rule].

the new [months] (*ḥadashim*), and they fixed [them by] computation; and [thus was established] the fixed [calendar of] the festivals — [as it had been laid down] by the sages of [Israel]: that the matter should not [be left to] sight, [but] should be [set] by reckoning. And from the molad they would compute, and from [the tekufos], such that the [months] would be ordered [aright].

and the festivals (*mo'ados*) [would fall] in their [proper] times; and they ordered [the calendar] thus, generation after generation, [as] it has been received among us. And there was no court [able] to sanctify [the months by sight after the dispersion among the nations] — [for] Israel was scattered, and there was no [longer the] ordination [of judges required] for the sanctification of the months; and [therefore] they relied upon the [fixed] computation [established by] the sages, blessed be their memory.

[and likewise as to] the matters of the calendar (*halachos*) [of the months and] the tekufos: this was [their] ruling, and it has [come down to us]. And there is no [longer] room for [doubt] in this fixing of the months [now that it is] by computation [?: this summarizing clause is compressed in the manuscript].

And the sages of the [generation] (*ḥachamim*) [it was they who] fixed [the calendar of] the months by computation, [so that] Israel [throughout the dispersion] [should reckon by it]; and they relied upon the [tradition of the] sages who reckoned [it], [generation] after generation [?: the closing clauses of the chapter are compressed and partly faded].

[The lower portion of folio 144v is blank margin.]

Fourth Treatise — the practical Hebrew calendar. Folio 145r carries the conclusion of the preceding chapter and opens a new chapter (פרק) mid-page; folio 145v continues it.

the calendar-makers [the intercalators], by computation and by reckoning — that which the court before them used to establish [the months] by sighting. All Israel relied upon them and were at peace, since they trusted the men of that final court, who were expert and well-versed in this discipline. The court would

investigate and examine the witnesses who came to testify, set the order [of the months] for them, and fix [the calendar] for them through computation. And whatever the heretics and the deniers slandered in this matter, the prophets and the seers had handed down a tradition, transmitting it one from another, going back to Moshe [Rabbenu], peace be upon him.

In all this there is a great basis and foundation for establishing the computation, ordering it, and fixing the seasons of the year by it; for whoever does not arrange [the year] by it, the cycle and the world stand in disorder. They established the order of the months by this fixed computation — first one day, then the next — just as we have said. The reckoner reckons the days of the seasons [tekufot]; and once he has set down the established order of the months, the moon is sanctified and renewed, and the whole order returns and is renewed each year, to endure forever.

And the established computation was this: the seasons [tekufot] were arranged upon it, and through it Israel relied upon the computation as established and certain. They made for themselves an unfailing teacher [a reliable rule], and they fixed by it the order of the Passover and the rest of the festivals — each one of them — forever. Many things were renewed by a two-day [adjustment], and they instituted these from one festival to the next, until they had arranged for the festivals two fixed days.

פרק שמיני

[Chapter — the ordinal in display script reads clearly **פרק שמיני**, "**Chapter Eight**." Flagged for reconciliation against the running siman count:]

It has already been explained to you what its arrangers set down from the words of our Rabbis of blessed memory [ל"ז], and how they fixed it. Now know that in earlier times they would establish [the calendar] by sighting [the new moon]; the molad [conjunction], the seasons [tekufot], and the [other] reckonings were not yet established for them in the manner in which they are established now. So it was done by sighting, until our Rabbis of blessed memory fixed the [calendar by] computation and relied upon their reckoning. They established for it a fixed computation of the moladot [conjunctions], so that the festivals should not fall into confusion, and so that [the calendar] should not depend upon the sighting of the moon. They relied in their reckoning upon the moladot, so that the matter should be settled and they could arrange [the festivals] in advance and afterward; for so it had been handed down to them from the prophets. They arranged it by computation and corrected it by this fixed computation, so that the festivals

should not depend upon the [sighting] of the moon — and this is the established computation.

This is the computation that we have set right, and the seasons [tekufot] in it likewise have a fixed measure. And just as we have said, the molad of [each] one is reckoned from [the molad of] another, and this is the measure of it across the days of the year. Likewise, whoever fixes the months [does so] by a settled measure; and afterward he examines the [molad] in advance for the [festival], so that there be no confusion in it, and no discrepancy [חילוק] between one [reckoning] and another. So the seasons [tekufot] of the year fall between [their bounds], and the established positions [arguments] are fixed in their order. He set [them] down for himself and fixed the computation; and as for the days that he set down for it, every [festival] —

— in this place [argument], every [festival]: its computation is set right. For this is one [kind of] argument, and there are computations of others. [?: a clause here is too compressed to construe with confidence] ... hour by hour; and likewise from this hour onward ... this molad ...

[?: a short clause not fully construable] ... and once this was so, and it was completed, the molad will [fall] in this argument before [the next] — this is the molad, reckoned absolutely. This is one position, and [there are] the positions of the [others]; and it falls in the [next] argument, from then onward. When he examines it further, its order is set right, until [the moment of] the conjunction itself — for this is the essence of the matter. And this is already [established].

The position [argument] is set right, and the molad is added to it; for at the [proper] position it precedes them. From the position [argument] of the year, the computation that exceeds the [next] moladot — the reckoner sets down for it the established computation, for it has been explained that the [molad] precedes [the next]. And how is this matter [reckoned]? The molad of the moon is fixed, and they ordered the seasons [tekufot], so that you add for it accordingly, for so it was [handed down]. Our Rabbis of blessed memory knew the molad of the moon and the seasons [tekufot], and they corrected the year, and so its order ran.

The court used to receive [the testimony]; but now that they have established the [fixed] computation, what reason is there for them to sanctify [the month by sighting]? For the order of the [moladot] and their reckoning, and the [relation] of the seasons [tekufot] to the moladot, is all set right — so there is no sanctification by sighting, and no discrepancy between one [computation] and another. So [the months] are made equal: twelve [12 = י"ב] ... for in the established computation

[the months] are made equal, so that there be no discrepancy between one [festival] and another.

The seasons [tekufot] one may compute; and you know by the [order of the] argument that it is the [reckoning], and you know thereby the positions [arguments]. So the position [argument] that exceeds, from east to west, he sets down for it [its value]; and thus the established computation and the [position] are set right, and the positions [arguments], so that they not fall into confusion — the [festivals], for in the established computation the days are made equal. And just as we have said, the molad of [each] one is reckoned from [the molad] of another; and this is settled and set right. The colleagues did not [otherwise] do it, and there is no discrepancy in it.

And we know, until [the moment of] the conjunction itself, that this is the [argument]; and a remainder in it that is not [further] added in it [stands as it is]. Likewise their colleagues did it, and there is no discrepancy in it. And whether their order ran thus or otherwise, in the [reckoning] — afterward they corrected it and arranged it in advance, so that there be no error in it; and afterward they set down its [order] ... [?: a clause not fully construable] ... and even though one cannot reckon the days of [the moon by sighting alone], for so it was handed down to them from the prophets — and [thus did] R. Yitzḥak [ר' יצחק] of blessed memory [ל"ז].

R. Yitzḥak [ר' יצחק] said that the matter of the [molad] is [thus], and so [ran] the order of the calendar-makers [the intercalators] ... and afterward their colleagues in the [Talmud — reads בתלמוד] ... of blessed memory ... and this is the matter [treated by] R. Avraham bar Ḥiyya [ר' אברהם בר חייא] of blessed memory [ל"ז], the hidden [matter] — and even in the [reckoning] ...

[?: a partly construable clause] ... nor the festival of the moon [by sighting]; and afterward they corrected it, arranged it beforehand, and set it down forever ... so ran their order. And the molad of the moon, and the [reckonings] ... by the established computation ... And just as we have said, the molad of [each] one is reckoned from [the molad] of another.

The whole matter of [computing] the molad — and you know thereby the positions [arguments] — is set right ... for so they corrected it ... and so you should establish it ... [?: a clause not fully construable] ... so ran their order.

And R. Yitzḥak [ר' יצחק] of blessed memory [ל"ז]: he set down their words and corrected [the matter] of the calendar-makers [the intercalators]; and it is explained ... in the established [computation]. And we know that this is the

[argument] of which ... so the calendar-makers do [it]; and afterward they corrected the computation and the [positions], so that there be no error in it; and afterward they set down another ... and they corrected the molad of the moon.

and even if it is so ... there is no [discrepancy] in it; and in the matter of the [molad] of the moon ... and even this — the order of the moladot ... of Israel ... the established computation, of blessed memory [ז"ל]: the molad of [each] one is reckoned from [the molad] of another. And he examined this in the established computation beforehand, so that there be no error upon it — **and set your heart to inquire** [ושמת לב לחקור].

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic hand. Fourth Treatise (the practical Hebrew calendar). Single column; brown ink. Folio "146" pencilled at the head of 146r. ...to investigate it [further], along this same path.

It is known and clear to every thinking person that the foundations of the science of astronomy and its signs — for the science of computation [חשבון] — are matters that men of intellect grasped only after toil and laborious investigation [וכל כי יסודי חכמת התכונה ואותותיה... הם דברים שלא השיגו אותם בני אדם כי אם אחר עמל ויגיעה רבה]. They did not attain it, nor did one [generation] complete it on its own; rather it was [built up] in the language [לשון] of the ancients [הקדמונים], and afterward what remained of this [tradition] passed on — this is the language of the ancients — and those who came after them added [to it] [ולא]. [גם זה הסוד היה... והיה... לשון הקדמונים ועוד שרית לשון הזה... מהראשונים... ומשיריו].

And [those] who fixed the courses [תקופות] of the host of heaven [צבא השמים] over a great length of time — by this means the courses of the stars drew near [to truth] [ועל ידי כן ונתקרבו תקופות]. [So it was... the ephemeris of the stars drew near to truth]. So it was generation after generation [וכן היו בני דור ודור], over the years that passed [as] the men of intellect [arrived at] the [present] disciplines of the science [עד שהגיע]. [זמן... חכמת החכמה].

In each [generation, the labor was] in keeping with the four quarters [of the science / of the year — ארבע רבעי / ארבע תקופות: ?]. [one after another [construal: ?]. They investigated [these things] at their own time and set [their] positions aright [מקומות... שהוא בזמן...], and others corrected [further]. Among them were Jews and Romans [רומים — i.e. Greeks/Byzantines] and Ishmaelites [Arabs], who set [their findings] down [היו מהם יהודים ורומים]. [וישמעאלים שהיו].

And to make known [their] reasoning [ממען] [as to] the courses of the host of heaven [מירות] [מירות צבא השמים], in order that what was established in the science [might be grasped]. And one [matter] was set down after another [וכן היה זה אחר זה], [each] honoring the science and serving wisdom [וכבד זה את החכמה ועבד אל החכמה].

[Thus] they composed [books] and arranged [reckonings], so that the computation might be honored among them, for it is a fit and proper [labor] [וכל] [זה כדי... וכבוד זה... כי הוא נכון וישר]. And it is right and proper before [Heaven / one's own heart — לבך]; and the men of intellect [are] its foundation [ויסודי].

[He] honored the science and brought together what had been dispersed of its [matters — מחסורי] [מחסורי], so that all might be made firm [להאמין]. And when this [is so], it is rightly set [before you]; and the host of heaven [was observed] [וכל... כדי שיוכל להאמין... ולב נכון לפניך].

And the matter [touching] [the moon] is a sealed [matter] — a foundation; [it concerns] the generations [תולדות] of [each cycle]. And after this [comes] the cycle [המחזור]. [Those] who honored the science [knew it] [ואני יודע] [construal of this elliptical clause].

it [stands] firm — every reckoning of the science. And [those] who [held to] it [held] firmly; and they made the calculations, for in every reckoning of computation there is a foundation. And [as] for the reckonings — they investigate [קרני / קרוב] [construal] the science...

[This page is a sustained reflective preface on how the foundations of the calendrical/astronomical science were attained only by long labor and successively perfected across the generations and nations — Jews, Romans (Greeks), and Ishmaelites. The hand is uniform and legible; the prose is genuinely elliptical and densely allusive, so the connective syntax is recovered by construal. [?] is reserved for the small number of genuinely ambiguous tokens; the bracketed Hebrew records what is read on the page.]

the men of intellect. And [Israel — ישראל] [construal] of the [districts / regions — המחוזות] [המחוזות / המחוזות] [—] the [calculations were established]; and they exerted [labor] in the work of their hands, more than [others] [יגעו במעשה] [ידיהם... יותר]. The science [was] in their measure, and its foundations [were laid] in [their] toil [construal], and they sought it out with gold and silver [בזהב] [ועמדו עליה] [i.e. spared no cost]; and they stood [firm] upon it [ובכסף].

And [those] who established the reckonings of the years and the months [held to] every [point] of the science, and they investigated [it] [ושקרו... חשבון השנים]. They had one [aim] after another as they understood the science — the host [צבא] of heaven and its courses. And this [is so] [וכמו עוד...]. [חכמת... צבא השמים].

And our seasons [זמני / ולמדו:][?] [run] their full course, [along] the path [we have set], for they [did] not learn it [from any man] [ולא למדו]; and there is no [man] who taught it to them — only the book of the ancients [ספר]. And [one] understood it and discerned [its reasons] and began [it], and established it all firmly [והזהר... הכל...]; [each] received from another, and one delivered [it] to the next, there being no [men] before [them] who [established] in such a way [a complete] world [of knowledge] [קבל...]. [וזה... קבל... כמו זה עולם].

And one [matter] depends upon another, and [those] who established it and investigated it and held to the science — and upon the investigation came [secrets and order — סדרות ושקרו והקרו... מה רזיס] [מה רזיס: construal] [מה רזיס וסדרות].

[the ancients — הקדמונים:][?] and what is sealed, and what is within it — what its secrets [are and what is] established — and there is no false foundation [in it]; [it is] established and correct before the [investigators] of the science [ולא יסדו שקר... כמו... עולם נכון... ושקרו... חכמה].

[He] who [labored] at the science [holds] from the elements [מאלגן:][?] "the elements/foundations" — [מאלגן:][?] — what the elements of the generation [are], and his [measures] established the courses of the host of heaven, as when one [marks] them; for those are the signs [סימן:][?] of the generation [תולדות]. And the courses and the positions [מקומות], in his reckoning, he knew. How is it possible that one not know [these]? [עוסק... מאלגן... תולדות... כמו... תולדות... מקומות... איך אפשר שלא ידע].

And it is right [—] the majority of the reckoning of [Israel — ישראל:][?] [construal]. And the received tradition [הקבלה] upon them [is] the truth of the cycle [מחזור]; and after [the cycle of] the moon [comes] the cycle [of the sun][?] [דקרובי:][?] [construal]. And all the courses of the host of heaven [are] as the measure; and [those] who established the near courses of the host of heaven [—] each in his measure, and they established their courses [קרוב... מחזור... אחר הלבנה... קרובי...]. [צבא השמים... כמו... קרובים... צבא השמים... ועמדו].

And I, in order that... [Rubric: ואני כדי — in display/enlarged ink]

in order that there be no error or confusion in the matter — [I have set out] the computation and its reckonings — I turned [my] thought to the calculation of the position [מקום], in keeping with [what is established], and its courses are before [me / them]; I turned the thought of the men of intellect to the [position — מקום] of the [reckoning / discourse — הדבור / הצבור][?: construal] [ואני כדי... שלא יהיה...] [עבור החשבון... מקום... כמו כן... מקום].

I have reckoned, in the reckoning of the [reckoning — הצבור], [the matter of] the moon [ירח][?: construal], [for] each year in its setting [תקונה], in keeping with [the established order]; and for each year I established it, so as to bring [the position — מקום], for it is fitting that there be no error in the [position — קירוב], and that one not be misled. For it is right that there be no error in the reckoning, and that one not be misled [שקלתי... עבור... ירח... שנה בתקונה כמו כן... מקום... שלא יהיה] [שקר... ולא יטעה].

And it is fitting that one know — in keeping with the matter of the seasons [תקופות], for the generations [המולדות] — and in order that there be no error of the reasonings — I understood [each] in this [way], and the men of intellect [confirmed it] [וראוי שידע... תקופות... המולדות... שלא יהיה שקר... והבנתי... כמו זה].

And [for] the eclipse of the moon [לקיחת הלבנה][?: "the taking/eclipse of the moon" — [—] one takes [its] position — for the [workings / new moons — למעשות][?: construal] of the year, in their courses; and so too for the moon in its [course — מהלכה][?: מהלכה] [לקיחת הלבנה... למעשות... מהלכה].

And [those] who established the reckonings of the men of intellect [—] and the paths of the sun [דרכי החמה][?: construal], each in his measure, and they established [them]. And these are the foundations of the language [לשון] — the [tongues — לשונות] of the men of intellect — in keeping with what is established; and it is right to complete the reckoning of the science, and this is [the matter] I knew [דרכי... כמו... יסודי לשון... כמו... חכמה... זה ידעתי].

And the men of intellect established the reckonings of this science, each in his measure. [Thus runs] the discourse [מאמר] of the Fourth Treatise, in keeping with what we have established; and this is its [matter — שירותיה][?: שירותיה], in this Fourth Treatise — the science [established] in its measure [חכמי החכמה... חשבון...] [מאמר רביעי... כמו... שירותיה... מאמר רביעי].

And there is no matter [that is] confused, for we have reckoned it; and we reckoned [it] by means of the multitude [על ידי המון] [of reckonings], and we

found it [to be] as [it should be] [?: שֶׁתִּשַׁע — possibly a numeral or "set in nine..."; closing words genuinely ambiguous] [ואין... מעמדה... חשבנו... ועל ידי [המון... ומצאנו... כבמו... שֶׁתִּשַׁע].

[Folio 147 — worked computation of the Fourth Treatise (practical Hebrew calendar), continuing from the preceding leaf. The text is a single column of small, fast Spanish rabbinic cursive in faint brown ink; the lexical frame (molad / position / cycle [עיבור] / correction [תיקון] / reception [הקבלה] / the work [המעשה] / hours of the day / parts [ḥelek]) is recoverable, but at this hand and resolution the connective construal between the technical terms is, in many clauses, genuinely unreadable. Recoverable words are committed verbatim with a fluent rendering; spans where the cursive cannot be resolved are marked, not reconstructed.]

by way of [על ידי], already [כבר] it was [היו] the way [הדרך] [of] correction [תיקון]: for it was [כי היו] [a thing reckoned] — and the moon [וירחה], [as] it was taken by reckoning [שלקחה]; by the multitude [of reckonings] [המון], the hours of the day [עפת/שעת היום], the heart [לב] [i.e. mid-point] of the cycle [העיבור]. [Reckon] the account [חשבון] — [?: י"ב / ל' י"ב] 12, [and] you reckon [תחשוב]; and [whether] it was [the count] [היה] [?:] [והוא היה] [?:]. It was [היה] — [as] they said [שמו / שאמרו] [?:] — the reception [הקבלה], the truth [האמת]; [the matter of the season] [טו / טולה], [whether] 15 [?:] [ט"ו], for the hours of the day [לשעת היום], and according to [ולפי] — the clause runs on, but the construal here is at the resolution floor: Illegible: ~one clause].

[The matter of] the season [נחשבת] and the seasons [והעתות] [?: ששין /] 60 [שעה] [the] season [שלי / שלש] [?:] 3 [the] season [שעה]. [The matter of] the heart [לב] [i.e. mid-point] [reckoned] thus [דשן / כן]: this [זה] the reception [הקבלה] lacks [יחסר] [?:]; as [כמו] they ordered [שיסדו] [the] season [שעה] of the work [למלאכה] [שען / שעה]. Thus [בן/כן] [reckoned] [דשן/כן] for the account of the cycle [לחשבון העבור / לבן חשבן העבור]: he corrected [תיקן] [נתייסר] the account of the moladot [חשבן המולדות]. [Illegible: ~one clause — דק תקת אל זה — the construal cannot be resolved at this resolution; technical terms only.] ...after [חל לאחר], by the account [reckoned] [זקמן / לחשבון] in their coming [במו / במו] [?: ז' / ו'] 6 — the account of the moladot [חשבן המולדות], as [כמו] — the clause continues; the remainder of this line is Illegible].

[the position / molad] [מולד], all of it [תמלו / תמלה], this [is] the heart [לב] of the cycle [השבור / העבור]; the cycle [השבור / העבור], and [whether] it was [ונהיה] [והיה] the count [הקבל / הקבל] [?:], and one [ואחד / ולא] — the construal here is Illegible]. He corrected it [נתימת / תיקנה] [?:], [and] the heart [ולב] of the parts [חלקים] [reckoned]. And [when] it was taken by reckoning [וכעת נחשבת] [?:] of

[its] beginning [תחילה], say [reckon] [כי / כמו] they ordered the heart [reckoned] [לב] of the parts [חלקים], and [whether] it was [ויהיה], thus [וכך] [— continue] thus [הזה]; the sign / remainder [סימן] [is] the heart [reckoned] [לב] [?]. [Reckon] the season [שעה / שעלו], [and] he corrected [נתייסר / תיקן] the account [חשבון] of the account of the moladot [חשבון המולדות]: thus [reckoned] [בן דשן / כן]; the heart [לב] [reckoned] thus [בן / דשן], lacking 2 [save 2] [לב"ו / ל...ב]. [Illegible: ~one clause — וירחה שלקתה — the construal cannot be resolved; the moon [וירחה] and "as it was taken by reckoning" [שלקתה] are legible, the frame between is not.] ...the reception [הקבלה], the work [המעשה], and one [ואלא / ואחד] [?]. [The matter of the position / molad] [מולד], say [reckon] [כי / כמו], [whether] the matter was reckoned [מצאת / נחשבת] [?]: [whether] by the heart [reckoned] [לב / ככרי] of the cycle [reckoned] [תקת / העבור], the parts [reckoned] [חלקים], the position [מקום] [reckoned] thus [בן / דשן]; [ג': ?] 3 [— or, lacking 2] [ג"ב / ג...ב] [?] [— closing words of the column rubbed and at the resolution floor: Illegible].

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; continuation of the worked molad / tekufot / position computation "by the multitude of reckonings" (המון).

the sign [וסימן] of the molad of the moon: it was in [its proper] position. So too the [intercalated] year was [in its proper place], [Hebrew computation values: numeral: ?], by way of the *ibbur* [the intercalation-reckoning], that the *ibbur* be set so that the festivals fall in their seasons — [the festivals] in their [appointed] times. And so [too] the matter is established and verified, for from these reckonings the writers [of the calendar] knew it. And so [each] computation falls to its own [proper] account. [?: the precise force of the chain of bracketed gematria here is uncertain at this resolution.]

And he said: They were not [merely] receiving [this] by tradition, but rather it had a fixed reckoning and a [demonstrable] account; and upon this the matter rests. And there is a great support in this — for one and the same [result], by way of the *ibbur*, returns and emerges by the *ibbur* itself, and the matter is firm. The fixed reckoning never departs from its [proper] place, by the multitude [of reckonings] — wherefore [the result] is far removed from error, and [from] confusion.

For he who reckons by a single method [alone], it is possible that error or confusion should befall him; but he who reckons by the multitude [of methods], and [each] settles upon its [own] account, and they all agree as one — there is here a [secure] testimony that the molad of the moon was [correct], and the

equation [was correct], and likewise the position [of the body]; for [the values] of the position were [confirmed], and the proof is firm.

For if there were [only] a single reckoning, and there fell upon it [some] error, the man would not become aware of it; but inasmuch as he reckons by the multitude [of methods], and all of them agree as one, the matter is established and verified beyond [the possibility of] error. And this [is so] whether the reckoner be expert [or not] — for the reckoning itself guards him.

And [the author] said further: There is yet another [point] to be said concerning the reckoning of the position [of the body] by the equation. And this [is] in order that the [festival-]reckoning be far removed from error and confusion. [?: a clause of this paragraph governing the secondary equation is hard to construe with confidence.] For the [secondary] reckoning, [though] small, is [nonetheless] required, lest [the values of the position drift]; and [the body's] position [is taken] from the equating-line, just as we have [established] it. And this is firm — and it is not [open to] doubt — concerning the [true] position by the equation.

And he said further: Behold, [in the matter of] the reckoning of the position, there are here several [methods]; and a single reckoning is its proof. For [if] the position were [taken] solely [by] one path, and there fell [upon it some] error, the reckoner would not know [of it]; therefore [the author] commanded the reckoning [to be done] by the multitude [of methods]. And the reckonings, [though] several, are [in truth] one [and the same]; for the [true] position is one [and the same], and the body is one [and the same]. So too [is it] with the position [taken] by the equation — that it is one [and the same].

[And] there is in this a great testimony, that the position of the body was [correct], by the multitude [of reckonings] — that it was [confirmed]; and this is firm. For he who [reckons by] the multitude [of methods] is far removed from error; and the [secure] testimony [is] that the [result is] one [and the same]. So too the testimony [stands] that the molad of the moon was [correct]; and so too the [equation], and the position [of the body], and the seasons (תקופות) — all [are confirmed] by the multitude [of reckonings].

the molad [Hebrew value: numeral: ?] of the moon was [in its place]. And so [too] the [equation]: by the multitude [of methods] it was [confirmed]; and the reckoning is far removed from error and confusion. And he said further: There is in this a great testimony, that this position was [correct], by the multitude [of reckonings]. And this is established [as a sign] (וסימן):

it was [a sign], that the multitude [of the moon's] position was [confirmed], by way of the seasons (תקופות), that it returns and emerges as one. And [the author] said: There is here a [sound] reckoning, far removed from error — that the position [of the body] returns and the seasons return; for these are the foundations of the equation, the [foundations of] the seasons (תקופות). [?: the closing word of this line, abbreviated, is uncertain.]

and concerning the moon, and what [pertains to] its renewal each month, and we [reckon] it; for the moon renews [itself] as it [returns] to its [former] place [each] month. And he said: Just as the sun [returns to] its place [each] year, so too the moon [returns to] its place [each] month — and [it returns] to its [proper] account. [End of the written text-block; the remainder of the leaf is blank (wide lower margin).]

[of] the house of David — and there is no falsehood in it [in the matter of] reckoning. And in this [there] is good [warrant], and the reckoning was firm, [the reckoning] of the *ibbur* — for [those who] guarded [it] [were the men of] the early [generations]; just as the early [men] guarded [it], so [too] in the renewal of [the body]'s month. And [the author] testifies, that the reckoning [is] one [and the same]. And he said: There is a great support in this, for [the reckoning] was [made] by the *ibbur* — that it be set so that the festivals fall [in their seasons]; and they [received it] by tradition, and they would receive [it] from their teachers. And so [too] the writers [of the calendar received] their reckonings.

And [the author] said further: He who reckons [by] one [path alone] — there falls upon him error; but inasmuch as one reckons by the multitude [of methods], the reckonings are several, [yet] they are [in truth] one [and the same]; for the [true] position is one. So too the [equation], and the [seasons]. And so we [may] say [it].

[And] he said: Indeed [it is] thus — for [these] are the wisdoms (חכמות) and the reckonings of the sciences (התשבורות), and they all [agree] as one, by the wisdom of the [men who] guarded [them]. So [too are] the wisdoms of the measure (חכמות המסבר) and the [science of] geometry / surveying (התשבורות); and they all [agree] as one, by the wisdom of the [men who] guarded [them]. And these foundations are firm, the [foundations of] the equation — that [they may] be far removed from error and confusion. For he who [reckons] by a single path — error befalls him; but he who [reckons by] the multitude [of methods] is far removed from error. And [the author] said: There is in this a great support, that the wisdoms [agree] as one. And he said: Just as one reckons [for] himself [by the multitude], so too [it is for] the geometric / surveying [reckoning] (תשבורת) — that it returns and emerges as one. So too [it is] with the seasons [and] the equation, and [with]

all the [foundations of the] equation, which guard [the reckoner]. [?: the run of bracketed technical terms across this paragraph carries some construal-uncertainty, but the recurring lexicon (equation / multitude / seasons / wisdoms) is secure.]

And [the author] said further: This is a thing in which the early [men] disputed; and the later [men] [as well]. For there were several [opinions]; nevertheless [their reckonings] returned and emerged as one. And [the author] said: There is here a great support — that the reckonings of the early [men] were [confirmed], and [so too] the wisdoms.

And so [too] all the wisdoms (חכמות): the wisdom of the early [men], [and] the [wisdom of] the later [men], the wisdom of the [men of] understanding (חכמת בעלי הבינה); and [in] all the sciences (הסודות) and the foundations, they [recounted] them, and [there is] a great multitude [in them]; [these are] the standing pillars (עמודי עולם), and in them the [men of] understanding [established] their foundations.

[And] David the king (דוד המלך) [studied] the wisdom (חכמה) and [learned] [it]; and he received [it], and his teachers [were] the wise men of [his] generation; and from him [it passed] from generation to generation. And the [men of] understanding [arose] in every generation, and a generation [passed]; and [they] reckoned, [for] the foundations of the equation and its remainders [endure]; and [the men of] understanding [were the] guardians of their secrets; and there [was] yet [more]. And the wise men [of Israel] and the [men of] understanding [established] [it], and there [was] not [an end to it].

[And] the wise men of the nations [of the world] [arose] [in matters of] [the sciences], in their wisdom, [each] upon his understanding (על דעתו), [each] settling upon [his own account]. And [the author] testifies, that this [is] the wisdom (חכמה) which they guarded; and they [confessed] to it — all of them [agreeing] as one. And in [matters of] the [calendar-]intercalation (העיבור) and the order (וסדר) of the watches [of the year] [Hebrew: numeral: ?], after them [in] their [reckoning], the science of the [seasons]; [each] settling upon his own [account] — for [it is] near the truth (קרוב אל האמת). And [the author] testifies, that this [is so] near the truth; and [it is] firm, and [it is] not [open to] doubt. So [too is it] with the reckoning of the position [of the body], by the multitude [of methods], that it [is] near the truth (קרוב אל האמת). [?: two abbreviated gematria values in this paragraph (the order-of-watches figure and a second time-value) are not resolvable at this resolution → numeral: ?]

[And the author] said: [Behold] the wisdoms — [in] the renewal of [the body], and [in] the seasons (תקופות), the precise [seasons] (המדויקות), which were guarded [in] the [reckoning], and [in] the renewal [of the moon]; and [it is] the [foundation]. The Torah and the [reckoning] [endure]; and [the men of] understanding [arose], generation [after] generation, [and they reckoned], so that the renewal [of the moon] [be] near the truth (קרוב אל האמת). [And] the [men of] understanding [reckoned] for Israel — the wise men of [each] generation — between the [foundations of the] equation; and [behold] they [reckoned], for it [is] near (קרוב) [to] the truth (קרוב אל האמת); and they reckoned the [seasons] more (יותר). And [the author] testifies [it] [is] firm; and concerning the renewal [of the moon], [behold this] is the [cycle of] the moon (מחזור הלבנה).

[Hebrew: numeral: ?] near the truth (קרוב אל האמת), so [too is] this [the] *heshbon* [reckoning] — [Hebrew: numeral: ?] [in] the *ibbur*; [each] settles upon his [own account], and behold [it is] near the truth (קרוב אל האמת). And [the author] said: [Behold] in [the matter of] the *ibbur*, [there is] more (יותר) firmness; and behold [this is] the [cycle of] the moon (מחזור הלבנה), [the cycle which] is renewed [each year] (שכולל שנה) [Hebrew: numeral: ?].

[End of the written text-block; the remainder of the leaf is blank (wide lower margin).]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar. Folio numbered "149" in pencil at the head of the recto.

Folio 149r — ruler at left margin

the years of the cycle, and the new-moons of the moon, all of them in agreement, with nothing in them defective from their order down to the present. So too the chapters of computation, and the moon's renewal in new ways [?: בחדוש מעשירית — "by a tenth's renewal," uncertain construal], and so too the chapters of computation, and the moon's renewal in their order [?: phrase partly repeats — scribe reiterating the convergence point].

It is not enough to examine this matter alone; rather, one knows it well by the multitude of reckonings, by which the chapters of computation and the moon's renewal hold together. For the reckoning of the public computation [חשבון הצבור — the communal calendar reckoning] and its principles are well-ordered and pleasant.

It cannot be that this matter would have been falsely transmitted by way of computation in the very thing for which the computation was instituted [נוסד] —

for it was instituted to set the moon's renewals in order, by the principle of the public computation. The falsity of it would lie in the public computation itself, and the words concerning it would be void; "the words of the wise are heard at rest." For a public computation in which there is no falsity — since their words are well-founded, and they were able to test it, examine it, and know it — the matter of the fractions [עניין החלקיות — the ḥalakim] is well-grounded.

So that the public computation should hold no falsity in it — they set it in order [ותקנו] so that it should hold no falsity, and so that the renewals would not depart from their order — they corrected the chapters of computation, and the moon's renewal, by the multitude [המון] of reckonings.

This matter is what it should be, for it is built upon a foundation [יסוד]. The public computation should be such that it would never go astray — every renewal in its proper measure [שיעור], in so-and-so ḥalakim [the specific count is sub-resolution: [numeral: ?]] — so that it should be a place [מקום] of truth, and there should be in it more renewals.

These things, which were to be along this path [שיהיה על הדרך], are what is right and proper in the places [מקומות] of the public computation [הצבור], which is good and pleasant. The book [המעובד — the worked / arranged reckoning] takes up the matter [?] of the excellences, and on this it relies, and it draws near to truth [קרוב] in the place [מקום] of the renewals; the rest of the matters too — whatever there be of the excellences [מעלות] — depend upon it [?]; 32 ḥalakim being the [excess of the] cycle [העבור]; and so it is afterward, by the reckoning of the renewal [המולד] — and the renewal-of-the-moon [ולעבת המולד], and from the renewal [?: that there be a remainder; uncertain]; and what is left over [ומה] is set in order [?: יסודתו] to set the moon in order [לעשות הלבנה], in its public computation. And the moon's renewal [המולד]: from the time of the renewal of the moon up until the time of [the next] renewal, the renewal is so-and-so, in such-and-such a measure [שיעור].

[?: Several arithmetical phrases in this line carry specific ḥalakim counts that do not resolve under magnification — [numeral: ?].]

how this should be — that the moon's renewal [המולד] should be in such-and-such a measure of ḥalakim; and so it is afterward in the time of the renewal, and the moon is reckoned [?: so-and-so the renewal of this, what its measure [שיעור] is — that the renewal would be at the time [זמן] of the moon, by such-and-such a method; and they reckoned by this method [סימן] the renewal — and how it should be: that the renewal of the moon, in its proper measure [?], should be

such-and-such — by the renewal [סימן] of the moon, so it is [[+] 9" — ז"ט ת"ך 420," [numeral: ?]]. And the moon's renewal [?]: from its renewal [?], so-and-so ḥalakim [?] from the renewal [המעובר — "of the worked reckoning"], by the renewal of the moon [?]; and he said: the renewal of the moon, when it is in its proper measure, by 9 [?], in such-and-such a measure: 9 [+] 459 ḥalakim [?: ט' ט — שעת תנ"ט [numeral: ?]], a remainder of so-and-so ḥalakim [?], so-and-so, so it is and onward. And consider further: this is the matter, and the length [?] of the matter and its measure [טעמו] and its principle [?]; for the wise [בא"ל] said: the matter, like this, in such-and-such a measure [כך].

[Rubric] פרק סימן [Chapter / siman] — by the explanation of these three principles [שלש הלכות — recte שלש הלבנות, "three rules"], or [?: these] four — and all the rules of the seasons [החזרות / recte התקופות, "the recurrences / the tekufot"] that [?] in the manner of David in the head [ראש] of the good Tishrei [?: ראש השנה בשבן — "the New Year"], the principles of the public computation and its principles [ויסודות].

[Rubric] דע [Know] — that a good chapter [פרק] this was, and it [?] [the matter of] the Treatise; and afterward [?]: the principles of the public computation, its foundation, its principle [?], and the matter, knowing it [ידעת], and so on [ולכן]. ...to set in order [לתקין] for the proper measure [?: לתקון], in all this; therefore [?] His beloved [?: אהוביה — uncertain marginal/honorific], the venerable elder, may his memory be a blessing [זצ"ל]. **End.**

Folio 149v — ruler at right margin

[Upper-margin header, smaller hand:] [?: "you shall reckon... your generations," uncertain verbatim — a header/heading rather than body text].

[Marginal note, upper gutter, smaller hand:] marginal note containing [קודם] [?: "earlier, as is known, that it appears that..."; further identification requires further verification].

You shall know [ידעת] this: that you have already established [רחשבת] by the secret [סוד] of the public computation [הצבור], that everything is prior [קודם] — that one renewal [חדוש] comes after another, one after the next [?]. For if you do not know the renewal of one [?], how shall you know that of another [אחר]? Where, then, would the renewal be? For it cannot be [כי כליך] that a renewal [?] would have no order [?].

A renewal needs to be set in order, one new-moon after another, near to its setting [שקיעת], when the renewal comes; so understand this from it [מינה]. [?: a

clause on "no difference" between them — uncertain.] The moons [סַהרִין — recte "the new-moons"]: this teaches us [קָא מַשְׁמַע לֵן — קמ"ל] that the moon is renewed, and one renewal comes after another, from the moon's seeing [לְרֵאִיָּה — its re'iyah] at its established time [reading the Aramaic with the recurring מעתיקתא / סיהרא "the moon / its [appointed] time" vocabulary]; and they set in order [וּתְקִנוּ] the principles of their renewals, that they should be — they set in order the principle of their renewal-measure, to a full measure [לְמֵלָא]. And so the moon, by the moon's seeing; this teaches us [קמ"ל]: how it is needful for you [צָרִיךְ לךְ] — one renewal from another renewal, so that there be [a reckoning] from the moon's renewal. [?: a clause here on "up to the eve..." and "that it sit" with a numeral ג' ("three") does not construe with confidence — the embedded Aramaic moon-words (סַהרָא and the like) recur but the syntax is sub-resolution.] [?: מלי ... — recte "from the words..."]: this teaches us [קמ"ל] the renewal of the moon, by the moon's seeing [לְרֵאִיָּה/דְּרוּשִׁין], a renewal of such-and-such — for everyone, what the renewal of the moon is, where it is [אִיכֵן], between it and another [בִּינְתוּן].

[Rubric] דַּע [Know] — that as one examines [?: כִּי תִרְבֶּה חֲטוּ] and sets in order [?: הַהֲלָכוֹת — recte "the halakhot / rules"] of these [?], the renewal [?: וְלַעֲבוֹר — "and for the passage / intercalation"] of the moon's setting [?: עַל שְׁקִיעַת הַשֶּׁקֶה"ס — uncertain], and their principles [?: וְיִסּוּדוֹתֶיהֶם] — for it is well-grounded [?: שְׁנִכְבֵּר] by the matter [?: כֹּחַ רְנוֹס — uncertain] from the substance of the strength [?: מֵאֲמָן בֶּן חֵילֵק] of the days [הַיָּמִים], and the moon [?: וְהַלְבֵּנָה], as is right [כְּרָאוּי].

[Continued prose — beginning [תַּחֲלִית] and end [וְסוּפָה], "in the places [בְּמִקְוֹמוֹת] of the renewal," "in the courses of the days." The argument turns on a renewal's order being fixed relative to its predecessor and on the molad's being "called the renewal by the public computation." The clause-level construal is uncertain across this stretch; confident anchors only:] ...a beginning [תַּחֲלִית] and an end [וְסוּפָה], in the places [בְּמִקְוֹמוֹת] of the renewal, in the courses of the days [יָמִין ...] — this matter, here it is in its renewals [בְּחִדּוּשׁ]. [?:] ...for it is called the renewal [חִדּוּשׁ] by the public computation — the molad of the moon; one new-moon anew [חִדּוּשׁ], the moon renewed from the beginning [יֶרֶחַ ... תַּחֲלָה ... יֶרֶחַ], to set the renewal in order. [?:] ...and they made it known; if so, it is possible that it be, and all that one sets in order beforehand [שִׁיקָדִים] — the renewal [?: רַע"ש — numeral/abbreviation, unresolved], the molad of Tishrei [מֹלָד תִּשְׁרִי]. [?: a closing clause here is sub-resolution.]

[Lower half — the same renewal-sequence reckoning continues, equally repetitive. Confident anchors: שַׁעַת ("the time/hour"), with an accompanying

ḥalakim count that does not resolve at this resolution ([numeral: ?] — not asserted); מולד הלבנה / חדוש ("renewal / molad of the moon"); שִׁסְדְּרוּן / וּתְקֵנוּ ("that they set in order"); הלבנה ("the moon"); יִשְׂרָאֵל ("Israel"); בְּתִכְלִית ("in perfection / completely"); שִׁתְּבָאֵר ("as will be explained").] He set them in order [חדושו], by the reckoning, the time of so-and-so ḥalakim [שעת ... [numeral: ?]] — that the renewal of the moon, in its proper measure, is like a renewal following upon another renewal; and what is to be intercalated [ומה שיתעבר] up to so-and-so, and it is known [ונודע]. By the reckoning of the moon's renewals [מולד הלבנה], that they should set them in order [שִׁסְדְּרוּן], they set them in order and recorded them — how the renewal should be, and all that is right, the moon of the renewal — and they made it known to Israel [יִשְׂרָאֵל], completely [בְּתִכְלִית]. [?: the remaining clauses of this stretch, including a closing "where it is possible to see...", are sub-resolution at the clause level — verbatim anchors preserved, fluent reconstruction withheld.]

[?: a densely repetitive computational stretch continuing the renewal-sequence argument — recurring legible anchors are מולד הלבנה / חדוש ("the renewal / molad of the moon"), הצבור ("the public computation"), תקופת ("the tekufah/season-point"), הימים ("the days"), יִשְׂרָאֵל ("Israel"), and שִׁתְּבָאֵר ("as will be explained"). The connective tissue between these anchors does not construe with confidence on the scan, even under magnification, and the embedded ḥalakim/day counts do not resolve — [numeral: ?]. Rendered as honest gaps rather than reconstructed prose.] ...the molad of the moon [מולד הלבנה], by the reckoning of the public computation [החשבון ... הצבור], renewal upon renewal in their order, as will be explained [שִׁתְּבָאֵר]; over Israel [יִשְׂרָאֵל], by the days [הימים] and by the tekufah [תקופת] of so-and-so [[numeral: ?]] — and now they have known it [ועתה ... ידעו].

That there should be for it [שיהיה לה] renewals [חדוש], by [the measure of] the moon [הלבנה], its full measure [כפי ...] — [?: a phrase here naming the "good year" is uncertain]. And now [ועתה] [?: a clause about Israel and the renewal, sub-resolution] ...in renewal [בחדוש], one anew, that one set it in order beforehand, like the moon [הלבנה ... כפי], as will be explained [שִׁתְּבָאֵר]; and as is known [וכידוע], one is renewed [חדוש], that it is with the renewed [thing] [עם המוחדש], between the seasons [עתות]... [The leaf breaks off here.]

Fourth Treatise (המאמר הרביעי), continuation — the practical Hebrew calendar: the moon-renewal (חדוש הלבנה) and the reckoning of the molads (קשבו/חשבון המולדות), tied to the Talmudic basis of the fixed computation.

[Blank folio side: f. 150r. The recto shows only blank parchment with wide outer/lower margins, the pencil folio number "150" in the upper-left margin, and the conservation scale-bar (scan furniture). No body text is legible on the recto.]
[Librarian note: "150"]

The discussion concerns the moon's renewal (ראית הלבנה / חדוש הלבנה, "the sighting of the moon") and the established reckoning of the molads. A securely legible phrase reads: *the foundation of the reckoning of the molads* (יסוד קשבון / המולדות) [?: "קשבון" for the expected חשבון, "reckoning," is read as written]. The passage invokes the Talmud (התלמוד) [?] as the basis of the fixed computation, and recurs to the molad and to the terms *tekufot* (תקופות) and *renewal* (חדוש). The recurring idiom *neither earlier nor later, [each] in its place* (לא קודם ולא מאחר ... במקומו) appears here as genuine calendar idiom.

[?: The remaining clauses on f. 150v — the specific sequence of molad statements, the day-of-week and *ḥelekim* values, and the molad of Tishrei — are referenced in the text but cannot be resolved into confident readings or specific gematria values at this resolution. They are flagged rather than reconstructed. f. 150v]

[The folio breaks off mid-discussion; the argument continues on the next folio.]

[Treatise] Four — the practical Hebrew calendar; the reckoning of the molads (continued) ...in hours and *ḥelekim*; for the renewal of the moon — which is the molad — is settled and established. And the place of the molad is one fixed point, neither earlier nor later [than its reckoned moment]; and from it you know the molad of every month, just as you know the molad of Tishrei.

And know that the molad of Tishrei is at a known place, neither earlier nor later [than it should be]; and accordingly the place of the molad is one fixed point, and from it the moon's renewals proceed for every month. So you reckon the hours and the *ḥelekim* of [each] molad, and when you have the molad's hours and *ḥelekim*, [you have the molad itself.]

And the molad of Tishrei: from the molad to the [next] molad there pass twenty-nine days, twelve hours, and seven hundred ninety-three *ḥelekim* [29d 12h 793ḥ — the length of the lunar month]. And know that at the renewal of the moon there is its conjunction with the sun [?: construal — שקיעת החמה / "the setting of the sun" may rather be intended at this point], at the place of the sun and the place of the moon; for at the molad the moon is, as it were, joined with the sun, neither earlier nor later [than that moment].

And know that the molad of Tishrei comes at the end of a [reckoned] day, at the conclusion of the hours and ḥelekim; you shall not reckon it otherwise. For the reckoning of the molad is established by the experts of Israel, and from it you know the renewals of the moon, neither earlier nor later. And this is what they said concerning the molad — "this month is for you" [Shemos 12:2, החדש הזה לכם] — that is, the moon's renewal at its molad, neither earlier nor later, at a fixed place.

And know that the place of the molad and the place of the moon's setting of the sun [?: שקיעת החמה here too — uncertain whether "setting of the sun" or "conjunction" is meant], at the conclusion of the reckoning, is what is fitting [for the molad]. And accordingly the reckoning of Israel: this is what was said concerning the renewal of the moon and the molad of the moon, neither earlier nor later, at a known place.

And know that the renewal of the moon at its molad is at a fixed place; and you reckon it at a [known] place, by reckoning the hours and the ḥelekim, neither earlier nor later. And this is the reckoning of the molad, by which the experts of Israel knew the renewals — neither earlier nor later — and they said concerning the molad: this month [is for you].

And the reckoning of the molad, and the [whole] order of the molad's reckoning, is set out, so that you may know how the renewal of the moon comes about, at a fixed place; and so the experts of Israel reckoned it. And he said: the molad of Tishrei is at a known place [?: עבור / "the intercalation" may be the subject of the following clause], at the conclusion of the hours; for at the molad the moon is joined with the sun, neither earlier nor later, at a known place.

[The remainder of the leaf continues the same argument, repeating that the molad of Tishrei is at a fixed place, established by the experts of Israel, neither earlier nor later, and that from it the renewals of every month are known — closing the discussion of the reckoning [of the molads] [?: הלכות ... סדר — "the order of the laws," a possible structural marker at the foot, but written in body position, not a display rubric].]

And so this reckoning [holds], as we have set out, and it is fixed and established: for from the molad to the [next] molad it is [29d 12h 793ḥ], and the experts of Israel knew it from the place of the moon's renewal — neither earlier nor later — at a fixed place.

And know that the molad of Tishrei is at a known place, at the conclusion of the hours and the ḥelekim; and so you reckon every molad, by reckoning the hours

and the ḥelekim of the molad, neither earlier nor later. And the place of the molad, at the moon's setting of the sun [?: שקיעת החמה — "the conjunction / the setting of the sun"], is what is fitting; and so the experts of Israel reckoned the renewals of the moon at the molad of Tishrei, neither earlier nor later, at a known place.

And the molad of Tishrei: at the conclusion of the hours, at the moon's setting, you reckon [it]; for at the molad the moon is joined with the sun [?: עד מקום הירח — "to the place of the moon," uncertain], neither earlier nor later, at a fixed place. And this is the reckoning of the molad, and the whole intent of [the moon's] renewal — that you should reckon the hours and the ḥelekim, neither earlier nor later.

For the renewal of the moon is still distant [from sighting] [?: עדיו... להראות / "still [too early] to appear" — uncertain construal], until the time of its setting [of the sun] [?]; and at that place is the molad, at the conclusion of the reckoning, fitting and established. And so the experts of Israel reckoned: that the molad of Tishrei is at a fixed place, neither earlier nor later.

And know that when the moon was at the place of the sun [?: בשעת... היה — "at the hour [when]... it was," uncertain], you verify the witnesses [העדים — those who testify to the new moon's sighting]; and at the place of the sun, neither earlier nor later, the renewals of the moon proceed at the molad, at a known place; and accordingly the experts of Israel reckoned the renewal of the moon, at a fixed place.

And know that this is the reckoning [of the molad], by which the experts knew the renewals of the moon — for the renewal of the moon, and the renewals [generally], are settled at a known place; and at the place [of the sun] is the molad, neither earlier nor later, at the conclusion of the hours.

And the molad — when it is reckoned at its [proper] place — is fitting and established; and this is the intent of the renewal: that you should reckon the hours and the ḥelekim of the molad, neither earlier nor later, so as to know the renewals of the moon. And the moon is still distant [from being seen], at its renewal [?], until the time of its setting [of the sun]; and at that place is the molad.

And he said: the molad of Tishrei is at a known place, neither earlier nor later, at the conclusion of the hours and the ḥelekim; and from it you know the renewals of every month, just as we have said. For the reckoning of the molad is a fixed thing — what may you reckon, [if not this?] — and so the experts of Israel

reckoned [it]; for at the renewal [of the moon] this is the reckoning, neither earlier nor later.

[At the foot of the leaf, the same argument is repeated and rounded off: the molad of Tishrei is at a known place, the reckoning of the molad is fixed, and from it the renewals of every month — the diminished months and the full months [?: פחות / "lacking" vs. "full" — referring to deficient (29-day) and full (30-day) months] — are known; and so it shall be, that the molad shall be at a known place, neither earlier nor later.]

and were it not for the fact that the molad of Tishrei was at its [appointed] time, in its place, just as we have explained — that is, that it falls neither earlier nor later — the [calculation of] the deficient and the full months would have been overturned, and the whole reckoning would have been overturned along with it.

Therefore [the calendar reckoning] does not stand alone; rather, [it stands] only by [knowing] when the months are deficient and when they are full, [together with] that which precedes the molad of Tishrei.

And in this matter there is testimony [supporting one another], and the [witnesses'] testimonies — though He, blessed be He, knows their secrets — were [received] before [the establishment of] the witnesses [of the new moon]; and this is the foundation of the witnesses.

[Now] the testimonies do not stand by themselves, and one does not establish a [fixed] day by them [alone]. [Rather,] from the testimonies of the [witnesses], from their reckonings, and from the experts' precise computation — by which they know that the molad is at a known place, neither earlier nor later — does the matter [of the calendar] stand. And this is [the manner of] the precise reckonings, which the experts of the [reckoning] established, [setting] the precise time [of the molad]; and [thereby] the calculation of the deficient and the full [months stands]. By [the witnesses'] testimonies and their close [observation], they would know how to set the [fixed] day, neither earlier nor later, neither too much nor too little. And now [we shall explain this further].

[Rubric, in enlarged display script:] ויהודה [a single enlarged display word, vav-yod-he-vav-resh-he; read here as a proper name — "And Yehudah" (Judah) — opening a new sub-section. The enlarged glyphs are clear; the referent is not glossed further pending further verification.]

the molad of the moon, and that it [falls] over against the western [reckoning] — [it is] all one — so [too] is [the case] for the experts of [the reckoning]; their

precise computation and their close [observation] are six, and their close [observation is] six. And in this matter they would labor [over] the precise reckoning [of] the experts, by [their] close [observation], for the sake of [setting] the molad precisely.

A man would say to his fellow: "From where do you know this?" — and he [would] reply, "[I have] traditions from my forefathers, and so the matter [stands]." And the experts of [the reckoning] would not [merely] receive [a tradition] but [test it] by the words of the [received teaching]; and so [too] the Holy One, blessed be He — [as it is written,] "this month shall be for you" [Ex 12:2] — and so each one would say [it].

So [too] the experts of [the reckoning] would not transmit [a tradition] of their fathers [unverified] until they had written it [down] and arranged it. For [matters] of this kind have many [things] dependent upon them; [therefore] they would set down its meaning in the words of [the tradition], for they wrote it as an interpretation [of] the [received reckoning] of the [reckoning] of Abraham our father; and so it is [established] by reason. So [too] when one establishes the deficient [month] and the full [month] from what is fitting, all that is established by [proper] reckoning — they would test it, and so [it would be confirmed]. [For] there are testimonies regarding it that [require] examination; not everything is established by [direct] observation that they have observed it, for there are testimonies regarding it that [require] examination, and there are foundations [underlying it], and they wrote them [down].

[And likewise:] And the [Holy One,] blessed be He, [as it is written,] "this month shall be for you" — the matter [proceeds] from this. And so the experts of [the reckoning] would arrange the precise reckoning, [for] the deficient month and the full month [are] not [established] by mere [observation], lest [the day] err; for [the reckoning] was [as precise as the words] of Moses. And so [too] the [reckoning] from what is [fitting], up [to a known limit]; and so it was established by [proper] reckoning, that all is according to the nature [of the moon's course] in all [its] kingdoms [i.e., everywhere?].

So [too] the [Holy One,] blessed be He — and they would establish from it [the calendar of] Israel; and they knew from it [the day] as [a matter of] tradition. [As it is written:] "this month shall be for you" — and so [too] the experts of [the reckoning] established the deficient [month] and the full [month] from the nature [of the moon's course], up to [the time] when the moon's renewal [appears? / up to a known limit], by [proper] reckoning, in all [its] kingdoms [everywhere].

So [too] the [Holy One,] blessed be He, established Israel [in the precepts of the calendar], that they should compute it precisely from the nature [of the moon's course] in [its] place, neither earlier nor later. And so it stands for them, [and so] the matter is established by [proper] reckoning.

[Two final lines, foot of written area; remainder of leaf blank:]

just as we have explained — that is, [the reckoning] of the experts, [which is] one; and the reckoning of the [experts] is one [and the same] — [as it is written,] "this month shall be for you" — and so it is [established] by reason. And [thus] one establishes from it [the calendar], and [the reckoning] from its place [proceeds]; and they distanced [no one? / they removed any error?], and [in this] there is a [perfect] correspondence in their reckoning.

[Lower margin blank — not damage.]

[Marginal note, outer (left) margin, opposite the opening lines: "השער" — "the Gate" — apparently a structural marker; further identification requires further verification.]

and that the [moon's] renewals stand against the [rising of the] east, until they are equal [in their reckoning] for everyone, by [proper] reckoning — [thus] one establishes [the calendar] in [its] place, "in [its] way," in the cycle of the [moon's] renewal. So [it] was [in] the case [where] the [moon's] renewal was already established, [falling] neither earlier nor later in its place — that is [the rule] for us. And so [too] when the [moon's] renewal [falls] neither earlier nor later, and [when] the renewals are equal in [their] places — at that point [we have it].

And this is the matter, [now that] it is good [to set forth] the establishing of the [moon's] renewals: the [reckoning] is well established, and it is fitting [that] this [should be the] computation [of the moon's renewal], from the molad [of the moon]. And this is [the way of] the computation — [namely,] that they would labor over the matter of the molad of the moon and arrange it. As the experts of the [reckoning] said in [explaining] this computation: they were experts [in] the secret of the [matter], [knowing it] for what it is, and they [knew] the computation of the molad of the moon, [for] the witnesses of the new moon would come before them [and testify], and they would establish [the day] upon it. All the experts of the [reckoning] would test [a tradition], for the experts of the [reckoning] would say [it], and they would arrange [it]; [and] the experts of [the reckoning] would establish it from the witnesses' testimony, for they declared, "we have made known [to you] the truth of the matter," and they made it known to them.

And the experts of [the reckoning] would [examine] the precise reckonings [to know] when they were nearer [in time] and when they were more distant, and [thereby] their close [observation] [would be made known to us].

[New paragraph:] The accounts [/ computations] differ, one from another, in [the matter of] their [observed] times; in [the case of] one [that is] good, and in [the case of] another that is bad [/ defective], the close [observation] of each one [varies]; for indeed one [account] differs from another [in the result] of [its] close [observation]. And so it was: each [account] was established [as] one [day] over another by [proper] reckoning, and so it stands [confirmed] by the precise computation [of] the experts of the [reckoning].

And all [these are] reckonings [made] precise, [for] each one of the [reckonings was precise]. [The matter of] the establishment of the precise time [of the molad of] the moon [is one] of the foundations of the matter, [a thing] one [labors over]. So [too] the experts of [the reckoning], from [their] close [observation] over the new moons, [examined] every month — for [each] one [is established] over another by [proper] reckoning. And [in] the matter of the establishment of the deficient [month] and the full [month], [there is] a [variation] of one [day]: at times the molad would be [such that] it [would fall] earlier, and at times the molad would [fall] later. And as long as it [continued thus, the day would be set] over [another] day, neither earlier nor later, [neither] too much nor too little; for it is well established. [Thus] until [the] final day [of the month], when the molad [comes], it [is set] over [the next], neither earlier nor later in its place — for the molad [stands] at its [appointed] time. And [in] this way, when the molad [falls] neither earlier nor later, and when the [moon's] renewal [falls] neither earlier nor later in [its] place [— at that point we have it].

[New paragraph:] And the establishment of the renewals — [namely] that the [reckoning] of the deficient month and the full month [stands] neither earlier nor later — [is established] from the precise reckonings [of] the experts of [the reckoning], by [their] close [observation]; and [the day is set] over [another] day, [neither] too much nor too little. For [the new moon] never [appears] before its [appointed] day [/ never falls earlier than its place], and [there is a] correspondence [in the reckoning] until the end of [the] day. And [thus] the molad [of the moon] [stands], and [in] this way, when the molad [of the moon] [falls neither] earlier [nor later] — for the deficient [month] is [established] over [the full month]; and so it would be established by [proper] reckoning.

[New paragraph:] When the deficient [month] and the full [month] [are established], [they are established] in [their] place; [and] the experts of the

[reckoning] [examined] the precise reckonings, by [their] close [observation], [together with] the new-moon [witnesses] day by day; for [each] one [is established] over [another] by [proper] reckoning, neither earlier nor later than its place — for this is the molad of the moon and [its] new moon, [established] day by day; for the molad [of the moon] [comes] day by day, [and the calculation] of the deficient [month] is [established] over [the full month]. And the establishment of [the day] over [another] by [proper] reckoning — that is [the matter] of the precise reckonings [of] the experts of the [reckoning], by [their] close [observation]. And [thus] the experts of [the reckoning] would arrange the precise [reckoning] of the molad of the moon: at times [it would fall] earlier, and at times [it would fall] later, by [proper] reckoning; and so it would be [established] over [another] day, neither earlier nor later — and so it would [stand] in [its] place.

[Penultimate / final lines:]...[for] the molad [of the moon] [comes] day by day, [and the reckoning] would be made precise anew; and [thus] it would be [established as] one [day] over [another] by [proper] reckoning. And this is the summary [/ abridgement] of the matter, that the molad [of the moon] [stands], that it [falls] thus according to [its] place — [this is the rule] for [setting the calendar] [?: final clause heavily abbreviated; the closing words are legible but their precise construal is uncertain].

[Lower margin blank — not damage.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar: the reckoning of the molads, deficient and full months, and the renewal (visibility) of the moon. Continuous calendar prose; no tables on this opening. Spanish Rabbinic semicursive, brown ink, single column.

[Marginal word, outer margin alongside the opening lines: הישנה [?: "the old (reckoning)"] — a marginal sigil/keyword, content uncertain]]

and furthermore, with regard to the renewal [of the moon], should it occur on one day, the next day would already be a different one; and it might be the day of Shabbos, when [a fixed reckoning] is needed, so that the renewal [date] would fall back accordingly. And it would be the leftover hours [שעות שירות, the remaining hours] from them — those very leftover hours.

For this reason the renewal moves and shifts forward, and it comes about that the leftover [hours] govern [the date]. From them come the renewals, and so it is, so that the renewal might fall on the second day [Monday], or on a different day, as we have explained. And it might be the day of Shabbos, when the leftover

[time] is from a [whole] place [i.e., a full unit] — and so the leftover hours [recur] in their order.

From them [the leftover hours] come the renewals, and the moon moves and travels [in its course], and it would be the leftover [reckoning] for them, since the renewal moves forward. And on the second day [Monday], or on another day, as the case may be, and from them [come] the renewals, and so on, and the moon would be deficient [reduced], when its renewal [comes] from a [whole] place, as we have explained. And the new month [חדש] would fall to it on the second day, or on another day, [reckoned] from a [whole] place, as we have explained — this is a great principle.

For we say: every place [unit] of the renewal [reckoning] belongs to it [is assigned to it], when the renewal [is reckoned] from a [whole] place; and the renewal would [then] fall to it from that place [unit]. And on the second day [Monday], or on another day, Shabbos itself, and the day of Shabbos — this would be the [reckoning] for them, [drawn] from a [whole] place — a different renewal — and so it is. For this reason these are leftover quantities [מקואות / measures], and again [we return to the rule]: every place [unit] of the renewal belongs to it [the month] from its place. And every place [unit] of the renewal [is so reckoned], because the renewal is moving forward [advancing]; and so it is, so that there should not be more [than its due], nor less. [?: the precise sense of these closely-repeating clauses about "from a place / from its place" is technical and somewhat cramped — the recurring terms שעות שירות, ממקום, החדוש, הלבנה are committed with confidence, but their exact procedural force is paraphrased rather than over-determined.]

And so it follows that the day, that it shall be Shabbos day, governs [the reckoning] for them, [drawn] from a [whole] place — and these are different leftover [quantities]. And every place [unit of] the renewal belongs to it [the month], because the renewal is advancing. For this reason these are leftover quantities, [computed] from the place [reckoning], so that there should be neither more nor less than [the proper measure].

ועוד [And furthermore — enlarged rubric]: There is, with respect to this law [הלכה], one whose renewal [comes] earlier [first], and another [whose renewal comes later]; and from this you may understand the [whole] computation by itself — and this is the [matter] needed, that the renewal be reckoned by itself. The intention being the renewals, and the moon moves and travels [in its course], the leftover [reckoning] being for them, as we have explained at the beginning.

[Lower portion of 153r is blank margin — text ends here.]

According to our custom — and you should look into this from the whole body of those who rely upon the reckoning — and the small [residual] amount [רחם קטנה / a small quantity] [is taken] as on the day of the molad. And the next day [following], the molad [of] the morrow [reckoning] — so that it should be [proper]; and its equalization [its setting-even] would be as they said, [namely] for us [in our practice].

For the new month [חדש] would fall to it on the second day [Monday]; thus would the moon [be], travelling [in its course] forward. So would it move and travel forward; and from this, according to our custom, all Israel [follows] — and so [it is]: that the molad would be [reckoned] earlier [first] [בחר / chosen-first]. For from one renewal [you reckon] to another, [and] the renewal would fall to it on the second day [Monday], or on another day, [drawn] from a [whole] place — as we have explained, this is a great principle. For every place [unit] of the renewal belongs to it [the month] from its place, and the renewal would fall to it on the second day [Monday], or on another day, [drawn] from a [whole] place. [And so] the leftover [hours], that it should be Shabbos day — and the [Shabbos] day [stands] for them as the leftover [quantity].

[Short rubric / divider in the line: ויש עוד [?: an enlarged divider-word, perhaps "ועוד" ("and furthermore") — the reading עוד ויש is uncertain]]

and it [the renewal] would be a leftover [quantity] for the new month [לחדש], and again the renewal [is reckoned] from its place [unit]; and they said [it would be] for us, and its equalization would be as they said, for us. The moon — its renewal alone [reckoned] by itself [literally: by the moon alone]. [?: this clause — קבעו / "they fixed," and the closing הלבנה החדשה בלבד על ירח — is the clearest of the recurring set; the rest of the line is consistent calendar-procedure phrasing.]

For we say: that Shabbos day, this is the molad day, [reckoned] for them; and a leftover [quantity], when the renewal [comes] from a [whole] place — but the [leftover] reckoning is the [reckoned] leftover [quantity] for them [drawn] from the place. And the moon's renewal — the new moon [החדשה] alone [reckoned] by itself.

The leftover hours, the leftover [quantities], from them come the renewals; and the leftover [reckoning] from a [whole] place; and the leftover [hours] are leftover for the morning [מזרח / east], [as is] proper. And this is a great principle of the leftover quantities — [counting] from the second day [Monday] — the leftover [quantities] for them. For the leftover [reckoning], when the renewal

[comes] from a [whole] place, [is reckoned] for them, and so it is, that there should be neither more nor less.

And so it follows, that the renewal of the moon [חדוש הלבנה] [is reckoned] for them, [drawn] from a [whole] place; and the renewal would fall to it [the month] on the second day [Monday], or on another day, [reckoned] from a [whole] place — as we have explained. And the renewal of the moon governs [the reckoning] for them [drawn] from a [whole] place, so that there should be neither more nor less. The leftover hours, the leftover [quantities] — from them [come] the renewals — [as the moon moves] toward the morning [east] — [this being] proper, for us.

ועתה [And now — enlarged rubric]: to speak of the matter of the leftover [time], that the small quantity [קטנה] would be [as on] the day [of the molad]; the [renewal reckoned] earlier [first] [בחר], its renewal [coming] earlier — and they equalize [set even] the renewal — and so it would fall to it on the second day [Monday]. For from one renewal [you reckon] to another — the new month [חדש] would fall to it on the second day [Monday], according to the moon, so that the new month [should fall] properly — and the moon, its renewal [reckoned] by itself; and they said [it would be] for us, and its equalization would be as they said, for us.

For we say: the leftover [quantity] moves and travels forward; and so it [the renewal] would fall to it [the month] on the second day [Monday], [reckoned] from a [whole] place — as we have explained. And the [leftover] reckoning is the leftover [quantity] for them, the leftover hours, when [the renewal comes] from a [whole] place — so that there should be neither more nor less; and not forever [does it stay fixed], nor so [unchangingly]... [text ends mid-line]

[Lower portion of 153v is blank margin — text ends here; continues into f. 154r.]

The Fourth Treatise — the practical Hebrew calendar; the reckoning of the molad and the renewal of the moon. Continuation of the chapter (siman ~29) on the "leftover hours" and the placement of the new month.

[The written text on this leaf occupies only the upper portion of the page; the lower outer area is blank parchment, not damage. The conservation ruler lies along the left edge — photography furniture.]

there [in that place] the leftover hours [שעות שירות] are placed, and they belong [to the month] from a whole place [ממקום שלם], according to the practice [מנהג].

And so the renewal [חידוש] is at the head of the new month, according to the count of the renewal of each month. And the leftover hours, by their addition...

and so it is, that the renewal falls on the second day or on another, from a whole place — neither more nor less. For the count of the [day-]boundaries, when they are completed, returns to its place, since the leftover hours of each month are themselves the renewal — the renewal of the moon — for they are the leftover hours [computed] from a whole place; and Shabbos [שבת] [falls] according to the molad, and it returns [to its starting point]. The leftover hours of the months of the renewal advance and go forward [הולך], and [so] he returns [to] a whole place, from a whole place.

And so they say of him [ובן לידידו שיאמרו בן]: that the new month [חדש] falls [as] explained... [?: the run "and so they say of him" is a citation-lead formula; construal of the following clause is secure but the antecedent of the pronoun is the molad-rule itself].

the renewal of the moon is "a sign" [?: סימן — possibly the structural marker *siman*, but here it reads as part of the body sentence, "a sign that the count returns to its place"]; and the leftover hours, Shabbos, and the molad return to a whole place from a whole place.

And he said further [ועוד]: this is the matter [הענין]. Behold, the speaker [המדבר] says that the boundaries [התחומים] of this [reckoning], in this manner, come and return [כיון]; and the Place [המקום] was He who reckoned [סבר החשבון] toward the east [לבן מזרח] [?: "toward the east" — לבן is most likely a reading-error neighbour of לצד "toward," but the eastward sense is fixed by what follows]. And know, my son, that this matter — the boundaries of this [reckoning] return [to their place]. For all of them are completed, and they belong to the months [לחדשים], etc.

And after the boundaries [had been set], from the place at which one ends [מן] [הסמך] [comes] the placement [התשובה], and one reckons [count] from one new-month to the next, twenty-one... [?: a numeral "twenty-one" (עשרים ואחד) reads here in the run, but it is a count of day-boundaries, not a tabulated value].

until the day, one and twenty boundaries are advanced, twenty-one. And the [day-]boundaries [are reckoned] until the day that the seven days are completed [תוחק] [?: the verb at the line-end is rubbed], a new month to the next... seven days, and one ends [סמך] at the close of the boundaries, in the evening [בערב] — six days, a new month to the next, on Shabbos... until the day that the seven days are completed: seven days; and one reckons [reckoning] from a whole place in

[their] count [חשבון] — four [ארבעה], a new month to the next... seven days, [and so] the boundaries are advanced — twenty [boundaries]; on Shabbos the seven days, this [is] the boundary [גבול]... according to the practice [מנהג] you need [a] boundary [גבול], in this manner. He said further: this [is] the renewal of the moon — and the new month is one that [falls from] a whole place from a whole place, [neither] more [nor less]... and the reckoning [count] of the Talmud and the practice [מנהג], according to their [own] reckoning, is in this manner: it differs [יש] [בו חלוק] [?: the clause-end "there is in it a distinction" is secure].

[Lower portion of 154r blank — wide outer/lower margin, light foxing, no text.]

[The conservation ruler lies along the *right* edge of this leaf — the two leaves face opposite directions, as expected. Text is densely written across nearly the whole writing-block.]

Rabbi Yochanan [ר' יוחנן] [?: the name reads as the abbreviation "ר' יוחנן" but see the self-reference caution — the lead-in "they say" may govern an anonymous authority] said to his beloved [לבן ידידו] [?: "to his friend/beloved"; an idiom of address rather than a proper name] of the renewal [שמש] [?: שמש here functions as "service/leftover," matching שעות שירות, not "sun"]; and the new month [is] from a whole place [ממקום שלם], a distinction [חלוק] in this manner, [it] is a distinction. And the boundaries, when they return to their place, this is to teach [העניין] [?: "this is, that is to say, to teach"] that the matter [לומד] returns [to its place]; and the leftover hours [שעות], when... in the count, more [יותר] than [the] new month, and they come [together], the boundaries [התחומים]... and so it returns; the renewal of the moon [is] from a whole place [ממקום], and a new month from one [end] until the molad — neither more nor less.

And one [reckons] from a whole place to the day, this is the molad to the close [הסוף], the day... one needs precisely [צריך פרט], according to the practice [מנהג]: a place [מקום] in the reckoning [החשבון], more [than] the new month, until the day [יום] — the boundaries, behold, return; on Shabbos the days that are gathered [שקבוצן] [together], this is the molad to the close [לתחילת] [?: "to the beginning/close of the boundaries"]; understand it, for the matter [דעת רבה] is great [?: "great understanding," or "the opinion of the majority" — דעת רבה vs דעת רבים; rendered as the former].

He said: the matter [העניין] is done [נעשה] this way, so that the practice and the reckoning [הולך] should be settled [נוחו]; and the boundaries [וההפרש] [are reckoned] new month by new month, [neither] more [nor less], according to all of them; and according to Rabbi Ḥasday [?: "ר' חסדן הדיין" — possibly *Rabbi Ḥasday*

the dayyan, but the name is rubbed; could be a verb-form, not a name — treat as marginal-uncertain] the matter [is settled].

And the leftover hours [are reckoned] until the day, twenty-one boundaries; on Shabbos of the days [שבועת הימים] [?: שבת/שבועת ambiguity], this [is] the boundary; and a new month — the days that are gathered, this [is] the molad; and after this [צריך], the seven days [שבועת הימים] are [reckoned]... one needs precisely [פרט], a new month to the next, the close of the close [סוף בסוף] — in the evening [בערב] six days, in the close [בסוף]; the boundaries [are reckoned] to the day, in the evening — neither more nor less. He said further [ואחר]: that the leftover hours [שעות]... and to the second day [ולבי יום] the boundaries [are reckoned], twenty boundaries... [?: a numeral count of boundaries runs through this passage; the values "twenty / twenty-one" recur but are boundary-counts in the prose, not tabulated cells].

And there is in this a distinction [חלוק] — that is, the molad and the [computed] reckoning are not equal: the larger and the smaller [הגדול והקטן]; between the molad and the molad, a reckoning [count] [מתחסך] — this [is] explained [in] the reckoning [count] of the molad, that the place [המקום] [is taken] until... and the planet [הכוכב] [?: "the planet/star," i.e. the moon — read from context, "the body whose renewal is reckoned"] returns from the east [מזרח]; and the practice [מנהג] is according to this — to a whole place, etc.

[Margin / inline citation:] And so they say [ובכן יאמרו] of the renewal: and the new month [is] explained, and the leftover hours [are] from a whole place — neither more nor less, etc.

And Rabbi Yitzḥak ben Yaakov [?: "ר' יצחק בן יקפ" — ben-Yaakov is the most likely reading; the patronymic is rubbed] of [the place] Tkofet [?: "תקפת" — a place-name or "the boundary," uncertain] said, and Rabbi Avraham [bar Ḥiyya] [חידוש אברהם — most likely Abraham bar Ḥiyya, the standard authority on חידוש in this work], that according to the practice [as to] the visibility [ראיית] of the renewal of the moon [חידושה], one needs precisely [פרט] [?: "פ" = an abbreviation, "פרט," precisely] a place; the boundary [התחום] [is] toward the east [למזרח] of [the place] where it [the moon] is [שיהיה]...

and a new month, the molad of the moon [מולדות הלבנה] [is reckoned], and they said: the matter [is] done; the leftover hours of their boundaries [שיעור הבריתן] [are] this [reckoning] [?: "שיעור הבריתן" — "the measure of their boundary," reading בריתן as "their boundary/covenant-cut," uncertain construal], when one reckons [reckoning] and they need [להוצרכו]... and the moon [from] the east

[מזרח] — for then the renewal of the moon is at the close [בסוף] of the day, and it goes [as] explained [in] the matter; the boundaries of the practice [are] from a whole place from a whole place.

And the moon [is reckoned] from the close of the day [מחלקת היום] [?: "from the half/the close of the day"], and it goes from there to the renewal of the moon. They said in the west [במערב]: that there are leftover hours [שיש שעות הברית] until the close [?: "the surplus of their boundary"]; and behold, the planet [הכוכב] [moves toward] the east [מזרח] — that is, that the moon [הירח] [is reckoned] in the visibility [בראיה], its visibility, in the evening [בערב], not [otherwise]; and behold its visibility [ראיה] is in the count [חשבון], the leftover hours, this [is] the moon to the close [בסוף] of the day; and behold its visibility [is] explained, the close of the day, the boundary of the moon, in the evening, etc.

And so they reckon [וסבירים] [?: "and they reckon/hold," סבירים] in the renewal this [reckoning] of the boundaries [הברית]. And Rabbi Avraham [bar Ḥiyya] ז"ל [ז"ל], this [is] the practice [as to] the new month, that the molad of the moon [מולדות] [הלבנה], they said: the leftover hours of the boundaries [שיעור הברית] are this; and Rabbi Avraham [bar Ḥiyya], according to the visibility [ראיית הלבנה] of the renewal, [reckons] precisely [פ פרט] the boundaries [התחום], so that it should be good [להיותב] [?: "so as to be in good order"] in the place where it [the moon] is [שיהיה]...

[and] one ends [סמך] from the close of this day [מחצית היום] — this place; and the moon will be [ויהיה הלבנה] in the visibility [נראית]... etc.

[Lower portion of 154v blank — wide blank lower margin; light foxing across the foot. Text resumes / continues onto folio 155.]

at the end of the day, the eastern horizon. As the sun moves toward the western side and its light gives way, the moon then becomes visible there in the west; for the sun, which is in the east, and the moon, which is in the west, stand opposite one another. From this you may grasp the matter of the place of the molad [the renewal of the moon].

R. Avraham [bar Ḥiyya], may his memory be a blessing, already explained this in his book, and likewise R. Yitzḥak. The moon's becoming visible at the close of the day is at the western horizon; and they reckoned it from a fixed place, namely that the day completes from the place at which the molad occurred.

How so? When the sun sets and the day departs, the moon then becomes visible at the close of the day at the western horizon; and the watchers watched for it,

reckoning from the place where the molad occurs — that is, from the place of the conjunction. The moon, at the close of the day in the west, stands in opposition; and from there one reckons, since the molad precedes the sighting. They had reason to reckon it so: the difference of hours between the molad of one place and the molad of another place. For the molad of one place is in the east and the molad of another place is in the west, and the difference between them follows their longitudes.

How is the boundary reckoned? One looks to its precision — the value of the remaining hours [שעות שירות]. The sages of Israel transmitted this as a tradition; thus they said it to them in Jerusalem. And from where was it received? From the tradition of the witnesses in Jerusalem. For such was the custom of the world, that the months were sanctified by the testimony of witnesses; this is the matter of the word that I have explained.

And his sighting [ראייה] was reckoned from a place. This is what R. Avraham [bar Ḥiyya], may his memory be a blessing, explained in his book — how one must reckon for it the moment of precedence, and the difference between this place and that place in the time of the molad. For this molad is in the west, just as there are other places with their own reckonings; from this comes the need to fix the place of reference. And so too R. Yitzḥak [ben Yaakov?], may his memory be a blessing, who explained how this is computed — what the value of the renewal of the moon is.

And these are the words of R. Ḥasdai, and as he explained; and the words of R. Yitzḥak, may his memory be a blessing, who set it forth in his computation — may it be confirmed — namely the difference of hours of this reckoning. And this is what the matters of the [intercalations / additional days] [?: final words run faint] require.

[The remainder of folio 155r is blank — a wide blank lower margin, not damage.]

there are no witnesses in this matter; for, in the words of R. Ḥasdai, the watchers who watch the moon at its setting in the west are the ones who determine it. The argument concerns the moon — that they do not sanctify the new month by it when its setting in the west occurs, at the close of the day, in such-and-such a quarter of the sky. For so it would be: had the sighting fallen at the proper time, it would be fitting to sanctify it.

Why, then, did they say to them that it was permitted — when the molad had occurred earlier and they nonetheless did not sanctify it? Because there was a reason for it: the molad precedes the actual sighting, and the difference of hours

between this place and that place matters. They reckoned from the east, the molad preceding it, and they did not sanctify the month except so; nor could they act otherwise, for it would have caused confusion.

And so too those who watched for the new month in Jerusalem reckoned it from the molad; and from there one reckons, since the molad precedes the sighting. They had reason for this: the difference of hours between this place and that place. For the molad of one place is in the east and the molad of another place is in the west, and the difference between them follows their longitudes. So the molad is a place, and the moon's reckoning from it is a single matter — that is, reckoned from one fixed place; the moon was not to be sanctified by sighting alone. And so too R. Avraham [bar Ḥiyya] explained in his book, and likewise the other authority, may his memory be a blessing — what the value of this is.

And now [ועתה — written in an enlarged display hand, opening a new topic], you have already seen, in the words of [the foregoing authorities], that they computed the matter thoroughly. Here it is: when the molad of the sun [and that of the moon coincide], the matter of the conjunction is fixed.

Know that the wise men of the nations [חכמי האומות], by their reckoning, compute the true conjunction precisely, between the position of the sun and that of the moon; but our sages reckon it by their fixed reckoning, computed in terms of the remaining hours and the work of the molad [the molad-computation]. They said: this is the molad — and it amounts to such-and-such; and for each entry of the reckoning there is its value in the remaining hours.

Their intention in the molad was for the practical work of the fixed molad, carried out in terms of all the accumulated remaining hours; and they computed it in whole hours. Whoever wishes may verify their reckoning by computing the conjunctions themselves, whether the result comes out more or less. And likewise you may consider: when one computes the true conjunction there are observable sightings — and this is the way of the wise men of the nations; but the sages of Israel reckon by their fixed reckoning, not by sighting. For if the determination were by sighting, then according to their words the new month would be sanctified by the witnesses' testimony.

So it is with the remaining hours — it is just as I have explained. And so the wise men of the nations and the astronomers proceed by their computed values and their reckonings; yet you will find [a discrepancy]. And so too, if it occurred at the time of the true conjunction — that this is so — then whether in this place or in

that, there is still a difference in the time of the conjunction; for the molad of this place is before [that of the other] [?: the comparison runs into the faint line-end].

Therefore it is better to rely on this fixed reckoning; and for the practical computation a man trusts it, and this is what is fitting. For the renewal of the moon follows the fixed reckoning; but as to whether the renewal of the moon is determined by sighting, we hold that it is not, and the calculator does not err. For the value of the renewal of the moon in every place is reckoned from a fixed standard; it is not to be sanctified by sighting alone. And so the wise men of the nations act; and now I shall proceed.

[Lower 155v — final two lines, then a wide blank lower margin (not damage):]

this is correct; and the matter does not [admit otherwise]; nor can one sanctify the month by sighting, for so it is reckoned in such-and-such a value, and there is nothing further in this.

and now I shall set out for you, in what follows, by way of the [planetary] motions [דרך התנועות]; and you shall know the way of it, that one is able... [the legible text ends here; the chapter continues below a wide blank lower margin].

Fourth Treatise — the practical Hebrew calendar — the chapter on the renewal and visibility of the moon, treated "by way of the [planetary] motions" (continued).

[at] the place where the moon is to be seen [שתראה הלבנה], in the locality they specified; and according to this you may know the hour at which they said the molad falls. For the molad and the visibility of the moon vary from one place to another, and the moon's visibility is later [לאחר] at one locality than at another. And this is the reckoning of the conjunction [חבור], for the moon — its renewal and its visibility are not at one [and the same] hour at every place.

And this is sound, and it accords with the truth; one need not learn it from anyone else, for the reckoning of the molad goes by this method. And the intent of the author of the Beraita [בעל הברייתא — i.e. the *Baraita de-Shmuel* / the early calendrical authority], according to their words, is that the molad's remainder [שיריה] falls close to the setting of the sun [שקיעת]; and the disciple [תלמיד] is to know it by means of the [planetary] motions, and it is made known by means of the witnesses [העדים] who attest it.

And so the visibility [ראיית] of Tishrei is found, and one is able to teach from it. "Blessed is He who knows the truth" [ברוך יודע האמת] — and this is a matter [requiring] verification [בירור].

And after [we have spoken of] the visibility [ראיית] of the moon — when it falls close to the conjunction at one locality, after [the moon's] eastward motion [מזרח] — its visibility at the other locality [comes] later. For the eastward reckoning [מזרח] of the place is one thing, and the westward [מערב] another, each according to its own [longitude]; and so the moon's renewal is at the same hour, yet its visibility differs from place to place.

And in the receiving of its distances [רקועותיה] — its arcs/intervals] there is, in this respect, a difference. And the author says: as for the truth concerning the moon, which falls at the [true] place — there is doubt [ספק] and no [settled single] reckoning, and [it falls at] no [one fixed] hour. And this is [a matter] only to be learned by visibility [לדעת בראייה].

For if the visibility is [reckoned] thus, [then] the molad of Tishrei [is reckoned accordingly]; for the molad — and the visibility — are not at [the same] one hour. And the reckoning of the renewals [המולדות] is [the way of] the motions [התנועות], as we explained.

And after [all] this [it is found] in the place at which they [reckoned], and as we said.

[The leaf bears no visible foliation in this opening; the conservation ruler lies along the right edge, the binding gutter at the left, with a wide blank lower margin. The text continues directly from 156r.]

the renewal [חידוש] of the moon, that they specified, and that the moon will be seen [שתראה הלבנה]; for at the locality of Israel [של ישראל] the conjunction [חבור] falls, and the visibility of the moon [comes] later. And so it goes by its [own] place, for the visibility of the moon is [reckoned] later; whereas at the other locality the moon may be seen close to the molad, [so that] its visibility there is [reckoned] otherwise. And the author says: with respect to the conjunction [שבור], the disciple is to know that [the moment of] the molad's visibility is not at every place [the same].

The matter is that the reckoning of the conjunction [השבור — the conjunction] falls at one place, and the moon [is seen] later; and there is a difference between the renewals [שינוי המולדות], for the moon — its visibility is later at the [eastern] locality. And [as] the disciple is to learn for the visibility — they made known their reckoning by means of the true conjunction [המכוסה — the "concealed" true conjunction], thus, and its variant [order].

And as for the place: the true conjunction [מכוסה] falls at one place, [reckoned] thus; whereas at the [other] place it is the visibility [that governs], for there is [reckoned] the conjunction [son of] — that is, the [moment of] the renewal [חידוש], which has its own offset there.

And the renewal [חידוש] of the moon, with the true conjunction [מתכסה], [comes] later, [reckoned] to them [in one way]; and there is here the matter of the visibility of the moon — that the molad was at one hour, and the renewal [reckoned thereby], and this is the [reckoning of] east [מזרח]; whereas at the other locality it was the visibility, [reckoned] for them as [the] renewal, and there was [thus] a [further] difference. And the proof [ראיה] of this from the [planetary] motions: that the molad was at the locality of east [מזרח].

The matter [is] that the true conjunction [המכוסה] is concealed [להסתתר] — i.e. the *true* conjunction is "hidden"/sub-horizon], and the reckoning [חושבן] [proceeds] thus; and the true [conjunction] of the molad [is reckoned] at the west [מערב] at the setting [of the sun] — that is, the conjunction of [the people of] Israel [שבני ישראל]. And the visibility falls [accordingly], otherwise; and the molad at the place of east [מזרח] is one thing, and that of the west [מערב] another.

For at the place of east [the moment] is one thing, and so the [true] conjunction [comes] later at the west; and [as for] the moon — its renewal and its visibility [vary], for there at the east is the conjunction [son of] — that is, [this is] the rule [קנקנתה? / its measure], its reckoning being late.

And the matter of the renewals [המולדות] of the moon falls in the manner [על אופן] of [the motion of] east [מזרח] and west [מערב]; and this is the rule [תורת — the discipline of] the reckoning here, with respect to the precession [העברה — the carrying-forward] — what was transmitted [מסור].

And [as for] the reckoning [חושבן] of the visibilities [הראיות] of the moon upon this [basis] — these are [matters] given over to the [Mishnaic] tractates [מסכתות]: their account [ספרו], and their name is [as we have given]. ז"ל. [The passage ends, with the remainder of the leaf left blank.]

- Both leaves are continuous, fluent calendar-method prose, fully legible in the small Spanish Rabbinic hand at native resolution. There is **no *luah* (לוה) and no tabulated numerals on either leaf** — the discussion is qualitative throughout, repeatedly contrasting the *molad-hour*, the *true/concealed conjunction* (מתכסה / מכוסה), and the *visibility-hour* across two localities by longitude (east/west), but it does not state specific hour-figures here. (The prior draft's "so-and-so [hours]" placeholders, implying

compendiously-written gematria values, were a misreading: the page carries the recurring adverb כך, "so/thus," and generic place-words, not unreadable numerals.)

- The recurring technical vocabulary — חבור / השבור / שבור (molad), (conjunction), מתכסה / המכוסה (the concealed = the *true* astronomical conjunction below the horizon), ראיית הלבנה (visibility of the moon), / חידוש שעה (renewal(s)), מזרח / מערב (east / west = the longitude contrast), שעה (hour) — is lexicon-locked from the prior leaves.

[Treatise Four — the practical Hebrew calendar; close of the chapter on the visibility of the moon, then a Gate (שער) and Chapter Nine.]

[the discussion of the visibility of the moon], and there was here a great difficulty in this chapter. For it turned out that the [computed] visibility of the moon [ראיית הלבנה] conflicted [with the reckoning] in one place [?: clause-construal], and we could not settle it [?]. And now, see how much [labor] there was [ועתה ראה כמה ש...]; for [the matter] needed to be put in order, in [the reckoning of] the new moon [קלת? — likely the visibility/qualification of the new moon]. And [we set it down] so that there should be no doubt of it, neither for the [computer] nor in the setting of the sun.

If one should say [that the sun set] at such-and-such an hour of the day — it is at the setting of the sun [שקיעת החמה], toward the west; and at the setting of the sun the first day [begins]. So [we have] a settled reckoning, [namely] that the visible [moon] is at a [known] place, and the place [of its appearing] is by a [definite] reckoning. And the visible [moon] is after the true conjunction [the molad] by a [measure], and the place is by a [measure]. And now, see how much [there was] up to here [?: clause]; for there are doubts in [the matter of] the visibility [מספיקות], and we set them in order in this chapter, so that a person should not err. [A short stretch of allusive prose here repeats the point that the reckoning has been settled and that there is now no doubt — the specific intermediate clauses are written in a compressed cursive I cannot construe with confidence and are left unrendered rather than reconstructed: [?]].

And there was a difficulty in this chapter, [namely] that we found in the [reckoning] one [result] for one [purpose], and [another for another] — and we set them in order, so that there should be no doubt of it, and that it should not conflict, and that nothing [erroneous] should arise from it. For we [labored] over them, lest a person err in the matter [of the words] that I, Isaac son of Joseph the Israeli [ישראל], set down — the reckoning of the eras [חשבון]. And [there was] over it [much labor], in the way of [the visibility of the

moon]; for this is a foundation [מוסד], near to the visibility of the moon in its [proper] place, and necessary — [namely] the hour of the [setting?] of the sun and of the moon [שעת תנועת? החמה ובכל יום ויום], and the place [of its appearing]. And this is a great mystery [סוד גדול], a deep one.

And [these are] the orders of the eras [סדרי התולדות] and the [chapters?] of the chronology; and this [is] the disclosure of the secrets [סוד]. So that one may grasp the reckoning of this [matter, namely] the calendar [תקון] of Jerusalem [ירושלם] — known [as it is]; in the [reckoning of] the visibility of the moon [at] every single day [בכל יום ויום]. [And] the visibility of the new moon at the end [בסוף], when this is a Shabbos, by such-and-such [reckoning], the [moon being] eastern [מזרח]. And this is so [וזה כך]. The visibility [of the new moon] at the end, when this is a Shabbos, eastern: a [reckoning], and the place by a [definite] reckoning. And the time of the visible [moon] at Shabbos, at Jerusalem [שבת בירושלם], by itself [?: figures here are carried qualitatively in the source — numeral: ?].

the visible [moon] is so; and this would be settled. And when there was [a doubt?], this is the matter of which [the sages] spoke; and according to the words of Rav Nahman [ודברי רב נחמן] [?: name read with reasonable confidence; identification deferred]. So that they should give it [its qualification], whether the visible [moon] is fitting or unfitting [נאות או לא נאות]; the visibility of the moon at its renewal [בחירושה], whether it is fitting or [not]. [And] in the matter [of the determination] of the new moon at its place [?], it cannot be [made right] except [by the order of the new moon]: [a short compressed clause here is left unrendered rather than reconstructed — [?]].

[Gate — שער]

[Display rubric, brown ink: שער (Gate); no number attached.] He who [comes to] know the law of the visibility of the moon [דעת דין ראית הלבנה] and to make a [calendrical] reckoning [לחשב], let him [weigh] the visibility of the moon, whether it is fitting or unfitting; [namely] the orders of the eras [סדרי התולדות]. He should know the matter of the new moon and the [full moon?], in order to know the law — for this is the law of the visible [moon] — and from the place [where] the new moon [falls], that it should be visible at its place, by a [definite] reckoning, so that he should know its place. The eastern [moon] [falls] at [one] place; and one cannot make the visibility [come out right] except [by] the [order of the] new moon, [for that is] a foundation [יסוד]. This [is the rule] for Israel: the new moon [falls] at a known place, by a known [reckoning], so that the [calendar] of Jerusalem [is settled], and there should be no doubt of it for Israel at all, at the [time of] visibility — and over this, [its qualification] [?: short clause unresolved].

Chapter Nine [פרק תשיעי]

[Display rubric, brown ink: **פרק תשיעי** (Chapter Nine).] On the reckoning [כהשבת? — "the reckoning"] of the years [שנים], and the orders [סדרים], and the foundations [יסודות], which are three [in number].

Let us understand [the matter of] the calendar [תקון] and the festivals [המועדות], which [the early sages] arranged for us [כבר נתבאר לך]. For [the matter] of the new moons [ראשי החדשים] — already it has been explained to you that the day of the new moon would be a [matter] and a foundation; and the [fixing] of the new moons, and the [setting] of the calendar of the eras [התולדות] over Israel, by [the rule of] the visibility of the moon at its renewal. So [we have] that the new moon [falls] at a known place; and when [the sages] of the world [העולם] [had set it], it was [a settled order]; thus the [reckonings] are arranged over it [?: any specific figures here are carried qualitatively in the source — numeral: ?].

And in [the days of?] the calendar [בקיבת המועדים] — "in the fixing of the festivals", up to how many years after the destruction [עד כמה שנים אחרי החרבן]; and now I know that the Gate [the section] of the destruction [שעריה] — "its gates" was [defective/shaky] [רעועה], thus: [the sages of] Israel — and this was so. And the orders of the chronology [התולדות], and the [matter of] the new moon, [were] at their place, and their foundations; and [so were] the law of the dispute [דין המחלוקת] and the [setting in order] of new things [חדשות], thus. And the orders of the eras [are] over the visibility [of the moon]; and Israel did not know [whether a given year passed or whether it was full/defective] [ולא ידעו... שנה זו] — "this year defective", construal uncertain].

These doubts — that they should be settled — by this we shall settle the reckoning [על פי חשבון], so that there should be no [error] and that it should not conflict, and that they should not err in it; nor today, nor tomorrow [לא בזה ולא במחרת]. And it [the reckoning] was [made] secure [נשמר / נסגר?] over the law, with the dispute [resolved]. And over this [is] the conclusion [ההכרעה — the determination] in the fixing of the festivals [בקיבת המועדים] as they [the sages] saw [fit] for them; and over this [is] the [concluding] agreement [ההסכמה].

Fourth Treatise (המאמר הרביעי), the practical Hebrew calendar — Chapter Nine (פרק תשיעי), continued. The establishment of the calendar by the early sages, the Second Temple, the years after the destruction, and the resolution of the festival-calendar dispute.

the roots [ראשי] of the chapters [ההלכות] that belonged to the reckoning of the last generation [בדור האחרון]; for so it was with them, by its order. From the time the

matter was [thus fixed], the roots and the calculations [were arranged] with full wisdom — a received tradition [ויקבלה], and a tradition that came by the hand of the prophets [שהיתה ביד מהנביאים]. This reckoning and its correction — this transmission [המסור] was by their hand, of blessed memory, [over the] generations; and the new-moons [החדשים] and the festivals [והמועדות] and the conjunctions [והקבועות] were by their hand, generation after generation [בדי סידיהו].

The court [?: סנהדרין] established it, so that the reckoning should be by the cycle [בשבור] of the year [השנה]; and at the fixing of the new-moon —

For each man would know, by reckoning, the fixing of his year [?] and the days of the [intercalated] months; and all of this was [established] so that they should not be misled. The reckoning is this corrected [reckoning], by which the [festivals] and the remaining festivals [are governed], and the [intercalary] additions are within it. The beginning and the end of [the cycle] — this is what determines this law; and the months [?] —

And the corrected reckoning — by which the law was known [?] — is the thing [transmitted]. They [?: arranged] it in the chapters [?]. They [the early sages] inverted [?] it [?: revised it], and from it the fixing of the new-moons [is derived], and the festivals — that their [reckoning] should be by the hand of a Beit Din [a fixed court-reckoning], and not [dependent] upon witnesses. And the great Sanhedrin [?: a great court] — its arrangement was the [transmission] of the law, and its arrangement was by [?].

This was at the time of the Second Temple, as in the year of [?: a certain count]; and from [the year of] the destruction [the count of years after the destruction is reckoned]. The early sages, who were in the world in that place — and so said R. Meir [?: one of the sages], son of [?] —

And so [the cycle] is [reckoned] of the new-moons [?: 28-year cycle of the sun], for so [it is]. [?] all of them, that they should reckon by hand [?: by a fixed reckoning], and not depend on witnesses, [for] all Israel — so that each should know the way of [the reckoning]. And one cannot [reckon] each [festival] until the end of the world [generations]; [for] this would be a [perpetual] law [?], and the [years are intercalated] —

And by the corrected reckoning [?], at first the count was at the beginning [of the reckoning], and at the end of the [cycle] it was at the [end]. The [intercalations] of the new-moons [were fixed], and the festivals and the [additions] within it [the cycle], from the beginning to the [end] of the world [?].

When the [reckoning] of the new-moons [was thus] corrected — at the time of the Second Temple — this was [reckoned] from the year of [?] until the year of the destruction. And [each man] would reckon, [counting] from the eve [of the festival], and from the fixing of the heads of [the months] —

[the reckoning] of the year of [?], and the [intercalated] months are [counted] thus, [counting] by the fixing of the new-moons. [The blank lower portion of the leaf is unwritten, not damage.]

that its way was [established] upon [a fixed reckoning], to publicize the matter, and to take counsel [?: to act], so as [not to err]; and [for] the days [?: festivals], for [?] —

The [court] established it — so that the [reckonings] should be by them; and so [the count of] years [?] from the eve [of the festival]; and at the head of the year [?] —

For each man would [reckon] this — by the [reckoning] of the molad [conjunction], generation after generation; and so [they] said: [the count] for the generations [?], that each [festival] should be by [a fixed reckoning] —

For each man should know the molad and [know] when [each festival falls], generation after generation, and not [depend] on [witnesses]. And the corrected reckoning is the thing [transmitted]; one fixed conjunction for each [month]; [for] this is [the way] of Torah, and one cannot [reckon] otherwise.

They took counsel [?: provided] for them, [so] that from the molad [the festivals are reckoned]. And R. [?: a sage] — by the order [of the reckoning]: a complete [year] is [reckoned] upon the order, for it is [intercalated]. So [the reckoning] was [transmitted] generation after generation, [these being] the new-moons of [the year]; and [each] knew the order [?].

For [each man] should reckon the new-moons by reckoning, and fix them. And the festivals and [additions] in each year were [corrected by him?]; from [the era] of R. [Adda?] רב אדא, ע"ה — the calendar of Rav Adda bar Ahava, [counting] by the cycle of the moon [the 19-year cycle], [namely] 19 years [?: שמי"ט days]; and this is the order [that governs them?].

[He] arranged [the reckoning], so that the [festival] should fall upon [its proper day], and so [too] the molad [?], by [the reckoning of] the cycle of the moon. And from the eve [of the festival, the reckoning runs]: the heads of the year [?: the new-moons]; and there is no [error] in [this fixed reckoning]; rather it is fixed [?].

Their reckonings were corrected [?] by Beit Din [the court], [namely] R. [?] of blessed memory; and at the beginning the conjunction [?], and the [intercalations] —

The years of [the era?] — for so a regular year is [reckoned] full, [counting] one [day] after another; and [a year] in which they intercalate, the [count] —

The [festivals] of these new-moons [?] is the order — whether full or [defective]. The new-moons [are fixed] by their [signs], [namely] [the months] Tishrei and Sivan and Nisan [?]; and from [them] —

The [reckoning] of these new-moons is the order, whether full or defective. The new-moons are [marked] by their signs and by [the festivals]: and a [festival] descends [falls] upon [its day], and another [festival] upon [another day] — Pesach [is reckoned], and one [counts] from it [forward], counting them [the days/weeks]; and there is the [count] of the Omer [?: ספירת העומר] —

[Counting] from the eve of [the festival] up to [the festival]; from this [reckoning] the [festivals] are [derived]; and so [the count] runs the days of the Omer [?], from the eve of [Pesach] up to [Shavuot] —

And how many [days] are full and how many [days] are defective [in the count] — when [each year] they intercalate, [the reckoning is corrected]; and [so] one knows, by the reckoning [of this year], the [festivals] this year; and another [year is reckoned] —

[the festival] descends upon [its day, in the count] from one day to the next, and one [counts] from it; thus the order is full or [defective]: the new-moons [are reckoned] by their signs; and from [the molad] R. [?] [intercalates] —

[counting] from the eve of [the festival] to [the festival], a regular [count], and [so] the heads of the [months] are [reckoned] in their order, from the [molad] up to the new-moons, [and there is] no [error] in [the reckoning] —

and Pesach upon [its day], a regular [count]; and Shavuot [Atzeret] [is reckoned] up to [?]; and the [festivals] — [their reckoning is corrected] by Beit Din [the court], [namely] R. [?] of blessed memory —

[counting] up to [a festival, day] after [day]; and one [festival, day] after [another]; and Yom Kippur [?] —

The festivals: Yom Kippur [?] [is reckoned] up to [?]; the eve of Yom Kippur — they take counsel [provide] mercy for Israel; up to [the day of] Atonement [it is reckoned]; and there descends [there falls] —

[The fixed reckoning] descends upon Israel, up to [the day of Atonement]; and there descends the eve of Yom Kippur — and the [court fixes the festivals] —

[The blank lower portion of the leaf is unwritten, not damage.]

Fourth Treatise (המאמר הרביעי), the practical Hebrew calendar — Chapter Nine (פרק תשיעי) continues. The reckoning of full, defective, and regular years; the lengths of the months; the days of the week on which the festivals fall; and the postponements (deḥiyyot) that govern the fixing of the year.

Folio 159r — text in upper portion, wide blank lower margin

and likewise, it being something received by tradition [מסורת] from our forefathers, may they rest in peace, that there are fixed signs for it. And these are the festivals: the day of [the first of] Pesach and the day of [?: a second festival-day-of-week reference] — for the months are arranged each one over against the next [each month set against the one before it], one full and one defective, alternately.

[The reckoning of the months' days:] In a year that needs to have a month made defective [חסר], its arrangement is altered accordingly, so that there should not be more than one full month [followed] over against one defective month [in regular alternation]. Tishrei is full — thirty days; Marḥeshvan, in [a defective] reckoning, [twenty-nine] days; and likewise from then onward each new month [is reckoned] full and defective by turns.

So a regular [כסדרה] year is one in which the months keep their fixed alternation: Tishrei full, Marḥeshvan defective, Kislev full, [and so on]. [In such a year the count of] the days of the year is according to its kind — [common] or embolismic [מעוברת] — and the year is "regular."

Therefore, since this is so, one says: if the year needs to be made defective, that which it requires is taken from Kislev, and Kislev becomes defective, so that the year is [a] "defective" [year]; and if it needs to be made full, an additional day is given, and the year is "full" [שלמה].

[The lengths of common and embolismic years:] A common year that is defective has 353 [353 = נג"ג, days; a regular one, 354 [נד"ג]; and a full one, 355 [נה"ג]. An embolismic year that is defective has 383 [שפ"ג] days; a regular one, 384 [שפ"ד]; and a full one, 385 [שפ"ה]. [?: the exact gematria forms of these day-totals are abbreviated with gershayim; read as 353/354/355 for the common year and 383/384/385 for the embolismic year per context.]

And it is to be known further: the count of the days from one [new-]month to the next, and the count of [the days] from the festival [Pesach] to [its parallel], so that you may know on which day of the week [each] falls. [?: this stretch sets out the day-interval rules linking molad to festival.]

[The festival day-of-week rule:] The day of the new moon [of Tishrei] and the day of Pesach — on whatever day of the week the [molad / first] falls, the festival likewise falls; and from there you compute the rest of the festivals. For Pesach is [a fixed number of] days [removed] from [the first of the year], and Shavuot a fixed number from Pesach.

[The lower portion of the leaf is blank parchment — wide outer/lower margin, not damage.]

Folio 159v — text in upper portion, wide blank lower margin; catchword at foot

This is the rule [הדין] of [the festivals'] fixing in the embolismic years and the common years: [the days are counted] from the new moon of the year [Rosh Hashanah] until [the festival], and so the festivals' fixing is known.

A regular common year — [its festivals fall] thus; a defective common year — its arrangement is altered accordingly. And if it is an embolismic year, the fixing of Pesach [is reckoned] from it, [so that] the day on which Pesach falls is known and is held firm. And as for the embolismic years, you reckon them likewise.

[The principle of the postponements:] And know that the fundamental rule [יסוד] in [reckoning] their fixing is the true [astronomical] computation; and it is what our [Sages], may they rest in peace, arranged for us. [?: invocation of the received tradition; read ל"ז/ל"ז honorific.]

And the matters [governing this] are: that the new moon [molad] of Tishrei is not [allowed to fall] on [one of certain forbidden days], so that the year's fixing is not on [those days]; rather, it is postponed [נדחה] one [day]. [The deḥiyyah of ADU:] Rosh Hashanah is never [fixed] on day one [Sunday], nor on day four [Wednesday], nor on day six [Friday] — [these are the days ו, ד, ו of the rule "ADU"]. [?: the rubric "לא יפול ראש השנה" — "Rosh Hashanah may not fall on Sunday, Wednesday, or Friday" — is the standard form here.]

Therefore the fixing of the year proceeds thus: if the molad falls on one of [the permitted days], the year is fixed [on it]; and if it falls on one of [the forbidden days], it is postponed to the next [day].

[The second deḥiyyah — molad zaqen:] If the molad [of Tishrei] occurs at midday or later — that is, [at] 18 hours [from the start of the day] or beyond — the [day of the] molad is "old" [זקן], and Rosh Hashanah is postponed to the morrow. [?: "מולד זקן" — molad zaqen, the noon-limit rule; read 18 hours.]

And similarly there is a further postponement in a common year: [the deḥiyyah of GaTaRaD] — if the molad of a common year falls on day three [Tuesday], at [9 hours and 204 ḥalakim] or beyond, it is postponed; [?: the rubric "ג"ט ר"ד" — Tuesday, 9 hours, 204 parts — read per the standard four-gates rule, the gematria being partly abbreviated.] and the [deḥiyyah of BeTU TaKPaT] — if, in [a year] following an embolismic year, the molad falls on day two [Monday] at [15 hours and 589 ḥalakim] or beyond, it is postponed. [?: the rubric "ב"ט תקפ"ט" — Monday, 15 hours, 589 parts; the two parts-values are abbreviated with gershayim and read per context, not all glyphs being separately resolvable.]

These four reasons for postponement — and no others — are the whole foundation of the year's fixing. By them the day of the festivals is known and held firm, so that the [observance] does not [fall] on a forbidden day, neither on a Shabbos [conflict] nor [on the other excluded days].

[The remainder of the leaf is blank parchment — wide outer/lower margin, not damage.]

Fourth Treatise (המאמר הרביעי), Chapter Nine (פרק תשיעי) — continuation: the rationale of the four deḥiyyot and the fixed calendar.

it is fitting that the [molad of the] equinoxes [תקופות] be reckoned likewise. They [the Sages] needed to fix the spring season and the autumn season [each] in its proper time, and it is fitting that one fix the spring and autumn equinoxes by it [the calculation]. For the moon's mean motion [מהלך] over a given span of time yields [a particular result], and it is not fixed there [precisely] on the day itself; just as one fixes [the date] by approximation, so too one does not fix it for the following day. Thus, since the day is such that it is fit for fixing [the festival] on it according to the rule, one fixes it [accordingly]; but if it is not fit, [one defers it]. And this is the reason for [the rule] "Adam — they do not fix [the molad]" [ADU — the deḥiyyah of Sunday/Wednesday/Friday]: that a molad which falls on one of these days, one does not fix the festival on it but on the day following. So too the molad zaqen [molad of an old moon]: if the molad occurs at noon or later, one does not fix [Rosh HaShanah] on that day, but on the following day, since [by then] the molad already belongs to the next day.

[Red ink rubric:] **ורבן** [= "and Rabban / and our Master"], [introducing] Moses ben Maimon [Maimonides], [in] *The Course of the Three Luminaries* [מהלך ג' המאורות] = Hilkhoh Kiddush HaChodesh], [who explained] at the end of the chapter the reason for these matters. The reason is this: the moon, when it is in conjunction with the sun [בקרוב], its [light] is hidden [נסתם], and there is reckoning [חשבון] in that, for there are [those] who reckon it [the conjunction]; and one does not [actually] see the moon, but [only] knows it by computation — [it is known] in its [computed] place, not in its [observed] place. So they knew that it [the new moon] is [present], and that the day of its conjunction is a fixed day [יום קבוע]; and the day of its [visible] becoming-real [its being seen] is according to the rule of fixing the festival on the fixed day. Behold, [there is] a deḥiyah [delay] for the molad and a deḥiyah for the festival: the deḥiyah of Shabbos, and the deḥiyah [arising] from another deḥiyah [דחיה מחמת דחיה]. And the reckoning [חשבון] is according as one says: "[the molad] occurs at such-and-such an hour" — just as one says [it] occurs at the [computed] hour. The deḥiyah [ascribed] to the equinox, one does not [reckon] it [by sighting]; and the [actual] sighting [ראיית] is not [taken into account] either. Behold, the [system of] fixing rests on this: that the festival not be fixed [on a forbidden day], so that [the day] should not be a [problematic] day; and this is the reason [why the molad governs]. So I say that this is the reason: since [the moon] in conjunction is hidden, the reckoning [is what governs], so that there be no error.

Therefore the Sages of blessed memory said, by the testimony of David of blessed memory, that one must add [understanding] to these matters and search out their words [the Sages'], so that the matter may be set straight. The matter is [thus]: David said upon it [as he attested]. This [is] one [reason], from the side of the wisdom [of astronomy — חכמת התכונה]; and there is another, from the side of [the same] wisdom, which is the foundation [העיקר]. And the calculator [המחשב], because there are many [festivals], must not err. So when [the festivals] are fixed by this matter, the festival is fixed and one does not err; and one walks the [established] path, so as not to err in the reckoning — this [is] the reason of the molad. And this is what they testified [or: sealed], saying "Adam" [ADU] — the reason being a deḥiyah and a deḥiyah, namely [the rule] that there should be no [Rosh HaShanah on] Sunday, Wednesday, or Friday. And what one says, "and the [molad of] equinox," and one says "the deḥiyah" — for by it [the deḥiyah] there will be a fixed day for [reckoning] the molad; and behold the reason: that the festival not be fixed on a forbidden day, neither a Shabbos nor [the eve of a festival], lest one [profane Shabbos] — for at Pesach there is no boiling [no cooking allowed], [yet] there is a season [where it would conflict]. And what they testified [or: sealed] in their words, and the reckoning — since the moon, when it

is in good [position], is fixed upon it, together with the equinoxes and the deḥiyyot — these [are the principles], and they have been established and instituted [והותקנו].

just as our Master [Rabbi] Moses [Maimonides] was [the one] to explain it and to make it known — by which [it became known] in many matters: the [molad of the] months [חדשים] falls, and time has [its] fixed [reckoning], from the [moment of] conjunction [הקבוצ]. The molad falls at conjunction on a [given] day, before the molad in its [proper] time [קודם למולד בזמנה], when it is [thus]; before another molad, and [so on]. The molad is on day one [or: a [given] day], when the conjunction is in [its true] reckoning [באמת]; and the fixing [is reckoned] from day to day. The conjunction is [reckoned] so that one may fix [לקבוע] the molad in its [true] reckoning — a fixed day [יום קבוע]; the conjunction in its [true] reckoning may be Shabbos [שבת — i.e. when it falls on Shabbos]. The conjunction is fixed from [one cycle] to [the next]: for if the molad falls [on the prohibited point], one defers it by one day or two, for [the rule] is "they do not fix"; the deferral [is] because the molad has already passed [the limit] at the [reckoned] time. [That is] the reason: the conjunction in its [true] reckoning [is fixed] on a [given] day, [and] thereby [it is] fixed, so that [the molad] which falls may be explained [שיתבאר].

The reckoning [is set] so that the molad be fixed [יתקן] for this — and [thereby] there is no error in this; this is the fixing [התיקון], that there be no error. And the molad in its [true] reckoning [is fixed] on a fixed day, [reckoned] from one Shabbos [to the next]. And from the reckoning of the moon, [one knows that] the molad is real [in its reckoning], and that the festival belongs to it; for [the molad] which falls at noon [is reckoned] to the morrow, at the [reckoned] hour.

The Sages added [or: the Sages' addition], and were exact in the deḥiyah, [for] this was the matter of fixing [the calendar] — that one not err. For this [reason], the deḥiyah [arising] from a deḥiyah; and the matter [is] that there should be no error. And [the festival] is fixed: it [the molad] falls, [and] it follows the [established] path; and one follows the path of the luminaries [המאורות], and behold, the [festival] is fixed [in its place]. And what one says, "and the day-count," is so that there be no error in the fixing of the festival; for [if] the festival is fixed on Shabbos itself, behold, that is a deḥiyah-from-a-deḥiyah [דחיה מחמת דחיה], for it [Rosh HaShanah] would [then] be a Shabbos at conjunction; and behold the reason. The deḥiyah of the festival [arising] from a deḥiyah is more weighty [חמורה] than [the rest], and it explains itself [יתבאר]: a [problematic festival] — the deḥiyah of the festival from another [deḥiyah]; behold [this is] a

further [matter]. And from the matter of fixing [it], so that there be no error in the reckoning; for the [molad of the] equinox [התקופה] is [reckoned] so that the festival not be fixed [on a forbidden day], so that [the year] not be [wrongly] lengthened [לא יעבר — that there be no error in intercalation]. And one follows the path of the luminaries [the established course], and behold the [festival] is fixed [in its place]; this [is] the reason.

The intent of the Sages of the generation [חכמי הדור] who came after [the earlier ones] — they were exact [in their reckoning], and the tradition [is] in their hands from the prophets [נביאים], [that] one fixes [the calendar accordingly]. And what one says, "and the equinox" [התקופה], is so that the festival not be fixed [on a forbidden point], neither on a Shabbos nor at conjunction — for it [Rosh HaShanah] would [otherwise] be a Shabbos at conjunction; behold the reason. The deḥiyah of the festival is a foundation [יסוד], and it is no falsehood [ושקר] — for the Sages relied upon it [שסמכו עליו]; [thus] the Sages of the generation who came after were exact [וידקדק], [for] this [the deḥiyah] is a tradition [קבלה], and the tradition is in their hands [from the prophets].

[The chapter closes:] So the Sages of the generation who came after were exact [in this], for the tradition is in their hands; and the tradition [is] from the prophets — [thus] it has been established [הוקבע].

and the elders ordained it [the calendar] in this way, so that no Shabbos and no festival-day would be displaced; and this is what they meant.

For when the matter is examined, you will find that the molad always falls either at one hour or at another, and accordingly the festival-day either falls in its proper place or is pushed off. Were the molad left as it is, without these corrections, the day would not come out as it should: for sometimes the molad would fall on one day while the new-moon day was [properly] the following day, and sometimes the reverse — the molad would fall on the fourth day [יום ד'], yet the day [of conjunction] would properly be the third. So the day of the molad is fixed by means of these [corrections].

When the molad of the moon falls before midday — that is, before the sun reaches the meridian — then it is one way; but if it falls after that, the day of the molad is the following day. Thus when the molad of the moon falls at six hours [of the day, שעות ו'] or later, that day is "old" [molad zaqen], and is reckoned to the following day; and there is a further [consideration] in this regard [נמור פי]. So you find that whoever pushes off [the day] does so for good cause, in that the molad has reached [the limit]; and so it stands.

The deḥiyot, then, are what our Rabbis of blessed memory transmitted to us by tradition [מה שיסרו לנו רבותינו ז"ל בקבלה], and they said: the molad of Tishrei [is reckoned] from the [reckoned] molad to the following day; and there is the deḥiyah which arises from [another of] the deḥiyot, so that one pushed-off [day] gives rise to another. For when this [first day] is pushed off, the reckoning requires that the order of the year be such that [the festival] not fall improperly. [?: compressed clause]

So the deḥiyot correct the day-count and the month-reckoning together, and they were ordained over the order [of the year] for this purpose. And this is the rule: the year is fixed [as defective, regular, or full] according to the residue of days that exceed [the cycle], and according to the deḥiyot — for the deḥiyot are what make the year defective or full.

This is the matter we first set down: that the residue of days which exceed the cycle is what remains after the complete cycles [have been counted off]; and no fractional remainder [ḥelek] is left over between the years — only whole days.

After this [comes] the matter of the year — that is, [the determination of] whether it is defective or full. Its hours and its ḥalakim [the molad's fractional parts] are what are to be corrected, so that the reckoning comes out properly fixed; and the molad is either [left] regular or [made] defective, and the day [of the festival] either falls in its place or is pushed off.

For the molad of Tishrei, whether its days were defective or full, [is reckoned] to the following day; and the residue is corrected by means of the deḥiyot. And the difference between the years — that is, the matter of their being defective or full — the deḥiyot are what determine; so the reckoning comes out properly, and this is the law [דין] of it; and they were ordained over [the year] for this purpose. So consider the order of the molad of Tishrei: from it the year is fixed, and there is no fractional remainder between the years.

So know the rule: a defective year and a full year — their reckoning [comes out] defective or full; and the years are made defective or full according to the molad, whether [the molad] falls so or not. And they ordained that the order of the year and the reckoning of the months [be set] according to the residues [שאריות] of the cycles; and the residues of the cycles [are reckoned] against [the count]. [?: compressed]

For the order of the molad — the residue which exceeds the complete cycles, when it is corrected [by the deḥiyot] — in this regard the reckoning is fixed, so

that a residue of a year of [so-many] days, more or less, [yields a year that is] regular, or defective, or full.

The residue of a single [common] year is the same [as another's], and there is no surplus of whole days between them; rather, what they ordained is that the year be governed [by the residue]. And the residues of the year [are reckoned] over the cycle as a residue [over the whole], and against [the count] as a residue of days; and so the year [comes out] regular, or defective, or full.

[Thus] you find the residue of days that exceed the cycle, all of them together; and you find that the residue of the year is a single residue — a defective year [yields a smaller residue], a full year [a larger one] — and so this matter holds together.

And this is so: that the molad of Tishrei [falls] at the hour [stated], or before; and what they [the deḥiyot] correct is the residue, [the year] being defective or full. So when the molad of Tishrei falls at six hours [שעות ו'] or later — for at six hours [the day] is "old" [molad zaqen] — the day [of the festival] either falls as it should or is pushed off; and the residue of the year is what [governs], and so is the reckoning of it.

And the matter of the difference between a defective and a full year is [that one yields a smaller] residue, the other a larger; and you find that the residue of the year, whether more or less, is what they corrected by the deḥiyot. [The parallel "defective / full" clauses here are the author's own restatement, not a doubling.]

And know that a day which comes out so [as a deḥiyah day] makes the year defective; and what they correct [yields], more or less, in this regard, a defective year. And we have reckoned it according to [the residue], whether its days are defective or full; and were it not for the deḥiyot, [the days] would neither be added nor taken away — and so the molad would have been [as computed], and would not [have agreed], whereas now it does. Thus it stands. [The chapter's rationale closes here; the lower margin is blank.]

so it is with the fixed [reckoning] and so with the computed reckoning [קבוע], when the year is full. And in the case of the full year, its molad falls on a Shabbos; therefore the deḥiyah, and on that account it was [made] so, and it was [reckoned] so according to its computation; for there is no [room] for [doubt] in this.

And the converse: when the molad falls on a day permissible [for ADU], it is computed [accordingly] for the full year, so that they will agree, the observed [day] with the molad in its computation. Thus, even though in this case the molad

would have been [?: one day] earlier than its computation, since it [the conjunction] was [reckoned] one day earlier — the molad was [made] to agree, so that they should not differ.

When the molad falls on a day permissible [for the deḥiyah of] the full year, it was [reckoned] so according to its computation, since it [the year] is [established] as full; this is [its] computation, [namely] that the molad fall [so]. This residue of the year, since it is [a remnant] above the [days] of the nineteen-year cycle [מחזור] — over five days [completes] a full year, and over six [completes a defective year] — and the residue [of the year], [were it not for the deḥiyot, days would neither be] added [nor subtracted]; therefore it was made to agree.

[And here] the difference and the residue [of the year are reckoned]. For the residue, you should be [careful] regarding it, that there is [no] difference in [this matter] except for the [single] day. For the residue of the day, by which the molad of the year exceeds [the days of the cycle], is the residue [of the year]; and you have already learned that the residue of the year is this remnant. And [the masters of] reckoning agreed concerning it, [namely] what [it amounts to]: that the residue of the year is one day and a fraction, and this fraction is [smaller than] a day, [yet more than half a day].

[The residue of one] month, by which the lunar month exceeds [twenty-]nine days, is the residue of the month, and you have already learned that [the residue of the month is] this. So the [reckoners] established the order of the months: the full ones and the defective ones, and the remaining mean reckonings [חשבונות], in order to [arrive at] the true [conjunction].

For when [the sun and the moon] complete their mean motions — twelve mean lunar [revolutions] over against [the mean motion of the sun] — the [mean] motion of the moon [exceeds that of the sun]. [And were it not for the fact that] the motion of the moon [exceeds] the motion of the sun [in mean motion], this [excess could not be reckoned]; but the moon [moves] in [its] swiftness more swiftly than [the sun moves] in [its] swiftness, and [its] motion [is] swifter [than] the motion of the sun. And the moon [moves] in its mean motion swifter [than] the sun [moves] in [its mean motion].

By [these computations], not a [single] thing [will be] hidden from you; and there is no [room for any] error, neither [in this] nor [in that], for the matter [is established].

So they made [the order of] the lunar [motion] over against the order of the sun, that [its mean] motion [proceeds] over against the sun, so that [its] cycle [be

ordered]; and the rest of the [mean] reckonings, [proceed] over against [the true conjunction], as has been explained: the mean reckoning, [which] proceeds, [agrees with] the true conjunction.

just as [it has been explained] regarding the residue, which [you] should be [careful] of, that it be [so], as it is [right], and the residue of the year [arises] from the mean motion. And by the order of the [reckoning], you may [examine] it; and [the masters of the reckoning] made it [so], according to [their] saying, for [the matter is reckoned].

When the mean motion proceeds over against [the sun], over each [day], from [the day of] the molad, [the moon's mean motion is reckoned], so that the true [conjunction] will agree [with the molad], the observed [reckoning] with the molad in its [reckoning]; for [it would have been one day] earlier than its computation. Since [it is established] thus, [the molad was made] to agree, [so that they should] not [differ].

[For the molad], as it has been established, [is one day] earlier than its computation; and so [the moon's mean motion] proceeds. [And it would be one] day earlier, whether [in the case of the defective year], since [its residue is less], or in the case [of the full year], since [its residue is greater]. The residue of the year, [arising] from the [mean motion of the] moon over against this [of the sun], and the [residue]: a residue of [a small fraction] of the year over against this, [and] there is in it [a small fraction]...

[For] the residue of the day [reckons], by [the way of] approximation, the heart [i.e. the mean] over against the true [conjunction]; and [you should be careful] of it.

[Therefore the reckoners] ordered this [residue], and made it [so]; and the [order of] their reckoning [is established], over against [the true conjunction]; and [you may examine it]: for [the true conjunction], with [its swiftness] and [its slowness], differs by [one] day, [and more or less].

[And so] the [mean] motion proceeds, and the [reckoning] is ordered, and [its computation is established]; for [its computation] over against [the true conjunction] [is reckoned], [just] as [the order is reckoned, so the order proceeds].

[The reckoners] [made known] in [their] saying, that [the months were ordered], from [the beginning of their reckoning], for [the years that are] defective — over each of them, by the swiftness or by the slowness, [the reckoning differs] from [day to day]; and [the moon's mean motion proceeds] at the beginning of the

year, and over [against] all this, [the reckoning of] this [is] over against the [mean] motion [of the moon] at the beginning of the [reckoning], [and so it differs].

And the [moon] [proceeds] over against [the mean reckoning], and [its mean motion is reckoned], over against [the true conjunction]; from [the mean motion of the year] [arises] the residue of the year, [more] or [less]; [its computation], at the [day of] the molad, [agrees with] the true [conjunction], [and more or less].

[For] when the [mean reckoning] [exceeds] one day and a fraction, [and] you have [a remnant of a full] year, over against [it]; and from [this] [its computation is established] over against [the true conjunction]; and [were it] not [for this, the days could not be reckoned], by [the way of] the mean [reckoning].

[And the residue of the day] is [not] purely complete; rather [it amounts to] what [the true conjunction] [requires], that the [excess] over against [it] [be reckoned], [so as to] [arrive] [at the true conjunction].

For [the reckoning] [is established], whether [the residue] be by [the swiftness], by this [fraction], [or] by the slowness; and [were it not] for [this] [the reckoning could not be established], by [day to day], [and] one [residue] [over against this] [of the year], one [day] earlier [and] one residue [later]; and [were it not] for this, [it could not be reckoned] purely [by the mean motion of] the moon, by itself, [unless] over each [day], by the [swiftness] [or] the slowness, [the reckoning differs]; and [the mean motion of] the moon [proceeds] over against [the sun], [for] its [mean] motion, [and its computation is established].

And [were it] not [for] the slowness [and the swiftness] [together], [the reckoning could not be established]; and so [it is] for [the residue] of the [nine] [months], the leap-[months], over against [the days] of the [year]; and [were it] not [for this], [the reckoning could not be established] purely; [for] the [excess] over against [it], whether by [the swiftness] or [in the end] [in slowness] — they return [to] [agreement] [with] [the true conjunction].

The body text occupies the right portion of the leaf (the left portion and the bound-in ruler are blank margin / photography furniture). The subject is the calendar argument that full (מלא) and deficient (חסר) months must alternate so that the order (סדר) of the new-months (ראשי חודשים) and festivals (מועדות) self-corrects across the cycle.

[Verbatim, lines from the top of the text-block, reading right-to-left:]

שתהיה רחוק להעולם ומחסרים אותך שתהיה רחוק להסר כדי [...] שדות בזמן הרחוי לבא לאמנם שהם סומכין על [...] צריך קביעת המועדים בזמנם הרחוי שאינו ולוטין [...] מהסר מחסר תסר הקבה מים לרבווע חדשים והמועד[ים] [...] ומועדים המנוים על דעתם וכן זל תקנו [...] לנו חסרון [...] לנו חדש השבור ולא

[Conservative sense:] ...that it should be far for the world, and they make it deficient for you so that it should be far so as to subtract [?: construal of שתהיה / להסר uncertain]... the festivals in their proper time, since they rely upon [the reckoning]; the fixing of the festivals in their proper time is required... deficient opposite deficient... for the computation of the months and the festivals... and the festivals that are reckoned according to them; and so [the Sages,] of blessed memory, ordained for us the deficiency [?: clause-sense uncertain]... the "broken" (defective) month, and not...

[Verbatim, middle of the text-block:]

דרבת חדשים ומועד[ים] החדשים ויתרון בחדש[ים] חשטו חס תהיה המ[...]. השבור ותהלוות הש[...]. וקבש חדשה בשטר וחס [...] תשרי לשם מטה שחין [...] מועדים ולא קבוע כן [...] תורה היות שמענם לתשרי [...] רבי יהודה דרוכם בן רחוק [...] ושלשותם בחמש מרחק [...] לא תשרי ולא טבת מ[...]. שמפסח לשבוכות ולא חסר [...] ויהיה מלא לשלם ולא תובל [...] [...] חדיר הסמוך לשם מטה

[Conservative sense:] ...the practice of the [full/deficient] months and the festivals; the surplus in the months [?]. the "broken" month and the requirements of the [year/month]... and a new conjunction (molad) in [?: שטר uncertain] and deficient... Tishrei [?]. the festivals, and the fixing is not so... the Torah [reckoning], that we should hear/derive [the festivals] from Tishrei [?]. [Polemical reference:] R. Yehudah [רבי יהודה] — [the construal of בן רחוק is genuinely uncertain; the prior draft's "whose words are far from being received" is not warranted by the glyphs]... neither Tishrei nor Teves... [the interval] from Pesach to Shavuot, and not deficient... and it would be full to complete, and would not be carried [?: תובל]... the [new-month] adjacent to [?].

[Verbatim, lower text-block:]

ועבת ושלשתה הס מ[...]. מבסלו כשיהיה יום אחר [...] בחמש חדש עבת בשהיה [...] שני ימים נדעב ולא [...] זל עוס אחר לה ואחד מ[...]. שבור השנה כדאמרה של[...] עד שיתקסר בטבן עברה [...] שמעובת לשם מטה ח[...]. ואחנו חושבן דלם משם [...] השנה לתשעים ויהיה חונה [...] [...] תעבר ולא נשאר בידין [...] וסמלו והו יתקסה דברו

[Conservative sense:] ...and a full [month], and its threefold [?]. from Kislev, when it is another day [?]. in five [days/the fifth] a full month when it is [?]. two days [?: נדעב uncertain] and not... [of blessed memory] another [reckoning] to it, and one of... the "broken" (intercalated/defective) year, as stated... until it is

completed in its reckoning, [its] deficiency [?: עברה]... that is made full [?] to [?]... and we reckon [it] from [?]... the year by ninety [?: לתשעים — numeral/term uncertain] and it will be [?]... it is carried over and nothing remains in [our] hands [?]... and [?] and his statement will be completed [?].

[Marginal mark: a small siman/letters (gershayim-marked) in the inner margin (visible on the scan); content uncertain [?].]

[End of f. 163r. The argument continues onto f. 163v.]

The body text occupies the LEFT portion of this leaf (the ruler and outer margin are on the right). Reading right-to-left within the text-block:

[Verbatim, top of the text-block:]

תשיבת תקן ופת עבת ש[?] בערחשון וכסלו לבין [...] הוא אחד בעצמו ו[...] כן לבו ולחוס עוד לה [...] עולם שמא לא כן אלא [...] יתחייב חו ומ[?] וימשך [...] ואין למשית בשבסת [...] את עוס היום זה ולא [...] דך טוס שבתעבשתהי[...] שנה הקין חסר כסדר [...] שדר נכל [...] שיהיה קיבו [...] חדיר שען כמו שחושבן [...] וכן ולא בדיר קרחשון

[Conservative sense:] ...you will set in order [?: תשיבת / תקן] [the months], full opposite [?]... in Marcheshvan and Kislev between [?]... it is one and the same [in itself]... so [?] and to add further to it [?]... ever [?]; perhaps not so, but rather... it would be obligated [?] and full [?: ומלה] and it would be drawn out [?: וימשך]... and there is no [equating?] in [?: שבסת]... this day, and not... [the run of] the moon [?: טוס] that [?]... a year that is deficient in order (כסדר) [?]... [the?] order, in all that the fixing (קיבוע) be [?]... the [new-month] [?: חדיר] as the reckoning... and so, and not [deficient?] in Marcheshvan [ראש חודש/חדש = קרחשון] ...

[Conservative sense, continuing — the dense day-of-week / molad rationale:] ...so that the conjunction (molad) of the [year] should fall in its proper time, [the months] each following another in order [?]; the run of the moon (טוס = "the moon"/"the run" [?: this MS abbreviates the lunar term as טוס]) in its proper time of the new-months; a deficient new-month opposite a full one, so that there be a deficiency of the [whole] year, like its [proper] deficiency [?: many clauses here are genuinely elliptical and the connective sense is uncertain — withheld rather than confabulated].

[Verbatim, mid-text-block, just before the chapter rubric:]

קיבועה כוס נסבת [...] תהיה קביעה השנה רחוק להעולם ובח הלקס [...] חסר כשתהיה רחוק להסר ובח הלקס בו בשבת ומ[...] שיהיה קיבועה כוס נסבת ודעת חדש השבור [...] שחושבן קתת בני אדם והאות על זה היה תהיה ל[...] קרחשון כן הד רבעת פתיחיות והטריס [...]

[Conservative sense:] ...its fixing [as] the moon's conjunction [?]. ... the fixing of the year would be far for the world, and in [?: וּבַח] the portions (חלקים)... deficient when it is far so as to subtract, and in the portions on Shabbos [?] and [?]. ... that its fixing should be the moon's conjunction, and the matter of the "broken" month [?]. ... that the reckoning [is from] some of mankind [?: שְׁחוּשְׁבֵן קֵתַת בְּנֵי אָדָם — construal uncertain], and the sign of this is [?]. ... of Marcheshvan; thus the four openings (רבעת פתיחיות) [of the gates] and the [?: וְהָטְרִיס uncertain].

[Red-ink display rubric, centered, enlarged hand (clearly visible on the leaf):]

פרק [Chapter]

[The enlarged rubric word פרק ("Chapter") is plainly legible. The ordinal that follows it is in the running body hand and is not separately legible even under magnification; the prior draft read it as "פרק עשירי" (Chapter Ten), which fits the sequence after Chapter Nine but the ordinal word עשירי is not independently confirmed on the leaf — flagged [?].]

[Heading-line, continuing in the body hand:]

פתי כל פתיחיות שערים שעליהם היו [...] ראשי החדשים והמועדות והחשבון המתוקן ש[...] שתבטל ובכבוד היה כל מה ספירורו עד כן

[Conservative sense of the heading:] ...[in it the author] opens [פתי] all the openings of the gates upon which are [established] [?]. ... the heads of the new-months and the festivals, and the refined computation (החשבון המתוקן) that [?]. ... [?: שתבטל uncertain], and in honor [ובכבוד] was all that [?]. ... up to here [עד כן]. ...

[Verbatim, lower text-block — the body of Chapter Ten begins:]

כשתדע מחמת מולד[ך] כפי מעמדו מטעות ימי הס[...]. אחד אחד מחדשין ומועדין ולקבוע יח וקס היא שלשה משו[...]. מחנן הסר הזה שחול כל מולד תשרי שלמה וז שנה מעו[...]. חלת היום כלעולם שיהיה סימן פתיחות מיה שעת מ[...]. לאחד קיבוע ריה היה ירחו מטב כן טוס המולד [...] של טוס שנה כן משעברת או תשועה בחר מימי חדו [...] למחרת יום המולד וכן [...] הס יחול מולד השנה בחר [...] שעת ומעלה ממחרת מהיום יביה מהרחת טוס המולד

[Conservative sense, Chapter Ten body:] When you know, from your conjunction (ולדמ) according to its position [?: מעמדו], the [days?] without error... each one of your months and your festivals, and to fix [the day]... from the reckoning [מחנן / מחשבון] of this deficiency, [for] every conjunction of Tishrei runs [as] full [?], and [?]. ... the beginning of the day forever [?: כלעולם] — the sign of the openings being so-and-so hours [מיה שעת] — "such-and-such hours," an indefinite slot, not a recovered numeral]... for one fixing [?: קיבוע]... so the conjunction (molad)

[runs]... of the [lunar] year, whether it be intercalated [משעברת] or a [common] year [?: תשועה uncertain]... [the day] following the day of the conjunction; and so the conjunction of the year falls on the morrow [?]. ... hours and a fraction beyond [?: מחרת], from the day [?].

[Verbatim, foot of the text-block:]

מולד טוס שנה תשועה ירחה קיבוע כיה [...] שנה תשועה מן ג שעות י"ד חלקים ומעלה מיום [...] ויהם [...] וערחה השנה היה מתעב כן יוס ה לקישביוס

[Conservative sense:] ...the conjunction (molad) of a [common] year [?: שנה תשועה], its fixing [?]. ... a [common] year: 3 hours, 14 ḥalakim [ג שעות י"ד חלקים [= 3 h 14 ḥalakim]], and more, from the day [?]. ... and the [moon-reckoning?] of the year is reckoned [?] thus, day 5 [?: יוס ה — "day 5"?] for the conjunction [?].

[The closing siman numerals the prior draft read as ג"ג / ר"ד are NOT independently legible on the scan; the partly-rubbed foot lines give "ג שעות י"ד" (3 hours, 14 ḥalakim) confidently, but the "ג"ג / ר"ד" reading is not supported — [numeral: ?] rather than asserted.]

[End of f. 163v. The day-of-week / four-gates reckoning of Chapter Ten continues onto the next folio.]

Isaac ben Joseph Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484), Spanish Rabbinic hand. Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar, Chapter Ten (פרק עשירי): the four gates of the common years (ד' שערים).

[Penciled foliation in upper margin: "164".]

the secret of this deferral (*deḥiyah*). And so too the secret of the deferral lies in this: that a full month follows a full one for the sake of the cycle (*maḥzor*); and the deferrals set the months and the years right. So when you know the *tekufah* — its portion (*ḥelek*) being such-and-such and its sign (*siman*) such-and-such — the *tekufah* falls rightly. And these are reckoned from month to month, and so the [year] follows in its regular order (*kesidran*), and the deferrals set the common (*pashut*) and the leap (*me'uberet*) year right.

You have now learned the deep secret of this deferral; and the near secret of the deferral lies in this: that the common and the leap year and the deferral are sufficient for [determining] its fixing (*kevi'ah*); and that the festival-days and their foundations follow from the regular ordering of the year, and the leap year is needed to set the heads of the months right.

You need only know this: that he who knows the molad of the year [knows] the way [to its fixing]. And this, too, is sufficient [to bring it about]: know that the molad of the year is the foundation, and from it [proceeds] the deferral.

By way of the deferral and the [day-of-week] sign you reach the fixing of the year; and the sign that is established by way of the [molad-]reckoning [governs] the days, and through it you know the molad and the week, and from them [proceeds] the molad. For he who knows the reckoning of the molad and its portions (*ḥalakim*) — and that this is the established molad — for him the heads of the months [are fixed], and the reckoning of the days of the week and their portions is set right.

For these signs (*simanim*) of the years, and the things made known by way of the [molad-]reckoning, are sufficient — that the molad of the year is the foundation, and from it [proceed] the heads of its months and its appointed times.

And the day's [molad-]reckoning is precise, and the sign is precise, and from it [comes] the molad; and the heads of the months [follow] from after it. He who knows this [knows] that this is the established molad, rightly ordered (*mekuvan*), and that the reckoning of the days of the week and their portions is correct.

And so this fourth [matter — the] gates: *qof-lamed* [77], *qof-samekh* [07] [i.e., the day-totals reckoned to these values] — for the study [of them]; that is the gate. The signs (*simanim*) of the years are renewed and made known [thereby].

[Lower margin: blank — not damage.]

and you should know that this is the way [to it]: that the year is full, and that you know the molad, and the *Pesach* [molad] falls on it on day three [Tuesday], and so the [year] is set. By way of the *tekufah*, on account of the [molad of] *Pesach*, [you reckon] the deferral; and by way of the *tekufah* you know the fixing of *Pesach*, [and that it falls] in their regular order, as it was. So this is the way to set the year right, and the deferral [follows]; the [molad-]reckoning sets it right, and you reckon [it]. From here on, [reckon] by way of a single molad — by it you fix [it]; and a single [reckoning] is sufficient. For the foundation is the molad; and this is the way, [reckoning] by a single molad, [so] that you reach the sign that is suspended on [the day of] the molad: the days of the week and their portions, and the investigators (*ḥoqrim*) and the explainers [say so], for the things made known are these.

The common years are four — the [molad of] *Pesach* on day three [Tuesday] yields its order, and so the year is regularly ordered (*kesidrah*); and the fourth,

the gates: *qof-lamed* [קל], *qof-samekh* [קס], for the study; that is the gate. The signs of the years are renewed and made known.

[Red ink header, centered:] שְׁעֵרי הַשָּׁנִים [recte: הַשָּׁנִים] [The Gates of the Common Years] — [to its left, in red:] בלמוד הראשון [in the first study]

[Red marginal note at this line: "הַשָּׁנִי" — the rubricated section-word repeated in the margin as a catch-rubric; further identification not required.]

הַפְּשוּט. The common [year]: when its [molad-]reckoning is on day three, [the year] being deficient (*haserah*), [then] *Pesach* falls on it, and its sign shall be: in regular order (*kesidrah*) — for the whole [molad-]reckoning is, in this, sufficient for the sign and the order; and [reckoning] this way, its sign is *nun-bet-he* [נב"ה]. From here on, reckon [so].

When the year is such [that] the [molad of] *Pesach* falls on it on day [N], its sign being so, but it is not in regular order, it is deficient. And when it is not [so], the [matter] follows from after it: the *Pesach* [molad] on it [falls thus].

[Gate One:] שְׁעַר הָא [Gate 1]. Its [molad of] *Pesach* and the day on which it is, with all that follows when its [molad of] *Pesach* falls thus and its sign is *nun-bet-he* [נב"ה]; and [for] its [molad-]reckoning that comes after it; and [for] its [molad-]reckoning [when the year] is deficient — its sign being so — the day on which its *Pesach* falls; its sign being [so], regularly ordered — *bet* [ב, day 2]. So when its *Pesach* is on day [N], its order [follows]; its sign and order are in this, and in this is the root [of the matter]. From here on, reckon [so].

When [the year] is such that its [molad of] *Pesach* falls on day six [Friday], its sign being so — but if it is not in regular order, it is deficient; and [when] it is not [so], the [matter] follows from after it. *Pesach* on day six [Friday].

When its [molad of] *Pesach* is on day [N] and its sign is so, all of it as it is; the day on which its *Pesach* falls, its sign being so, regularly ordered, with all that [follows]; and [reckon] the day on which its *Pesach* falls and its sign is [so], as it was — the [molad-]reckoning, with all that follows from after it: day [N].

[Gate Three:] שְׁעַר הַג [Gate 3]. And [for] the day on which its [molad of] *Pesach* falls, its sign being so: just as [for] the [molad-]reckoning that follows from after it. When its *Pesach* is on day [N], its sign being so for the [year-]type, [then reckon] so; when its [molad of] *Pesach* is on day [N], with all that [follows] from after it — its sign being so.

And its sign — when its *Pesach* is on day [N] — and when its sign is so for the [year]-type, with all that [follows] from after it.

[Gate Four:] שער הד [Gate 4]. And [for] the day on which its [molad of] *Pesach* falls, its sign being so: regularly ordered [if it falls] on day three [Tuesday], Shabbos [as a fixing day], its [year] being full — so [reckon]. When [the year] is such that its [molad of] *Pesach* falls on it [as] full, and so its sign is [so]; and [when] its *Pesach* is on day [N], its sign being so, with all that follows from after it: day [N]. And so when its *Pesach* is on day [N] — except [when so-and-so] — the [matter] follows from after it; *Pesach* [on it].

When its [molad of] *Pesach* is on day [N], its sign being so for the [year]-type, [then] full, with all that [follows] from after it: day [N]. And when [the year] is deficient, with all that follows from after it; the [molad-]reckoning [of] *Pesach* on day [N], except [when so-and-so] — day [N]. And [for] day [N], its sign being so.

These [gates] were arranged, and the root was made known; the signs of the common years are brought forth for [whoever] does them — so-and-so being [the day]. So [the matter] of the gates [stands]: their signs are [thus], as the gate [requires].

[Lower margin: blank — not damage.]

Isaac ben Joseph Israeli, Yesod Olam. Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar, Chapter Ten (פרק עשירי): the Four Gates (ד' שערים). Bodleian MS. Huntington 299, Spanish Rabbinic hand, 1484. Brown/red ink, single column. Page 1 = folio 165r (pencil foliation "165", conservation ruler at left margin); page 2 = folio 165v (ruler at right margin). The lower third of 165v is blank outer/lower margin, not damage.

[The top line of the page is the close of the preceding Gate exposition from the previous folio:] ...in Gate Three, and it [the year] is regular (כסדרה); and in Gate Four, that it is full (שלמה) and ḥaserah [deficient].

[Red ink header:] **The Gates of the Intercalated Years (שערי השנים המעוברות).**
[Run-in note, in brown:] These, accordingly, belong to the First Lesson (כן הם בלמוד הראשון).

Gate One (שער הראשון), which is when the molad [of Tishrei] falls on a Shabbos [Saturday]:

When the molad falls thus, the year will be either full (שלמה) or regular (כסדרה), and Passover within it falls on a Sunday — and its mnemonic is *Shabbos* (שבת).

And [if] the molad falls thus and the year is deficient (חסרה), then the year is regular (כסדרה), and Passover within it falls on a Shabbos — and its mnemonic is *Rishon* [the first].

Gate Two (שער הב), which is when the molad of the year falls on a Monday (יום ב):

When it falls thus, the year will be regular (כסדרה), and Passover within it falls on a Tuesday (יום ג) — and its mnemonic is *Shabbos* (שבת). And [if] it is so [but] the year is deficient (חסרה), then the year is regular, and Passover within it falls on a Sunday (יום א) — and its mnemonic [?]. When the molad falls thus and the year is full (שלמה), then it [Passover] falls on a Tuesday; and likewise when it is deficient, it is full, and Passover within it falls on a Wednesday (יום ד). And the regular year that comes after it — Passover within it falls on a Thursday (יום ה), and its mnemonic is *Sheni* [the second]. For the intercalated year is regular, and there is in it a reckoning [heshbon] for the molad of the [following] year. And know that this is the rule (זה הכלל): the intercalated year is governed by the deḥiyot [postponements] just as the common year is, except for the deḥiyah [whose mnemonic is] *BeTU TaKPaT* (בט"ו תקפ"ט)[?: lettered molad-limit abbreviation, committed glyph-by-glyph]. ...for it is not pushed off [נדחה] from this, and it is regular, and its mnemonic is *KeHaB* [?]. So it [Passover] falls on a Tuesday — and its mnemonic is *KeFaT BeHaKBaT* [?: lettered mnemonic string, committed glyph-by-glyph].

Gate Three (שער הג), which is when the molad of the year falls on a Tuesday (יום ג):

When it falls thus, the year will be deficient, and Passover within it falls on a Tuesday (יום ב) — and its mnemonic is *Gimel* [the third]; and its mnemonic is *HaShaN* (השנ"ו)[?: lettered siman, committed glyph-by-glyph]. And the full year that comes after it: Passover within it falls on a Thursday (יום ה), and its mnemonic. So it falls on a Shabbos, and its mnemonic is *BeTU TaKPaT* (בט"ו תקפ"ט). The intercalated year is reckoned by these mnemonics, and the common years likewise; and they are reckoned [as set out] for the Lesson, so they may be reckoned to establish [the fixing of] the gates.

[Closing of the gate set, continuing into the next folio:] For in the four mnemonics of the gates [are contained] all the [year-]types. And in the mnemonic *HG HiSeR* (חג חסר)[?: lettered siman, committed glyph-by-glyph] — its full reckoning is at the rate of the fourth [part]: the common year. And he said further (ועלה תרים)[?: a phrase introducing the addendum that follows on 165v]...

[Lower margin of 165r blank.]

[The page opens by continuing the addendum from the foot of 165r:]

by Sundays [or "the deḥiyah of *BeYU*"][?] regularly, throughout every year, that it will be regular, and now [follows] another matter (ועתה עניין אחר). And here are the rules [or "mnemonics"] of the four gates of the [intercalated] year and their establishment, [as set out] for the Ninth Lesson, in their proper order, as we have said. And [we are] to recall the truth of the molad of the year by way of computation: it falls at a given hour, [counted by] the days of the week and the ḥalakim [parts]; and the boundary [gevu]l of each one [mnemonic] is by sevens [seven-day cycles]. And the common years are reckoned by their mnemonic, and the intercalated years are reckoned by their mnemonic. And the four gates of the intercalated year, with [the molad of] its [Tishrei], so that the molad of the year and the length of the gevu]l [are known]; for when the year is governed [is established] by its mnemonics — these are the [year-]types that are stated — so that one may know the molad of the year [as it] stands. And know that the molad of the year falls at a fixed hour [ot], and this is the *tekufah* [season-point], and each one [falls] within its [proper] times, and the rest [follow] by sixes [six-day intervals], and so on (וכן הדבר). And the order of the reading [קריאה] is by the four parts [reckonings] within it, for the reading is from where it [the count] begins. And the reading at [a given] time, for it is the closest [boundary]; for "the closest" [הסמוך] is read after it — and that is the *tekufah*. And the time itself is read again [נקרא], by zachor [marking]; and it is read at its time, and one returns [counts back] for it. And the time of it is by the seven [days], and the [reading by which] it is read anew [is its renewed reckoning]. And [as for the] mnemonic that is renewed (פחות החדש)[?] — these are the readings [קריאות] at their times, [whether] one [count back] from this or one from that. And there is no exhausting [end] to it, and the rule of the gates [הסתפק]: that it is between [the months of] Iyar[?] and the fourth [part], for the fourth part of the year is [thus]. And the addition (וכדי לבאר): the rules [mishpetei] for the Lesson — for the year was [reckoned] truly [נכון], by these laws, that the molad falls within its proper times — [as set out] for the Lesson.

[Red ink header:] **The Lesser Gates of the Common Years (שערי הקטנים)**
[Run-in note, in brown:] [As set out] for the Ninth Lesson (בלמוד תשיעי).

[Centered rubric:] **Gate One (שער א).**

[Run-in:] [As set out] for the Ninth Lesson (כלמוד תשיעי).[?: the lesson-number run-in appears on both sides of the rubric.]

The rule of every common year (כל סוג שנה פשוטה): [the day on] which Passover falls within it is a function of [the molad of] above [i.e. of Tishrei], by the times and the parts [hours and ḥalakim] from above. And when the molad of the year [falls] within the geṽul of the First Mnemonic (סימן ראשון) — the year will be regular (כסדרה), and it will not be deficient (לא נקבע) on a Shabbos, and the molad [of Tishrei is reckoned] from the molad and the establishment [tekufat] of the molad. So it is regular, and there is in it [the count of] the deḥiyot of the molad (דחיית המולד); and there is no [postponement] beyond the First Mnemonic — for there is no molad reckoned this way and that. So the [Tishrei-]molad of the year, [reckoned] thus, will be regular, and the year is [thereby established]. And the establishment [ḥeshbon] is by the molad of the year — its proper reckoning, except that the *tekufah* is full; for the molad of the year falls [at a known point], at the rate of [the appointed] reckoning. [Per the mnemonic] *HaSh* (חש"ש)[?: lettered siman, committed glyph-by-glyph] — *LeḤ TaTSh* (ל"ח תתש"ט)[?: lettered molad-limit value, committed glyph-by-glyph, not arithmetically verified] — so that the time of the year [molad] is by the proper rule; the days of the week, by the deḥiyah [postponement], are reckoned by these — but it is not [pushed off]. The molad of the year was [reckoned] truly [נכון], [per the mnemonic] *KeDeS* (קד"ס)[?: lettered siman, committed glyph-by-glyph]; the time, the establishments, the molad [are] by [the value] *Heh* (ה); and [its mnemonic] — the year will be lesser [katanah], and Passover within it [falls] on a Sunday (יום א). And its establishment was [on day] *HRi* [?]; and the establishment of the common years [is reckoned] thus: the gate of the common year, and it [Passover] falls, and [thus is] the rule. And Passover within it [falls] on a Wednesday (יום ד), by [the mnemonic] *NeMaShTaW* [?: lettered siman, committed glyph-by-glyph]. And when the molad falls [thus], and its establishment is from the geṽul, the deḥiyah: the molad of the year was [reckoned] thus. And this is the molad reckoned (חייל)[?]: at the rate of the time [ot], by *ShTaRBG* ḥalakim[?: lettered hour-and-parts value, committed glyph-by-glyph], and the establishment; and at the [appointed] time, the establishment *TaKPaT* (תקפ"ט) — so that there is in every common year a *tekufah* established [reckoned] truly, like the year of the First [reading]; and the new beginning [head] of the year [Rosh HaShanah]. And the renewal [of the cycle] (ואחיותי)[?] — or [up to] the [hour] *Yod* (י'): the time *TaTHRSh* (תתחר"ש)[?: lettered hour-and-parts value, committed glyph-by-glyph], the parts [ḥalakim], from above — and the rest [of] the common years are obligated. ...that its mnemonic [is] the year-*bachor* [reading][?], or [up to] the [hour] *Resh* (ר'), and it [Passover] falls. *BeḤoR* (בחור)[?: lettered siman], and likewise *VeTU* (וטו) the year — and it falls. At the [appointed] hour [ot]: the time *Sha*[?] — [up to] the hour-value *Vav-Heh* (ו"ה) [or "*MoeS Het*"] [?: lettered hour-and-parts value, partly committed].

Fourth Treatise (המאמר הרביעי), Chapter Ten (פרק עשירי) — the Four Gates (ד' שערים). Continuation of the Lesser Gates of the Common Years, worked per Gate.

[The upper portion and the wide lower portion of this leaf are blank margin (not damage); the written block sits in the middle-and-lower part of the column.]

the reckoning (השבור) by which it runs (כדרכו) — that this be its measure (שעורו), [namely] the boundary (גבול) of so-and-so [numeral: ?] in a year — was deficient (חסרה), and the molad was [numeral: ?]; so that it would be later by [numeral: ?].

A common year (שנה פשוטה), when its course runs in order (כדרכה), such that the molad of the second [year] (מולד שנה שניה) is later by [numeral: ?].

This boundary (זה הגבול) amounts to one ḥelek (חלק אחד) over the reckoning (על (השבור), and within it there is [numeral: ?]; so the day-of-week of the molad (יום (קביעות המולד), if it be [numeral: ?], then the boundary of this molad is [numeral: ?], and there are within it [numeral: ?].

the hour, the seconds, and the ḥalakim of the day; and the day is such that it runs from [numeral: ?] until [numeral: ?]; and if it were [numeral: ?] until [numeral: ?] hours [?: two molad-limit hour markers, the small embedded numerals do not resolve glyph-by-glyph]. We have given it thus, and the day is the day [numeral: ?]; the seconds of the boundary are [numeral: ?], and the remainder is [numeral: ?].

[Mid-folio:] The molad of the year, counting from the third [day] (מן יום ג') until [numeral: ?]; and the boundary of this is [numeral: ?] — that is the surplus (המותר), which is the excess by the reckoning (השבור); and the hour of the seconds, and above that the day [numeral: ?].

This belongs to the reckoning we have given. The remaining seconds and the rest of the seconds are [numeral: ?]; and the day is the day [numeral: ?] up to the day [numeral: ?] [?: a chain of day-of-week limit markers, the embedded numerals are too small to commit].

So the day-of-week of the molad, if it be [numeral: ?]; for it has [numeral: ?] days, and that is the surplus that endures (המותר שיתקיים); and a common year, whose course runs in order (כדרכה), the molad of which is [numeral: ?].

and one chooses (ובוחר) the value that is [numeral: ?]; thereby the molad and the reckoning are [numeral: ?]; and this is the boundary, and this is the surplus that is the boundary [numeral: ?] from the third [day] — that is, by it [the count] runs.

and the molad of the year is [numeral: ?], and the matter and its boundaries (גבולותיו) and the choosing of the value. The year is common, regular and ordered (כסדרה), and within it there is [numeral: ?]; the boundary that begins to draw out the count (שמתחיל להמשיך) [numeral: ?].

the choice is [numeral: ?], and one chooses it; and a common year, its course as a common year, [is reckoned] as we have explained (כמו שפירשנו).

[The ruler/scale-bar is on the outer (right) side of this leaf — opposite the recto, confirming a distinct facing leaf; the inner (gutter) margin is at left. The lower half of the column is blank margin.]

[Top, continuation of the First Gate:] ...[numeral: ?] one ḥelek, and the molad of the year is [numeral: ?]; and if the boundary is later, then the day is [numeral: ?] up to [numeral: ?].

The hour and [numeral: ?]; and the molad is so; the boundary of this molad is [numeral: ?], and the surplus is [numeral: ?]. There are within it [numeral: ?] ḥalakim of a day, and the rest of the seconds; and the day is the day [numeral: ?], and not the day [numeral: ?] [?: day-of-week limit markers, the embedded numerals are faint].

A common year, its course in order (כדרכה), and the molad of the year is [numeral: ?]; and the day-of-week of the molad, if it be [numeral: ?], has [numeral: ?] days; and that is the surplus that endures (המותר שיתקיים). The boundary of the molad is [numeral: ?]; this is the boundary, which is [numeral: ?]; the molad is [numeral: ?].

a year regular and ordered (כסדרה), and the molad of the year is [numeral: ?]; from the third [day] (מן יום ג'), [numeral: ?] ḥalakim; the seconds are [numeral: ?]; and the day-of-week of the molad, if it be [numeral: ?]. The remainder of the seconds, and the day is the day [numeral: ?]; the molad is [numeral: ?], the choice being [numeral: ?], and one chooses it. The seconds and the molad are [numeral: ?]; the year is regular and ordered (כסדרה). So the day-of-week of the molad, if it be [numeral: ?] up to [numeral: ?], then there are within it [numeral: ?]. The boundary [numeral: ?]; the choice is [numeral: ?].

Gate Two (שער שני)

[Rubric in enlarged brown ink.] ...by which the order runs; the boundary that is [numeral: ?]. They said (אמרו): as for the boundary that draws out the count, and [numeral: ?]. The Gate of the years whose course is in order, and we have given it

[numeral: ?]; from the third [day] [numeral: ?] alone (לבד), and the rest [numeral: ?]; and above that, the boundary is [numeral: ?].

The molad and the boundary are so, and the surplus is [numeral: ?]; the day-of-week of the molad, when it begins to draw out the count (כשמתחיל להמשיך); the year [numeral: ?] and not the year [numeral: ?] [?: paired day-of-week limit markers, the embedded numerals are faint]; the order in its place, and within the year [numeral: ?]; the day of the molad, if it be [numeral: ?], and [numeral: ?].

the choice is [numeral: ?]; the molad is [numeral: ?]; and [numeral: ?]; the boundary is [numeral: ?]. They are the seconds, and within them is [numeral: ?], like the boundary [numeral: ?]; and the boundary from it, which is [numeral: ?]. The reckoning is [numeral: ?] from the third [day] — that is, the boundary [numeral: ?].

A common year, regular, ordered by fours (כסדרה); [numeral: ?] ḥalakim; everything per the reckoning, by the molad and the second (שבור); the molad of the year is [numeral: ?] from the count [numeral: ?]; the seconds and the boundary; the day is the day [numeral: ?].

Gate Three (שער שלישי)

[Rubric in enlarged brown ink.] ...and a common year, regular (פשוטה כסדרה); the molad of the year is [numeral: ?]; and the day-of-week of the molad, if it be [numeral: ?], has [numeral: ?] days; and that is the surplus that endures.

The boundary draws out the count (הגבול ימשיך); from the molad up to [numeral: ?] hours, [numeral: ?] ḥalakim; and the day [numeral: ?] [?: an hour-and-ḥalakim molad limit, the embedded numerals are faint]. So-and-so [numeral: ?] of a day, and the day runs from [numeral: ?] until [numeral: ?]; if it be [numeral: ?]. They are the molad, and they are the boundary; this molad is [numeral: ?].

So the reckoning, when it begins to draw out the count; the boundary from it; this is the molad [numeral: ?] from the third [day]. [numeral: ?] ḥalakim, the choice being [numeral: ?]; and the boundary of the seconds, and the day [numeral: ?].

the molad of the year is [numeral: ?] from the third [day], and above that [numeral: ?] in their place; and [numeral: ?] of the seconds; the day is the day [numeral: ?]. And there are within it [numeral: ?]; and [numeral: ?]; and what is in it [numeral: ?].

Gate Four (שער רביעי)

[Rubric in enlarged brown ink.] ...and a common year, regular; [numeral: ?] ḥalakim, [numeral: ?] hours [?: an hour-and-ḥalakim molad value, the embedded numerals are faint]; the boundary of the molad of the first [numeral: ?].

The day-of-week of the molad, if it be [numeral: ?]; in their place, and above that the boundary [numeral: ?]; from the third [day], [numeral: ?] until [numeral: ?] hours.

The seconds are [numeral: ?] from the count; the year regular and ordered (כסדרה), by the second of a common year; and the day-of-week of the molad, if it be [numeral: ?] until the day [numeral: ?], then it is [numeral: ?]. The day-of-week of the molad, when it begins to draw out the count; the boundary [numeral: ?].

the rest of the seconds, drawn out from the molad; the boundary [numeral: ?]; the molad [numeral: ?]; and the day-of-week of the molad, if it be [numeral: ?].

and one chooses it; and a common year, its course as a common year; the day-of-week of the molad [numeral: ?]; the rest of the seconds, and the day [numeral: ?].

[numeral: ?] one ḥelek, and the molad of the year is [numeral: ?]; and if the boundary is later, then the day is [numeral: ?]. The hour and [numeral: ?]; and it is [numeral: ?]; and the molad is so; and the boundary-molad-reckoning of a common year, when it begins to draw out the count; the day is the day [numeral: ?].

the year is deficient (חסרה), by the molad of the deficient year [?: the contested word read as שמואל by the first pass is, in this calendrical context of a deficient common year, far more likely a verb/quantity (e.g. וּשְׁמוּאֵל/שָׁחַ as a reckoning term) than the proper name R. Samuel — NOT committed as a name]; the year being [numeral: ?], a regular year; [numeral: ?] hours; the boundary [numeral: ?]; the boundary of the molad [numeral: ?], and below it [numeral: ?]; and it is [numeral: ?] in order (כסדר), and one chooses it.

[The lower half of folio 166v is blank margin.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; Chapter Ten (פרק עשירי) — the Four Gates (ד' שערים). Continuation of the per-gate Lessons, here the Gates of the Intercalated years (שערי המעוברות), worked gate by gate.

Script: Spanish Rabbinic semicursive, primary hand; brown ink. Conservation ruler and black photographic strip along the left edge (furniture — ignored). Wide blank lower margin (not damage).

[The opening lines continue the matter of the preceding folio — the surplus and boundary computation for the closing gate of the Lesser Common Years.] ...and when we subtract it [the surplus] it remains [numeral: ?]. And he equated it, and the boundary [גבול] of the molad is [numeral: ?]. A common year that is [numeral: ?] hours, [numeral: ?] ḥalakim — that is [numeral: ?] days [numeral: ?] hours; and one whose remainder is [numeral: ?] hours, [numeral: ?] ḥalakim, on day [numeral: ?]; and one of [numeral: ?] hours [numeral: ?]. By this rule [כיוצא בזה], day [numeral: ?] surplus [numeral: ?], and so likewise a common year whose [numeral: ?]...

Gate of the Intercalated Years [שער המעוברות]

By the same Lesson [בלמוד הזה] and by the same two boundaries [ובו ב' סימנים]:

The molad of the boundary [numeral: ?] — its boundary is such [כמה] that the molad of the first [day] is [numeral: ?] hours [numeral: ?] ḥalakim; and the remainder [וחנוק] of the first [day], a common year, is so much, and the molad of the first [day], a common year, is so much; and a deḥiyah of the molad of the first [day], a common year, is [numeral: ?] days [numeral: ?]. An intercalated year whose [count] is such — afterward it will be the [numeral: ?] day; and between them [ובין] [numeral: ?]. And the days of the Gate of the Intercalated years and its boundary [וגבול] [are] as the Lesson sets out [כדרך].

The first Gate [השער הראשון]

its boundary is such [כמה], and from this is the surplus, the hour of the molad [numeral: ?]; subtract until the [numeral: ?] hour; the remainder [numeral: ?] hours, [numeral: ?] ḥalakim, on the first [day] [hinukh]; subtract; the molad of the common year [numeral: ?]; he equated it, and equated it; afterward it will be [numeral: ?] day; and between [numeral: ?]. And the molad falls [וחל מולד] on day [numeral: ?] at the hour [שעת] [numeral: ?].

[Continuation, mid-folio:] The first [day] [day-of-week marker] [numeral: ?], the hour of the molad — read as [numeral: ?] ḥalakim, day [numeral: ?]; subtract until the molad [numeral: ?]; and the days of a common year are such, and its remainder [וחסירה] [numeral: ?]; he equated it, since it is [numeral: ?] day; the molad falls [numeral: ?] day, day-of-the-week such, and it will be... and so forth, day [numeral: ?].

[Lower portion of the column:] ...a common year, day [numeral: ?], surplus [numeral: ?]; the molad falls so much, on the molad day [numeral: ?]; the boundary is so much, the surplus [numeral: ?] [the molad falling] at the hour of the molad [numeral: ?] — and from this the molad [numeral: ?]. The hour of the molad of the first [day] [numeral: ?]...

The second Gate [השער השני]

A deḥiyah of the boundary [קביעות], a common year [or: the established date], [numeral: ?]; and the molad of the common year falls so much, the surplus [numeral: ?]; the Gate of the Intercalated years, in the order [בסדר] of the Lesson, is such — for it is set out [שנתבאר]...; until the hour of the molad of the first [day] is [numeral: ?] hours, [numeral: ?] ḥalakim; surplus [numeral: ?], and another remainder [ומיחס] [numeral: ?]; by this rule [הכא תקפט] — that is [numeral: ?]...; and there is no [intercalation/passing-over] [ולא יעבור] until the hour [numeral: ?]; the deḥiyah of the molad of the established date [קביעות] is such, and the molad...

[End of inscribed text on 167r; wide blank lower margin follows.]

Script: same primary hand; brown ink. Conservation ruler and black strip along the right edge (furniture — ignored). Facing-leaf sliver visible at the gutter (left edge). Wide blank lower margin.

[Top of column:] ...an intercalated year that is so much — the established date [year] is [numeral: ?]; the deḥiyah of the molad is such, the molad of the common year [numeral: ?]; and the molad of the established date, a common year, is such [כדפה]; and he equated it [ושיו] [numeral: ?]; on the manner [על דרך] that we have said, by this rule [כמו]...; the established dates [הקבועים] [are] seven days [numeral: ?]; and there is in them a boundary [סימן] and a boundary, the first [day] and its boundary [ונבול], the first [day]...

By the same Lesson and by the same two boundaries [סימנים]: a common year whose molad is so much — and he equated it and equated it; the molad of the common year [numeral: ?]; on the manner that we have said, by this rule [כמו]...; that is, the days of a common year, seven days, the Gate of the Intercalated years; and there is so much [in it], by which it... and the boundary [are] as the Lesson sets out. And from this the molad [numeral: ?]...

The molad [numeral: ?] hours [numeral: ?] day; subtract; a deḥiyah of the molad [numeral: ?]; and from this the molad of the established date [numeral: ?] — afterward it will be day [numeral: ?]; and between them, day [numeral: ?]; and from this falls the molad on day [numeral: ?] at the hour of the molad

[numeral: ?] — and from this the molad [numeral: ?]. At the hour of the [numeral: ?] day [Shabbos], a common year of [numeral: ?] day; he equated it and equated it; afterward it will be... and it will be between [numeral: ?]; the Gate of the Intercalated years and its boundary [are] as the Lesson sets out.

And now [ועתה] it is well [טוב]: a common year and the intercalated years, each one by itself [בכל אחד]; and afterward, the matter [הענין] in [its] order. And the common years and the intercalated years — there is for them the first [day] [numeral: ?]...

By this rule [כיוצא בזה], the common years are so much, day [numeral: ?]; ...and so forth, day [numeral: ?] — the intercalated years; and there is in them so much; the first [day], a common year, and the intercalated year [are] so much, day [numeral: ?] hours [numeral: ?]...

The fourth Gate [השער הרביעי]

and its boundary [are] in the order of the Lesson, day [numeral: ?]; and the boundary [גבול] of the common year [numeral: ?]; the common years it is so much, day [numeral: ?], and the intercalated years...

The common years it begins from [מתחיל מן] [numeral: ?] and extends until [ומשך עד] the molad [numeral: ?] day; the intercalated years it begins from [numeral: ?], and besides the common years it begins so much [numeral: ?]. The boundary of the common year is so much, this fourth [הרביעי] [day] begins from [numeral: ?]...

[The ordinal sequence of boundaries:] ...the third [השלישי] of the common years is so much, the boundary [גבול] [numeral: ?]; and the second [is so much]. And the fourth [הרביעי] is the boundary [סימן] [numeral: ?], this fourth begins from [numeral: ?]...; in the intercalated years it begins, and from a remainder it begins [מתחיל]; the established dates [קבועים] are so much; and in all the common years it begins so much; the boundary is the [numeral: ?]...; and from [numeral: ?] it extends until the molad [numeral: ?]; subtract; from [numeral: ?] it extends until the molad [numeral: ?]; and from this [מן בה] it extends until [the day] [numeral: ?].

the intercalated year, it is the boundary [סימן] [numeral: ?]; the common years is so much, day [numeral: ?]; and the intercalated years it is so much [numeral: ?]...; the third [השלישי] of the common years is so much, day [numeral: ?]; and the boundary [גבול] of the established date, a common year, is so much; the established dates [קבועים] [numeral: ?]; until [numeral: ?], and the intercalated

years day [numeral: ?]; the remainder [רויח] [numeral: ?] [a gershayim-marked value]; and the fifth [והחמישי]...

[Final inscribed lines:] ...the intercalated year, it is the boundary [סימן] [numeral: ?]; this is the fourth [הרביעי], it begins from [numeral: ?]; and the fifth [והחמישי] it is the boundary [numeral: ?], and the boundary, and all the common years [are] so much...

[End of inscribed text on 167v; wide blank lower margin follows.]

**

Fourth Treatise (המאמר הרביעי), the practical Hebrew calendar — Chapter Ten (פרק עשירי): the Four Gates (ד' שערים). Continuation of the Gates of the Intercalated years, worked sub-gate by sub-gate, followed by the Four-Gates table (לוח).

it begins from, and it runs on until it was [reaches] the limit [גבול], and it runs through the common years up to [the boundary]; this was, and it runs on through the common years up to [numeral: ?], and in the intercalated years this is the *siman* [סימן], and this begins from [numeral: ?] as it was; and the *siman* of the [Shabbos / sabbatical?] is this day [numeral: ?], and the boundary [גבול] for all the common years of the cycle [מחזור].

The common years that follow them begin from [numeral: ?], up to [numeral: ?], and the rest of the common years from [numeral: ?]; and in the intercalated years this is the *siman*, and this begins from [numeral: ?] as it was [literally "as the first ones were"]. The *siman* of Shabbos [day] is this day [numeral: ?], and the boundary for all the years of the cycle that begin from [numeral: ?] up to [numeral: ?] — and this is the molad of the year, and it runs on until it was [reaches] the limit, since it is intercalated. You see, then, that the *siman* of this year is [numeral: ?], and the common year was as [the others] were, and it runs on until it was [reaches] the limit. And in the intercalated years this is the *siman*, and this begins from [numeral: ?] as it was. The *siman* of Shabbos day is this day [numeral: ?], and the boundary for all the years of the cycle.[?: this opening passage is the close of the per-gate boundary series carried over from the prior leaf; the per-gate molad-limit values are faint throughout — flagged [numeral: ?] rather than pattern-filled]

You see, then, that the *siman* of the year is its *siman*, so that it may be easy for you to be [find] the order [סדר] of all... so that the order of this is in order, [each] within [its] cycle, and to compute it within the cycle, and to know what is its boundary.

[Here a new sub-section opens.] The Lesson [הלמוד] of the year: and after one calculates it and arranges all of it, and the boundary of the table [תקלה / table?] year by year and year, and there is for it a boundary in the common years — that is, the molad — and the molad was. And the year that begins from this, its boundary is from this; and the surplus [מותר] within it [is] [numeral: ?]; and the molad was, and it runs on to the limit; and you shall know, then, that it is this year, and so you shall know. And it begins from [numeral: ?] and there is its molad, and the *siman*...

and you shall know the day on which the molad [falls], for it is [day numeral: ?], and you shall know the [day]; and the *siman* of the year, and its molad...

The cycle [מחזור] is the molad up to [numeral: ?], and the rest of the common years [begin] this day, and the *siman* of the year that begins from [numeral: ?]... [?: the per-line molad/limit values across this band are sub-legible — committed as structure with [numeral: ?] for each unread value]

You see, then, that the *siman* of the year, in which is the order of reading [קריאת] the [gate], and also the order of the common years of the [cycle]; he established it [תקנו], to make it [reads] easy for you, and to know its boundary year by year.

The Lesson [הלמוד] of the year: and after one computes the whole of it, and the year — and you shall know that it was; the boundaries, and the order of its reading; in all the computations of the matter, and the [way of?] [numeral: ?]; the calendar of the [court / authority? — אלהב...], the [son of ...], and the [way?], and within it [a] cycle; and within the boundary, the common years; ...it was; and you shall know.

You see, then, that it was; and the order of its reading, the table; ... in the boundaries, and the year; in all the computations, when you take up... [numeral: ?]; the calendar [לוח] of the year... [numeral: ?]; ... this day; the order of ... and from the limit of the common years; ... from the limit; this day, and you shall know. And it was [day numeral: ?], and it is [numeral: ?], and the south [דרום]; ...the *siman*, and the boundary, the boundary it had; ...to know the order of an order; ...the molad of the year, what is its surplus; ...they said the boundaries, and they are exact [וד"ק / "and they are precise"]; ...the year that is fit for the cycle [למחזור ...רא].

[New Gate]

שער — *Gate*. And after [וחר] one returns [שביר]... the [reading] of this is the molad and its molad, and [the cycle?]; ...and you shall know...

[The closing two lines of the leaf, lower-margin:] The smaller [common years?] that are fit for them [שסיירין? / "that they ordered"], the *siman* of the common [years] he [the author] established; they said the boundaries, and they are exact; ...more than this, and the moon [הירח], and the calendars [הלוחות] / "and the steps"?, how... the computation of the year, fit for the cycle.

In these gates of the four Lessons [שערי ד' הלימודים], one inquires [מחקר / מחקר] concerning it [the topic] more than...

[Below this the lower outer margin is blank parchment — not damage.]

[The text resumes at the upper inner part of the leaf; the lower portion carries the ruled four-gates **table**.]

in the matter, and in the matter of fixing it [סדור? — "their ordering"], it is fit for the...; the year — its common years they have [established?], and there is for it...; we shall know, then, the molad of the cycle, all of it...; ...it was; and its molad, and you give it within them; ...all the cycle [reads] in summary [בלסכס / "in a summary form"]; ...all the moon [or "tables"] [reads] within it, the day [numeral: ?], and Jerusalem [ירושלם]; the matter that it is recalled close to [near]...; and in the matter [or "the gate"], the matter [literally].

You see, then, that it is fit for it, an upright [order — סדר / סדר]; ...in the matter and in the matter, and within it a cycle; and on it [the molad?]: that the molad of the cycle, all of it...; it was; ...its molad and you set them down; ...all the cycle [reads] in summary; ...all the moon/table [reads] within it, [the day numeral: ?]; ... Jerusalem this is its computation; and you settled the Lesson [הלמוד]...[?: this band repeats the boundary/molad framing of 168r in close parallel — lexicon-locked rather than re-flagged word-by-word]

And after they were established, like the order [כמו שתרי], how it is established, like the [way] this is upon it; ...the *siman* of this is, like... established it [תקנון]; ... the cycle to the orders within them — for whoever computes it... the limit [גבול] is not laid [נופל] within the boundary [לטבת / לטבן] this day; ...intercalated [/ ...נעברת]; the [years]...

and Jerusalem [reads] this is its computation. And you settled the Lesson...[?: marginal punctus before this line]

[Several lines of the molad-boundary computation, partly legible:] close to [near] the [calendar / table — לוח], it is established, like that you bring [שתביא] it within an upright order; ...after they were established, like the order, how it was, and so they said: you shall know the day; ...common years, the common years; ...and

[numeral: ?] and the rest of the common years; the cycle, the molad of the cycle, and you set down what is in it; ...the boundaries... the day; ...it was; and a boundary [is] not laid within the boundary [לטבן], this [day numeral: ?]; ...and you settled — there is an order; ...after them, the boundaries; ...common years that are fit [for them?]; ...and within it [the] day, the time [זמן], when [an even week — שבוע]; ...seven within the week [or "and a full week"]; and the boundary [is] the *siman*; and they have ordered them, and they are arranged [וסדורים] within the four boundaries.

These are the boundaries of the first [common years], and you shall know the [common years]; the *siman* of the cycle. [numeral: ?]; ...and you knew the boundaries of the [common years], the first ones [הראשון], and the *siman* of the year, the common year...; and you knew the *siman* of the common years of the cycle [הרבעית? "the fourth"], how it [reads]; and what they ordered as it [reads]; ... like that they ordered them [כמו שתרי].

You see, then, that it was; and the order of its reading [or "of its ordering"], and the *siman*, what it [reads], and so [the order]...[?: the surrounding band repeats the parallel order/siman formula]

[The Four-Gates table — לוח]

[Red/brown-ink prose line directly above the ruled table, partly legible:] ... וכן יסכם ס'ה[הראש]קים הנקראים אוהב — *[The note above the table; transcribed verbatim — its precise sense requires further verification: "...and likewise the order of the ... which are called ...".]* [?: caption line not fully resolved]

The table is ruled in a grid. It reads right-to-left: the **rightmost** column is the argument column (prose row-labels), and the columns to its left carry the gate boundary-values (gematria). The header row gives the column rubrics. Four data rows follow.

מספר העולים (count of those rising) [nume ral col]		[argum ent — row label, RIGHT MOST]		בח	קט	וזח	שע	בט	נב
גבול col 1]	[num								
ד' [4] · רבן	ז"ח [num	ארבע מולדי	ז"ח · נ"א	ה"ח · ר"ל	ה"ח · ו"ם	ה"ח · ר"ל	ב"ט · ר"ק	כ"מ הקפ"ע	

מספר העולים (count of those rising) [nume ral col]	גבול [col 1]	[argum ent — row label, RIGHT MOST]	בח	קט	וזח	שע	בט	נב
הראשון	eral: ?]	שנות ה[המ... [[the four molad ot of the years of the ...]	ר"ד [nume ral: ?]	[nume ral: ?]	[nume ral: ?]	[nume ral: ?]	[nume ral: ?]	[nume ral: ?]
ד' [4] · רבן שני	ז"ח [num eral: ?]	שנת חל[מ] י"ב אז עשו לפניה סולם לתקנה לאחר הקפס [the year ..., 12; then they made before it a "ladder " to repair it after the	ה"ח · ו"ם [nume ral: ?]	ה"ח · ר"ל [nume ral: ?]	ה"ח · ר"ל [nume ral: ?]	אטרל / אטרל [nume ral: ?]	אטרל [nume ral: ?]	נ"ח · ד [nume ral: ?]

מספר העולים (count of those rising) [nume ral col]	גבול [col 1]	[argum ent — row label, RIGHT MOST]	בח	קט	וזח	שע	בט	נב
		cycle- comple tion]						
· ד' [4] · רבן שלישי [or רבן עליל]	ז"ח [num eral: ?]	שנת [שבור] שאחר הקפס ולתקנה לפניה [the year [of repair?] that follows the cycle- comple tion, and to repair it before it]	ה"ח · ר"ל [nume ral: ?]	ה"ח · ר"ל [nume ral: ?]	ה"ח · ר"ל [nume ral: ?]	אטרל [nume ral: ?]	אטרל [nume ral: ?]	כ"מן הקפ"ע [nume ral: ?]
· ד' [4] · רבן רבעי [fourth]	ז"ח [num eral: ?]	שנת ערב[ו] לתקנה ולאחר הקפס [the year ... to	ז"ח · ר"ל [nume ral: ?]	ז"ח · ה"ח [nume ral: ?]	ד"ח · ת"לה ה"ח [nume ral: ?]	ו"נ · רטא [nume ral: ?]	א"כ · ר"טא [nume ral: ?]	א"כ · ר"טן [nume ral: ?]

מספר העולים (count of those rising) [nume ral col]	גבול col 1]	[argum ent — row label, RIGHT MOST]	בח	קט	וזח	שע	בט	נב
repair it and after the cycle- comple tion]; שנת ערב[ו] קאל[ו] זו מעוברו ת [the year ... these are interca lated]								

[LAYOUT: dense numeric table — the gate-boundary cells (day-counts of the molad limits) are written in a small, faint hand; the structure, the argument column, and the header rubrics are recovered, but most interior boundary-values do not resolve cell-by-cell even under magnification — flagged [numeral: ?], NOT pattern-filled. The wide blank lower margin below the table is blank parchment, not loss.]

Fourth Treatise [המאמר הרביעי], Chapter Ten [פרק עשירי] — the Four Gates [ד' שערים] (continued).

Spanish Rabbinic semicursive, single hand throughout, brown ink. Both leaves are prose; the wide blank outer and lower margins are the page format, not damage.

And now that we have already explained for you, above, the matter of the common years on their own and the intercalated years on their own, the point is this: within each kind of year, the molad [molad — the conjunction reckoned for the calendar] of the one is close to the molad of the other. So set down the boundary-siman [siman — mnemonic marker] for each one accordingly. For from the molad of this year to the molad of that one, once you reckon the surplus [מותר — excess] of days and the remainder, you will know by how much the one runs ahead of the other.

And know that this is the foundation we have laid: the principle of the boundaries [גבולים] and the simanim holds for the intercalated years exactly as it holds for the common years. For from the molad of this year to the molad of that one there is, between them, a fixed surplus; and once you know it, you will know by how much the one molad runs ahead of the other, and you set its siman accordingly.

And all this is only so that this siman may serve to make known the surplus of the one molad over the other; and from the surplus you will know the boundary, and from the boundary, the siman.

So set down for the common year the siman of its boundary accordingly, and for the intercalated year the siman of its boundary accordingly, each one on its own. For the surplus of the one over the other is fixed; and when you do not reckon the surplus of days, you cannot establish the siman; and likewise, when you do not reckon the boundary, the siman of the cycle [מחזור] is not established.

For this is the rule of the matter: the siman of this boundary and of that boundary, and the surplus of the one adjacent to it [הסמוך לו] — when you set it down, its boundary-siman is fixed, and the one adjacent to it has its own siman, and the cycle-surplus accordingly. And when you reckon the days of the cycle and its boundaries, you will know the surplus, and from it the siman of the cycle and its boundary.

And after this we have set, for each siman, the surplus from the beginning to its end. And here too we have done as we explained above. For at the beginning of the years, the cycle-surplus is fixed, and this is what we set out in the latter table [בלוח האחרון]; for the cycle-surplus is the equalized [המכוון] surplus — this is its siman — and the deḥiyot [postponements] of the cycle return to the beginning.

And likewise for the siman of the first year and for the boundary of the first, this too is so. For the small year [השנה הקטנה], its siman one [is] near; that is its siman, and the one adjacent to it has its siman, and the surplus of the one

adjacent to it accordingly. The latter is the boundary, and the surplus of the one adjacent to it accordingly, and its direction accordingly.

This is the matter of the third boundary. Here we have completed explaining for you the matter of the two kinds of year [שני העדרים / שני השנים — i.e. common and intercalated; [?: the noun is written שני הע, abbreviated]], so that the one kind should be near to a siman; and the one that follows it has the siman of the one adjacent to it, and its surplus accordingly, in setting the boundary of the siman; the one adjacent to it [is fixed] accordingly, and its direction accordingly.

And now that we have already explained the matter of the years on their own — that the molad of the one is near the other — as we explained, each one on its own: if you reckon the surplus of days of the first year, and you reckon the surplus of days of the cycle [דין המחזור — the case of the cycle], this is the rule, and from it you will know the surplus of the molad of the cycle. From this it is established without doubt [בלא ספק]; and from this they return to the matter — the moladot, and the cycle-surplus — and its siman accordingly.

For the molad of the cycle is the equalized one; this is its siman, and you set the boundary of the siman, and the one adjacent to it [is fixed] accordingly, and the surplus of the moladot of the cycle accordingly.

For when the surplus of the molad of the cycle is the equalized surplus, you will know its siman; for the molad of the cycle recurs, and from its surplus you will know that the surplus of the moladot of the cycle is accordingly so. From here you will be able to know the surplus of the rest of them, whatever they may be.

And likewise the molad of the cycle, whatever it may be — for the cycle is fixed. And by this path you will know the surplus of the days of every cycle, for the cycle is fixed and the moladot accordingly. And the rest by this same method [דרך]. And from this you will know the boundaries, [given that] the cycle is fixed — and this is what we explained above, since the cycle-surplus is fixed; this is its siman, and the deḥiyot of the cycle return to the beginning.

[The following is set as a short run-in list of per-gate boundary statements, each line briefer than the body lines above:]

- For the cycle to be [what it is], the molad of the cycle is [so], [for] the moladot to be [so].
- For the molad of the cycle to be [so], it is the second surplus from this; this is the cycle's.

- And for the moladot to be [so], the molad of the cycle is the latter [האחרון]; this is so.
- The siman: for the molad of the cycle to be [so] — the surplus of the cycle is equalized, and so.
- For the molad of the cycle [to be] a complete year [שנה שלמה], the latter cycle is [so].
- For the moladot of the cycle to be [so], this is so; the cycle is [so].
- The molad of the latter cycle [is so], so that the surplus proceeds [ילך], [and so].
- For the days of the week [ימי השבוע] there is, for the molad of the cycle, [a value].
- The gates [שערים], each one apart from another, each one — its moladot, until there is the reckoning of the moladot.
- These [are] according to the reckoning [החשבון], whether it is shortened [התקצר] or as the count [כמספר].
- The one that comes [הבא] of them is from the beginning [מתחילת] of the years of the cycle.

For the seven simanim [שבעה סימני] of the cycle, each one is fixed, [in] the matter of the moladot — this boundary follows accordingly, some of them so, and a year so, or so.

The moladot accordingly, each on its own; and behold, all of them [are reckoned]. And the matter is either the difference [חילוף] for common years [לשנים פשוטים], whichever they are, or the difference for intercalated years [למעוברים], whichever they are.

And behold, the [remaining] arrangements [מעמדות] of the rest [are reckoned], whichever they may be; and likewise either difference.

For the count of the moladot [מספר המועמדות] is set for the common year, for all of them; for all of them are made equal to one another [שכולם הם משווים זה לזה], so that this measure [מדה] holds.

And now everything is arranged for you [ועתה הכל ערוך לך] like this latter table [וכו']. [כלוח זה האחרון], etc.

[End of Chapter Ten's prose explanation on this opening. The dense four-gates day-count table referred to here ("the latter table") stands on the facing leaf (170r), visible here only as an uninterpretable sliver of a single argument-column across the gutter — see Readability.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; Chapter Ten (פרק עשירי) — the Four Gates.

Folio 170r holds the dense day-count / molad table; folio 170v holds the continuous prose that explains how the table was constructed and how to enter it.

Folio 170r — the cycle-positions table

[Red ink caption, above the frame:] צורת — "Figure."

[Red ink title, top of frame, verbatim]: לוח מעמדות מעלות ראשי המחזורים הקבועים — שנוי סימני המחזור — "Table of the standings of the degrees of the heads of the fixed cycles; the variation of the cycle-signs."

[Right-margin rubric, written vertically alongside the argument column, verbatim:]: שנות המחזור וסדרם — "the years of the cycle and their arrangement."

Structure. The table is a ruled grid of **19 data rows** (the years of the nineteen-year cycle, the argument column at the right reading downward 19-1 = א-יט) by **8 data columns** of values plus that **1 argument column** — i.e. 19×9 cells. Each interior cell holds a three-part molad triple in gematria: a **day-letter**, an **hour** value, and a **ḥalakim** value (e.g. ה יח שלא = day 5, 18 hours, 331 ḥalakim). The eight column-rubrics are written diagonally across the header band; they name the successive cycle-positions (each a מעמד / molad-station of a year-class). The rubrics are at the legibility floor at this resolution — several read as compounds beginning מולד / מעמד followed by a position-word [?].

The interior is a genuinely dense small-hand grid: each of the 152 data cells packs a full three-glyph-group molad triple, and a large share of those groups sit at or below the legibility floor of the scan even under magnification (the hour and ḥalakim sub-values especially). I transcribe the argument column, the title, the header band, and the cells I can read glyph-by-glyph with confidence; the remainder are flagged [numeral: ?] rather than pattern-filled, because the boundary-values across a row do **not** form a smooth staircase and any "completion" would be fabricated.

The argument column (rightmost), read top to bottom, runs: א, ב, ג, ד, ה, ו, ז, ח, [recte 15/טו], י, [recte 16/טז], יא, יב, יג, יד, יה (19-1; the scribe writes 15 and 16 as יא / יב rather than the conventional טו / טז).

Representative committed cell-readings (rightmost data column, the first of the eight, read top to bottom by row of the argument):

Year	leftmost cols → ... → first data col (rightmost)
(1) א	... [numeral: ?] ... [numeral: ?] ... (331 ;18 ;5) ה יח שלא [?] ב או [?]
(2) ב	... [numeral: ?] ... ב שרם ... (204 ;5) ה רד [?] ...
(3) ג	... [?] ז ב תתצא [?] ... ה דקם ...
(4) ד	... [?] ה רנו [?] ... ב יח כב ...
(5) ה	... [?] ה רנו [?] ... יח כב ...
(6) ו	... [?] ה רנו [?] ... יח תשיח ...
(7) ז	... [?] ה רנו [?] ... יח תשיח / ב תתקנב ...
(8) ח	... [?] ה שלא [?] ... ב תתקנב / ה שלא ...
(9) ט	... [?] ה שלא [?] ... יח תשמא ...
(10) י	... [?] ה שנו [?] ... יח תשמא ...
(11) יא	... [?] ה שנו [?] ... ה סד תקס ...
(12) יב	... [?] ה כב תתקנב [?] ... ז יד קעא ...
(13) יג	... [?] ה כב תתקנב [?] ... ז כב תתקנב ...
(14) יד	... [?] ה שעא [?] ... ז יד קעא ...
(15) יה	... [?] גה שעא [?] ... ה שעא ...
(16) יו	... [?] ז תתע [?] ... ה שעא ...
(17) יז	... [?] ז תתע [?] ... ו י רו ...
(18) יח	... [?] ו יח ז תתע [?] ... ד יח ו ...
(19) יט	... [?] ח כב תתעו [?] ... ב י תקלה ...

[Closing prose below the table, folio 170r foot — verbatim and translation]:

ראה כי כל הגבולים האלה הם נטועים ונבדקים בכלל הפשוטה ולפיכך וכבר הודעתוך קודם.

"Observe that all these boundary-limits are fixed and verified within the common-year reckoning as a whole, and therefore — as I have already informed you above."

Folio 170v — prose (continuous)

After you have arranged, from top to bottom, the rows of the table according to the order of the years of the cycle — its days and its remainders — its order is as you see it. Then take the row of the year you require and look across to the column you require; for the column-headings are set in order, and they tell you the molad of that year of the cycle. The table is thus arranged for you upon a

clear order, so that you may rely on it. And when you have done this, you have found the molad you sought, and there is no need to take the day apart and reckon it anew.

For all that I set down here regarding the standings of the molad and its rules — and what I established for it of the boundary-limits and the variations of the cycle — was already explained above row by row. Now I have set out the table itself in the order of these stations, so that all of it lies before you as a clear arrangement; and I have done this only so that the seeker, when he enters it, may find what he seeks at once.

These boundary-limits are what stand in the table for the variations, while the rest are fixed and verified. So I have arranged for you the standings of the cycle in their order, and I have settled the rules upon a clear order, year by year.

Know that the molad of the first year — that of the head of the cycle — is the foundation, and from it the others are reckoned. When you know the molad of the first year, you compute likewise for the rest of them; for from one comes the next, and they follow one upon another. And so too I established for them the standings.

And from the molad of the first year you take the remainders and the variations, and from this you know the rule of the cycle and how the molad of the head of the cycle stands: for when the molad will be of such-and-such a value [?: numeral lost], the year will be of one sort, and when it is otherwise it will be of another sort. So know that this is the molad of the first year, and from it you compute likewise for the rest; and you settle the standings upon a clear order, so that the molad lies before you.

And so I have made known to you the rule of the standings of the cycle, in the order of their boundary-limits, year by year, until the cycle is completed — and I have already informed you of this. The matter is ended; the lesson is concluded (סיים הענין סימן הלמוד).

so that it will be in accordance with the signs [סימנים], to serve for the position [מעמד] of the cycle that follows it; and its sign [is] the molad of the [following] cycle [מולד המחזור], exactly so [קתא]. And likewise [you proceed] for the rows of the table [שורות הלוח], in this same order [כסדר], one after another [זה אחר זה], until you reach — by this means — the position of the molads.

For so it is regarding the seven positions [שבעת המעמדות] of [each cycle], and [from them] the molad of [each] cycle [is derived], exactly so. And in this way it

will serve for the molad of the cycle that follows it [שיהיה מולד המחזור הבא אחריו], and its sign [will be] so. So [you proceed] from cycle to cycle [מחזור ומחזור], one after another, to know the molad of each, and to reckon [it]. And in regard to the molad: take the excess [מותר] of the year — that is, the residue [שיר] of the seven positions of the molad [שעת המעמדות של מולד] [?: construal of שעת here uncertain] — and from it [comes] the sign of the molad of the cycle [סימן מולד המחזור].

So [too] the sign [will be], and likewise. After this [comes] the matter of the cycle [שהמולד], you take it and you know it, and the rest [you reckon] one after another. And likewise [you derive] the sign [סימן], one after another [מהן סימן]; [its value is] ז"ו [?: numeral / gershayim] — [so?] read the sign [קרא סימן], [reckoned] in the third [place] [שלשית]. So [proceed] for the positions of the table [מעמדות הסדורים], as it is written below [כתבת... כן] [?: construal uncertain].

And so [you proceed] for the cycle [המחזור], and the day [וביום] in which the molad falls [שיהיה מולד המחזור] — so the molad of the cycle [will be] בת"א [?: numeral]. And likewise [for] the tekufah [תקופה / תקפ']; and it will be [so]: בת"ד [?: numeral]. And so the reckoning, in regard to the year's excess [מותר]; and the cycle [will be] so. And the residues [are] so much: בכ"ה [?: numeral]; and so on [וכן זה].

And so, after the matter is set out [סדורים], one knows the rows of the table [שורות] in regard to each: the excess [מותר] of the year, [reckoned] in days [בימים]; so it will be the sign of the year, exactly so. [And] the sign of the year, that the seven positions of the molad [של מולד] [are derived] — and so the seven positions of the molad of each one.

[Foot of 171r:] ...the rows of the arranged [positions] [שורות הסדורים], according to the order, the sign of the cycle [מחזור], as it is written first [כמו שכתב] [the molad] [will be] in that hour [בשעה ההיא], and its excess [is] so much [ושיו... מותר] [?: numeral, faint] — a ḥelek [חלק].

one [residue]; and take a sign [קח סימן], so that it will be a sign for the cycle that follows it; and the molad of the cycle [מולד המחזור] [will be] so, exactly so [קתא]. For this [is the rule]: the sign of the molad of the cycle [is] all of it [כליו], and from the sign [come] the parts [חלקים]; and the position [מעמד] — that no sign at all shall be altered [לא ישתנה כלל סימן].

And likewise [you proceed], from cycle to cycle [מחזור ומחזור], one after another, so that it serves for the molad of each. So [too] the sign of the cycle-years [סימן]

[שנות המחזור]: this is the excess [מותר] of the cycle, which is found from the difference [חלקים] [reckoned in] parts [מן... נמצא] [?: source-word uncertain], the residue [שיור] of the cycle, exactly so. The cycles, these are they [המחזורים אלו הם], so that you may know them by this means, for each.

From the table of positions [מלוח המעמדות], [reckoned] in every day [בכל יום], one knows [the molad] for each cycle. And the molad of every common year [מולד כל] [take from it the residue, and the sign [is so]]. And so for the residue of the cycle [שיור מחזור], its sign [is so]; and likewise the molad, [reckoned] in days [בימים] — as it is written [כמו שכתב] — and after that the residue [שיור] [in] parts: a *ḥelek* [חלק], [with its] place [מקום]; and the residue of the cycle, the one adjacent to it [הסמוך לו] — that is the sign of the positions [סימן מעמדות], and one knows the sign of the cycle-years [שנות המחזורים].

Find its excess [מצא מותרו] [as] a residue [שיור] for the boundary of the cycle [לגבול... מחזור], [reckoned in] parts [חלקים]; that is the way [הדרך] to begin [להתחיל]. So it [the rule] is [from] the place adjacent to it [הסמוך לו] in its residue [בשיורו], from its beginning [מתחילתו]; and you will know the sign of the cycle [סימן מחזור].

[Marginal note, gutter margin alongside this passage:] [Margin: בקיאות] [?:] — a brief marginal annotation in the body hand; further identification requires further verification.

So, in regard to the residue of the years of the cycle [שיור שנות המחזור], one after another, until the final cycle [המחזור האחרון] of them all; for so [it is]. So, [for] the signs of the years [סימן שנות], the molad of every common year [מולד כל שנה] — its sign [is] so, so that it will be [right]; and the residue of the cycle, the one adjacent to it [הסמוך לו] — [from this] you will know the sign of the positions [סימן מעמדות], and likewise the cycle-years [שנות מחזורים].

This is the sign of the molad [סימן מולד], [reckoned] as [נ"ו] [?: numeral] [parts], a *ḥelek* [חלק], with [its] place; and find its excess [ומצא מותרו] [as] a residue for the boundary of the cycle [לגבול... מחזור] [in] parts. That is the way [הדרך] to begin [להתחיל] from the place adjacent to it [הסמוך לו] in its residue [בשיורו]; from its beginning [מתחילתו] you will know.

So, in regard to each: you take the residue [שיור] of the cycle, and you find it [as] a sign [סימן], so that it will be a sign for the cycle that follows it; and likewise [for] the rest. And from these [computations come] the signs of the cycle-years [סימי] [מותר מולד] [this is the excess [מותר] of the molad of the cycle [המחזור], which is found from the hours [מן השעות], so that you may know.

And likewise [for] the gates of the residues [שערי השוורים]: their sign [is so], the sign of the positions, and likewise the cycle-years [שנות המחזורים]. The first [הראשון] [will be] so; [these are] the residues, so that there shall be no [missing] sign for any one of them [שלא יהיה סימן].

[Foot of 171v:] ...take the residue [שיור] of the cycle, and the sign of the cycle [is so]; for the residue of the [whole] cycle alone [בלבד] — so is the great residue [שיור הגדול] of the cycle. And take the residue, the one adjacent to it [הסמוך לו], to know [it] for each; the positions [are reckoned] in their signs [בסימניהם], all of it [כלו].

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar. End of Chapter Ten and the opening of Chapter Eleven (פרק אחד עשר).

Folio 172r — ruler at left; text in the upper-right quadrant, with a wide blank lower-left margin

[Continuation of Chapter Ten, from the prior leaf.]

the positions (מעמדות) adjacent to it, and likewise the matter adjacent to it, in order to know each one of the positions in its signs.

When you have the residue (שיור), you have the sign of the year, that is the sign of the year. The positions and the signs were derived from one another, and likewise from the residue (שיור) of the cycle (מחזור) you derive each one's sign. So this was the rule: from the residue of the cycle you find the sign of the cycle, and from the sign of the cycle you find its residue; and from the residue of the cycle [you derive] the residues (שיורין) of the cycles.

[Large display heading, brown ink:]

שער [Gate]

Every cycle — its residue (שיור) is the residue of the cycle, and so this was the rule. The cycle — its sign and the residue of the cycle [give] the signs of the cycles. The signs of the positions are derived from one another. From the residue of the cycle [you take] one from another the positions; and likewise the positions [give] the signs of the cycles. The signs are derived: for the positions, the sign of each one; and for the cycles, [the sign] of the moon (?), the molad of the moon. And so it was: the molad of the common year (שנה פשוטה) was the molad of one year, and likewise [the next] year. The molad of the common year was the molad — the sign was such-and-such (כך וכך) — and the molad of the [next] year (?); and the sign was such-and-such, and likewise the [next] year; therefore the sign was such-

and-such (כך וכך). [The author uses "such-and-such" (כך וכך) as a generic placeholder for the worked-example values throughout this passage; that idiom is the manuscript's own.]

[Lower right, worked examples with cycle numbers and sign-values:]

the cycle (מחזור) of this year — its molad — the sign of the cycle was [802 =] תתב; and the residue (שיורית) of this — the sign of the cycle was [274 =] רע"ד, and so it was. The molad in the common year (שנה פשוטה) — the sign of the cycle was רס"ם [= 300 (?): the final letter is abraded; candidates רס"ד / רס"ה / רס"ם]. The molad of the intercalated year (שנה מעוברת) — the cycle; the residue (שיורית) of this — the sign of the cycle was [274 =] רע"ד, and it was. And the matter was this: the molad — the sign of the cycle was רס"ם [$\approx 260+$; last letter abraded as above], and so it was. The molad of the intercalated year — the sign of the cycle was [274 =] רע"ד, and this was. The molad — the cycle; the residue of this — the sign of the cycle was [numeral: ?, abraded], and it was.

until the sign was זי"ז תת"ב [the run reads תתב / זי"ז; first group ambiguous — 7-7-? or a label]; and the sign was זי"ו תתק"ע [reads 875 / ? = תתק"ע; first group ambiguous]. [These two closing molad-sign runs of 172r read clearly as letter-strings; the first group of each (זי"ו / זי"ז) does not resolve to a confident gematria value and is given as the bare letter-run.]

Folio 172v — ruler at right; text in the upper-left two-thirds, with a wide blank lower margin

[Top of leaf — close of Chapter Ten:]

and likewise the sign would be such-and-such (כך וכך), and so it is (זה הוא); the residues (שיורית) of the cycles in their reckoning [are] the signs.

[Display heading, brown ink:]

פרק אחד עשר [Chapter Eleven]

[Opening:] This will be at the beginning, to make known how [to do this] ... and to make known the seasons (תקופות) and the foundations (היסודות), so that you may compute the hours (שעות) of the sun, to set it in its place.

So that you should know, for the season (תקופה), the sign that is in it, [for] the [solar] year — the cycle until [the next], and the remainder of the position until the [next] position. In the holy tongue this teaches [the matter of] the day of the

equation (השוואה) and the seasons (תקופות). And so, when you compute the season (תקופת) of the year — the season for each one [?: clause edge].

[Body of Chapter Eleven — on computing the solar seasons (tekufot), the true position of the sun, and reconciling the solar year with the lunar reckoning:]

It is necessary for the equation (השוואה) that there be a place for the position. And you require, for the season of the year (תקופת השנה): such-and-such, the sign of the position, and the excess (מותר) of the position — the foundations (היסודות) which are required for the reckonings, to set them in order (לתקן). And if there was a deficiency (וחסר), so it was. The matter is the seasons of the sun (שנות השמש) and the positions, so that the signs were such-and-such (כך וכך).

The molad of the position was such-and-such, so that it is comparable (דומה) to the position (לעמדה). There is a place at which the [solar] year begins; it differs (מובדלת) from what is [reckoned for the moon]. Such-and-such was [derived] from this, and so as to reach the end (לסוף), [the rest follows]. The reckoning of the position [?: clause]. The signs of the cycle — every position is derived from this.

Such-and-such was the sign: the molad of the [solar] year begins (יתחיל), the sun rises (עולה); therefore he will set in order (יתקן) the seasons (תקופות), each one; and you will compare (דומה) it to the [solar] year. The signs of the positions [are derived] one from another. This position is sifted out (נברר) from [the foregoing], and the sign was such-and-such.

the sun (השמש), a position adjacent (סמוך), [its] revolution (סיבוב), so that the cycle was such-and-such; and the position was such-and-such. The seasons (תקופות) here [proceed] from the equation, the degree (המעלה) being stated; and the matter is that the cycle [gives] the season of the [solar] year (תקופת השנה) for each year. [As for] the [solar] year, the seasons of the [solar] year [together with] the lunar ones (הירחיות) — the season was such-and-such. The reckonings of the sun [are] equal (שוה) in their reckoning, [each] adjacent (הסמוך) [to the next], and [each one] passes over (ועובר).

[worked-example string of season/position values]: ...the season such-and-such — its sign such-and-such, the position [reckoned] for each one, the molad such-and-such, the position; [those] of the sun [with] the lunar ones (הירחיות), and the seasons (תקופות); the sun rises (עולה), this is adjacent (סמוך) [to the next], and it passes over (ועובר).

[the final lines]: ...every [reckoning] of the sun is equal (שוה), in its reckoning, [throughout] the [solar] year; the molad [of the moon]; the day — going from day to day (מיום ליום הולך), and it is consumed (ושרף) [i.e. the fractional remainder accumulates and is spent off day by day].

[Below this the leaf is blank to the foot — wide blank lower margin, scribal layout, not damage.]

Fourth Treatise [המאמר הרביעי], Chapter Eleven [פרק אחד עשר] — the solar seasons [תקופות].

[The text block sits in the central-to-gutter band of the recto; wide blank lower margin (not damage); conservation ruler and black strip along the left edge — photography furniture, ignored. A faint sliver of the facing leaf shows at the right edge — ignored. The passage continues directly from the Chapter Eleven opening of the previous folio.]

[the sun] travels and goes around, and so it is by its measure [כדי כן היה], and the seasons are reckoned by the rule [כמשפט]. The day on which the sun reaches the start of its course is the beginning [תחלת], at the end of its measured time, and the start of [the next].

The four seasons of the sun [תקופות החמה] correspond to the four [points], and to them correspond the seasons [תקופות]. The point [נקודה] from which the motion of the sun [begins] — and the seasons of the year [תקופות השנה] are four, as we explained. And the season of Tishrei [תקופת תשרי] is [the autumnal one]: from the end of summer and the beginning of autumn, when the sun stands near its lowest place [מקום החמה], at the southernmost point of its course.

Now you already know that the four seasons of the year stand opposite one another: the spring season [תקופת ניסן] opposite the autumn season [תקופת תשרי], and the summer season [תקופת תמוז] opposite the winter season [תקופת טבת]. The point [נקודה] from which the sun begins each of its seasons is the point [reckoned] for it according to the rule [כדין], and so [the calculation] runs.

And the season of Tishrei [תקופת תשרי] is when the sun is at the start of the sign [מזל], and from there it travels toward the south, so that the sun reaches its lowest place [מקום החמה] at the southernmost extreme of its course. Thus it is fitting to reckon the seasons. And the equation [השוואה] — its purpose is to bring the solar reckoning into accord with the lunar, as we shall explain, each season according to its rule [כדין], so as to set it in order [כראוי].

the season of Tishrei [תקופת תשרי] ... and from the autumn season [it travels] until the spring season [תקופת ניסן] ...

[Remainder of the written area is blank parchment — wide lower margin.]

[This leaf: ruler and black strip along one edge — photography furniture, ignored. The text occupies the upper portion of the leaf (roughly the top third); the lower two-thirds of the leaf are blank parchment (wide lower margin, not damage). A geometric figure (a circle with an inner arc) sits at the lower-left of the text region; its lower-left rim caption reads *מעלות החמה*. The prose runs above and alongside the figure.]

Upper lines (head of the leaf)

that which is at the start of Cancer [סרטן], at which the sun stands at the point [נקודה] of its course; ... the start of Tishrei [תשרי] ..., its time being the true time [הזמן האמתי] ...

Right-hand text block (alongside and below the figure)

The center of the sun [מרכז החמה] stands at the start of its course, its time being thus; and when the sun stands at the center of the sun [מרכז החמה], its motion stands [uniform]; and when the center of the sun is at the start of the sign [מזל], so too is the season of Tishrei [תקופת תשרי].

And when the sun reaches the start of Cancer [סרטן], its motion stands at the center of the sun [מרכז החמה]; and so the season of Tishrei [תקופת תשרי] ..., until the sun reaches the point [נקודה] of its course.

The center of the sun [מרכז החמה] stands opposite the start of the sign [מזל], when its motion is at the center [מרכז]; and the equation [השוואה] — its purpose is to bring the solar reckoning into accord with the lunar, as we explained, each season according to its rule [כדין], so that it be set in order [כראוי]. The season [תקופה] of Nisan [תקופת ניסן] stands opposite the autumn season, and the summer season opposite the winter — and from one season [it travels] to the next as is fitting [כראוי].

Now you already know that the four seasons of the year [תקופות השנה] stand opposite one another, as we explained: the spring season [תקופת ניסן] opposite the autumn season, and the summer season opposite the winter season; and from one season it travels to its opposite season according to the rule [כדין].

the season [תקופה] ... the way the sun travels [שדרך החמה] over the year, its measure being thus [כמו זה]; and the measure of its travel over the year is the equation [השוואה] ... so by the rule [it travels] ...

[Below the lower lines: blank parchment to the foot of the leaf — wide lower margin.]

Diagram. A geometric figure of a circle (with an inner concentric arc) representing the solar circle, set at the lower-left of the upper text region of the leaf. A vertical diameter runs from an apex at the top down through the center; the upper rim carries letter-labels, and a curved caption מעלות החמה ("degrees of the sun") is written along the lower-left rim. The bulk of the figure falls below the legible band of this page-read and its lower labels cannot be resolved here. The figure illustrates how the sun's degrees are measured about the center.

- ב (apex, top of the vertical diameter): [reading confident]
- ד (upper rim, beside the vertical line): [?: ר / ד ambiguous]
- Center and lower-rim labels: not legible at this resolution — [?]
- Lower-left rim caption: מעלות החמה ("degrees of the sun") [reading confident]

[Margin: a small pen-mark resembling a question-mark / abbreviation stroke sits in the right margin beside the figure — not a structural siman; no legible content.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; Chapter Eleven (פרק אחד עשר) — the solar seasons (תקופות), continued.

[The discussion of the center of the sun and its uniform motion continues from the prior leaf.]

the center of the sun ascends [or: the center of the sun rises] when the point of the sun [נקודת החמה] is at its true position [שורש] — that is, the time of the equation, in accordance with the time of the equinox.

So too, when the center of the sun is at its midpoint [שאמצעית], the time of the equation [זמן תקן] is its true position [שורש], in proportion to the time of the equinox. And when the center of the sun is at its end [קצה], and its end [קצת צ] [?: a numeral or letter-label here is faint], the periods [מחזורות] and the time of the equation are at the true position, in proportion to the days of the heavens [ימות השמים]. So too the center of the sun moves and passes through its degrees [על עדי? חלקי].

The seasons of the year [תקופת? — recte: tequfot], whether by the count of the days [מספר ימי], its reckoning was as it was in the time of Ptolemy [בטלמיוס], according to what they have said. And he said: the passage [מעבר] is opposite the sun [צד יום] and the equation [ומחנה?], and so forth; and he said: the count of the days of the sun [מספר ימי החמה] was thus-and-so, and the count of the days of the moon [ימי הירח] was so close [קרוב] to the way [על דרך] — close, by some hours [צ? שעות] — and behold, the days of the equation [ומחנה] were so close, [numeral: ?].

The days of the sun were thus, and the days of the heavens [ימות השמים] were such-and-such [קל? — numeral faint], and the moving spheres [הולכים], and he said that they pass [שעבר] until they remain [שהנשע]. By means of the spheres [הגלגלים], the sun is reckoned, and what was the difference between this and this [שאמרו זה] — for now its reckoning is at the equation [זמן תקן], and the time of the equinox; thus they have said, as one says: the difference of this and this [numeral: ?]; and now it is reckoned, the time of the equation [זמן החורף — i.e. the winter (Teves) season] and the time of the equinox [זמן הקור].

This is now the difference [שוין], so the way is close: behold, the time of the sun [ימות החמה] is, in their time [בזמנם], the true position [שורש], according to the time of the days of the heavens [ימות השמים], in proportion to the days [כברי ימים].

And the season of Tammuz [ותקופת תמוז], and likewise the season [תקופת] — its summation [חזמתת?] is the difference [שאמשד? — recte: between] the true position [שורש] of the sun [השמש] — in its time [בזמנם], this and so forth — and these are the days [קודמת], the four [הראשית? — recte: the first/the four], that precede it [קודמת] now, in proportion to the four [לראשית], that come [שעשק?]. And [it is] not from the periods [מקרחות? — recte: from the periods/cycles], and from there [ומכאן] is a good sign [טוב סימן]; and the matter, you should know, is the true position of the sun [ידעת שקר], and they made it [ועשו] a passage [מעבר], and likewise this — that Israel was [שישראל היה — i.e. the practice of Israel was] complete [נקל] now. By means of the truth of the seasons [התקובות] — recte: each one of the seasons], you should know that the way is [שהיה היא] — recte: it is known], the count [צד מסוס?].

Now, in proportion to the four, the seasons and the difference [וכר? ותקובת זמן?] in the four [הראשית], in their time [בזמן? — recte: when they were], it preceded [קודמת] the great [גדול] reckoning, in proportion to the first [לפ? — recte: בלבד, "alone"], in the first time [בזמן הראשון].

Reckon and know that the season [שתקובת] is in its month [בשנה — recte: in a year], year by year [שנה כב — recte: each year], how distant [כמ? מרחק], the molad of the month [מולד החדש] thus [שכן], its sign [וסמנו]; and [it is] thus, in order to recall its true position [להכיר מתקן] and to make known to people [ולדע? צריכה] that the year is [שהשנה], you require [לעשר — recte: the difference] of the season [התקובה], whether it is in [לם — recte: לא, "or not"], for [כי הן] he said [ללמד] to learn [ללמד] from it, and the great [רבה — recte: רבה], in proportion to the reckoning [בר חבון — recte: בחשבון], to recall [לזכר], as it is written [כדי כרזית? — recte: כדכתיב, "as it is written"], and so forth [וכן].

And the difference [הקדורה — recte: ובהפרש] between the eclipses [הקדורה — recte: the obscuration/eclipse] of the moon [יהודה — recte: of the moon] which they reckon [מעשברין — recte: שמעברין] the year [את השנה] — if not [אלא חס], thus [סק] the season [תקובה] would be lacking [היתה חסרה]. And so [וכן], they began [היה] of the laws [שלש — recte: ושלם] of the rules [הלכות], which they reckon [שמעברין — recte: which they intercalate], the year [את השנה], in their time [בזמן], it was [היה] as is known [שכמו שהורעת], the difference [שקר] of this and so forth [דבר זה], and its secret [וסודו], in proportion to its passage [מעברו — recte: in its intercalation], from time to time [מעת לעת], in proportion to its order [מעיסדו — recte: at its appointed time]; and their account [קדמושו — recte: their predecessors], the reckoning of the equation [חשבון התקן], so that they not lack [שלא יחול — recte: שלא יתבטל] the season [התקובה] for the difference [לראש — recte: לעולם, "ever"].

Now there is a passage [נש היה במעבר — recte: there is here an intercalation] in proportion to its passage [מעברו — recte: in its intercalation], and the equation of the seasons [קבוע התקפה — recte: the fixed reckoning of the season] and the rest of the appointed times [ושאר המועדים] as they have established [כמו שהראו] for them [להם], a good sign [טוב סימן], so that it not lack [לכי שלא — recte: so that it not be lacking], the truth [החמת — recte: the truth] of the seasons [תבליות — recte: of the seasons].

The intent in the calculation of the intercalation [כוונה בחשבת השבור — recte: שנחשב] now [שנעשה — recte: שנחשב] is only [אלא] that what is reckoned [שנעשה] [ומה] they have established [שנעשה], so that we require [צריכין] it, or that we [בקיבוע?] establish [נקבע] the months [החדשים] and the appointed times [ומועדים] in their time [בזמנם], as it is [כמו] from the molad [לבו מולד — recte: from the molad] of the year [השנה], thus [כן], its month [שעשו] — its calendar [סמך — recte: סימן] is reckoned [תקן]. This is [היה כמו] as we have

explained [שנתבאר], in its calculation [בעבר — recte: in the intercalation]: it has a reckoning [יש לו חשבון], or none [ולא? — recte: or it has none]; and if [ואם] there is a time [יש לו זמן], you require [צריך] the time [כמן — recte: זמן], it was [היה], or it was not [ולא], complete [תשלם תבאת — recte: it is completed] from the count of the heavens [השבור — recte: by the calculation of the intercalation], that it be reckoned [שתהקן — recte: that it be reckoned/corrected], so that it be at its end [שתהקן עתה זולת — recte: at its proper time], at the time of the equation [עתתקן — recte: at the time of the equation], and the seasons of Tishrei [ותקובת תשרי].

For [ולכין] a matter is established [דבר מעלה נכונה כל כך — recte: a matter is established quite firmly] just so, in order to [כדי] explain [לבאר] this wisdom [לחכמה הזאת — recte: this science] for itself [לבדה? — recte: by itself], and in order [וכדי] to recall [להזכיר — recte: to mention] the difference [שקר — recte: the difference] of the reckoning [החשבון], the equation [התקן]; this was [היה] the passage [לקבוע הפסח], its detail [פרטיו], by the establishment of Pesach [וליהודיע] and the rest of the appointed times [ושאר המועדים], and to make known [מאד] that it is [הוא] established [נכון], and its equation [ולתקן] until [עד] one is [מאד], its season [נרס? — recte: its level], that it may be ascertained [שיחול — recte: that it may fall] upon a sign [על סימן]; and Pesach [הפסח] falls [תפא — recte: יחול] in its proper time [בזמנו] in [כל] each [בכל] year and year [שנה ושנה].

And behold [והנה], the difference [הפרש] is small [הקסוף — recte: small], in the matter of the season [בתקובת השנה], and the difference [וטהנשן — recte: וכשנחשב], when one reckons [היה], the equation [מעשד? — recte: the equation], it stands [ועומד] upon this [על זה]; and in order [וכדי] to know [לדעת] the count of the days [עד הספר ימי] of the season [התקובה], or that we reckon it [שכו? — recte: that one reckons it], the time of the season [התקן — recte: the equation], in another year [מזמן השנה לשנה אחר — recte: from year to year], besides it [זולתנו — recte: apart from us]; truly [לבי? — recte: but], behold [הא], in establishing the intercalation [כעשי כמתן השבור — recte: in fixing the intercalation], we add to it [זל? ליסד לה — recte: we found for it] the reckoning [החשבון], the equation [תקן], and we make it known [ויק? — recte: and let us know] the going [המהלך] of the equation [התקן — recte: of the equation], such [שיהיה] that it be a good sign [טוב סימן], in proportion [כמו] to what they made [שעשו] in its equation [בתקן], the time [עת], the molad [המולד], its time [וזמן? — recte: at its time], and [it does] not [ולא] lack [חסר — recte: it does not deviate], its going [להלך — recte: in its course], the being [היות], and from where [ומפני שהיום] [כן], its beginning [מתחלה], as we have explained [כמו שנתבאר], and not lacking [ולא חסר], the equation [המעשה — recte: the reckoning], and not [ולא] upon the truth [על]

of the four seasons [דס? עומס — recte: the four seasons], the difference [חרס — recte: the difference], the four [העשד — recte: the four], and its straightness [וטווח — recte: like] what we have made known [שהורעתך — recte: known], and now [ועתה] we have made known [הוי? — recte: we will make known].

You know [ידעת] that the equation [שתקן] of the seasons [התקובת], the first [הראשית], in the calculation of the intercalation [במחשבת השבור — recte: in the calculation of the intercalation], it is necessary [לב? — recte: it is necessary] for us [צריך לנו] to reckon [לחשב — recte: to reckon] from where [שקרים? — recte: that which is], thus [כן], a constant [חוק? — recte: a fixed amount], that we may make it known [שתלענו? — recte: that we may establish it], to make it known [לתקן — recte: to establish], the time [עת] of the going [המהלך — recte: of the course], the difference [שיות?]; the difference [השקר — recte: the difference] is that which [הא] is fixed [שנאמר? — recte: שנאמר, that we say], to the beginning of the course [ההלכה], in any place [במקום שטוי? — recte: in whatever place], the way [הדרך].

The course [ההלכה — recte: this course] is its beginning [מתחלת — recte: its beginning], that the seasons [שתתקובות], its equation [המתקן — recte: are reckoned], in proportion to their order [בכל שיצאתו? — recte: as they issue], the reckoning [החשבון], and the season [התקובה] is complete [תשלם], a part [חלק] in each [בכל] part [חלק], the hour [משעה — recte: the hour], a third [שלשת — recte: a third], a half [חלוס — recte: a portion/a half], thirty [שלשים], from where [מזמן] the going-forth [שמוצאו — recte: its issuing], by means of [על ידי] them [כן], thus [כל זה].

You reckon and know [לחשב ולדעת] that this [וכי זו] — [and] what [שתהיה? — recte: that there be] this [זה] going-forth [יציאת — recte: a passage], and a difference [זוה], that it be [שיהיה], upon the way [על הדרך], that they have said [שאמרו] in passing [בהעתקת — recte: in the transfer], the molad [המולד], the great course [זה יציאת — recte: the long known course], and this difference [זוה יציאת — recte: this long passage], in a country [במדינה], in a country [לכל מדינה], a known course [ידוע ארוך — recte: its season] and its difference [ושל — recte: and that of], necessary [צריך] for us [ליחס ליחס — recte: to ascribe to it], the molad of a new month [מולד חדש] that would be [שהיא] in its writing [כותבו? — recte: as it is written], so that [כדי] we may know [לדעת] — recte: to know] the year [שנא?], its distance [מרחקה], from us [ממנו], and what [כב? — recte: and how much].

[New chapter heading begins here on the facing leaf; on this leaf the chapter continues.]

that it explains [שיתבאר] this [זה], in the chapter [בפרק] after this [אחרי זה]. And the difference [והפרש — recte: והשקר] is fixed [קב — recte: fixed] upon the saying [על אמרת], the year of the season [שנת התקובה]...

to the opinion of [לדעת] Samuel [שמואל]: [שס"ה] 365 and a quarter [ורבעה] days [יום] complete [שלם], and it is [והיה], according to him [לטיה — recte: to him], the time of the seasons [מדת? הזמן] from season to season [שמתקובה לתקובה], in proportion [הסמוכה] to it [לה], it is [היה], [שס"ה] 365 days [יום] and six [ו'ו] hours [שעת], and the difference [ומחנה — recte: ומחצה], that this time [שהזמן הזה] was [היה] the true position [שורש] of the sun [שדף — recte: שמש] in this [על זמן] — that is [נחרסי — recte: namely], the seasons [חדשי — recte: months/seasons] of the moon [הלבנה].

Its computation [מעשהו — recte: its reckoning] is in proportion [כברי] to the days [תק"ם] 540 [שעת] hours [ו'ו] six [יום], [שס"ה] 365 days [ב' ימים — recte: two days], [חלקים] ḥalakim [תק"מ — recte: and the sign], 41 [והסיק — recte: and the sign], complete [שלם], and you already know [וכבר ידעת] that the time [כי זמן]...

the year [השנה], the close [הקרוב — recte: the approximate], to [על] the opinion of [דעת] Rava [רבא] precisely [בדקדוק — recte: precisely] it was [היה], [שס"ה] 365 days [יום], 5 hours [ה', שעת], 997 [תת?צ?א — recte: תתקצ"ז or similar; numeral faint] ḥalakim [חלקים] and one [וחד — recte: and a fraction], at [מד?]...

we have already made known [ורנעם — recte: we have made known], a fraction [משה? — recte: a portion], in a ḥelek [בחלק], until [עד] this [שהוא], to this [לבו? — recte: to it], the time [זה] of the season [התקובה], the time [זמן] of this [זה], the true position [שורש — recte: שדף, the difference] is so much [כך], we say [נראית — recte: we say], that it was [הוחיה — recte: it was], the true position [שדף] of the sun [שמש], according to [על כן] the days [נחשים? — recte: the days], of the moon [לבנה], in proportion [כברי] to [ב'] two [ב'] days [ימים]...

seven [ז'] hours [שעת], 980 [תק"ם — recte: numeral faint] ḥalakim [חלקים], and a remainder [ומצא?] this time [הזמן הזה], this [זה], a difference [שדף — recte: the difference], 540 [על כן? — recte: numeral faint], for [כדי] the moon [נחשים? — recte: of the moon/the lunar reckoning], in proportion [לבנה] to two [ב'] days [ימים]...

nine [ט'] hours [שעת], 980 [ש' חלקים — recte: numeral faint], it does not [לא] equal [נעשה], and the remainder [והסימן — recte: and the sign], two [ב']?

[numeral: ?], complete [שלם]; behold [הרי], the difference [שקר — recte: the difference] which is found [מוסר — recte: found] for it [לה], the equation [התקון], and Samuel [ושמואל]...

[at] the season [שעשה? — recte: at the season], the time [זמן] of the season [התקובה], the way [שדף — recte: the difference], its course [עלה — recte: came out], in proportion [בכדי] to two [ב] ḥalakim [חלקים], a fraction [מ?? — recte: less], it is [רשע? — recte: less than], from it [מכל — recte: from], they were [קיבו — recte: they fixed], from us [מפני], that we made [שעשו] them [מהם]...

Fourth Treatise, Chapter Eleven (conclusion) — folio 175r

[The opening shows two leaves; the foliated leaf is 175 (pencil "175" in the gutter). The faint facing-leaf slivers at the outer edges of the scan belong to the already-translated 174v and are not transcribed here.]

the matter of the seasons (tequfot), and they made the days of the year three hundred sixty-five days and a quarter [365¼], and likewise according to Shmuel and according to Rava. Now the reckoning of the season is more accurate than this, for the wise men gave a season to the multitude that they might have a fixed rule, even though there is a discrepancy [הפרש = שקר, "discrepancy" — the scribe's habitual spelling] in it, so that all people might find the seasons easily.

The foundation of this reckoning and its secret hangs upon this: that the wise men saw that the days of the year are not equal to one another — and so it is in one place, and in another place it is otherwise. And the season of the year that we have set is by Rava's reckoning, which is the [true] season; for the wise men set the season of Tishrei [תקופת תשרי] and the season of Tammuz so that it might not be lost to them — as they said, "the season of Tishrei" — and they fixed it.

And here there is a discrepancy between the seasons [הפרש בין התקופות]: between the seasons of Rava and the seasons of Shmuel, this is the difference [= שקר] between the one and the other, and the source [מקום] of the matter is otherwise; and so it is.

פרק שנים עשר — Chapter Twelve (folio 175r, lower portion)

[Chapter Twelve.] [Heading in enlarged display script: פרק שנים עשר, "Chapter Twelve."] On the manner of fixing the times of the seasons by reckoning, and what the intention is in the reckoning.

Know the season of Shmuel — and know its standing and the time of its fixing within the year — which has come down to us; and you know already on what it

stands. Now the season of Shmuel: each season is ninety-one days and seven and a half hours [91 = צ"א ימים ז' שעות ומחצה days, 7½ hours]; and so was the whole year by his reckoning [365 days and 6 hours], for the four seasons together [$91\frac{1}{4} \times 4 = 365$]. And the difference [שקר = הפרש] between this and that — between Shmuel's reckoning and the true season — is small.

For the season of Shmuel is by his own reckoning, and the time of it was easy to fix, since the year by him is three hundred sixty-five days and six hours [שס"ה 365 = דימים ו' שעות 6h]; and herein lies the matter, that the season of Shmuel and the season of Rava differ.

You already know that there is a difference between the new moon [מולד] and this season; and the season of Shmuel carries forward into the next year, for it is fixed [תקן] by his reckoning, as is the season of Tishrei [תקופת תשרי] of that year.

And they said: the season of Shmuel — and they said it was reckoned in full [בשלם] — it was [such-and-such] [numeral: ?], and the season [תקופה] [numeral: ?].

[There follows, to the foot of the leaf, a chain of computations giving the season-by-season day-counts and their remainders (simanim); several of the individual gematria sigla are faint and are flagged below.]

until the season of Tammuz [תקופת תמוז] returns; ...and by Ptolemy [כתלמיון recte: בטלמיס = Ptolemy]] it will be [such-and-such] [numeral: ?].

Chapter Twelve (continued) — folio 175v

The remainder [שירי] of the days of the new moon [מולד] lies between season and season; and this season [תקופה זו] is the [reckoned] day, and it comes by way of the calculation.

And the season of Tishrei, and its remainder [ושיריו], and the days of the cycle [ימי] [המחזור] and its computation; for in it the hours [run] one by one.

At the start of the cycle, by the reckoning of Shmuel upon the [given] time: the season that follows close upon it within its cycle; ...upon the moon [הלבנה] for all...

by his reckoning the season was [such-and-such]; and they said it, and they reckoned it; and what is the difference; for [it lies] in the hour.

[Mid-leaf the computation runs in dense siman-bearing lines: each season's day-count, its remainder (siman), and the running total across the cycle. Several

interior numerals are small and faint; resolvable fragments are committed, the rest flagged.]

The cycle [המחזור] is two hundred [200 = ר legible; units faint, numeral: ?], by [several] reckonings [simanim]; this is the reckoning [חשבון], the season of Tishrei; the new moon [מולד].

the cycles [המחזורות], the days that run until the season [עד התקופה], the seasons of...; by the number of the cycles [כמספר המחזורות].

To the cycle [למחזור]: the remainder [רס"ו ?] is this; the remainder in hours; by the number of the cycles [כמספר המחזורות] there are hours; ...a season [תקופה] of one hour is found.

the hour and the time of the seasons; ...the difference therein [numeral: ?].

The season of Tishrei: the difference is this; the remainder [is] forty-two [numeral: ?]; ...the seasons of Tishrei [for] this season; and the siman: it is fifty-two [נ"ב ?], and it yields [the next].

The remainder: this remainder in hours [is] forty [numeral: ?]; ...the seasons.

and they returned [וישוב] and took [ולקח], and after this the siman [הסימן]; the remainder [is] fourteen [יד ?] ...

the seasons; the cycle's [מחזור] siman; and so it is; and the seasons of Tishrei.

And they reckoned; and what is the rest [ושאר] of the [reckoning] details [פרטין] — the siman [is] seven; the siman, fourteen; this is the season of Tishrei.

The siman: it is sixteen; and they reckoned; the siman [is] forty-two [numeral: ?]; the season of Teves [תקופת טבת] — the siman is good.

To the reckoning, and... the season of Tishrei; this season [תקופה זו] is [such], and the season of Tishrei.

upon all this; the difference; ...and so it is reckoned, and so it is.

[The leaf ends with three short lines continuing the seasonal computation; their interior numerals do not resolve cleanly and are flagged.]

the seasons; ...and the difference; ...the season, and they reckoned.

it was, and it will be after this; and so it is reckoned, and so it is good.

it was, and it will be thereafter.

from the beginning and to the end of the year [מבראשית ועד סוף ה' (?) עולם], the seasons (tequfot) were reckoned by approximation [היו תקופות... להקריב (?)]. And he prepared [the reckoning] of the season, and he fixed it as the season of Shmuel [תקופת שמואל]; these mean [motions] are fixed [?]. By approximation [literally "by mouth", על פה] the season is fixed for him [?], by the mean [reckoning].

The season of Shmuel comes to [so many] hours [שעות — value not read, [numeral: ?]], and the surplus [מותר] over [the mean] is more [than the astronomical season] [יותר על — the trailing computation is faint, [numeral: ?]].

[The remainder of 176r — several further lines of the same tequfot-residue reckoning, with two-letter gematria simanim — is legible in outline but the numerals do not resolve glyph-by-glyph at this resolution; the connective phrasing the prior draft supplied here was not anchored to the leaf and has been withdrawn. [numeral: ?] throughout.]

[The text breaks off here on 176r; the lower portion of the leaf is blank parchment, not damage.]

[The closing lines of Chapter Twelve continue the same reckoning: the season-residue (the surplus of the season-time over a complete week, with its residual hours) and the molad-residue, each reckoned by mean motion. The prose is highly elliptical; the recurring terms — תקופה (season-time), מולד (molad), מותר (surplus/residue), מחזור (cycle), שבוע שלם (a complete week) — are legible, but the specific numeral simanim attached to each are faint two-letter gematria and do not resolve glyph-by-glyph. [numeral: ?] throughout this stretch; the fluent connective prose the prior draft supplied has been withdrawn as unanchored.]

[Bold display-word, mid-page] **דע** — Know: [a short summary follows restating the reckoning of the season-time of Tishrei by the mean [motions] and the residue against a complete week. The body of this summary paragraph is legible in outline but numeral-dense and elliptical; its specific values are [numeral: ?] and its connective wording is not committed beyond what is read above.]

[End of the upper text-block of 176v; a blank space follows, then the chapter heading.]

[Body heading, p. 358, in larger display script, preceded on the same line by the running-header fragment "השבוע נ'"]

פרק שלשה עשר — Chapter Thirteen

[Red-ink marginal note, right margin, beside the opening lines: "ולחבר ... לתחת זה" [?: a constructive helper / cross-reference note; "and to join ... to under this"; verbatim text faint, further identification requires further verification]]

On fixing the times of the season-times [תקופות], of itself.

[The chapter opens with the procedure for finding the day-count difference between one season-time and the next, and reads off its siman (remainder-marker). The opening sentences are legible but elliptical; the prior draft's expansions ("to know the mean position ... something else", the planets/moon comparison) over-read the surviving connective text and are withdrawn. What is read with confidence is the numbered reckoning below.]

- The molad of Tishrei was [thus]; this [is] its siman [סימן]: [siman: $24 = \text{כ"ד}$ and $422 = \text{תכ"ב}$; reading of these two values is plausible but not certain at this resolution — [numeral: ?]].
- And the molad of [the next] season-time [was thus]; [siman: ז"ז or similar two-letter value — [numeral: ?]].
- Every season-time from this [point]: the season's [residue] [מותר] [is reckoned] thus; [the season comes to so many days — value not read, [numeral: ?]]. -...so many in the year; this is the surplus [מותר] of the [reckoned] season over [the mean] — [the season being] more [than the mean astronomical season] [?: יותר — trailing computation faint, [numeral: ?]].

Treatise Four (המאמר הרביעי) — the practical Hebrew calendar. Chapter Thirteen (פרק שלשה עשר) continued, then Chapter Fourteen (פרק ארבעה עשר).

[Spanish Rabbinic semicursive, single primary hand, brown ink, with red-ink chapter rubrics and red-ink marginal siman markers. Page 1 = folio 177r, conservation ruler on the left; Page 2 = folio 177v, conservation ruler on the right — two distinct facing leaves. Wide blank lower and side margins are the manuscript's ruling, not damage.]

Folio 177r — Chapter Thirteen, continued

the surplus of the [tequfah] of the moon over [that of] the sun, and how you are to instruct the one who computes [?: faint], so that it will come out for him correctly. Set it down and reckon it thus and so [כך וכך].

This is the [siman] [סימן]: such-and-such [numeral: ?] days and such-and-such [numeral: ?] simanim, [Interlinear / marginal: הסימן] which remain to them [המוסר להם], so that the [season] of their reckoning will be in your hand, as is fitting.

And reckon every [tequfah], and set it down [ותקן] — and you have already gone through the cycle [המחזור]. Once you fix the times by means of a table [לוח], the fixing of the seasons will then come out for you correctly, so that there will remain to you [a remainder] complete, of itself [מאליו], in every year, by way of the simanim.

[Now there are] differences [השלמיות] which they passed on from the cycle [מהמחזור], a fixed quantity, far from its time [מרחק עתתו]. So, since it is far from the [molad], a season comes out, and a difference of its time from the [tequfah]; and the differences which they passed on from the cycle — when you wish to instruct the one who computes [ר' כדי] [?: construal of this clause is uncertain on the faint line] — the bound that is added, for the fixing [לתקן]. And every season of its [season]'s fixing will be in the hand of the one who computes [תקופת תשרי].

For the [siman] is [numeral: ?], [the moon's surplus] [recte/uncertain: faint short numerals here]; and the [siman] [numeral: ?] of the months [חדשים] is [numeral: ?], and the [siman] [numeral: ?] for them, that is, for the months of the moon [לבני], for the months of the sun [recte: faint]. The fixing of this and its setting-down [ושלוח — recte: ושלוח] from its reckoning [מהתקבץ], so that the [season] [tequfah] is of itself in your hand, as is fitting. As for the days of fixing — they are [numeral: ?].

For the surplus [מותר] of three seasons over the mean season [על תקופת השוה] [is] such-and-such [numeral: ?], and the months are such-and-such [numeral: ?]; the [siman] [numeral: ?]; thus the [tequfah] [numeral: ?] [recte: faint sexagesimal values not legible on this run].

And know that Rabbah and Rava [רבא ורבה] [Aramaic: the Talmudic sages] — they were reckoning, in order to know [the season-times], so that there should remain to them the surplus of the seasons, in this [reckoning]: the surplus of the [season] of Shmuel [תקופת שמואל] over the [season] of [recte: faint] — these are the times of the [complete] week [השבוע], and the seasons. So know [the times] of the seasons [עתי התקופות].

[Marginal note containing: הסימן — red ink, right margin of this opening; a [siman] number-marker. The numeral is faint; further identification requires

further verification. The catchword-like single short stroke at the lower-left corner of the leaf is a ruling/pricking mark, not text.]

[Lower half of folio 177r is blank ruled margin.]

[Top of the verso text block continues the same seasonal computation.]

they have already [reckoned] [כבר קימו] for the fixing, the fixing in the [complete week] [בשבור — recte: בשבוע], so as to know its time, the time it was, and its fixing. And now, just as it stood, to fix it, so [too] the time of its seasons [recte: faint]. The fixing — to the time it was — is by the well-known reckoning [recte: faint], and the most exact, more than [the season] of Shmuel [משל שמואל]. And know that this matter is by the way of the well-set computation, for the days are [numeral: ?] — the surplus of the differences which they passed on from the cycle [מהמחזור], a fixed quantity over the days [על ימים]...

[Red-ink marginal rubric here: "המתקן / ... סימן" — a [siman] marker plus the catchword-like word המתקן ("the one who fixes / the corrector"); further identification requires further verification.]

and you fix the [siman] [tequfah] of [Tishrei] [תקופת תשרי] and set down the [season] [ותקופת]; and there will remain to them [a remainder] complete from the cycle, and the [siman] [numeral: ?]. So the fixing was complete from the cycle, and the [season] [תקופת] of the well-known [reckoning] — and the [siman] [numeral: ?]. The simanim were complete, of itself [מאליו], so the difference of the well-set [computation] is in the cycle [במחזור], as fitting. The matter of their fixing — there is in it some [variation] [יש במה], for the simanim do not remain to them equal, every [year] [recte: faint]; therefore the fixing — its time being according to [the season] of Shmuel — is [the one] passed on...

another [reckoning], and there does not remain to them [a remainder], for [its] time was [numeral: ?]; and another which is more than another, a remainder [מותר] which comes out as a remainder to it, in such-and-such [days] [recte: faint], by such-and-such [numeral: ?] days. And [the cycle] of the [moon] [recte: faint] is such-and-such, just as [the time] of the season was...

פרק ארבעה עשר — Chapter Fourteen [Red ink, larger script]

The order [סדר] [is] 98 [נ"ח — recte: צ"ח], one [חד], [ז'] 7 [?: the leading numerals of this enumeration are faint; candidate reading $98 \cdot 1 \cdot 7$]; and just as [the cycle] [recte: faint], the foundation of refinement [recte: faint], which they reckoned [שמכירין], the [times] [recte: faint], the foundations [המוסדים]; and the difference, for the time of the [season] [תקופת]; and they come out, just as their time was,

and the [season] [recte: faint]. So the [season] of Tammuz [תקופת תמוז], and so the...

by power [בכח] and balance [וטועין] upon them [עליהם] [recte: faint construal]; for this is the fixing of the time of its [season] [recte: faint], by the number [מספר] of the days that come out, that he reckon them [recte: faint]; and they said that the reckoning is in its order [בסדור], from this [siman] and from one [tequfah] [יוס ז' — recte: faint] in the fifth year of the cycle [בשנה החמשית למחזור] של לעבדה.

So too [its] continuation, for the [season] [תקופת] [recte: faint]; the [season] [שתי] [recte: faint] passed on, they come out [הצו], to be done [לעבד]; and they put [ויתשו] [recte: faint] their times by the well-set computation [הכוונה] [?: construal uncertain on faint line] — for thus their fixing was, and their reckoning, and they reckoned [וחשבו] thus and so. And the order [וסדור] of the years of the [complete week] [השבוע — recte: faint] — go [זל — recte: faint], for there is [time] for the seasons [עתי התקופות]...

[for] the times [למיים — recte: faint] of the [reckoning], so that the [season] of Tammuz [תקופת תמוז], and so the [season] [recte: faint] upon it [עליו], and they were upon them, the simanim [?: faint], and they put [ושמו] upon them the difference [recte: faint]; for the moon [הלבנה] — this is its difference and its surplus [מותרה ולסימן] [Interlinear / above the line: faint]; the days, and the [siman] [numeral: ?] [siman] of the [season] [recte: faint].

[A long run of the same catechetical pattern repeats, with the recurring lexicon תקופת תשרי / תקופת תמוז / מותר / מאליו / מהמחזור / השבוע / השנה / סדור שנות השבוע and faint distinguishing numerals throughout. The distinguishing numeric values across these parallel clauses do not register under magnification — they are flagged [numeral: ?] and consolidated below.]

there is some [variation] [יש כמה בכ] [recte: faint]; the fixing — to know [the season] of Shmuel [לדעת תקופת שמואל], upon it, as the time of the [season] [עת] [recte: faint] was; and the most exact [המדויק] was [the one] passed on [מסור] in the hand of the one who reckons [בד החשבון — recte: faint], for the moon [הלבנה], and it is the fixing [התקון], that more [than] another it was [שתי רב חדש — recte: faint]...

the well-set [computation] in the cycle, from the moon [מהלבנה], so [it] fixed another [את תקן אחר], and the most exact [ומדויק] was [the one] of the seasons [התקופות]; and the order [סדור] of the years of the [complete week] [שנות השבוע — recte: faint] in the cycle [במחזור], as the moon [כהלבנה], and it was...

[Foot of folio 177v breaks off mid-computation; continues onto folio 178r. Lower margin is blank ruled space. A single short ink stroke and a stitching mark sit at the lower gutter — codicological, not text.]

Isaac ben Joseph Israeli, Yesod Olam (Bodleian MS. Huntington 299, 1484; Spanish Rabbinic hand). Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; Chapter Fourteen (פרק ארבעה עשר), the seasonal-computation template.

the seasons (תקופות) that fall [?: clause continuing from 177v]. And we have already explained the matter of the [19-year] cycle of the moon and the order of its reckoning, and that one adds to its arrangement of the seasons whatever is needed to set them in order, so that they may be set in good order, each one in its place. And in this matter — the season of Tishrei [תקופת תשרי] — we go on to explain how it is set [מתוקן], and how it stood in former times, so that its arrangement might be set right and so that the seasons might come out in their correct places.

For it is by the [season of] Tishrei [?: that the year is anchored], and through it the seasons come out, each one in its place; and yet [the scribe writes] that this is not difficult [to grasp]. So know that the matter of the seasons goes by [reckoning] the sun [על דרך החמה] — the seasons of the year that pass over the year's course in their order; and the difference [הפרש] between the season of Tishrei and the season of the moon [תקופת הלבנה], and the surplus [מותר] that there is between this season and that. From all of this you arrive at the true reckoning [התקון] [האמתי], so that the seasons may all be set in order. Indeed, the difference between the seasons of the sun and the seasons of the moon, when you take account of [?: the cycle], and the surplus that there is between them — from this you arrive at the precise computation [התקופה הברורה]; and concerning this the masters of computation [בעלי החשבון] have spoken.

And the master Rava [רבא: name uncertain — could read "the master, our teacher"] said his words, and they are well-founded, and from them you reckon: thus did the men of the [reckoning] season understand. So he set down the writing of "new month, new month" [חדש חדש] — that is, he wrote "guard the month" [שמור את החדש] (Devarim 16:1), and from this they understood [the rule]: thus the season of Tishrei, and the difference, and the surplus, [stand] just as we have set forth above [for] the season of the moon, in its [proper] order. From the moment it [the moon] is born [נמצא] until the day of the season, the years are completed and you find the rule [הדין]. And once it is set, this is the order; and thereupon there was [established the rule] for "guard the month," and from this they found that...

the order of the season of Tishrei [?: continuing], and this is not difficult: for the matter is known by the established way [על דרך הקבוע] — the surplus, and the difference between season and season; and the surplus that there is between [one] season and [another], by which means the order of the season of Tishrei comes out, and the difference, and the surplus, as we have explained above. And though some have spoken otherwise, the matter is well-founded, and from it you reckon: this is the order of the season of Tishrei.

And he said, "guard the month before [the] season" [שמור את החדש קודם התקופה] — that is, that it not happen that you keep [the festival] before its season [קודם [תקופתה], for the new moon [החדש] comes before the season; "guard," then, [means] that you guard Pesach so that it not [fall] before [its time], for thus did he set down the writing of "guard the month." This is what we said: guard, lest you should reckon... so that it not come [out] before its season [?: clause].

For it is the chief principle [העקר] that you guard the month before the season, and you reckon it: this is the foundation of [the rule] "guard the month" — guard it, lest you keep Pesach before [its] time, [for] there is a difference of about a day's length between [the festival and] its season. So [it is written] "guard," that it not fall before [time]. And concerning the day of the new moon [יום החדש], whether it be a full month [חדש מלא] of thirty days [or a defective one]: a full month, when it is set, this is its order [?: clause]; and they have spoken — for it is "the month that passes over [the year]..." [וכבר אמרו מעובר]

[Body text ends at the foot of the written area; the lower half of folio 178r is blank ruled parchment, not damage. A few ink-smudge marks at the lower edge are show-through / handling marks, not text.]

[Ruler / scale-bar on the right margin; text block on the left. No running header visible.]

and he said to them [?: opening clause continuing from 178r]: "guard the month" [שמרו את החדש], and from this they understood — and the season passed [over], "guard the month." And the meaning is: take account of the days [התעמים בימים], from new month to new month, and the like — to make this known, and to teach [the rule]. So [you must] do this: take account of the season [תפיק התקופה], for the season [is reckoned] from new month to new month, and the like, just as we have set forth above.

And the season passed, "guard the month," and "remember" [וזכור] — that the season [תתקופה] is thus, for the men of the [computation] season, and the like. And the season passed [תקופה?: clause], "guard the month"; "remember the day of

the season" [זכור את יום התקופה] — that is, the men of the [reckoning] season; and the difference: the days [are reckoned] from the season of the sun [משנת החמה], and we explain to them about the moon [הלבנה], whether the month be full [or defective]; for it [the moon] is born and you arrange it, just as we have set forth above. And the rule of the new moon: a new moon, a [defective] new moon — by this you reckon, just as we have set forth above the order of the moon, whether it be full or defective. And though some have spoken otherwise, the matter is well-founded, and from it you reckon [the rule for] the day of the new moon and the day of the season.

For the men of the season understood, and from them you reckon: thus is the order of the season — that the difference of the seasons goes [reckoned] from the season of the sun [משנת החמה], and we explain to them; for the season of Pesach [תקופת הפסח], when it is set, this is its order; and the men of computation [בעלי החשבון] have spoken, just as we have set forth above the season; and from the moment it [the moon] is born [מה שעובר], until [?: the day], so that the reckoning be true [כדי שיהיה רובו...].

For [there must be] the [correct] intention in the matter; and he said: more, that there be the season of the new moon — like one who guards the new moon — when it is set, this is its order; for the lack [החסרון], so that there not be a lack [כדי שלא יהיה חסרון]. The order of the new moon, just as it was [stated]: from new month to new month, like the day of Pesach, [reckoned] for the men of computation [שיאמרו לבעלי החשבון] — and what is written, and the men of computation [מעמרים]: i.e. "those who intercalate", and what is written, "guard the month" [שמור את החדש]; and though some have spoken otherwise, [the matter is well-founded].

And remember the day of the season — that the [season of] the men [of the year] is so; the year of the moon [שנת הלבנה] is [reckoned] like Pesach, for the day [of] the new moon, [the day of the season] [?: enumeration]. And the master spoke his words, "remember..." — and concerning the master's words about the moon, the new moon was full [or defective]; and "remember the day of the season" — that is, the men of [computation]; and there is [a difference between] the day of the moon [reckoned] like the men [of the season] — for this is the foundation [העקר] [of the rule], that the matter is so.

And he said: "guard the month," and "remember..." — and the new moon is so, [for] the foundation [of] the moon [is reckoned] in this manner; for one who guards it, when it is set, this is the order. The matter is "guard the month" before the season [?: clause]; and [it is] the foundation of the Torah's [precept] — for the

matter is so, [in that] one guards Pesach, lest it [fall] before its season; "guard the month," then, before [time]. And though some have spoken otherwise — behold, his words are known. [And he said:] "guard the month" [reckoned] by [the season of] the new moon — and the new moon is so, by the season of the sun [תקופת החמה]; the difference of the new moon [is reckoned] from the season of the sun [מתקופת החמה]; and not [otherwise] — there is no [season] without a new moon, and there is no season without the festival of Pesach [ולא רסחין לעשות הפסח]; for the season is fixed — from new month to new month, or [from the] new moon, the year being [reckoned] for the year that has been intercalated [שעיברתה], to set it [right].

So you [must] do this: from new month to new month, or new moon to new moon... so that it [the season] not fall, before [time] [?: clause]; for "guard the month," that it not happen [that you keep it] before [its season], for the new moon [comes] before the season; "guard," then, that you guard Pesach so that it not [fall] before [its time]; and likewise the new moon — and what is written, and remember, just as we have set forth above. And what is written: "set apart the Torah" [ויחדת התורה], to fix [the season] [לקבוע]...

[Body text ends near the top of the lower third of folio 178v; the remainder is blank ruled parchment, not damage. Ink-smudge marks at the lower edge are handling/show-through marks.]

[Continuation of the **Fourth Treatise (המאמר הרביעי)**, the practical Hebrew calendar, **Chapter Fourteen (פרק ארבעה עשר)** — the seasonal computation: the surplus of the tequfah over the year, "guard the month / remember the day of the season," and full and defective months. The text runs on directly from the preceding leaf; it is unrubricated.]

to fulfil what is written, "*Guard the month of Aviv*" (Deut. 16:1) — that is the season of Pesach. And it [the verse] became a foundation for fixing it [the festival] in its proper season. For this reason the Sages set apart the Torah passage [?: construal of ליום/ליו here uncertain] dealing with the season of Pesach, and they gave warning concerning it: that one must take care that the day of the season of Pesach [the tequfah of Nisan] not fall on the day of the new moon of the moon [the molad of the lunar month], nor on a day that precedes it.

For the season [tequfah] is bound up with the year [the solar year], whereas the new moon [molad] is bound up with the moon [the lunar month]; and there is a difference [הפרש] between them. They [the Sages] taught that one must reckon, by way of computation, the surplus [מותר] of the season over the molad: how

much one [the solar reckoning] exceeds the other [the lunar reckoning], and by how much one falls short. And in like manner [one reckons] the surplus of the molad each and every day, until the day of the season comes round again [?: the close of this line is faint].

For the year of the sun [the solar year] is three hundred sixty-five days and a quarter of a day; and from this you derive the day of the season. But the year of the moon [the lunar year] is shorter than it. Therefore there is a difference between the season and the molad, and there is reckoning [a computation] in this matter.

And so it is written: "*Guard the month*" — guard the new-moon [the molad], **and** "*remember the day of the season*" [remember the tequfah] — for the season is bound up with the sun and the molad with the moon, and one [reckoning] does not match the other.

The year that is "full" [שלמה] and "defective" [חסרה]: each year of the moon is either three hundred fifty-four days [a regular lunar year], or three hundred fifty-five [a full / abundant year], or three hundred fifty-three [a defective year]. The day of the season therefore moves forward by a certain amount each year, since the solar year exceeds the lunar year. And so the season advances year by year — there being a surplus of the season over the year [each year], and the months are "added to" or "reckoned" [intercalated] according to this difference.

[A few lines here treat the running surplus and the intercalation of the embolismic month; the body of folio 179r closes with a numeral:] ...and the surplus [accumulates], and they intercalate it [the year], and the reckoning of it stands at fifty-seven [נ"ז]. [The remainder of the leaf below this line is blank — wide lower margin, not damage.]

[The text on 179v is the **cycle-remainder (שארית / מותר) computation** keyed to the 19-year cycle (מחזור): the running surplus carried across whole cycles, stated remainders, and embedded siman (סימן) memory-pegs. It is numeral-dense and unrubricated. The homily on the 365¼-day year and the "*guard the month / remember the season*" (Deut. 16:1) verse belongs to 179r and does **not** recur here.]

three hundred sixty-five [שס"ה] and a fraction, less than [a whole]: from the cycle [מחזור] — from what it [the cycle] runs to — comes the surplus [מותר] for them [the cyclical reckonings]; a year [shortfall], and [a further] surplus, and [over] two [ב'] years... and the surplus [מותר] [is carried] over the year, and they set it [the remainder] back to the cycle.

The surplus of the cycle [מותר המחזור] is two hundred sixty-six [רס"ו]; and concerning this they say that it is the year [-fraction] that [carries] back [למפרע] — and likewise [carry it] over its reckoning, so that the reckoning comes out [נמצא חשבון]. And they carry it back, and set it [back] to the cycle, and concerning this they say [the same].

And the remainder [for] them, by way of computation, is for them: [over] one cycle [it is] [numeral: ?] — siman [סימן] [numeral: ?] [the leading figures of this siman are faint at mid-column]. Siman [numeral: ?] [נח?/fifty-eight uncertain — [numeral: ?]], and so they reckoned, [these being the] computed-numbers for them; and they stand [as the foundation of the] cycle.

The cause of the variation [סבת החילוף] is that the moon [לבנה], by its siman, and the sun [שמש] in their conjunction [the molad], move [each] at the rate of its season [תקופה]; and they are seven... [numeral: ?] [the figure here is faint] in Tishri [בְּתִשְׂרִי] the sun crosses over [עוברת], and [a further reckoning follows] [?: end of line faint].

and its siman [is] a remainder [for] the cycle [numeral: ?]: a faint figure here, read as part of the רס"ו run but not committed]. And the first [cycle] — [as] they [the Sages] taught upon it, of blessed memory [ז"ל] — they said: it was one day [יום אחד] that was [from] the world[’s creation], and [a value] that was [reckoned]... one day [it was] [numeral: ?], so that the computation comes out [נמצא חשבון].

[over] a single year, the surplus of [the years of] the cycle [is], from what they reckon — and one is obliged to reckon for every year going back to the cycle [numeral: ?]: the per-year value here, ל"ב/ב? uncertain — [numeral: ?] — and the completion [התמסות/השלמה] for them is so [much]; and it [is] [numeral: ?] [ל"ב? uncertain], and the [further] remainders for them, and likewise: and there is [a value] [numeral: ?], and [a value] [numeral: ?], and [a value] [numeral: ?]; these [are] the remainders for them. [Several consecutive faint two-letter figures — committed only as [numeral: ?] slots, not pattern-filled.]

So [the matter of] the division [חילוק] — they enquired, and considered it, in [the passage of] the season of Pesach [קביעת הפסח] and the [reckoning of the] festivals [המועד]; and a known [fixed value] is that they reckoned, and [there is] a siman [numeral: ?] for the season of the festival [to set] the season of Pesach in order...

For it is the **first cycle** [המחזור הראשון] that was [from] the world[’s creation]; thus they reckoned. The surplus is two hundred sixty-six cycles [מותר רס"ו מחזורים] and [numeral: ?] [a small figure follows רס"ו — [numeral: ?]] complete years [שנים שלמות]...; intercalating, and [over] [numeral: ?] [its remainder] — its siman [is]

[numeral: ?] [ל"ל?/ל"כ] [uncertain] — [this is] the same foundation [המוסד] for [several] books [ספרים], [namely] [numeral: ?].

The surplus is two hundred sixty-six cycles [מותר רס"ו מחזורים] and [numeral: ?] complete years [שנים שלמות] [twenty-...?]; ...a siman [numeral: ?]; and [numeral: ?] the foundation [המוסד] for [the] books [ספרים] is [numeral: ?] [ד"ל] [uncertain], [a] siman [numeral: ?] [ל"כ] [uncertain] — [this is] the reckoning [חשבון].

the [seasons] that have passed, to three [לשלש], up to a year... as their reckoning of this [is], so is this [computation], [and so forth]. [The body of folio 179v closes here; the lower portion of the leaf is blank.]

Treatise Four (המאמר הרביעי), Chapter Fourteen (פרק ארבעה עשר) — continued: the seasonal computation; the surplus of the *tequfah* over the molad; the reckoning of R. Adda and the reckoning of Shmuel.

[Script: Spanish (Sephardic) rabbinic semicursive, single hand, brown ink. Both leaves are continuous prose of Chapter Fourteen; no rubricated headings, no tables, no diagrams in this opening. Folio 180r has the conservation ruler on the left and the pencil foliation "180" at the top; folio 180v has the ruler on the right. The two leaves are distinct sides of the same folio, one continuous forward flow. The text block occupies the upper two-thirds of each leaf; the lower third is blank parchment (not damage). The hand is a closely-spaced, run-together cursive — legible, but the embedded *ḥalakim*/hour/day numerals are the chief difficulty.]

If so, the molad of this present year — and it was on the fourth day [of the week], 839 *ḥalakim* [ד' תתל"ט], and so it is. With the renewal of the sun [מחדש השמש], the years being the days of the season, the days of the years of the [19-year] cycle [שנות המחזור]. And from the surplus [מותר] of the second [year over the first], as the cycle [accumulates] —

in their reckoning [מספרתם], this is the surplus, and so it comes out for them [זה] [שעה אחת תק"ן חלקים] one hour and 550 *ḥalakim* [בסוף שנה] at the end of a year [מותר החמה על הלבנה] is one hour and 485 *ḥalakim* [תפ"ה חלקים]. And when the year has passed [וכשתעבר] [זו התקופה] — behold, this is the good [reckoning].

Six [...] is the sign [סימן] that the days of the years [שני השבורים] that have passed [שעברו] of this year [are such-and-such]; for the surplus of the sun over the moon [מותר החמה על הלבנה] at the end of a year [בסוף שנה] is one hour and 485 *ḥalakim* [תפ"ה חלקים]; and when the year has passed [וכשתעבר השנה], the season —

behold this, that there is between them [the molad and the season]. The reckoning [is]: 7 days, 9 hours [ז' ימים ט' שעות], and 642 ḥalakim [תרמ"ב? — numeral faint] more; and behold, there is between this and the moon —

and 30 days [ל' ימים], 9 hours [ט' שעות], and ḥalakim, in order to reckon the moon [וכדי לטעת הלבנה]. And it ascends [עלה] to 13 days [י"ג ימים] and 9 hours [ט' שעות] and ḥalakim more, up to [a span by which] you may reckon the moon [להבין] [הלבנה]; and this is its meaning [וזוהו ענין כי].

For the surplus is bound [קשור] up to one year [עד שנה], and from this you may understand [ואתה תבין] that we have understood it [שהבנו]; therefore [...] establish it [...]; for this is by their approximation, as we have explained [בקירוב כמו שירדנו].

And the cycle and the season [המחזור והתקופה] — the [reckoning?] of the season precedes [...] without [tracking] the moon [שלא כהלבנה]. And now [ועתה], in order to make plain to the seer [להראות] —

he made known [להודיע] the days of the week [שבת] of the [solar] cycle [...] the establishment [תקון] of the seasons, according to the opinion of R. Adda [לדעת רב] [...] R. Samuel [לבן שמואל] — i.e. the reckoning ascribed to Shmuel; and according to the opinion of R. [...] when [...]. And we have found that it [...] not [...] before [קודם], and these [...] hours [...], and there is no need [...]. (interlinear: ב) before the season [קודם התקופה] [ר': ?]. And the establishment [תקן] — and the establishment of the season [תקן התקופה] comes first [...] without [tracking] the moon [שלא כהלבנה], from the reckoning of [...].

The reckoning of the season is first [...], and this is the reckoning [...] more than [...]. R. Adda [רב אדא] established it [ויתקן] [...] for the great rabbis [לרבני רבא], and they made it [ויעשו]. And these [...] are close [קרובים] one to another [זה לזה], in advance, as we have come to know [כמו שירדנו].

And from the cycle [...] one year [...], and the establishment of it [...] over [...]. They differ [...] one from another [...], not [...] before that [...]; and now [ועתה] we shall return to the matter [נשוב לאמר] — "to speak".

To make known the reckoning [...] — the establishment of the season according to the opinion of Shmuel [תקופת לדעת שמואל] is [...], and the difference between [...] and the establishment of the seasons according to the opinion of R. [...] of his cycle [...], when [...]; for this season [...], and according to the opinion of [...] it was complete [שלם], and from the beginning [ומתחלה] [...] of the cycle [...] he established [שתקן] [...].

[...] complete [שלם] [...] in order to make plain from the beginning [להבחין מתחלת] the time of [...] from the establishment of [...]; and [...] like Shmuel's [כדעת שמואל] [...] the first season [...]. As [...] [זמן: ?] of the cycle precedes [...], so was the molad first [...], the season of the moon being first [...], like Shmuel's reckoning; and according to the opinion of Shmuel, the molad of the first [season] was on [...]. [...] like Shmuel's: it was the molad of Tishrei [מולד תשרי] of [...].

And from the reckoning that he established [...] the season according to the opinion of Shmuel [תקופת שמואל] — and this [...] of the season; [...] one year [...], and the difference [ההפרש] [...]. They said: the season [...].

[Foot of 180r: lower third of the leaf is blank parchment — not damage.]

If so, the [reckoning] was first, and the established cycle establishes the seasons [לתקן תקופות], and so they are all equal [שווים]; and they established it [...] the days [...] [וימים] [...]; and the difference [...], for the difference is more than [...]; and the days [...] [וימים] [...] the sign [סימן].

And it was difficult [היה] to make plain [להבחין], the season [...] this is, and it was [והיה] this [...] up to [...]; nor was it [ולא היה] [...]; and the establishment [תקון] of the season [תקון התקופה] [...] before [קודם] the molad [...]. And he established it among them [...]; for [...] before [...] R. [...], and the seasons [...] of the cycle [...]; for it was first [...], and the molad of the year [מולד השנה] [...].

If so, [...] the establishment of the season [...], and the season comes before the molad [קודם המולד], for [...]. And the cycle [...] the establishment of [...]; the season precedes [...], and what [...] more than [...]; and as for the establishment of the season according to the opinion of Shmuel [לדעת שמואל], it precedes the molad [...].

And there is no need [...] that they said [שאמרו]: the season [...] the cycle [...] he made plain [הבחין] [...] for him; the moon [הלבנה] [...] before [...]. And as for the [...], the days [ימים] are 9 [ט' — nine] [...]; and the season [התקופה] [...] before the molad [קודם המולד], the season [...] of the moon [...]; for [...] up to [...] of the season [...]; and the days [וימים] [...] of the season [...] before [...]; and the moon [...].

And as for the [...], the moon was first [...] of [...] of the moon [...], before the establishment of the season [תקון התקופה]; and [...] up to [...] of the season [...]. The moon [...], and what [...] in the season [בתקופה] [...], and it was first [...] without [tracking] the moon [שלא כלבנה].

[Mid-folio:] **And now we shall return to what we began** [ועתה נשוב למה] [כבר חתמש: ?] [שהתחלנו].

And the seasons of the year [תקופות השנה] [...] the cycle, for [...] R. Adda [רב אדא] [...] this is [...] before [...] not [...]; and the establishment [...] R. [...] the establishment [...] the seasons [...].

And [...] the seasons [...] he established it [...] the days [ימים] of [...] of the seasons [...]; for the year [...] is not less than [לא פחות] and not more than [ולא יתר מן]; and the days [...] less than [...]. And [...] more [...], and they put [...] over [...] according to the words of R. [...] [על דברי ר']. And [...] the moon [...]; for this [...].

And the moon was first [...], for so it is [כי ככה], it being established [...]; and behold, [...] in advance [...]. And the establishment [...], and the establishment of the season [ותקנת התקופה] is established [...]; and behold, the seasons established [...] and they [...] until [עד] [...].

If so, the moon was first [...], for [...]; and behold, [...] more than [...]; and the establishment [...]. And the seasons [...] he establishes [...], the establishment [...] according to the opinion of Shmuel [לדעת שמואל] [...]. The molad [...] the establishment of the season [...].

[...] the molad of Tishrei [מולד תשרי] [...] nine hours [ט' שעות] and ḥalakim [...]; and the season [...] was the sign [היה סימן].

And as for the [...] establishment [...], they were equal [שוים]; and behold, [...]; and now [ועתה] [...] for [...]; for from the beginning [מתחלת] [...]. And as for [...], the establishment of the season according to the opinion of Shmuel [לדעת שמואל] [...]; for [...] up to [...]; and now [ועתה] [...].

[...] the season [...]; and behold [...]; and the establishment of the season [...] over [...] sevenths [?]; and they [...] in the season [...]. And as for [...] [?: חסר ב] up to [...]. The reckoning of the season [...]; for it [...] up to [...] of the season [...]; for [...] the days [ימים] [...].

[...] for the season [...] up to [...] in the season according to the opinion of [?]; and from the [...] for the season [...]; for they put [...] for the [...] up to [...] for the season [...]; and they reckoned [...] the season [...], the days [ימים] [...].

[...] for the season [...] over [על] [...] of these [...]; and we have found [ומצאנו] that the seasons [שתקופות] and [...] the moon [...]; for [?: שעברה] [...]; for [...] is the sign [סימן].

[Foot of 180v: lower portion of the leaf is blank parchment — not damage.]

Bodleian MS. Huntington 299. Sephardic semicursive, brown ink, single column. The close of Chapter Fourteen (the seasonal/tequfah computation), ending "סוף" (End)

partway down 181v. Wide blank lower margins on both folio sides. The embedded gematria values (hours and ḥalakim of the several tequfot and the molad) are faint and largely do not resolve under magnification; each unrecovered value is flagged [numeral: ?] once.

[f. 181r]

[A faint marker, apparently [ן]סיח ("section"), stands at the head of the first line.] ...a point, that the season [tequfah] should fall at one point — and this is false; for it is impossible that the season of the sun and the season of the moon should both fall together at one and the same point. This is what was intended [?: construal of the line is uncertain].

For if you reckon by the season of Shmuel [tequfah of Shmuel], whose year exceeds [the true year], its season does not fall at the beginning of an hour with no fraction, but accrues an excess. And so too, when you reckon the seasons one after another, the accumulated difference [hefresh] grows from one to the next, so that the season does not return to the point at which it began but shifts forward by the amount of that excess. By contrast, R. Adda fixed his reckoning of the season [tequfah of R. Adda] so that it accords with the 19-year cycle [mahzor] and with the molad, in order that the seasons should not depart from their fixed measure across the whole of the cycle.

Know, then, that the difference between the season of Shmuel and the season of R. Adda is [numeral: ?] — that is, that the year of Shmuel exceeds the year of R. Adda by [numeral: ?] hours and [numeral: ?] ḥalakim. And therefore, when the seasons are multiplied across the years of the cycle, this difference accumulates until it amounts to [numeral: ?].

For the year of Shmuel is 365 days and [numeral: ?] hours; whereas the year of R. Adda is 365 days, [numeral: ?] hours, [numeral: ?] ḥalakim, and [numeral: ?] regaim. Thus the year of Shmuel exceeds the year of R. Adda, and over the 19 years of the cycle this excess sums to a full measure, by which the seasons of the two reckonings are separated.

And know further that, by the reckoning of the molad, the season [tequfah] and the molad do not begin together at one point either; for the molad has its own course and the season has its own course, and between them there is a difference [hefresh] of [numeral: ?] hours and [numeral: ?] ḥalakim. So when you wish to know how far the season stands from the molad, take the difference between them and you will find it to be [numeral: ?].

So far the matter of the differences. Now we shall return to the question of the seasons [tequfot] [?: the closing clause of 181r is faint].

[f. 181v]

as has been explained at the end [ףס] [of the foregoing]. And he will know, when the reckoning is properly fixed, that the season of the moon returns by the cycle [mahzor] to its measure, so that the difference is not lost. [?: this opening line is construed from a faint reading.]

And so too R. Adda fixed the cycle of the moon, so that the seasons should not depart from the cycle; and by this reckoning they return to their measure, with a difference [hefresh] between them of [numeral: ?]. Therefore he said that the season [tequfah] is [numeral: ?], so that it accords with the molad and with the cycle, and the seasons do not depart by even a single point.

There is, moreover, a further reason [sevara] in the words of R. [?] concerning the season, namely that the season of Shmuel is more than [numeral: ?] and is therefore the larger, while the season of R. Adda is less and so accords with the cycle and with the molad. And the accumulated difference between them, across the years of the cycle, is [numeral: ?].

And R. Huna bar [?] [the patronymic does not resolve] said in the name of [?] [numeral: ?] hours, and so forth; and another reported in the name of [?], and so forth. Upon these matters their reckonings are founded [?: construal uncertain].

For the season of Shmuel is the larger, and his reckoning the simpler, while the season of R. Adda is the more precise, since it is fitted to the cycle and to the molad. And he fixed it so that the seasons should not depart from the cycle, neither falling short of it nor exceeding it.

And the rule of the matter is this: the season of Nisan [tequfat Nisan] is the principal one, and it is called "holy" [קודש]; for it is the first of the seasons, and from it all the seasons are reckoned. Whoever wishes to know the season of Nisan in a given year, let him reckon by the cycle and by the molad, and he will find it. And the season of Nisan must fall [numeral: ?] — three [days] before [the term] — the end.

End [ףס].

in Kislev, and likewise to reckon, for the marker [siman] of his tequfah [seasonal point], how much the tequfah of the sun [will be]; for this is the matter he recalled.

as it stood, in the calendar-reckoning [heshbon] of the great cycle, and they reckoned it from the outset, so as to draw it near to the time of the tequfot.

For the marker of the cycle [mahzor], he said: behold, this difference [hefresh] of every cycle — and the cycle [is reckoned] as it was, just as the marker is twenty-two, twenty-two for every cycle.

at the time of the tequfot, this stands upon the difference; and David, peace be upon him, said how [great it is]. One need not be ashamed of the marker as it is, [reckoning] the marker just as it was — as David the King, peace be upon him, said. And we shall know, by way of the tequfot, in the days of David, peace be upon him; and likewise the markers, for the holy points [the qodesh-reckonings].

[A passage on the markers (simanim) of the tequfot and the accumulating discrepancy across the 19-year cycle:]

this difference is reckoned from the marker, and the marker [recurs] likewise. And it was, at the reckoning of the cycle [mahzor], a discrepancy [?: a damaged word, likely "of the cycle"]; the cycle is "holy" [qodesh]. At the time of the tequfah, the marker of the tequfah of Tishrei [stands] upon the year — this is the marker of the tequfah, so that the reckoning is complete.

And the marker of Tishrei is according to the knowledge [reckoning] of Shmuel; and we found that, according to Shmuel's calculation, it is just as the cycle was [reckoned] for the cycle. This is a marker: twenty-two, twenty-two. Behold, this is the "falsehood" [sheker — the cyclic discrepancy]; the falsehood was established in order to set [the reckoning] in order — the falsehood of the year — so that there will be in the year nine hundred [?: numeral faint], that is, when it was a complete [year/cycle].

and the cycle was [reckoned] for the year, and they took up the third [reckoning] and [completed it].

and how the foundations of the intercalation [yesodei ha-ibbur run]: the causes of the intercalation [sibbot ha-ibbur] and its mysteries [sodotav], and these matters are clarified by the markers — so that here there is a [fixed] reckoning; and the cycle [stands] likewise. And he said: to make known to Israel the markers [simanim], that they are [fixed]; the marker of the houses [batim], and likewise [the reckoning stands]. Israel was [instructed], just as he said, [to know the markers].

[The lower half of the leaf is blank parchment — wide bottom margin, not damage.]

[to make known to Israel the markers,] and the craftsmen [ḥarashim], and likewise these the craftsmen [shall know].

For so are the words of R. David, that this is the marker, that the sun [ḥamah stands] upon them at the time of the tequfah of Tishrei. Upon this it stands [?: a short damaged phrase].

that it is so, in the days of David, peace be upon him; and we found the marker. And they timed it [to] the tequfah: the marker — behold, this is twenty-two, twenty-two — like the marker [reckoned] from the cycle [mahzor].

And likewise it is a "falsehood" [sheker]; the falsehood was established to set [the reckoning] in order. It stood upon the difference [hefresh], so that this is [fixed]; behold, at the reckoning of the cycle [mahzor], the marker [stands] for the intercalation [‘ibbur]. And behold, the time of the tequfot is the matter, just as the marker of the tables [luchot] — after it, in the year [following], the cycle will be good in [a certain] respect, just as the marker is twenty-two, twenty-two.

[The column continues:]

[such is] the way of the difference [hefresh] of [one cycle from the next] cycle [ben mahzor le-mahzor]. [This is] the "falsehood"; R. David, peace be upon him, [taught it], and we [follow it]; and this comes upon them, that [the reckoning holds]. [The tequfah] of Tishrei [stands], just as it stood, [reckoned by] twenty-two, twenty-two, in the days of David, peace be upon him; and we found a marker — this is his marker — and his time was [reckoned] for the marker.

the time of the tequfot, in the seasons [zemanim]; and the difference [hefresh] of [one] cycle [from the next, ben mahzor], a marker — just as the marker of the tables [luchot] — after it, in all wisdom, that [it holds]. The cycle [mahzor] is good in [a certain] respect, just as the marker is twenty-two, twenty-two, to set [the reckoning] in order; [and so] the way is near to the [reckoning of the] year.

[The lower portion of the column, the final visible lines:]

the foundation [yesod] of the [matter]; [R. David,] peace be upon him, [taught it], and we [found] the time of the tequfah; and we found that it is the cycle [mahzor]; just as R. David [taught].

[This is] the introduction to the tables of the tequfot [haqdamat luchot ha-tequfot]; for so [it stands] — and that the sun [ḥamah stands so] in the days of David, peace be upon him; and we will know the markers [simanim]. [Here ends] the introduction to the tables of the tequfot; in general [bi-khlal].

[The lower half of the leaf is blank parchment — wide bottom margin, not damage; a few stray ink flecks in the margin.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar — the seasons (tequfot): the discrepancy between the reckoned and the true tequfah, continued.

[ויהי] / וכן לבד' כ"ה ימים ויהי / ...and likewise separately, 25 days, and there will be / [the running figures continue the worked example begun on the previous leaf]. The discrepancy (sheker) is reckoned thus, and the [reckoned] tequfah of Shmuel is established for you.

תקופת שמואל / The tequfah of Shmuel: the difference between the tequfah of Shmuel and [that of] R. David — [its hour-count is reckoned], and this is the true difference. And he established the matter so that you may reckon them, the difference [running] from the molad up to the tequfah.

And the season of the discrepancy in which there is the discrepancy [is reckoned]; and a [further] tequfah, [its] difference reckoned, and within it the discrepancy as explained. And he established it so that you may reckon them.

ועוד צריך / And further it is needed [to clarify], concerning the deficiency (ḥisaron): [that] from its season not [matching] its season there is a deficiency of the discrepancy — within [the year] which is $365\frac{1}{4}$ [days: שס"ה ורביע] there is the discrepancy, [namely] the discrepancy of the [solar] year. [These] amount in the established [reckoning] to [numeral: ?] ḥalakim each; and the established difference is [numeral: ?] ḥalakim alone.

[The figures here build the running total in ḥalakim — written very small; numerals: ?] ḥalakim, which are [so many], and the season-and-the-discrepancy is established thus; and a tequfah of the deficiency, [for] which there are [numeral: ?] days, and over and above this, within it, the ḥalakim — [apportioned] to each one of them, [its] count and [its] order of placement.

ועוד צריך / And further it is needed [to clarify], as is the way of true reckoning, as we set forth. Turn now to a [further] established method — the way of true reckoning (דרך החשוב האמת) — that we may make clear [its] order. When [the season] returns and comes round in its order, even as R. David [ר' דוד] stated, that the difference of the [mean] motion of the sun (מהלך השמש) in the established [tropical] year [is so much], and within it the tequfot and the [tables]. And this is established for you [as] R. David stated, that [it amounts to numeral: ?], so that

there would be no deficiency — that the deficiency not [match] its season. These are the chapters of the order, [namely] the established [reckoning].

[He] established it by their reckoning, [for] R. David [held] that the discrepancy of the [true] year [is so much], so that the [reckoned] season does not [match] its [true] season; and [so] R. David [stated]. Turn to it.

וְעוֹד / And further: in order to make clear, as is needful, the matter of the true reckoning, that you may know it — this is the true reckoning, and behold this is established for you. And when [the year] turns, [you find] that the [reckoned] season [is so]; this is the way of the true [reckoning], so that the matter be made clear, in order that you may know each season by itself (שתדע כל תקופה בעצמה).

And the difference between them — behold, what is the difference? Reckon for yourself: behold, what is the difference? And these are the four established seasons, so that you may know the difference of each of them and its true [value]. Turn to it.

[Here a worked total — the years (?) and within them numeral: ?] ḥalakim, [which are so many days]; over and above this, within it, the molad [figures] established for you. Reckon the [true] season of each of them, and the true [value]. And the tables (והלוחות) that we appended for its sake: behold, it is established for you, [as] R. David stated, that the difference of the [mean] motion of the sun within the established [year amounts to so much]; [there is] no deficiency [whereby] the deficiency would not [match] its season. These are the chapters of the order. And [numeral: ?], in order that you may know each season by itself.

[The text ends high on the leaf; the lower portion is blank parchment, not damage.]

[as for] the seasons (tequfot): it is established for you thus. The [mean] motion of the sun [is so much] ḥalakim; in the [solar] year [there are so many] hours; nine ḥalakim (ותשעה חלקים), and the discrepancy of the established [year is so much], so that you may understand it. And there is to it up to the tequfah, and this is the deficiency as established. And it is established that each one of them [is so]; the discrepancy is [so many] hours and nine ḥalakim, reckoned for the tequfah. The [established] tequfah amounts [to so much; numeral: ?], so that the matter be made clear, as the established [reckoning], and so that you may know each season by itself.

And behold, [as for] the [true] reckoning, [namely] the [mean] motion (the deferent) of the sun: behold, when you have reckoned, [if] the [reckoned] season comes round, then you shall add it [back]. Turn to it, [for] the deficiency is established, reckoned for each of the four seasons. The established difference [is so]: behold, it stands common (universal) for them all between them, [as for] the seasons; over and above this, [there are so many] hours and one [ḥelek], and behold the seasons over and above this [are so many] hours and one [ḥelek], and so it stands; and behold the seasons [are numeral: ?].

[And as for] the [mean] motion of the sun [is so]: behold, what is the [true] reckoning, established thus? And these are the established ḥalakim, the [mean] motions [running] from the molad up to the tequfah, [as for] the season of the discrepancy in which there is the discrepancy. And over and above this, [there are so many] hours and one [ḥelek]; the difference of each [is so much], [namely numeral: ?] ḥalakim. The [mean] motions amount [to so many] hours; nine ḥalakim in the established [reckoning], that you may understand it.

[It] returns and is established that the season comes in its order (חוזרת). The [mean] motion of the sun [is so], and within it the tequfot and the ḥalakim, [as for] the season of the discrepancy in which there is the discrepancy. [It is] established for [each of] the four seasons by themselves; this is the [established] season. And behold, you have [the means] for the discrepancy, that you may know each season by itself.

And this is the way of true reckoning, as explained; it stands common (universal) [for them all]. Therefore this is the way of the true reckoning, in order that you may know it. And we appended it between the season of the established [reckoning], so that the [reckoned] season does not [match its true] season; and the [season of the] discrepancy [is so], [namely so many] hours and one [ḥelek]. And we made clear [its] order, and we began (והתחיל) it.

The [reckoned] tequfah [comes] thus, so that you understand [the matter] (שתבין); and thus when [the season] returns and comes in its order — [behold] there is the discrepancy in the [established] season. And when [the year] turns, you shall add [back], and this is the way of the true [reckoning], so that the matter be made clear, in order that you may know [it].

And the difference, when [the season] returns and comes round, even [as so]; and [as for] the difference, the established [tequfah is so] — and it is established for you thus, the [true] reckoning. They appended it — and the deficiency is established, reckoned for the season; and within it the difference as established,

[namely so many] hours and one [ḥelek], and the established [tequfah] thus; [as for] each one of them, [its] count and [its order].

וְעוֹד צָרִיךְ / Turn now to a [further] established method, the way of the true reckoning, that we may make clear [its] order. When [the season] returns and comes round in its order, even as R. David [ר' דוד] stated, that the difference of the [mean] motion of the sun [is so much] in the established [year], so that there would be no deficiency [whereby] the deficiency would not [match] its season. These are the chapters of the order. And [now] turn to the way of reckoning.

וְאָמַר / And he said: in order to make clear, as is needful, [the matter] that the [exact] hour of the discrepancy be removed [/ resolved — להסיר], [namely] the matter of the [true] reckoning, that you may know it.

And we made clear [the matter] of the molad and the foundations of intercalation (העבור), and the molad of the [mean] sun, and that there are the established ḥalakim — the differences and the [established] hours, and that the days are reckoned with [their] full count, as is needful. And [we set forth] the [reckoned] tequfah, [as for] the seasons of the [established reckoning] and the foundations and the order; and we appended the [reckoning], [as for] each one of them.

And we made clear [the matter] of the foundations of the intercalation, the year of the discrepancy in which there is the discrepancy: thus is the matter of the established reckoning, and within it the seasons and [their] establishing, [for] each one of them [its] order; and [we made clear the matter of] the foundations of the intercalation.

And behold this is the established [reckoning], that you may know it: it returns and comes round in its order; and we set down the order of the years of the [solar?] cycle (סדור שנות הש—), and within it the seasons (tequfot) and their molad (ומולדם), as is established — the reckoning for part of [the season of] Pesach (לקצת הפסח) and the remainders of the festivals (ושירי המועדים), several [times].

[The text ends high on the leaf; the lower portion is blank parchment, not damage.]

Yesod Olam — Fourth Treatise (המאמר הרביעי): the tequfot (seasons) and the "way of true reckoning"

[The leaf is foliated "184" in pencil at the top corner. The ruler/scale-bar lies along the left edge (photography furniture, ignored). The text block occupies the upper portion of the leaf; the lower margin is blank parchment. The narrow strip of script at the far-right edge belongs to the facing leaf (183v, already covered) and is not transcribed here.]

they had, regarding the rule of the seasons, the same rule that Shmuel had laid down [?: opening clause runs in from the prior leaf]. According to this rule the difference [הפרש] is [a fixed amount], and there is no discrepancy [שקר] for them — neither a deficiency [חסרון] nor any surplus.

This is the way of true reckoning [דרך החשוב האמת], and the seasons computed by it require no correction [תקנה] and no deficiency. By this reckoning the seasons fall out precisely as they ought, with no shifting from one year to the next, and so they are fixed and established.

And these are the men who knew the secret of the seasons [סוד התקופות] and of the intercalation [העיבור], and they computed by the way of truth: they were the Sanhedrin, who fixed all this and ordered it. From them the secret of the intercalation and of the seasons was received, and they passed it down to Israel; and so the matter stood, that they were the ones who knew it and possessed it.

They were the early ones [הראשונים], and what they did, they did in their own time, and they knew it [?: line-end faint]. The members of the Sanhedrin would intercalate the year and reckon the seasons — not according to a single fixed reckoning of one year being like another, but rather they would calculate it [precisely], each year according to what that year actually required. They reckoned the four seasons, and they would correct [the calendar] accordingly, and they would not let the discrepancy accumulate against them. They knew that this — the way of truth — was without any deficiency, and they computed the molad of the moon [מולד הלבנה] and so forth.

[?: a clause here on the Sanhedrin's authority] And since the Sanhedrin no longer exists [בטל הסנהדרין], everyone reckons by this [fixed] rule that they laid down for us, and we no longer reckon each year on its own; for the rule that we now have

suffices for us, since they ordained it for all Israel, and likewise ordained the intercalation.

Indeed, the early ones had no need of this [fixed rule], for they knew the precise reckoning — the one that has no deficiency and no error. But once the [exact] knowledge was no longer available to them [as a living court], they needed a fixed reckoning, so that there would be a fixed order [סדר קבוע] for the seasons and for the intercalation; for were it not for a fixed order, the matter would not be set in order, and the times of the festivals would not be known.

Therefore the [final] generations needed a fixed rule, so that it should not be left to each person to reckon as he saw fit — Reuven by one [reckoning] and Shimon by another — and so that everyone in Israel should be of one mind, and not each man do as is right in his own eyes [cf. Shofetim 17:6]. And so it was that this matter was given over to be reckoned by a fixed rule.

the moon and the season fell out together [?: short bridging clause], and the secrets of the season were [in their hands], and they performed [the calculation], and they knew it well [?: line faint at foot]. For all things have their fixed time and their fixed measure.

[The remainder of the leaf below the text block is blank parchment — not damage. A faint brown stain crosses the lower margin (water-staining), over blank space.]

[On this leaf the ruler/scale-bar lies along the right edge (photography furniture, ignored); the text block occupies the right-hand column of the leaf, with the gutter and a sliver of the facing leaf visible at the far left. The text continues directly from 184r. The lower margin is again blank parchment.]

the secret of the season, by which we may know the [true] season [?: opening clause continues from prior leaf]. By it the difference [הפרש] is corrected [מעבירין] [?] and we set the seasons [in order], and likewise we set the molad. And so the reckoning of others who came [after them], who had received [it], was [in error] [?: the construal of this contrast is uncertain].

R. Yehudah teaches thus, and there is [?] — for it would not have been left to each individual to reckon according to his own way; rather, all Israel knew the secret, with no [variation] [?: clause runs short here]; and so they fixed it.

[The text now turns to the dispute of the Sages over the season of Creation.] All Israel knew it, with no [variation] [?: short clause], and they heard the teaching, and behold this [is so]. They made it known to them so that they should know it

well: that the tradition was in the hands of R. David and R. Yehoshua [ר' דוד, ר' יהושע — both names legibly inked]. And from them — from the difference [between them] — [the matter] was reckoned, and a measure [שיעור] was given for it.

For there is a difference between them in the [reckoning of the] seasons, and likewise in the molad — and from this came the [variant] reckonings.

And those who reckon the seasons in this way had no error and no [deficiency] [?]; and the season fell out in its [proper] place [?]. [The discussion continues:] for those who came after them — the later authorities — when they wished to compute the molad of the moon, it was no longer [in their hands as a living tradition], and so they had to compute it by a fixed rule.

It was [R. David] [?: name faint] who provided this — just as we compute and fix the new moon [את החדש], so too [we fix] the season. And they made known to all Israel that they should compute [reckon] it [thus], for the matter was given over to them; and the season fell out in its place. So [the reckoning] was established for Israel, and the teaching [הוראה] was [set down], by a fixed rule.

And thus is the foundation of the intercalation [יסוד העיבור]: the year is [reckoned] [by] the difference between [Shmuel's] season and [the true] season [מחמת] [?: clause faint], from one year to the next, and so forth. R. David [?] gives a measure for [the year of] Israel — that the year is [365 days and a fraction] [?: the explicit parameter is not legibly inked here; no value committed — see QA] — and from this comes the difference and the discrepancy.

[The argument restates the methodological refrain:] and so the order of the seasons [סדר התקופות] is fixed [?], one season after another, in their [proper] order: the season of Nisan [תקופת ניסן], and the season of Tammuz [?], and the season of Tishrei, and the season of Teves [?: the season-names here are partly inferred from the standard sequence and are not all legibly inked — committed only where read]. They reckon by the way of truth and there is no error, [neither] in the early reckoning nor in the later one; and when they computed the molad, the season fell out [together with it].

close to one another [קרוב זה לזה] [?], Israel... [?] and again [?] [the matter] fell out by the [accumulated] excess of the days, and so the rule [stands] [?: foot lines very faint]. According to the days of the [19-year] cycle [?] the reckoning is established.

[The remainder of the leaf below the text block is blank parchment — not damage. A faint brown water-stain crosses the lower margin over blank space.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar — the section on the seasons (tequfot). Folio 185r concludes the prose of the preceding chapter, then opens Chapter 16 (פרק טז); folio 185v continues Chapter 16.

Judah ha-Nasi [יהודה הנשיא], of blessed memory [ז"ל]: all these reckonings were instituted and ordained by the court [בית דין]. They were a discrepancy [שקר] [against the true sun], yet they are the foundation — the supports [הסמיכות] and all the structures [מבני] upon which the computation rests, [namely] the months [החדשים] and the seasons [התקופות]. He who knows their discrepancy [שקר] and their deficiency [the ḥissaron], and recognizes their secrets [סודות], from these will grasp how much is left over and how much falls short [in the reckoning].

For so the matter stood: at first they were [reckoned] from observation [ראיה], by the court, in accord with what is hidden [in the heavens]; and afterward they reverted to the fixed reckoning [חשבון]. The cycle of the moon [מחזור הלבנה], moreover, reverted to being [governed] by its foundation [יסוד] [resting] upon its own correction [תקנה], so that one might rely upon it [לכל עניין] [for the year].

This is the discipline of the seasons [תקופות]: he who computes [it] — and there is no [way] for him [to do so] except by [this method]. When he computes a season [תקופה], the season comes at its [appointed] place [?: a degraded clause-joint here], and he knows when each season arrives, so that whether a man computes the season of Tishrei [תקופת תשרי] or computes the season of Nisan [תקופת ניסן], [it be] by the [fixed] reckoning [בחשבון] truly, without any [error] [בלי כלום].

The seasons, though their discrepancy [שקר] [against the true sun] is slight [מעט], require correction: they were given, at first, by observation, and afterward [reverted] to the [fixed] reckoning — [each] season arriving by its reckoning [בחשבון], so that one might rely upon it. So the seasons proceed for [the start of] the year [ראש השנה], [each] coming truly, and there is no way to do this except [by this method].

פרק טז (Chapter 16)

[Rubric: enlarged ink, line break before and after.]

I will now reveal to you in this chapter [אגלה לך בזה הפרק] a knowledge [דעת] [that will profit you], for I have come upon a foundation [יסוד] and a clear demonstration [ראיה נכוחה] by which to correct [לתקן] every [reckoning], so that you may know the [true] computation truly, with its foundation, and may know how to set it in order. By this method you will know the [true] positions [מקומות] of the luminaries truly, in a manner that brings them into order.

And so the correction [התקנה] [proceeds] by this method: that you know the [true] place [מקום] — what it is — by a [single] reckoning. For say [נאמר] that the place is such-and-such [?: an illustrative value follows that I cannot resolve to digits — the source states a quantity here]; and the position you have [computed], should you wish to know it — [namely] the place of the season's arrival, by reckoning — you may know it for each season, and may know it truly.

[The premises being thus,] you may then reckon [תחשב] the [true] places, [knowing] how much they amount to, and set them in order. And you must know that the [true] place of the season comes truly, in such a way as brings it into order, its computation [being] sound [נכון] and its foundation [secure]. This is why the seasons [are reckoned] with their premises [הקדמות], which are needful, so that the reckoning be correct [מתוקן].

And afterward [it was] ordained [נתקן] and set in order for others [?: for later generations], its arrangement [שתעריך] being thus; the [true] positions of the luminaries [המאורות] amounting [to] what they amount to. The places of the luminaries [המקומות] proceed [thus]: and afterward [it was] ordained and set in order for others, its arrangement being thus.

The [reckoning of the] luminaries [המאורות] proceeds thus, in mean [motion] truly; their places [in the] cycle [are] thus, and this is the manner [of it]: those of Rav Adda [רב אדא] are in [one] place and those of Shmuel [שמואל] are in [another] — by their [respective] cycles [למחזור] for the seasons, according to their foundation. For so it is in the world [בעולם]: say [an illustrative case], and [thus the difference between] one cycle [and another].

[The page text ends here. The lower portion of the leaf is blank parchment; a water/foxing stain crosses the lower-outer edge but no text is lost. Text resumes on 185v.]

[Conservation ruler on the right margin — photography furniture, ignored.]

up to this [point], it is a weighty [נכבד] foundation that needs no [further] correction; and afterward you reckon how much the season [yields], [for] the year [is reckoned] thus: the discrepancy [שקר] [against the true sun] is slight, so [I have set this out] in order for their [proper] disposition.

The [seasons'] discrepancy, [though slight,] requires correction; and if [you compute] their places, it is fitting that you know the [true] arrival of each season. They are fixed [נקבע], [each] in its place; so [it is for] the season of [Tishrei], and so for each one.

The [true] place of the sun [מקום] in its mean motion comes truly; and this [holds] for each season, in [the value of] the six hours [שש שעות] [of the solar surplus] — [a value the source gives here that I cannot resolve to digits]. Therefore the season of [Tishrei] [?: name partly abraded] comes at the [true] place: it is the place of the season — what it is — and we may know it for each season, [reckoning] truly the place of the season's arrival, by reckoning; the seasons['] place comes truly; it is the place of the season; this [holds] for each one.

There is a difference [of so much] [?: the source states a quantity I cannot read]; as for its [parameter, it amounts to such-and-such] [?: numeral lost], for the season [of Tishrei], [reckoned] truly.

Say [an example] for the season of Tishrei, the difference [הפרש] being [so much]; and so [it is] for the season of Nisan. As for the parts [חלקים — ḥalakim], they amount to [so much] for the season [תקופת], [reckoned] truly; its place comes truly.

Therefore the [true] place of the season comes in such a way as brings it into order, its foundation [secure]; this [holds] for each one.

The discrepancy of the cycle [שקר המחזור] is [so much] for each one; and so for [the season of] Tishrei, whose place comes truly.

[for] the season of Nisan, and for the season [תקופת] of [Tishrei]; say thus [an example] for the season; [reckoned] truly; its place comes truly.

The places [המקומות] [are reckoned in] the parts [ḥalakim], amounting to [so much] for the season, [reckoned] truly; the cycle comes truly for each one; and for [the season of] Tishrei, whose place comes truly.

and afterward [it was] ordained, [for] the season of Tishrei; the foundation of the luminaries [המאורות] proceeds thus, [reckoned] truly; from the cycle [המחזור], [so much]. As for the [season of] Tishrei, whose place comes truly: say thus, [for] the molad [מולד] [reckoned] truly, [a value] which was prior to the moment [רגע] of the molad of Tishrei [מולד תשרי] of the cycle [המחזור].

[The page text ends here. The lower portion of the leaf is blank parchment; the same lower-edge water/foxing stain crosses blank parchment, no text lost.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar. Chapter 16 (פרק טז), continued: the foundations (הקדמות) for a correct seasonal reckoning — the true place of the sun, R. Isaac's difference-parameter, the discrepancy of the cycle, and the molad and tequfah of Tishrei.

[The text occupies roughly the upper two-thirds of the leaf; the lower portion is blank parchment. "186" is pencilled at the top-left margin (a later foliation hand).]

[Running into this leaf from the previous folio:] ...the cycle, in order, and the days, so that the discrepancy may not exceed the proper measure. For it should be set out and arranged so that the reckoner will know the position both at the molad of the moon and at its difference [from the sun].

It is in this way that you should proceed with the premises for the inquiry: that you should know, both at the molad and at its difference, the position of each according to its course; and you should compute the cycle to its beginning, and you should know the place of the moon both at the molad and at its difference at any given time.

For this reason it is necessary that you know the place of the moon at the time it stands [in opposition to / aligned with] the sun; and you should know its difference from the sun, and you should know its place at any time as well.

Likewise, you should compute the position of the moon, and you should know its position at the time of the molad, so that you may know its place; for it is from the position of the moon and the sun [that the molad is fixed]. Therefore you should be careful concerning their reckoning, so that the discrepancy not increase. And know the position of the moon at the time of the molad and at the time of its difference [from the sun].

You should compute the position of the moon at the time of the molad, and you should be careful in the reckoning. You should know its place, so that you may know the place of the moon and the discrepancy of the cycle. For at every molad it advances by a fixed amount, and that is the cycle's order. **as they said.**

You require for the moon a fixed measure, and you require its discrepancy and the difference [to be added]; and this is the reckoning. So in this way you may know the moon's place at the time of the molad, and likewise the discrepancy of the cycle.

You should compute the place of the moon at the time of the molad, and you should be careful in the reckoning; and after this comes its difference, so that the discrepancy does not exceed the proper measure. For thus its place is fixed, and the cycle [returns] to its beginning; and so it is at the time of the molad and at the time of its difference.

And so you should arrange it, and you should know its place, and you should know the place of the moon both at the molad and at its difference; and likewise

the sun, the molad of the one after the other. The cycle [returns to its beginning], and after that you should know the place of the moon.

He calls this the foundations, so that the reckoner may know how much to add by it; and this is its measure. The foundations and the rest are entirely a great matter, the tables [being for] the discrepancy.

And concerning the discrepancy — this is its measure: it is good but increases, and over time the discrepancy and the others, the tables, are arranged in their order. And the breadth of the cycle's positions [moves] upward or downward, and [you compute] the place of the moon according to the order of the difference.

It is required that you arrange it in the tables, and you should be careful in their reckoning. And after that comes the position of the moon, and you compute its place. As for R. Isaac — that the cycle is set in order, and the discrepancy, its correction [?: the specific parameter R. Isaac assigns here does not resolve at this resolution] — the discrepancy is good but increases.

[Final lines, then blank:] One who reckons the foundations, and his knowledge and opinion of this inclines toward the words of the astronomers.

[The text occupies roughly the upper two-thirds of the leaf; the lower portion is blank parchment. The conservation ruler lies along the right (outer) edge.]

The completed reckoning, then, comes out for you according to the motion [of the luminaries], as it should; and in order to complete [the determination of] the seasons, you set out the positions accordingly.

Thus for the moon and for the sun good positions arise for you, so that the day [of the molad] may be good. So the reckoning should be set out and arranged, so that the matter may be set in order. And concerning the matter of the moon — its difference [from the sun] — you should know when it is; and concerning the matter of the sun, you should know its course.

For the discrepancy increases over time, and the reckoner corrects it, so that the reckoning be set right and its measure [held]. At the time the moon stands [in opposition to] the sun, its place is fixed, and you reckon accordingly.

Then there is a defined parameter — מרבי"ך [a calculated value, abbreviation unresolved [?]] — and the place of the sun; and over time the position [moves] upward, the difference. The discrepancy of the cycle, and from it the excess; for from this is the molad, the beginning of the cycle at the beginning. And in this way one may know the place of the sun both at the molad and at its difference.

Behold the discrepancy is good: at the time the moon [stands in opposition to / aligns with] the sun, its place is fixed, and you reckon accordingly. For at that time comes the position of the moon, [moving] upward, and you reckon it — so that the foundations may [proceed], and you may know the place of the moon at the time of the molad.

It is required that you arrange the matter, and after this comes the reckoning, and you compute it in the tables. For the discrepancy increases over time, and is corrected.

siman [סימן — displayed marker; an enumerated example follows]. It is good for the reckoner; and its measure is good but increases, and over time they reckon the discrepancy and correct it accordingly. And there is [a value] of ninety-four ḥalakim [94 = צד חלקים ḥalakim]; you should know it, so that its measure [be set]. For its time comes out [in] days; you should know it, so that its measure [be set].

So when its reckoning comes out for you — at the hour comes the molad, its discrepancy, and you reckon it. And the foundation is that at the hour comes the position, twenty-seven ḥalakim [27 = כז חלקים ḥalakim]; in the siman it is good, twenty-one hours, seven hundred thirty-one ḥalakim [= כא שעות תשל"א חלקים = 21 hours, 731 ḥalakim].

[Final lines, then blank:] ...at the hour of which is the position [?], the foundation, so that they [be] in it; and the position of the moon. And as for the seasons of the moon, they precede [תקופות הירח קודמת — the seasons of the moon precede], and the foundations of them are corrected, for the seasons increase, and so the matter continues.

Treatise Four (המאמר הרביעי), Chapter 16 (פרק טז) — concluding; then Chapter 17 (פרק יז) begins.

Script: Spanish Rabbinic semicursive, single hand throughout, brown ink. Both leaves are continuous calendrical prose; **no ruled table appears on either side.** Folio 187r (PDF 379) carries the conservation ruler at its outer margin; folio 187v (PDF 380) carries it at the opposite margin — two distinct leaves. Archival pencil foliation "187" at the top outer corner of 187r.

and the seasons (תקופות) — so that you may know on which day, in which hour, and in how many ḥalakim each season falls; for as the sun travels, so the reckoning goes. For if the sun's place were exact, the season would be exact and there would be no error in it; but since the sun's place [in the reckoning] runs

ahead, the season runs ahead, and there is in it an error. And the true, corrected place is the one we have determined — for the sun runs ahead and the season runs ahead with it.

[Mid-page display rubric — **Gate:] שער [Gate]** [the Gate's numeral is faint and I cannot resolve it: [siman: ?]].

The sun in its [proper] course (חמה כדי מהלך החמה): in the measure of the sun's travel, so the season goes, and the seasons that have passed (שעות שעברו) [are reckoned] — and there is in it an error (והיה בו) — for the true place is exact (שהוא צדיק), and that is the matter (הוא עלה) [?: construal of this clause is uncertain]. The season was first at its proper place (שקרוב ... תקנה), at the very beginning (לעת בתחלה), and there was no error in it (ולא שהדיוס) [?: phrase uncertain] at the outset; and the season runs ahead (שקרוב), and so it is (וזה והיה) — and the matter of the true place of the season is the corrected one (העובדים המדויקת המסורה הדריי) [?: this run is densely abbreviated and several words are construed with low confidence].

the sun (החמה) at the beginning (בתחלה), and there is in it [an error]; and the season runs ahead and reaches to the end (ועד סוף), and the seasons that have passed — twelve seasons (י"ב שעות) [numeral: 12 = י"ב] [reckoned] from the place of the sun (מן השמש) [?]; and the seasons run ahead upon the [reckoning] (על אם) until [the cycle] reaches its end — to stand at the place of the cycle (לעמוד) (תקן) — and the season runs ahead (שקרוב) until the end. And twelve seasons (י"ב שעות) [numeral: 12] go forth and stand at the beginning (בתחלה); and there is in it the discrepancy of the cycle (הפרש העיבור), which is so-and-so [numeral: ? — a specific advance-figure is named here but its glyphs I cannot resolve]; and so the cycle (וען ... העיבור): twelve of the sun's months (י"ב חדשי) (החמה) [?] in the cycle (בעיבור) [?]; and the deferent of the rest [of the motion] (המדור השאר) yields its [proper] place (יורד לה), and from the cycle the season [is taken] (מעיבור הדק), and it goes (הולך) [?: construal of the chain is uncertain].

and there is in it the discrepancy (וזה הפרש) — until the season [comes] to its end (עד שהשעה לבסוף) — and there will be one [season] (וחזרה לעמוד) [?]; and there is in it [an error] (וזה היה), and there is in it the discrepancy, until the discrepancy is exact (כדי לעמ"ה ולל ש"ד לרמה) — there is the sun's place corrected (תקנה) — and there will be the season (והיה החמה) at the head of the cycle (בקנה העיבור) [?]: that is, twelve seasons (י"ב ... שעות) [numeral: 12].

and there will be the seasons, twelve seasons (י"ב שעות) [numeral: 12], and the discrepancy (וזה הפרש): there will be the season in its place (שתהיה במקומה); and

one [season] after another (חדא אחר חדא), and one [year] after another (... וזה
לעמ"ה), and there will be twelve seasons (י"ב שעות) [numeral: 12] from the place of
the sun (מן השמש) [?]; and so the matter (וכן הדין), and so the law (וכן הדין) [the
formula recurs] — for in the place of the sun (במקור) [the season is fixed], and
from there it proceeds (השתהיד) [?].

the season runs ahead (טוב הקטות) [?] until its end and its discrepancy, and the
discrepancy reaches its measure (... מקראתם הטוב) [?]; and the [reckoning]
proceeds — first the sun, then the season (שעת ראשונה) [?]; and
there will be twelve seasons (י"ב שעות) [numeral: 12] from the place of the sun,
and the discrepancy between them (וזוה ... בינתם) [numeral: ?].

[the same argument is rehearsed once more: the per-season advance, the per-
cycle accumulation, and the corrected season referred back to the true place of
the sun. The hand is legible but the clause is heavily abbreviated with embedded
gematria; I commit the running argument and flag the individual
advance/discrepancy quantities [numeral: ?] rather than supply values I have not
read glyph-by-glyph.]

and there will be the season at the head [of the cycle] (וזהר ... העיבור) [?]; and the
discrepancy (וזוה הפרש) [?]; and at the end there will be one season (לבסוף שעה), and
from there [it begins again] (ומשם) — the place is corrected (לעמ"ה השת) — until
the discrepancy [stands] (הדק) [?].

[Foot-of-text on 187r — **chapter rubric, display script:**]

פרק יז [Chapter 17]. Because (לפי שן) ... [the chapter opens here and its first
words continue onto the line below and onto 187v] — the reckoning is clear (תורק)
[?]: "the reckoning is established/correct".

[The remainder of 187r below the rubric is blank parchment (wide lower
margin); foxing / water-stain at the foot — not text loss.]

[Chapter 17 continues from 187r:] ...Joshua (יהושע) [Joshua, i.e. the era reckoned
"from the days of Joshua bin Nun"] and the great reckoners who joined to [the
reckoning] (ורוב המחברים), so that you may reckon (לדעת); and from the cycle (מן
... העיבור) the season [is taken], and it goes, twelve seasons (י"ב שעות) [numeral:
12] from the place of the sun (מן השמש) [?]; and one [season] after another (חד
אחר חד), and one [more] (וחד), until you complete (עד שתהיה) one season and one
[further] season (כל אחד וחד) — and there will be in them so-and-so seasons (כהן ...)
[numeral: ?].

And so the law (וכן הדין): the seasons (השמעות) and the discrepancy (והפרש), so-and-so seasons in so-and-so years (סנה ... שעות) [numeral: ?]; and the place of the sun (מקום השמש), and one [season] after another (ושמו), and twelve seasons (י"ב) [numeral: 12]; and one after another (חדא לחדא) [?].

And so it is established (וכן נהגן): one [season] after another (לחדא ... לחדא), and so the seasons (השמעות) in the cycle (לחדא ... בכל מן) [?]; the [reckoner] of the cycle (בין חזון) [?], and [you] reckon it (וכתב); and the discrepancy (וזה ... הפרש) [?]; and one [season] after another (וקראתם דרור) [?] until the discrepancy [stands] (שלא למקום השעה) [?] — the season of the cycle and its place (ועד ... מקראתם) [?] — until the [reckoning] is established (היו מושכ ובל) and it goes (ובל מקרס) [?].

And so the law (וכן הדין): and you complete (וכל ולא) it (לחדא) [?]; and the season of the cycle (השעה) — there is the discrepancy (היו ... מקרס) [?] — and the [reckoning] proceeds. And so as to reckon (וכדי) — the seasons that will be (מרקבי) [?]: from the days of Joshua (מימות יהושע) [era anchor] — and there is between them (ויהיו ... חתה) [?]; and so the law (וכן ... חתה) [?].

[A worked chronological span: the seasons accumulated year by year from the days of Joshua, the error carried forward, and a running total of years and seasons. The figures are written compactly between the words; per the numeral discipline I commit the prose frame and flag each specific quantity [numeral: ?] rather than supply an unverified value.] ...so-and-so years (סנה ... לחד ... סנה) [numeral: ?], and the discrepancy (מתחיל) [?]; and they reckoned (יהיו), the seasons (שעות), so-and-so years (סנה) [numeral: ?].

and from the days of Joshua (מימות יהושע) the reckoning (חמת), so-and-so years (סנה) [numeral: ?]; and the season at its place (היה ... קדוש), and the discrepancy (הדור) — and there is in it (היון) — there is the [reckoning] (וקראתם ... לה ולכל) [?]; and the seasons (השמעות); and one season (שלם) at the place of the sun (למקום); and there will be (ויהי) [?].

[Mid-leaf, a marked transition into the calendrical-halakhic register — a small display word breaks the line:] **"to count the report (of the new moon)"** [recte: **למנות השמועה למקום השמש** ...] [?: the display word is heavily abbreviated]. And all the witnesses (וכל העדים) [recte: "and all the witnesses"] [?] — they sanctify (שמקדשים ... לבסוף) [?] — so that there will be the [court] of [the calendar] (היה ... לבית תחיה) [?]; and one season for the cycle (סנה) [?]; and they sanctify it (יקדישו אותו) and reckon it (וכתב); and there

will be [the season] from the place of the sun (היה ... מן השמש), and they sanctify (ויקדשו) [?].

[Near the foot of 187v — the halakhic close, in two short lines:] ...from the days of Joshua bin Nun (מימי יהושע בן נון); a city walled (עיר חומה) [i.e. the halakhic category "a city walled since the days of Joshua bin Nun"], and they are obligated (ונתחייבו); a walled city (עיר חומה) [?], and they are obligated (ונתחייבו). [This bottom cluster is the rabbinic formula עיר חומה ... מימות יהושע בן נון ("a city walled since the days of Joshua bin Nun") with the verb ונתחייבו ("they are obligated") — a halakhic register that fits the transition out of the pure seasonal computation. The individual words are legible; I commit them and flag only the precise syntactic link to the surrounding reckoning [?].]

[The remainder of 187v below is blank parchment with foot foxing / water-stain — not text loss.]

Bodleian MS. Huntington 299 (1484), Spanish Rabbinic hand. ≈ folios 187v (facing) / 188r / 188v.

[The opening photographs two leaves. The right-hand leaf carries the tail of the preceding chronological example — the close of the "days of Joshua" / walled-city reckoning carried over from the prior folio; the left-hand leaf is **folio 188r**, which both continues that reckoning and bears the new chapter rubric **פרק יז**. The text leaf fills only the upper two-thirds of the page; the lower third is blank margin (not damage).]

and so it is for all of them. So know it. For Rabban Yoḥanan ben Zakkai [רבן יוחנן] ... the tribe of Judah and Benjamin [שבט יהודה ובנימין] ... in the time of the Second Temple [בזמן בית שני], by the count of the years ... And this is the dating-era of Israel [תאריך ישראל], and this is [the count] from the molad. They reckoned for them the count of the destruction [מנין החרבן] and the years.

And now [ועתה], those who know the era and the count: this concerns the release-year [שמטה], for that count is entrusted to a court [מסור בידן לב"ד = לבית דין, "to a court"] to publish the sabbatical-week of release [שבוע השמטה]; and so it was for all the release-years [שמטות], so that no one err in the count [ולא יטעה אדם בדין]. The point is that one should know how to reckon for the standing [era] the sabbatical-week of release [שבוע השמטה], so that the world's sabbatical-weeks [לשבוע השמטה] be reckoned by the count of the release-week [שבועות העולם]. And so this was the count, and this is a benefit for the world [וזוה הוא לעולם].

For according to the matter of the dating-eras [קצת מענין התאריך], the count of the Christians [חשבון הנוצרים] and the Ishmaelites [והישמעאלים] runs for them by years; one must keep watch [שמור] over what is written in a book by one of them [שהוא כתוב בספר חד מימן], that it accord with the kingdom of the [Temple-]House [מלכה הבית], and properly so [וכוונה כך] ... in the days, the year of the destruction [שנת החרבן], from the count of the months.

פרק יז [Chapter 17]

[Display rubric, brown ink, centered, with enlarged opening letters. Heading reads simply "פרק יז" — "Chapter 17."]

Know the dating of the era [דע פעולת התאריך]: that one should know how to reckon by it; and this is the era of the world, and upon it ...

[Following the rubric, the left leaf continues with chronological-era reckoning:] ... and these months, and the year of the destruction [שנת החרבן] ... and this was the era of the Greeks [יונים ... יונין] — [counted from] Alexander [אל סכנדרוס = Alexander]. And the era of the [nations] — the count ... of the Second Temple [הבית השני] and the time it stood [שעמדה] ... that one know how to reckon ... from the destruction of the First Temple [חורבן בית ראשון], and from there one reckons ... and these are the dating-eras [תאריכין] for the world. For according to the matter of the era [קצת מענין התאריך] the eras vary ... The count of the Christians [חשבון הנוצרים] and the Ishmaelites [והישמעאלים] runs for years; and one who keeps watch over what is written in a book [שומר שהוא כתוב בספר] reckons from his count, and properly so [וכוונה כך] ... the count for the era [לתאריך] ... and he reckoned by means of the dating-era for the standing [era].

[There follows a stretch of further era/chronology reckoning naming the **Persians** [פרסיים] and detailing year-counts and remainders, the terms heavily abbreviated. The legible anchors: שנת [year]; ויהי פרטן פרסיים [and their reckoning was {of} the Persians]; מולדו [its molad]; הבית [the Temple/House]; דרך השלם [the complete reckoning]. The interior year-numerals and remainders are written in small abbreviated gematria and do not resolve glyph-by-glyph at this resolution — see Readability.] [numeral: ?]

[The text leaf on this opening sits on the **right** (ruler far right). It is **folio 188v**. Text fills the upper half of the page; the lower portion is blank margin. The content is a continuous run of **molad / tequfah era-reckoning**: an opening chronological clause, then a long list of dated molad-and-tequfah values keyed to months and years.]

the sons of the Holy House [בני בית הקדש] [in the time of] David [דוד], and after them [ואחרי כן] others arose ... the Christians [הנוצרים] and the Ishmaelites [והישמעאלים] ... for the era [לתאריך] ... one reckons ... the months ... and the year [שנה]; and this is the count.

Know the era [דע התאריך]: that one should know how to reckon by it, and one knows ... the era ... and according to it ... the complete reckoning.

[Then begins the long molad/tequfah list. Each entry pairs a quantity of days/hours/ḥalakim (in abbreviated gematria) against a month-name (Tishrei, etc.) or a year-marker, with the recurring words **מולד** [molad], **תקופה / תקופה** [tequfah/season], **שעות** [hours], **חלקים** [ḥalakim], **ימים** [days], **יקרא** [it is called / falls on], and **ויהי** [and it was]. The structural reading is secure; the interior numeral values are written in small superscripted abbreviation and are largely unresolved at this resolution and must not be pattern-filled — they are flagged below.]

and the molad of the Levanah [the moon] [מולד הלבנה] was on day [יום] ..., and the tequfah [ותקופה] [fell] at ... hours [שעות] and ... ḥalakim [חלקים] ... [numeral: ?]

And one reckons the molad of Tishrei by [the cycle of] Shmuel [לדעת מולד תשרי], and likewise by [the cycle of] Rav Ada [לדעת רב אדא] [recte: the draft's "Rabbi Moshe" was a misreading — the pairing here is the two standard tequfah authorities, Shmuel and Rav Ada] ... for the cycle [למחזור] ... [numeral: ?]

the count [is] ... days [יום] and ...; reckoned for the era of ... [numeral: ?]

[There follows the dense entry-list proper — a long sequence of lines each of the form "and [for] day N ... and new-moon [וחדש] [month] ... the era [תאריך] / molad ...", running:]

and on day [וביום] ... from it the tequfah falls [ממנו תחול תקופת] ... and a new-moon [וחדש] ... and it falls on [ויקרא] ... and it was a molad [והיה מולד] [numeral: ?] and it was on day [והיה יום] ... and the era [התאריך] ... [numeral: ?] it falls [יקרא] [on] ... and it was [והיה] [numeral: ?] and a new-moon [וחדש] ... and it was [והיה] ... it falls [יקרא] [numeral: ?] on day [ביום] ... to reckon [the tequfah] by [the cycle of] Shmuel [לדעת שמואל] [numeral: ?] the tequfah of Tishrei falls [יקרת ... תשרי] ... it falls [יקרא] ... and a new-moon [וחדש] [numeral: ?] and the year [ושנה] ... and the tequfah [ותקופת] ... [numeral: ?] and the molad [ומולד] ... and the third [tequfah / השלישית] ... it falls [יקרא] [numeral: ?]

[The list continues through several more such lines, each a molad/tequfah value against a month or year, ending the upper block of the page. The legible recurring

terms across this block are: **מולד** (molad), **תקופה / תקופת** (tequfah), **ימים / יום** (days/day), **שעות** (hours), **חלקים** (ḥalakim), **יקרא / יקרת** (falls on / its falling), **חדש** (new-moon/month), **תאריך** (era), **מחזור** (cycle), and the proper-noun tequfah-cycle names **שמואל** (Shmuel) and **רב אדא** (Rav Ada). The numeral payload of each entry does not register cell-by-cell at this resolution and is flagged collectively, not pattern-filled.]

[Closing lines of the upper block, securely legible:] ...a small cycle [מחזור קטן] ... this year is regular [שנה זו תהיה כסדרה] ... and the rest are deficient [והשאר חסרות] ... [it was] a regular year [שנה כסדרה], and know [ודע] ... by the whole count [בכל] ... a regular year [שנה כסדרה] ... and the rest deficient ... this year [שנה זו] ... in order [כסדרה] ... and a full [leap-]year [שנה שלמה] ... the great cycle [מחזור גדול] of ... [numeral: ?]

[The leaf ends here; the lower half is blank margin (not damage).]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; continuation of Chapter 17 (פרק יז), the dating-eras (תאריך) and the determination of weekdays for the festivals.

so that you may see the new moon (molad) of one month and that of the next, and you may know by which of them the molad falls — by the great cycle (המחזור הגדול). [?: opening clause partly construed]

If the cycle was such that in a [given] year it fell within the intervening months [?: מקמחזורים], you must add to them what is lacking, [reckoning] this together with the additions, until you arrive at the molad. And in this way, even though the cycle was diminished, you add to it the addition that is lacking, in order to arrive at the molad.

For the day-counts (כל שבתם) are days for one month and days for another, and you set them in order and rest [from the count]; and in [reckoning] all the years, see by which of them [the molad falls]. Then it has been established and ordered, and they are set and rest; and once a day has passed and another comes, the seasons (תקופות) are [reckoned] again, [as] one comes after another; and from all the years of the world you will see which day it is.

And after this, you must arrange the table (לוח) for one [month] after another. For the day on which the molad of the cycle falls — see by which of them it falls in [a given] year, by which the cycles [are reckoned]. One after another you must see by which of them [it falls], and [the molad of] one year is near [that of another].

And you must arrange the table for one [reckoning] after another [?: וְשֵׁר תַּעֲרֹךְ לִיּוֹם אַחֵר]. For after this you see the seasons (תְּקִיפּוֹת), [whether] in a year, [and likewise] in a month and likewise [in] the day [?: כְּעֵלּוֹתָם]; and you should know by how much [it amounts] in [each] of them.

For [in] a year and [in] the days [of it] you should know what the seasons of it are; and this it is. And so, when it is a day [of one month], the day of the season is [different from] another, and there are days that come before it [?: דְּנֵעֵבֶר], and the day that comes after it [?: חֹנֵנֶס] is [reckoned] by what the molad gives; and the table that arranges [it] — the season [shows] that it [falls] thus.

For the molad of [this] day [is found], [whether] the molad of [a given] day, and likewise [the molad] of another; and so the molad of one season comes from the molad [of another]. And the day of the season comes from the molad [?: מִלֹּד]; and likewise the season comes from the molad, with its additions, and so the molad [comes] from the season.

The day-count [is reckoned] for the months, and likewise from the molad you arrange the months, [putting them] in order; and there is the table by which it is arranged.

And for the count of the day on which the molad falls, see by which of them [it is]; for the day [on which] the molad of [one] month [falls] gives the day of the season, [and] the season [follows] from it. The molad of this day [?: וַיּוֹם שֶׁמֶשׁ] is from the molad; and so the molad of [this] day [follows] from the season.

[The day] on which there are seasons — there is for them a season-of-seasons [?: שְׁקִירָא יִסְרָאֵל], the day on which the molad [falls]; the day of the season that comes after [it], and from it the molad. And likewise the season-of-the-cycle (תְּקִיפַת הַמַּחְזֹר) [falls on] this [day], [followed by] the next molad. For there are days on which they begin [the count] for the molad of [one] month, and that [molad] is from the molad [of another], and likewise the molad and the day [follow].

And the day-count begins [?: מִתְחִילִין] for the months and likewise [for] the cycles [?: לְמַחְזֹר]; and there [is the rule] for what is gathered [in] the reckoning; and likewise [for the molad], the day-count [follows] from the molad. And the molad of one comes after another, and they begin [the count] for the molad.

For the day-counts (קְדוּרִין) [are taken] from the assembly [of months], [each] day after another, in order [?: לְעֹדֵדִים]; and likewise the seasons (שְׁמַטְמַשׁ) [are reckoned], and the day [on which] there is the molad.

The determination [?: הורתן של] of the day of the season, and likewise the molad [?: וכה], and the day on which there is a [new] month [?: מציאו]; for the day on which there is the molad of a month is also the molad of another [?: מציאו]; the day on which there is a [new] month, and the molad of [that] day [?: ממנו], is the day [?: היה] on which there is a [new] month, the molad — and likewise a day; [the day] on which there is the molad of a month [?: כט ממנו], is the day on which there is a [new] month, the molad; for the day on which there is the molad of the season [?: שן שרבי], and [the day] on which there is the molad [?: שן] for the deferment [?: (לעבור) היה].

For the day on which there is [the molad] for them, and they know which is [its] season [?: שקורא ים] for them, and how its days are [reckoned] [?: כמה ח' דיס]; the deferment [?: אפלים] for them — until the determination [?: מקמתחיר]; for they are arranged [?: שהם תקנום] for them on the eve of Shabbos (ערב שבת) and on the eve of Pesach (ערב פסח), so that in all the years it might be [thus], as they said: "the day [of one month] stands, and [another] comes" [?: יחיה את'].

for the year [?: ישנה] of the [new] moon [?: גריל], and its quarters [?: וכבעו], for the day-counts of the seasons (לסדר תקופותיהם); for the molad [?: מ' מוסר] that goes up — and they add to it [?: שסיסמכו עליו], and it is [thus] for the dating-eras (לתאריכים). [?: opening line]

They arrange [the count] [?: התנון]: for there is a [new] month [?: שלם] when they fix it [?: יקבעו אותו], a month, and [the count] comes [?: וגוסם] for the deferments [?: לתקבעוטם]; and they set [?: נוחסכו] them [?: כמ'], for the day-count [?: פס]. For [each] month the molad goes up [?: שדלקובה], it is [reckoned] for one [month] after another [?: היה וכ' נתלה לשלש לפי], so that [it is reckoned] [?: ויהי].

And they arrange [the count]: [?: ותתני] for the day on which there is the molad of a month — see by which of them the molad of [that] month [falls]; for there the molad is the great [molad] (מולד הגדול), [from] the day, and [the molad] of [another] day [?: וזה לקבוע אירוס]; and likewise the molad of one [comes after another] [?: אם זה ז' לחדש].

And they arrange [the count]: [?: ותתני] the molad of a [new] month — see by which of them [the molad is], for there [it is] the molad of the day, [followed by] the molad of [another] day; and the molad of one [day comes after another] [?: זה ז' לחדש], and so a month, and likewise a [new] month, [followed by] the molad of [another] day [?: זז לחדש לבנה הכ פתמל].

For another month [comes after another] [?: מאחרים כל יום מאחרים], and they go, and the months [?: ובעשמים], for [the count] they fix it [?: סם קובעה]; and [the new]

month [is reckoned] for the molad, and for [reckoning] it [?: הזה הוה כירוב]; the [day]-count [?: סטוש] near [it] [?: בקרוב].

The determination [?: שלשת התנאים] of the seasons (התקופות) — this [is] their molad [?: אכלה], and they are arranged [?: וחסם תקנם] for the reckoning, [the count] going up [?: למחבון בכאז]; you should know that one [season] after another [?: שיומם] — [whether] one [season] after another, [each] one after another [?: היה], in order [?: בעלם].

For the year [?: שטם], the day-count [is reckoned], and you should know its molad and that of another [?: מ' ידיע מחדשיהם], [the season being] in order [?: שלה]; and they begin [?: והם תכלה] for the reckoning [?: בעלם]; you should know that one comes after another [?: וידיק שיומם הראח], one season after another [?: דרארת], it being [reckoned] from the day [?: היה שיומם וחלם].

For [in reckoning] the cycle (כסמא), the molad of [this] day [?: שיהול], and that of another season [?: ויומכה], in order [?: בעלם]; and likewise [for] the deferment (לעבור), the molad of [this] day [?: כלות], and likewise the season [?: שירול וזה ז'], up to [?: מ' מאל] the molad of [another] day [?: ויומשך], the day [?: עד יום] of [another] month [?: זה לחדש] for one [reckoning] after another [?: שבתם הרי שתי].

The molad of the day [?: קבוש] — there is one day after another [?: ט בוס מפה], the season [?: שמעוב] [following] the first [?: התני]; the molad of this day, and likewise [?: היט וח], the day on which there is a [new] month [?: ובכר זה], [followed by] the season [?: שמעוב], for one [reckoning] after another, the deferment-seasons [?: לדחות] [?: dense run — calendrical molad/season chain].

[For the molad of a month] [?: עד ז' לאחר], for one [reckoning] [?: שדה], and the molad of [another] day [?: ויוס כל לאחר]; for there the deferment [?: שדהז כפ']; and likewise [?: ושר כל לאחר], and the season [?: שמעוב], in order [?: התני]; [for] the molad of a month [?: ז' ידיו קבוש], up to the day on which there is the molad [of another], and likewise [?: שדה אד יוס כס לאחר], one after another in order [?: סבת שתי שמ']; and the [season] is fixed [?: מקתב אירוס] near [?: שחוסכת] them [?: שן לח דחמה], and the molad and the season [?: ולסנה ולמתני מאחר]: this is the way of soundness (דרך החישוב), to determine the day on which there is the molad [?: לקד פר היה]; for this is the true [reckoning] (הצדק), a year in which [?: לחיסוב] — for the matter [?: כפ תחשבון] [is settled], and not by accident [?: ולא אחיו]. [?: dense run; deferment/molad chain]

And one should begin [?: ותתחיל], and say: "by [reckoning] it [?: לק' לבסי]"; for the cycles [?: מחזורים] are forty-nine (מ"ט) years [?: מ"ט שנה]; [in] each cycle [?: כעש]

[הקמחזור] there is this [?: זה], and a sound (true) reckoning [?: כסוד עבלת]: what [?: ולא] each one of them [?: אכל חיף] is [?: אינם יודעים]; and they reckon not [?: מכירים]. [?: closing run — likely the "forty-nine years" = 49-year jubilee/shemittah cycle reference]

And this [?: ונתבועות], that he know [?: וידיע] its secret (סודו) — for what [?: ומה] [it is]; its determination [?: טיבו חללה], and they know not [?: ולא ידעו] its origin [?: כל] [דרך מקרה], and [they reckon] not [?: ולא ידע]; for whoever says [?: אומר] that the day [?: שזה] is from [a given] [?: מן ליס] way [?: דרך מקרה], and they reckon not [?: ולא ידע]; the [day-]reckoners (מכירים) of the year, the salvation [?: מן השני] [if] from the [reckoned days] [?: להם] — [השנה הישועה] for them [?: שיתאמרו] [דעשברית], and they said [?: כ סנה תלונת] thus a year is completed [?: closing dense run — the chapter's concluding reflection on the calendar's hidden reasoning]

[Lower portion of folio 189v blank.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar — Chapter 17 (פרק יז), continued.

Folio 190r — recto; conservation ruler on the left, "190" pencil foliation top-right. The text occupies a short block at the top of the page (about eighteen lines); the lower two-thirds of the leaf is blank parchment.

[the reckoning] you still need to carry forward [צריכה לעבור], in the matters of the intercalation [העבור], and... and all of them [וכל חכמים] agree on this; and the [?:]... You arrive at its reason [את טעמו]... how the day of [the cycle] inverts [מחדש]... you arrive at [תגיע], day [?:] of the month [?:]; in the year of this intercalation [העבור] this day was [?: נטהר/נראה — uncertain], and they returned [חזרו] to the fixing [לקבוע] of the year... a year [שנה]... for them [להם]... and the day [?: יום]... for the cycles [למחזורים]... they returned [חזרו]... and they said [ואמרו]... [a span of about two lines here is genuinely unconstruable: a chain of abbreviated day/cycle clauses — [?: ...]].

And on this matter [ועל זה] [a difference of reckoning is in view] — [?: the clause is abbreviation-dense and not construable]... so that the day be [שיהיה היום]... and they took pains [ונשתדלו] so that the day be [שיהיה היום]... and they returned to it [חזרו] again, so as to add to this [להוסיף על זה]... the year that this fell in [שנה]... so that the day be proper for the fixing of the season [קביעות התקופה] of this year... as for the cycles [למחזורים]... and the intercalation [העבור] of this one for them was [?:]... and they reverted to it, and the season fell on [?:]... day [?:] for them [להם].

The cycle [המחזור] was [?: a fractional part — חמישית "a fifth" is the draft's guess but the glyph is not clearly partitive; flagged]... and the day of the season [יום] fell on this, and it ran its course in this way [והל בזה]; so that the day be... for the fixing of the year of the season [קביעות שנת התקופה]... and they reverted [וחזרו] to the cycles [למחזורים], and took pains so that the day be proper — this season [התקופה הזאת] always [תמיד]; and this reckoning is proper [וזה החישוב טוב], and this is the season-reckoning of the year [תשועת השנה]; and they differed [ונחלקו], for they did not [act] and did not... and so on, and they revert [וחזרין] to it... a season for the cycles for them [למחזורים], and it ran its course... the cycle that came after it [?], and they differed [ונחלקו] from this; this was [the difficulty] in the fixing of the season of this year... and [one] said it was an inversion [מחדש] of the cycle... and they said... so as to fix [לקבוע]... the seasons agree with their cycles [מסכימים למחזוריהם]... and they reverted... so that the day of the season be [קביעות התקופה]... and this is for the fixing of this season [שיהיה יום התקופה]... day [?] of the month [?].

And the season agrees with the cycle [והתקופה מסכמת למחזור], and so on [ויכו].

The intercalation [העבור] of this [fraction] of the cycle [למחזור], and they agree [ומסכימים]... [the text breaks off; the wide lower margin is genuinely blank parchment.]

*Folio 190v — verso; conservation ruler on the right; the text occupies a short block at the top of the page, the lower two-thirds blank. A circular diagram is visible at the inner edge — it belongs to the **facing leaf (191r)**, not to this side, and is not described here.*

the cycles [למחזורים], and it ran its course [והל בה]... for them [להם] at its time [בשעתו]; for the cycles [למחזורים]... day [?] of the intercalation [לעבור]... the cycles for them — these days returned [חזרו]... so that it be [שיהיה] for their cycles [למחזורים]... and the intercalation [העבור]... for the year [לשנה]; so that the year be... for the fixing of one of the days [?]... for them... and they [?] do not agree [מסכימים] with them [להם].

And the year [ושנה]... for the cycle, that it be [a fraction] of their cycles, and they agree [ומסכימים]... they reverted [חזרו] to the fixing [לקבוע]... of the eighth-part [שמינית] of their cycle... and the intercalation [העבור], day [?]... for the fixing... and they differed [ונחלקו] for them... for they act [עושים] in the intercalation [העבור] of the year... an inversion [חדוש]... and so on; and the season of Nisan [תקופת ניסן] in this [year/season] fell [?]... day [?] of the month... day [?] of the month — for it is a season that inverts [?].

[A run of roughly four lines here is a near-identical repetition of the disagreement/recalibration formula — העבור, לקבוע, ויסדו, שיהיה היום, recur, but the connective material between them is genuinely abbreviated and not construable: [?: ...].] ... and they fixed [ויסדו] so as not to fix [שלא לקבוע]... for one of the days fell on this [arrangement]... and they reverted [וחזרו] to the fixing [לקבוע].

And they differed [ונחלקו]... for the reckoning of the season was proper [החישוב טוב] in this, for the day was [?]. ... and these rely [?: סמכו] upon them; and the head of the season [ראש התקופה] is the first [הראשון], and this came [?]. ... the difference in fixing [?]. ... and this is in its place [וזה במקומה], according to [?] the season fell more [יותר]; how the season inverted [?], and they relied [סמכו] upon it from the start [בתחלה]; and... the season... and how he reckons [ואיך יחשב]... from the matter [מן החומר]; for him a [fixed?] arrangement... so that the day be... and you have an arrangement [זה לך סדור / וזה לך סדור — uncertain].

The intercalation of the year [עבור השנה], and the seasons [ותשועה] in their cycles [מחזורים], and a cycle [ומחזור]... year [שנה], the cycles for them [מחזורים]... and the cycles returned [חזרו] for the fixing... the first [הראשון] and the year... and the day [?] on this; behold [הרי] this is [?]. ... the first and the year [השני], and the third and the fourth and the fifth [והרביעי והחמישי]... and they do not agree [ולא מסכימין]... and they do not... in the year, for the fixing of the cycles [למחזורם], for [those of] the intercalation of the year [העבור השנה]... and these remaining ones [והשארם] of their reckoning agree [מסכימים]; for there fell for them an arrangement of their order [סדר שלהם]: year... and the season... and the third [והתשלישי] — and so it is, and so it is [והרי והרי].

[The text ends here; the lower two-thirds of the leaf is blank parchment.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar, Chapter 17 (פרק יז), continued.

Script: Spanish Rabbinic semicursive (one hand throughout). p. 387 = folio 191^r (ruler at left; bears the circular figure plus the prose surrounding it). p. 388 = folio 191^v (ruler at right; a single-column prose page headed by a three-line vocalized verse couplet captioning the wheel).

The page carries a large circular diagram in its upper-left quadrant; the body prose surrounds it (in the right column, and in a block beneath the wheel).

Diagram. A large wheel divided by radial spokes into twenty-four sectors, drawn as three concentric rings around a common center from which all the radii issue.

The hub bears a short caption, reading across several lines: **כי על דרך / קביעת / העגול / חדש** — "for by way of the fixing of the month: the wheel." The figure serves as the great cycle from which the months, seasons, and intercalation-pattern are read off. The outer ring carries single ordinal gematria letters numbering the sectors in sequence; the middle ring carries the corresponding keviyah strings (a numeral plus a four-letter day-of-week / full-or-defective signature); the inner ring carries a further set of short letter-labels.

- Hub (center caption): **כי על דרך / קביעת חדש / העגול** ["for by way of the fixing of the month: the wheel"]
- Middle ring (keviyah signature strings — ordinal numeral + four-letter signature, reading around the wheel): legible specimens include **ז תארם, לא מארם, אבהל, אבהל, כח אבהל, כט אבהל, ל מארם, אכההל**; a run of these strings is committed where legible, and the few thin or abraded ones are flagged [?] individually rather than reconstructed.
- Outer/inner short labels (ordinal sector-letters and one- and two-letter marks): partly legible specimens — **ט [9], י [10], יח [18], כ [20], כט [29], לא [31]** — read where clear; the faint ones flagged [?] individually.

[Body prose, 191r — right column]

so that the wheel may serve to recall and bring to mind the great cycle: for in it, year by year, the season and the molad are fixed; and from it one knows the order of the months — which is full and which defective — and the order of the leap [intercalary] years.

He has set this wheel before you so that by it you may know, for any given year of the cycle, both the day on which its season falls and the day on which its molad falls, and accordingly which of its months are full and which defective.

[Body prose, 191r — block beneath the wheel]

Therefore, whoever wishes to recall and bring to mind the cycle — to my mind, the complete reckoning and the meaning of the sign — let him reckon by this wheel. By it the order of each thing is known: the molad of every year and its cycles, and the running [literally "course"] of the reckoning.

This is the established reckoning [התקון] — the fixing of the fundamental, of the season and the molad together — and Israel reckon by it. By it the seasons and the molad are fixed for the fixing of this great day; and the sun [runs] in its circuit.

This figure is drawn here in black ink as a memorial [זכרון], a sign set before you.

[Verse couplet — caption to the wheel, vocalized, head of the page]

[A three-line vocalized verse couplet stands at the head of the page, each line set off and closed with a scribal flourish. It captions the wheel on the facing recto and is NOT a new chapter rubric. The vocalization is legible; rendered for sense:]

— "By the number of the days, for [the fixing of] the month and the molad of the months, this is the sign: — the great wheel, year by year, [shows] the cycles — the day of its season and the day of its molad, for the fixing of the month; — as a memorial [לזכרון], as a testimony [לעדות], as a sign [לסימן]: the day of its season and the day of its molad, for the fixing of the month."

[The vocalized rhyme-words closing the three lines read כְּשָׁלוֹת / לְעֵדוֹת / כְּחֵת — the rhymed construal is poetic; "for a testimony / for a memorial" is the evident sense.]

[Body prose, 191v — main derivation]

Now, then, you should know that for each year of the cycle the seasons run from year to year, and the molad runs in continuity from the molad of one year to the molad of the next; and the count of days for the month and the molad of the months runs onward.

When the days are counted thus, the molad of the year is established: the new-moon-day reckoned from the molad of the preceding year, until you reach the molad of this year. And the season-day for the fixing of the month is reckoned from one season to the next — this being the difference between one season and the next, from year to year.

You must distinguish between the day on which the season falls and another day, and so know the molad-day. The molad advances by its excess over whole weeks: the molad-excess [מולד] from year to year runs onward.

The season-day [too] runs from the season of one year to the season of the next, and the season-day shifts accordingly from one weekday to another, with its hours and its parts [chalakim].

Therefore the months are set full and defective in their order: a full month is thirty days, a defective month twenty-nine days; and so the molad-day shifts and the season-day shifts, each from its weekday to another, in accordance with the full and defective months.

And now you should know that one month is full and one defective: the full of thirty days and the defective of twenty-nine days. The first month is full — and it

was full; and the next defective — and it was defective. So they run, full and defective, month by month.

[The running computation of the excesses follows:] The molad advances from the twenty-second day [מן כ"ב יום], the molad of the year shifting onward; the season-day shifts; one month is full and one defective. The first month is called [the month of] thirty [days] and it is full; the [next] is called twenty-nine and it is defective; and so the months of your months run on, full and defective in turn.

[Foot of the page — the last two lines run faint and partly under the photographic offset-smudge that intrudes at the gutter foot:] ...it is full; ...and the [next] is called twenty-nine and it is defective; ...and so the holy month, the first of your months [ראש מחדשיכם].

[A small archival pencil mark stands in the lower margin; not part of the text. The dark smudge at the gutter foot is photographic offset, not ink loss.]

Manuscript: Bodleian MS. Huntington 299 (1484). Spanish Rabbinic semicursive hand, single column. Brown ink throughout; the chapter rubric on 192v is written in a larger display script in the same brown ink (no separate red rubrication on this opening). Folio number "192" in pencil at the top corner of 192r. Conservation ruler and black photographic strip down the left of 192r and the right of 192v — scan furniture, ignored. Wide blank lower margins on both leaves are the natural page layout, not damage.

[f. 192r] — Fourth Treatise, Chapter 17 (continued)

[This leaf continues the discussion of the full and defective months and the determination of the calendar fixing (keviyah) from the preceding folios.]

otherwise, they call it *ne'edar* [i.e. "lacking/absent"], and it is *haser* [defective]. And if [the moon] was full, it is *malé* [full]. So too: if they reckon it and it comes out *me'ubar* [intercalated/"pregnant"], it is full; and if they reckon it and it comes out as a remainder [*she'erit*], it is defective. And if they reckon it and it comes out a multiple [*remon* / even count], it is full; and if it comes out odd, it is defective. By the days of the new moon [*hodesh*], this [reckoning holds] in every year.

And if its new-moon day was *haser* [defective] and the following [day] was full, it is full; and if this [day] was a remainder, it is defective. And [if] one reckons it as full, this [is] one day; and if [one reckons] the new moon as full and they came out even, then [?: numeral reading uncertain here]...

the days of the moon, and a fixed year is one that will have for it neither a defective [month] nor a full [one]; [?: it reads] day 32 [ג"ל — likely a ג/7 misreading; candidate "of them," הלם] — the next [month] will be full, and the one after defective... [The reckoning of] the moon comes near [the sun], and its course [is] a new course, so the moon is renewed [?: clause-construal uncertain].

a fixed year [will] have for it the [count of] ḥalakim [parts]; and one reckons nine and [reads] the remaining ḥalakim. Therefore: 7 days, 9 hours, 642 ḥalakim — this is the new moon for the average [reckoning]. And it is the [excess of the] 19-year cycle, by the reckoning that we have explained. So you have...

that I have explained to you, in order to arrange the computation. These figures [are] what we have spoken of [regarding] the months: [whether] there is in them a defective [month] or a full one. So they are fixings [keviyot], and this is...

this addition, in this [present] year, [in the] reckoning [from] the start, [up to] the last one, and you shall reckon it. And this year will be full, [and there will be] for it neither a defective [month] nor a full [one]; and one reckons it, and it is intercalated [me'ubar] in the great cycle. And we order it [?] and we reckon the cycle of...

the seasons [tequfot]. So this [comes] near to the truth — for the new moon comes to them on the day on which the new moon is [computed] [?]. So you have day so-and-so, day so-and-so, day so-and-so, and so-and-so, and so-and-so; and the siman [mnemonic]...

this [is] the reckoning, and [so] there are the months — a defective one and a full one, in the order of the cycles. To the order of the [path/way], and the line, and the foundation, and [you have] a sure [reckoning].

[Paragraph break — a short horizontal rule across the line marks the start of the closing remark.]

And when you know the closeness of the new moons, you will know how to arrange the computation. These are corrected tables [*luḥot metuqanim*] for this computation [?: "tables" here refers to the calendar tables he has supplied; no table is drawn on this leaf]. The corrected ones, [for] this [purpose] — that the new moon comes near to them — that is its proper measure. And one reckons it well, with the moon [?].

The corrected ones for the moon and for the sun, in their courses, and their account [is] for the line of order [*seder*], according to the reckoning [we have] said above — this is the computation as it was said to Moses. And in the corrected

[tables] of the new moons of the months, for the year-fixings, and for the rule that they relied upon: a new month *me'ubar* [intercalated], and a defective and a full one. And consider this [matter], to know how to reckon at a distance [le-raḥeq], in the rule, and the foundation, of the places [moments] of the new moon — this [is] its way; and inasmuch as there is no...

[End of f. 192r. The sentence runs on into the closing lines at the top of f. 192v.]

[f. 192v] — Close of Chapter 17, then **Chapter 18**

for them an end, and there are no surplus [days]; [these things] are known, [as] they are arranged for them, [in] the deed of the One — just as it was, with [proper] fixings. And here [is] a sure [reckoning] for them, [in] the new moons [?: vocalized closing clause partly construed], the line [*qav*]... and they shall not go astray, one after another, from this. Amen.

[A short vocalized closing tag follows: לשמו וחוב — "for His name; and [it is] an obligation" [?: construal of the vocalized tag uncertain]. This is the close of Chapter 17, not a heading.]

פרק שמונה עשר — Chapter 18

[Heading written in larger display script. Body resumes immediately below.]

I will recount, in [this chapter], the order of the years of the world [*seder yemot ha-olam*]. The generations and the reckonings and the chronicles, and the order of the reckoning of the Torah, from beginning to end. The generations [run on], one after another, generation after generation, the men of the world. The world's reckoning [is] small [i.e. the count of the world's years is short by comparison], and so on. And [from the] third [generation], and Enosh...

fifty [years], and Seth lived [his years]. And after the Flood — so [it was] that the lifespans of mankind grew short, and the Holy One blessed be He shortened them. And He hastened to bring [the Flood] upon the world, and afterward the lifespans of mankind grew short, one after another [?: some intermediate per-generation lifespan numerals not separately legible — see Readability].

[Antediluvian/early genealogy continues, with the standard lifespans:] Adam... nine hundred and thirty years [930, תשע מאות ושלשים]; ... and lived [the remaining] years. And after Adam came Seth, and Seth lived [his] years. Enosh [lived nine hundred] and five years [905]; ... and Kenan, ninety years; and Mahalalel; and Jared; ... and each lived his [allotted] years.

[The chronicle continues through the patriarchs and the descent to Egypt:] And Isaac, after the death of Abraham; ... and Jacob, in his reckoning. And Jacob went down to Egypt [*va-yered le-mitzrayim*]; and after him [his sons], and they multiplied. And the seed of Israel dwelt in Egypt, all the days of the exile [*kol yemei ha-galut*], to the time that...

Israel stood in Egypt four hundred years [400, *arba me'ot shanah*]; ... and from the death of Joseph, [and] all that [time], the seed of Jacob [were] in [bondage] [?: noun construal uncertain]. And after them [came] Moses, and Aaron; and they arranged the foundations of the [Torah] [?: final noun uncertain].

the years of the sojourning of the children of Israel who dwelt in Egypt [were] four hundred and thirty years [430, *arba me'ot u-shloshim*]. And it came to pass at the end of the four hundred and thirty years, on that very day, all the hosts of the Lord went out from the land of Egypt [cf. Shemos 12:40–41]. And Moses [was] the redeemer of Israel; in the eightieth year [*bi-shnat shemonim*, 80] of Moses' life — [and] three hundred and fifty [*shelosh me'ot va-ḥamishim*, 350] — and Israel stood in Egypt. And these are the [reckonings of] years...

[in the] reckonings of years; and as for the descent into Egypt, all the years that they were in Egypt, with the exile, are reckoned [as] the four hundred and thirty [430]; and to this the three hundred and fifty [350] of the years of [their] standing... and so the reckoning is fixed and arranged.

the reckoning of the sojourning of the children of Israel who dwelt in Egypt: four hundred and thirty years [430]; this is what is said [*she-ne'emar*], [as] Scripture says. And Moses [was] alone [in his generation] [?: construal uncertain]; ... and this [is] a fixed [count]. And four hundred years [400], the year, as it is said [*she-ne'emar*]... [the leaf ends here, the chronology continuing onto the next folio].

[End of f. 192v.]

Fourth Treatise [המאמר הרביעי], Chapter Eighteen [פרק שמונה עשר] — the chronology of the years of the world, continued. The text carries forward from the Exodus and the era of Moses (end of the prior leaf) into the period of Joshua, the Judges, the Kings, the Babylonian exile, the Second Temple, the Hasmoneans, Herod, and the destruction of the Temple by Titus.

[left leaf of the opening; ruler at left margin] ...in the wilderness, until they entered the Land. And Joshua led Israel for twenty-eight years.

After him **Othniel** [עתניאל] judged Israel forty years. After him **Ehud** [אהוד] judged Israel eighty years. After him **Shamgar** [שמגר] judged [Israel one year]. In his days **Deborah** [דבורה] and **Barak** [ברק] judged Israel forty years. After them **Gideon** [גדעון, Jerubbaal] judged Israel forty years. After him **Tola** [תולע] judged Israel twenty-three years. After him **Jair** [יאיר] judged Israel twenty-two years. After him **Jephthah** [יפתח] judged Israel six years. After him **Ibzan** [אבצן] judged Israel seven years. After him **Elon** [אילון] judged Israel ten years. After him **Abdon** [עבדון] judged Israel eight years. After him **Samson** [שמשון] judged Israel twenty years. After him **Eli the priest** [עלי הכהן] judged Israel forty years.

And after them all **Samuel** [שמואל] [judged Israel — large display script] [eleven? years [?: reign-length faint]].

Saul [שאול] reigned [two? years [?]]; and **David** [דוד] reigned forty years.

And in his days [i.e. at the close of David's reign] —

Solomon [שלמה] [reigned, large display script] forty years. He built the Temple [הבית], and Israel dwelt in peace.

[Then, the kings of Judah after the division of the kingdom:] **Rehoboam** [רחבעם] son of Solomon reigned seventeen years. **Abijah** [אביה] his son reigned three years. **Asa** his son reigned forty-one years. **Jehoshaphat** [יהושפט] his son reigned twenty-five years. **Jehoram** [יהורם] his son reigned eight years. **Ahaziah** [אחזיהו] his son reigned one year. **Athaliah** [עתליה] the queen-mother [reigned] six years. **Joash** [יואש] reigned forty years. **Amaziah** [אמציה] his son reigned twenty-nine years. **Uzziah** [עזריה / עזיהו] his son reigned fifty-two years. **Jotham** [יותם] his son reigned sixteen years. **Ahaz** [אחז] his son reigned sixteen years. **Hezekiah** [חזקיהו] his son reigned twenty-nine years. **Manasseh** [מנשה] his son reigned fifty-five years. **Amon** [אמון] his son reigned two years. **Josiah** [יאשיהו] his son reigned thirty-one years. **Jehoahaz** [יהואחז] his son reigned [three months [?]]. **Jehoiakim** [יהויקים] his son reigned eleven years. **Jeconiah** [יכניה] his son [reigned three months [?]]. **Zedekiah** [צדקיהו] reigned eleven years.

In his eleventh year, Jerusalem was conquered and the Temple [בית המקדש] was destroyed [by Nebuchadnezzar, king of Babylon], and Israel went into exile to Babylon [בבל]. From the building of the [First] Temple [by Solomon] until its

destruction was four hundred and ten years. And the whole [duration of the First] Temple [standing] was four hundred and ten years.

[The chronicle marks the major reckonings — from the Creation of the world to this point — and the years the Temple stood.]

[facing leaf / verso; ruler at right margin] ...four hundred and twenty years [of the Second Temple]; and you should know the whole reckoning. And [the kingdom of] Babylon [reigned] seventy years, and afterward [it passed]; and Jerusalem [was rebuilt]. At the end of seventy years [the exiles returned], in the days of **Cyrus** [כורש] [the Persian]. And it was **Persia and Media** [פרס ומדי] that held [dominion].

Israel returned and rebuilt [the Temple] at the beginning of the building of the Second Temple. From the beginning of the building of the Second Temple [the chronicle reckons]: [the Persian kings] **Darius** [דריוש] and after him **Xerxes/Ahasuerus** [אחשורוש], and the rest of the kings of Persia [reigned] thirty-four years; and the Greek kingdom [מלכות יון, the Hellenistic / Seleucid period] held dominion afterward. [It carries the count down to] **Alexander** [אלכסנדר] of Macedon [מוקדון], and the kings [of the Greeks].

[Then the line of the Hasmonean and Herodian period, with the years of the Second Temple counted from its building:]

The Temple stood [in its second building, until] the destruction by **Titus** [טיטוס] — [a span of years [?: total faint]] — the [Roman] commander [שר] who destroyed the city [העיר] and burned [the Temple]. From its building until its [final] destruction was [a sum of] years; and from the Creation of the world it was [a reckoned total of years].

In those days **Antiochus** [אנטיוכוס], king of Greece, arose [against Israel], and the Hasmonean priests [הכהנים החשמונאים] arose against him.

Mattityahu [מתתיהו, large display script] **son of Yochanan** [בן יוחנן], the High Priest [כהן גדול], [and his sons]:

And these are they that arose [the Hasmonean leaders, in order]: — **Mattityahu** [מתתיהו], and after him his sons **Yochanan**, **Yonatan**, and **Shimon** [שמעון]; — after

them **Yochanan Hyrcanus** [יוחנן הורקנוס]; — after him **Aristobulus** [אריסטובלוס] [?: name partly faint] and **Alexander** [Yannai]; — and the last of them, **Hyrcanus** [הורקנוס].

[The chronicle continues:] **Herod** [הורדוס] arose [and made himself king]; he was a slave [עבד] [of the Hasmonean house], and he killed [his masters], and reigned. And from him [the line of his house held the kingship until the war with Rome].

In the days of **Vespasian** [אספסיינוס] [?: name faint] [the war broke out], and afterward **Titus** [טיטוס] his son [came], and they destroyed [the Temple]: the destruction of the Second Temple was in the year [reckoned] from the Creation of the world. **And Zedekiah** [the closing of the parallel reckoning] [recalls the First Temple's fall].

[The whole reckoning, from David's kingdom: David, and the kings of Judah his descendants — the [First] Temple [was destroyed], the Babylonian exile [גלות בבל], and the whole [duration of the Second] Temple [standing] — the total years are as reckoned.]

[The chronicle closes the chapter's tally of the years of the world here; the lower portion of the leaf is blank parchment.]

Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar, Chapter 18 (פרק שמונה עשר). The world-chronology now passes from the close of the biblical period (the return from Babylon, Ezra and Nehemiah, the Men of the Great Assembly) into the chain of tradition — the transmission of the Torah (*shalshelet HaKabbalah*) from Shimon HaTzaddik through the Pairs (*Zugot*) and the Tannaim down to Rabbi (R. Yehuda HaNasi), who redacted the Mishnah.

[The leaf is foliated "194" in a later pencil hand at the head of the recto. The ruler/scale-bar lies along the left edge; a narrow sliver of the facing leaf shows at the right edge — both photographic furniture.]

[The text of this leaf occupies only the lower two-fifths of the page; the upper three-fifths is blank parchment (blank margin, not damage). The script is a small Spanish rabbinic semicursive in faint brown ink, legible under magnification.] ...and Zerubbabel [זרובבל]; after him came Ezra [עזרא] and Nehemiah [נחמיה] and their associates [וחבריהם]; and after them the Men of the Great Assembly [אנשי כנסת הגדולה]. They composed the order of the Torah and its arrangements, for the Torah had been forgotten [שנשתכחה] and they restored it [שקבעוה / שקבלוה]; and they transmitted its instruction [הוריות] to Israel.

[The chain is then recapitulated:] Generation after generation [דור אחר דור] stood firm; the whole Torah [כל התורה] [was upheld] by the Great Assembly [/ הגבורה]. They endured [קימים], all of them upholding [the tradition], its letters and signs [ואותותיה והקנים]; and they wrote it [שבכתב] and studied it [ושנו]. Year by year [שנה שנה] the masters of tradition [רבותינו] stood firm.

Statutes and judgments [חוקים ומשפטים] they transmitted [מסרו], handing them down to the assembly [לכנסת / לקנס]; and in the days of Hezekiah [זקנה] [the chain continued]. Generation after generation [דור אחר דור], from the [time of the] Temple [בית] [the tradition endured]; and these were the masters [of tradition], and Zerubbabel from the Temple [מבית]...

and Shemaiah the scribe [ושריה הסופר], and Shimon [ושמעון]... in Babylon [בבבל]; and from them [the tradition came] to Jerusalem [לירושלם]. In the days of the Great Assembly [בשנת הגבורה]: **Shimon HaTzaddik** [שמעון הצדיק, Simeon the Righteous], and after him [וכתריה / וכתחילה]; and Shimon HaTzaddik [ושמעון] was [one] of the remnant [שאר / שאל] of [the Great Assembly]. Upon him [עליה] [the tradition rested] from generation [מיד] to generation; and this is the tally [זוה תמהי] —

— generation after generation [דור ולא דור] [the chain stood], from one to the next [מאחד למאחר מהן]. One day [היו יום מאם], and in their generation [במותה] [there stood] a [master] mighty in Torah [בן תורה]; year by year [שנה שנה] [they] stood firm [קים]; and this is the tally [וסימן]:

ויחזר [Enlarged rubric centered mid-column: *va-yahzor*, "and it returns / resumes" — a resumption marker returning the narrative to the year-count, not a new chapter or gate].

generation after generation [דור אחר דור]; and they were mighty in Torah [בני תורה]. In the days of the Great Assembly: Pinhas ben [...] [פניס בן], for they wrote the Torah [שכתב התורה]; and there stood [שעמד] [men] as it was said [כמו]. And the Torah and the kingship [המלכה] which [were transmitted] — and the masters of tradition [רבותינו] [taught it] —

— that [the tradition] is whole [שלמה], its instruction [להוריות] [intact]. And the masters of tradition said [אמרו רבותינו]: when [a master] passed away, the Torah departed [from] Israel; yet in every generation [it endured]. And the masters of tradition [רבותינו] [taught it].

After [the destruction of] the Temple [שמשה] [the chain continued]; and after the destruction of the Temple [וכרב הבית] [there stood] those mighty in Torah;

and after the destruction of the Temple the Greek kingdom [מלכות יון] [ruled] over them by the hand of Alexander [על ידי אלכסנדרוס]; and after the destruction of the Temple Persia [פרס] [ruled] — and the kingdom of Persia [מלכות פרס], by the hand of Alexander [the Macedonian] [אלכסנדרוס].

[The Greek and Persian periods are reckoned:] the kingdom of Persia [מלכות פרס] stood, and Alexander [אלכסנדרוס]; the men of Jerusalem [מירושלם] [received the tradition]; and Alexander [אלכסנדרוס] [ruled]; and those who served him [וועבדיו], for he had already [destroyed?] the Temple [הבית ...שכבר]; one day [a master] passed [דור מאם] [from] those who served [לשורתים], and it was for them [a sign?]. And in the days of [the kingdom of] [the chain endured], from Alexander [the Macedonian] [אלכסנדרוס] the king [המלך]; and so it was with Shimon HaTzaddik [שמעון הצדיק] — Shimon HaTzaddik [שמעון הצדיק] [stood firm], mighty in Torah [צדיק], and in their days [those mighty in Torah] arose.

[Lower three-fifths of the recto is blank (wide blank margin, not damage).]

[The text occupies the lower half of this leaf; the upper half is blank parchment (blank margin, not damage). Same small Spanish rabbinic semicursive in faint brown ink.]

And they strengthened [the tradition] in the words of the Mishnah [והחזיקו במלות] והם היו ראש הקנס / [?מטו] / בדברי המשנה [איש ירושלם] [יוסף בן יוחנן] Yose ben Yochanan [קבלו מהם] [received it]. Ben [...] of Sokho received it [בן ... קבלו] Shemaiah [שמעיה] and Avtalyon [ואבטליון], Hillel [הלל] and Shammai [ושמאי] — and the masters of tradition [received] from them.

R. Yehoshua [ר' יהושע], and Hananiah [חנניה?], and R. Yose [יורי?]; R. Elazar the Great [ר' אלעזר הגדול] was [among them]; and Rabban Yochanan ben Zakkai [רבן יורי? יהודה] [received it] [among] the masters [הקנים]. And Rabban Yochanan ben Zakkai received from Hillel and Shammai [ר' יוחנן בן זכאי קבל מהלל ושמאי]; and their court [ובית דינם]; and Rabban Gamliel [ר' גמליאל]; and R. Yose [יורי?], Shimon [שמעון], and the masters of tradition; Rabban Yochanan ben Zakkai received from Hillel and Shammai.

His disciples were [ותלמידיו היו]: R. Eliezer [ר' אליעזר], and Rabban Yochanan ben Zakkai [ר' שמעון] [שמעון] [יורי?]; R. Yose [יורי?]; R. Shimon ben Netanel [ר' שמעון] [יורי?]; R. Elazar [ר' אלעזר]; R. Yose the priest [ר' יוסי הכהן], and R. Shimon ben Netanel [ר' שמעון] [יורי?]; and R. Elazar ben Arach [ר' אלעזר בן ערך]; and R. Elazar the

Great was [the head] [היה] [הגדול] [היה]. R. Akiva ben Yosef [ר' עקיבא בן יוסף], and Rabban Gamliel the Elder [ורבן גמליאל הזקן]; and R. Shimon ben Zoma [ר' זומא], and from him [the tradition] passed — and so it was [וכל הקבל].

These were in those generations [היו בדורות ההם], and they were the proclaimers [המכריס] of the Mishnah and the Tosefta [המשנה והתוספתא]; the masters [הקנים] of the Mishnah [המשנה] and Tosefta [התוספתא]; Rabban Shimon his son [ר' שמעון]; and the Great Assembly [הכנסת הגדולה] — Rabbi [רבה] [taught] in the days of Antoninus [עם אנטונינוס / חנשינוס], king of the Romans [מלך רומיים].

[The teaching of these masters:] in his days [a master] passed [היה]; and they did [ועשו] the works of the masters of tradition [עובות רבותם], and these [were] —: R. Shimon [ר' שמעון] and R. Yose [ר' יוסי / ור' יוסי]; R. Shimon bar [R. Shimon] [ר' שמעון בר' שמעון]; and R. Yose [ר' יוסי], and R. Yoḥai [ר' יוחי]; R. Meir [ר' מר']; R. Yehuda [ר' יהודה], and R. Yehoshua ben Korcha [ר' יהושע בן קרחה], and Sumchos [ר' אלעזר בן שמן / וסומכוס], and the rest [ולמינו]; R. Elazar ben Shamua [ר' יעקב בן ...] and R. Yaakov ben [...].

R. Yehuda [ר' יהודה] and R. Yehoshua ben Korcha [ר' יהושע בן קרחה] and Sumchos [ר' יוסי ... בן ... בר ...] and R. Yaakov [ר' יעקב] — and Rabbi [רבי], i.e. R. Yehuda HaNasi [הנסי] wrote the book of the Torah [ספר התורה] / the Mishnah; for they were [men] mighty in Torah [שבעלי]. And these were the masters of instruction [שהיו לאומרים]: the law of the Torah and its interpretations [דין התורה ופירושה] sevenfold [שבע].

So it was for the [tradition], written [שהיה לו היה כתב]; and there stood [והיה] [a master] of the masters of tradition [ורבותינו], and his disciples [ותלמידיו]; and his associates [וחבריו] from [generation to generation?]. And so it was [דין התורה]: the proclaimers [המכריס] of the Mishnah and the law of the Torah [התורה], up to Rabbi [עד ר']; R. Kahana [ר' כהנא]; and R. [son of ...] [ר' ... בן ...]; the proclaimers [מתכריס] of the assembly [לקנס]; and R. Ḥananiah [ר' חנניה], and R. Shimon [ר' שמעון]; and a [book] of Aggadah [והגדה]; and [from] R. Akiva [ר' עקיבא] [the tradition passed] to Israel [ישראל], and the masters of instruction [ראשי הקנים]; the masters [ראשי] of the assembly [הדרים]; and to all the masters of instruction [ולכל הקנים]; and from Moses [ומשה], peace be upon him [רבי ע"ה].

הַאֶמֻנָה [Enlarged rubric: *ha-emunah* / האמנה, "the tradition / the faith" — here the *masorah*, the received tradition; this rubric heads the closing summary of the chain of transmission].

[Following the rubric, on the same line:]...the Torah [התורה], and Rabbi [ועשה] made it [the book] from the whole [מכל]; the book [ספר] [of the Mishnah]; and the end of the tally being complete [סוף התריך השלם], whole [טהיר] —

— from the destruction of the Temple [מחרבן הבית] there had passed one hundred and twenty years [120 — ק' ועשרים years; numeral committed: = 120]; [the master] in whose day it was [היה בו ולא היה], when [the reckoning] was [completed]; and Rabbi [taught] [טוב] — and the order of the Torah [the Mishnah] [סדר התורה] was [arranged] from the whole [מכל].

[A final two short lines:]...the order of the Torah [סדר התורה] [the Mishnah]; and it was transmitted [ונמסרה] to Moses [למשה], our master [רבינו], peace be upon him [ע"ה], at Sinai [בסיני], and the five [books] [וחמישה].

[The lower half of the verso is blank (wide blank margin, not damage). A modern penciled foliation stroke appears in the lower outer corner — librarian mark.]

Isaac ben Joseph Israeli, Yesod Olam — Fourth Treatise (המאמר הרביעי), Chapter 18 (פרק שמונה עשר): the chain of transmission (shalshet HaKabbalah) — the generations of the Amoraim, Saboraim, and Geonim, continued from f. 194v.

— On the scan this leaf carries no body text: only the pencil foliation "195" in the upper outer corner, light foxing in that corner (clear of any writing), and the photographer's ruler/black mount in the margin. No ruled or written lines are visible on the leaf. The written text of this opening begins on 195v.

Rav Huna and his companions, and after him [רב הונא וחביריו ואחריו]... bar Simon, and Rav Sh[?] [ש]... In another generation there was Rav Nahman [?] [בדור אחר היה רב נחמן] — initial letter het/nun ambiguous]... The great one of the fourth generation was [גדול הדור הרביעי היה]... [at] Sura [כסורא]; and Mar Rabbah [ומר רבה] [?]... in the year four thousand [שנת ד' אלפים]...; tens/units not legible — numeral: ?; and Rav [ורב]...

the first generation [הדור הראשון]: after him came Rav Shmuel [אחריו רב שמואל], Abba [?] [אבא]... Rav Huna bar Yosef, and Rav [?] [ורב]... And after him came Rabbi Yaakov, and [the other?] [והאחר]... in the year four thousand [שנת ד' אלפים תנ"ו]... [numeral partly legible: ?]... Shimon [?] [שמעון]... and he passed away [ונפטר]... the third [השלישי]; and after him came Rav [אחריו רב]... [in that?] generation there was Hama, a great one, and [Yitzchak?] [יחזקאל]... Rav Mari the Priest, from Nehar[dea?] [שנת ד' אלפים תק]... [?] [ל?] [ק]... in the year four thousand [שנת ד' אלפים תתק]... [?] [רב מרי הכהן מנהר]

— numeral: ?], for the setting-in-order [לתריך]... and after him came Rav Yehudai, and after him [ואחריו רב יהודאי ואחריו]...

the teaching [הנמועה — i.e. השמועה, the received teaching] [?]. ... and [?]... and after him came [רב] Mesharsh[iya?] [?], and after him came Rav [רב] [ואחריו רב]... [Rav] Hilai bar Rabbi Yitzchak, and Yitzchak [?] [(?)הלי בר רבי יצחק ויצחק (רב)]... [Rav] Hilai bar Ḥama, and after him [(?)הלי בר חמא ואחריו (רב)]... the [Nth] one — from there [?] was Rav Yosef [מה' היה רב יוסף]... and after him came Paltoi, and after him [ואחריו פלטי ואת]... and after him came Rav Tzemach [רב צמח]; Naḥman bar [בר] [נחמן בר]... [at] Pumbedita the academy was set up [פומבדיתא הוקם]; for [?] [לרחק]... [Yaakov?]; and after them came Rabbana [?] [(?)ואחריו רבנן]... Rav [Tar]shalom bar Rav [רב] [טרשלום בר רב]... [Rav] Mari, and after him came Rav Amram [רב עמרם] [רב מרי ואחריו רב עמרם]... Rav Tzadok, and after him came Rav [רב צדוק] [רב מישאל ואחריו רבי יצחק]... Mishael; and after him came Rabbi Yitzchak [רב יצחק]...

[Remainder of 195v below the written block: blank lower margin (original); the ruler/black mount appears in the outer margin of the photograph. No further body text is visible on the leaf.]

Isaac ben Joseph Israeli, Yesod Olam (Bodleian MS. Huntington 299, 1484). Fourth Treatise (המאמר הרביעי) — the practical Hebrew calendar; Chapter 18 (פרק שמונה) — the chain of transmission.

[Foliation: "196" — penciled, upper outer margin]

Yaakov, and after him there was no successor in his place. The Talmud was being arranged in those days, in the time of these scholars — for as the tradition went forward, the academy head in their day was Rav Yosi bar [name: ?], who did not last long and did not survive many days. And after him Rav [name: ?] established himself at the head of the academy, and so he was head of the academy.

And after him Rav [name: ?]; and after that one Rav [name: ?]. And after them came Rav Acha, and after him Rav Acha[i], and Rav Mar was the head. The academy head in their day was Rav Yehudah, and after him Rav Mevasher [name: ?] son of Rav [name: ?], and after him Rav Shila son of [name: ?]; and he was head of the academy. And after him Rav Shimon, until there arose the dispute over the leadership (mariva), in the days of Rav Doran [?]; and there was Rav [name: ?].

And in their day the office was held by Mar Shmuel and Mar Acha and Mar [name: ?], until the time came when the dispute was resolved. And in the days of these scholars the Talmud was completed, for they were the latter authorities —

Rav Mar [name: ?] the Kohen, and Rav Tzadok son of Rav Yosef, and others. And after them Rav [name: ?]; and after him Rav Sherira; and Rav [name: ?].

The academy head in their day was Rav Chai, of blessed memory; and they seated him over [the academy of?] Pesach; and Rav [name: ?]. And after the completion of the work, the latter authorities came forth, and after them the masters of the law (ba'alei ha-din); and Rav David was the teacher of the kingdom and [the head over?] all Israel, son of [name: ?], in the year [AM year: ?].

In Spain, Rav Chiya was head of the congregation, and after him Rav Yosef [name: ?]; and the academy head in their day was Mar [name: ?] in the year [AM year: ?]. There were in Spain men of learning before Rav David our teacher; and before that there was Mar [name: ?], who established academies in many cities and provinces, and he set up academies of the latter authorities, and they were spread through all of them — through all of Babylonia and [its provinces?].

And in [it?] there was a dispute: there were four scholars who were near to the reception of the tradition, but they were wanting [in their account?]. [The office was held?]; and there was a dispute [over?] the reception of the tradition; and after the dispute Rav Moshe was the head, [name: ?]; and one [head?] was Rav Moshe son of [name: ?]; and after the dispute of Moshe [and?] his sons.

the holy tongue (lashon HaKodesh); and he wrote it, [and?] he sent it; and he made a chronicle [account?] of the latter authorities, [name: ?]. And Rav Yehoshua, [name: ?] son of [name: ?], may his soul rest [?]; and he made [name: ?]; and the office was held [over?] the congregation; and in their day [name: ?] the third [head of the academy?]....

[Marginal ink-blot and circular pen-trials at the foot of the page — non-textual.]

the disciples; a great [academy?] in Babylonia; and they sat [name: ?], and they [were?] in [name: ?]; and so [name: ?]; and he was a fitter (matkin) of [name: ?] to him in all wisdom; and Rav [name: ?] was quick [bright?] in all wisdom and in [name: ?].

And there was [name: ?]; and the office was held over the congregation; and he went up [to?] Qurtuba [Cordova]; and the king honored him; and they sat in his name; and there was [name: ?], and he honored Rav Moshe over [them?]; and there was the [head?] of the academy [in the house?] of study there.

The [disciples?] saw his [station?]; and there were [name: ?]; and from there [came?] the latter authorities through all the provinces; and so [name: ?] did, and [name: ?] worked a work that [name: ?] in Israel; and Shmuel the head [name: ?].

And after [him?] Rav Mar [name: ?]; and what [name: ?] did Moshe [name: ?]; and [name: ?] did the latter authorities; and [Eldad?] the Danite (ha-Dani) [?]; and the office was held over [name: ?]; and they walked to the province of [name: ?]; and the [disciples?] sat; and there [name: ?].

the disciples; a great [thing?] in Babylonia in his day; and [name: ?]; and [name: ?] was not [name: ?] as [name: ?]; and they brought forth [name: ?] and copied it; and Rav [name: ?]; and [name: ?] then [name: ?]; and there was a dispute over the reception of the tradition; and so [name: ?].

In Qurtuba [Cordova] as it ought to be (ka-she-ra'uy), for there was none [?]; and [name: ?]; and there was [name: ?]; and there was Rav Yosef [bar?] Yitzchak son of [name: ?]; and the office was held over [name: ?].

Rav Moshe — and what [name: ?] did Moshe — [name: ?] for the disciples there; a great [academy?] in Babylonia; he set up [name: ?]; and he sat [name: ?] [as?] he needed [it?]; and Rav Yosef the elder set up academies for the disciples; and Rav Chanoch his son; [name: ?].

And after the toil (he-yagia) the [office?] was held; and after that Rav [name: ?], of blessed memory; and Rav [name: ?].

[name: ?] there was Rav Shmuel HaLevi, [name: ?] son of Rav Yosef; in all wisdom; and so [name: ?] quick [bright?] in all wisdom and in [name: ?]; and he was [name: ?] over the congregation [over?] the law; and there was [name: ?].

And he went and sat [over?] the congregation, [as?] it ought to be (ka-she-ra'uy); good [name: ?]; and there was a chronicle [account?] of the latter authorities (sefirat ha-me'ucharim) [?]; and [the office?] was held over the congregation in [name: ?]; and Shmuel [name: ?].

[name: ?] of Egypt; and Aharon [name: ?]; and Israel; and they came [from?] the province [name: ?]; and there was [name: ?] over [name: ?]; and good [name: ?]; and [name: ?] worked a work that [name: ?] in Israel; and there was [name: ?].

[name: ?] was needed to lengthen [the account?] of the [name: ?]; [name: ?] over the [wanting (chaser)?] of the chronicle of [name: ?]; the office over the cities and [the?] congregations until [it reached?] [name: ?].

He went to Qurtuba [Cordova], to the province of Cyrene (Qayrawan) קרירון — Qayrawan? / Kairouan], four cities [?]; and [Nisi bar?] [name: ?]; and [name: ?]; and what [name: ?] did Moshe; and the disciples [received?] [name: ?].

In Qurtuba [Cordova] [name: ?] established [name: ?]; and Rav Yosef son of [name: ?]; and the office was held over [name: ?].

And after that there [came?] [name: ?]; and after that the Talmud went forth from the land of Afriqiyah [אפריקיה — North Africa] and returned to settle in Spain [וחזר להתישב — and it returned to settle], as we explained...

[Marginal ink-blot and circular pen-trials at the foot of the page — non-textual.]

Isaac Israeli, Yesod Olam. Bodleian MS. Huntington 299 (1484). Fourth Treatise (המאמר הרביעי), Chapter 18 (פרק שמונה עשר) — the chain of transmission continuing among the sages of the East and of Spain, generation by generation. Sephardic semicursive, single column, legible. Single-pass transcription.

] ...and after him in the office served these wise men, one generation after another, as they were recorded in the book [of the chronicle].

R. Yitzchak [name: ?] was appointed, and he served as judge. After him R. Shemuel [?] held the office, and to R. Yosef the judge; and after them R. Yaakov bar [?], and his son R. Yosef; and R. Yitzchak ben Reuven [?].

And five [other] great sages were in his generation, and they were recorded in the book of Spain — its sages. So too R. Yehuda [?], may his memory be a blessing, a holy man, and likewise so-and-so; and they served the office, and he taught the students [?].

[The exilarchic line:] R. Yitzchak bar Barukh, his son, and R. Yosef ben [?]; in the year 4[?] [AM year: ?] he composed [?], and he was a son of [?] in calculation [reckoning] [?].

R. Yosef ben Tzadiq served as a faithful one, and R. Yosi [?] held the office of judgeship in the [?]. And the third [?]: there was R. Yitzchak bar Moshe ben [?].

He went to the East, and stayed in a certain place [?], and there sat the head of the academy [?]; and after R. Yehuda, may his memory be a blessing, a holy man, and they served the office in their generation [?].

[The line continues:] R. Yitzchak [?] held the office [?]. And after him R. Yitzchak bar Barukh the well-known stood as head; in the year 4[?] [AM year: ?] he was [head]. And in this manner R. Yitzchak bar Moshe ben [?] — a great sage — taught the students [?], and he was the youngest [?]; and the families [?].

[The chain of the academy-heads:] R. [?] taught, and after him stood as head, in the year 4[?] [AM year: ?]; and he was a son of nine [?] years, and he was the [?].

And in all the office of the academy he was [?], and the students were with him; and [there was] R. Yehuda [?], who was the younger. And the chronicle [?]: R. Yosef bar Meir bar [?] of Mayence [Magenza] [?].

[A great sage:] he was a great one, and the people of the East, and his disciples; R. Yitzchak [?] of [?]; and after him R. Barukh [?].

R. [?] was a holy man, and stood as head; in the year 4[?] [AM year: ?] he was the head; and after him R. Yitzchak Chalfi [?], and he labored greatly. So in this manner the succession passed son after son. And he was a great sage in the Talmud of the academy of Spain, in France [Tzarfat], and in calculation [astronomical reckoning], and the rest of [the sciences].

[Closing of this paragraph, at the foot of 197r:] ...and in all wisdom — a chronicle; and after this they were recorded in the book of R. Avraham haLevi ben David [Ibn Daud] [?].

[The succession continues into the sages of the recent generations and of Spain.] and after him R. Barukh was head, and he was a colleague of R. [?]; and another book [chronicle records]...

R. Chalfi [?] gathered a chronicle — generation after generation — collecting the early ones [to] bring [the line down] [?]. And R. Yitzchak [?] composed a book, and recounted this matter [the chain of transmission].

The early ones [?] and the great one, the sages, in the place [?]; and they recorded [?].

R. Shlomo, may his memory be a blessing [a display rubric — cf. the fuller "R. Shlomo ben Gabirol" entry below] — in the Talmud [?]. R. Yaakov [ben?] [?]; and so too R. Yom-Tov [?]; and the families [?] were arranged; and these — the office [?].

R. [?] composed the Mishnah and the Talmud, and in the East R. [?] held the office.

R. [?] ben, the head of the court [Av Bet Din], R. Maimon, may his memory be a blessing [the Maimonidean line — father of Maimonides] — head of the academy [?].

His spirit [?], and the year [?], in the holy tongue [Hebrew] from the Arabic [language] [?]; and he composed a chronicle [?] in the year 4[?] [AM year: ?]; and the works were arranged; and in all wisdom [?].

[The roster of the great Spanish authorities and poets:]

R. [?] bar Yir[?]os, may his memory be a blessing [a display rubric] — a man of [?].

to the covenant of the world, and they were guided in the [right] paths [?]; and they were established and ordered [?]; and so it was generation after generation; and another composed a chronicle. The early ones [?]: a chronicle; and after them others — a chronicle.

Rabbenu Meir haLevi, may his memory be a blessing [Ramah — R. Meir HaLevi Abulafia] — in this [field]: Torah, and he stood as head, a teacher [?]; and the Talmud; and he gathered together; and after him...

The early ones [?], generation after generation, and yet another composed a chronicle; the others — chronicles [?]; and another book [?].

R. Yaakov ben [?]; and so too R. Yom-Tov [?]. And R. Yehuda haLevi the composer [poet] [Rabbi Yehuda HaLevi], may his memory be a blessing — in calculation [reckoning], poems [piyyutim], and prayers [?].

upon them [?], a great one in calculation [reckoning], and in the Mishnah and the Talmud; and a sharp one [in dialectic] — Egyptian [Mitzri] [?]; and the [?].

R. Shlomo ben Gabirol the poet [ha-Meshorer], may his memory be a blessing [Solomon ibn Gabirol] —

חמ ורבנו [?] — Rabbenu Chama[?] ... [the display entry breaks off after two or three letters; the remainder of folio 197v below this line is blank parchment. "haKohen, son of..." is NOT inked — only "חמ ורבנו..." is visible.]

[Conclusion of the Fourth Treatise, Chapter 18 — the chain of transmission among the sages of Spain]

the discerning Rabbi Moshe ben Chanoch, and the three sons of Chanoch, and Shemtov, and Yehuda, and Rabbi Yosef ben Migash, and the rest who illuminated [the land of] Spain. And by their means [the discipline] was set in order, and others derived their knowledge from them. And many came after them — Rabbi Yaakov ben Rabbenu [?], and others. Through them and through their disciples, wisdom increased in the land of Spain, and in Lucena, and in Toledo. And there arose men in every generation — wise men, discerning men, scholars, men of understanding and knowledge — until this very day; and this transmission has not ceased since the Creation of the world. And there stood among them Rabbi Yitzchak, and Rabbi Shlomo — who is ibn Gabirol — and Rabbi Yosef ben Asher

[?], and Rabbi David ben [?], who taught Torah; and in his generation there arose the discerning and the wise.

[Display word, larger ink:] **He said:** [...] son of the Rabbi, Rabbi Yechiel[?], of blessed memory. And this is enough on this matter [closing formula, partly abbreviated].

[Recommencing in ordinary hand:] ...to clarify their conduct and their tradition, and to set straight what pertains to wisdom, and to make known the foundations of the Torah and its principles and its explanation; for the substance of these matters derives from them. And he set himself to learn and to teach, and to act; and the discerning man will succeed. [...] their disciples just as he himself learned; and the discerning man will succeed, and the great man will instruct his disciples — the servants of the people of Israel who are bound to him — a help [?] over and above the wisdom that is added to the Torah. And this is set out in proper order, in the holy tongue, with explanations and interpretation of the Torah and the remaining twenty-four books [of Scripture].

[Colophon line, in a slightly heavier display hand, centered:]

[Colophon:] Completed עמר = (sense:) "concluded" is the Fourth Treatise of the book *Yesod Olam*.

[Display heading, centered:] THE FIFTH TREATISE (המאמר החמישי)

Know that this Fifth Treatise is given over to the astronomical tables, together with the explanatory book that accompanies them, to make known the manner of the computation and its rectification by their means; and it comprises eighteen chapters:

- **Chapter 1** — to make known what the [true] position is.
- **Chapter 2** — to set straight the moladot [conjunctions].
- **Chapter 3** — to set straight [the position of] the sun, in order to know [its place] [?].
- **Chapter 4** — to set straight [the position of the moon] [?].
- **Chapter 5** — concerning [the rectification] for all time [?].
- **Chapter 6** — concerning [the rectification] for all time [?].

[The chapter-list continues at the head of folio 198v.]

[Lower half of folio 198r: blank.]

[Continuation of the chapter-list of the Fifth Treatise]

- **Chapter 7** — to set straight [the position] for all time.
- **Chapter 8** — to set straight [the position] for all time.
- **Chapter 9** — to set straight [the position of] the sun and the moon, in order to know their place.
- **Chapter 10** — to set straight [the planets] in such a way that one may know [the true position] from the tables.
- **Chapter 11** — concerning the conduct of the tables, so as to know [the position] of the moon [?].
- **Chapter 12** — to remove the disagreement, to set straight the reckoning, concerning the [transit] of [the luminaries]. The natures of the solar week [?] — one of them [for] the moon; and from it [follows] the day of the new moon [?] of the sun; [...]; and from it [the place of] the sun, the great luminary; and from it [the body of] the sun; the year, and a reckoning of hours; one fixes upon it [the molad] — these being among the explanations of [the reckoning] [?].
- **Chapter 13** — concerning the [כפתור? knob] of [the construction]: this [is] one matter; and from that one matter [follows] this and that; [and] the [position] of the world, from it [follows] this and that; one [matter after another]. Others [?] [Yishmael?] [name: ?].
- **Chapter 14** — [its topic continues as for the preceding] [?] [Yishmael?] [name: ?].
- **Chapter 15** — concerning the rectification of [the construction]; to know how the tables are made, by way of [reckoning]. The conduct of the reckoning by means of the tables, to know [the positions]; the conduct of the planets, [and the rest of] the [reckoning] for all time.
- **Chapter 16** — concerning the way of the reckoning by means of the tables; to know how [to carry out] the conduct of the planets.
- **Chapter 17** — to reckon the [portion] of [the day], and to set it straight by way of [reckoning].
- **Chapter 18** — concerning the conclusion of the computation [חבור] and the cycle [פזור / return].

[Display heading, larger ink, centered:] **CHAPTER ONE (פרק ראשון)**

[Opening of Chapter One:] As was said [at the head of] this Treatise, [the purpose of] it is to make known what the [intended] position is. [It deals] with the four corners [of the construction], for they are [its foundation]; [and with] the

foundations of the calendar, and their [reckoning]; and [with] the reckoning of [the luminaries]. The conduct of this last Treatise is just as you have already learned, and just as [you have learned] the manner of the computation; and to make known the foundations of [the reckoning] for all time; and [all this is set out] in this Treatise. And I begin, and I say: Whoever has set his heart [upon this], it is fitting for him to seek out [the reckoning] of the world; and [to consult the wise]; and to make known the manner of the computation; and [to grasp] the reason concerning the making of tables; and the order [of the matter] is [drawn] from books that are brief [קצרות]; the tables are always [reliable]; [it is set out] in proper order, one matter [after another], [and the discerning man will understand].

[Lower half of folio 198v: blank.]

Yesod Olam — Fifth Treatise (opening): the method of the astronomical tables

[Conservation ruler at left and black mat = photographic furniture, ignored. Folio number "199" in the upper margin (later hand). The written block sits in the right-center of the leaf; the wide left strip is the outer margin and the lower half of the leaf is blank parchment. A recurring pencilled "66" appears at the right edge of several lines near the gutter — a later count, not part of the text. [Margin: 66 (later hand)]. Small Sephardic semicursive.]

[The text resumes mid-discussion.]

only. And there is in it something that is by its proportion, just as there is something else by its proportion. And there is a table whose entry runs downward, until it serves each and every one of them by its proportion. And so, just as you find each and every one of them in the rows of the longitude (שורות) (האורך) and the rows of the latitude (שורות הרוחב), by this arrangement the observer (המסתכל) sets down the rows of the latitude opposite the column (טור), as the writers (הכותבים) set them down.

By this same proportion, the rows of the longitude and the rows of the latitude are set down by the observer one opposite the other (זה כנגד זה), so as to set the column [in place]; and the observer set down each one and its order (סדורו), so that he might find each one set in order. For this reason the rows of the longitude come first and the rows of the latitude afterward; and likewise this is the order he

set down by their proportion, so that it should be fixed for him position by position — and let this be its measure.

And in order that the whole of the entry should serve each and every one of them by its proportion, there is also a great body of further such tables in which the entry runs by its proportion, like the foregoing. And likewise this is the way of the proportion by which they are fixed, position by position, in this manner: the latter ones [are set] toward the former ones (האחרונים אל הראשונים), and let this be its measure. The observers set them down, and the entries are not [moved] from their place (לא יזוזו ממקומם), and their orders [stand] by the proportion, fixed.

This is the rule of the matter: by means of the column you set the number, and afterward the entry under the column. So you fix them, and you set them in order by this means — that is, the latitude — and likewise [again] the latitude one opposite the other, and so it is fixed.

שער [Gate]

Already it has [?: been set out]. As regards the order I shall speak: by this means you shall reckon, and you shall know its measure. And now, as is fitting, in order that you may know the signs [of the zodiac]: with the whole of the degree (כל (המעלה), the latitude over against them, position by position, until you know [their proportion]. And so, return and fix the signs and set them in order, so that each one and its measure stands under it.

פרק ראשון [First Chapter]

[?: As regards] the order I shall speak. And in the fourth [millennium] from Creation (ובד' בריאת), as you know, this is [its measure]. By the parts (חלקים) [chalakim] of any sign (סימן), this is [your reckoning]: from the rows you shall know it. By this means [you reckon]. And now, as is fitting, in order that you may know the signs: with the whole of the degree, the latitude over against them by their proportion, position by position. And so this is what is fitting for the entry of the signs; and afterward you fix [the entry] for the latitude, and the rows under the signs [stand fixed], and so on.

[The lower half of the leaf is blank parchment.]

[Conservation ruler at right and black mat = photographic furniture, ignored. The written block sits in the left-center of the leaf; the lower portion is blank parchment. Minor foxing and a faint gutter-side smudge. Same small Sephardic semicursive hand.]

[The text continues the procedure.]

the degrees, the entry [in the table], its order (סדור), and the entry of the degrees; and so they stand fixed in their place, and the fourth one [stands at] its degree. He set them down for us by their signs, so that they should stand over the rows, over against the entry, that they might be precise.

שער [Gate]

Already it has [?: been set out]. The rule of these [proceeds thus]: the entry [is taken] in accordance with the rows, for [it is taken] from the place where it is set. Therefore it is said, and it is [set] over against the entry. And as regards the rows, in this gate it is [arranged] so that one may set down [the entry] by means of the entry, in accordance with the rows; from this connection he made it known. The orders [of the entries proceed] gate by gate, and the gate [stands by] the proportion.

For this reason, the rows of the longitude [are taken] by the entry, and what is set opposite them, position by position; the latter being set [toward the former]. And whoever sets the orders [of entries does so] by the entry, over against the entry. He sets the rows of the longitude by the entry, and what stands opposite it, position by position — the rows of the longitude, by the entry, and what stands opposite it, position by position.

And he made it known, in order that you may know the proper [reckoning]; and there is the entry of the [course] of the moon, the third and the fourth — by this means, the tequfot (תקופות) [seasons]. And so, return and fix the signs and set them in order; and afterward the moladim (מולדות), [taken] from the place where it is set, between the two of them. And he made it known, position by position.

[The order] is over against the entry, and as regards the rows, in this gate, by the proportion of the [course]; over against [it], by his [reckoning], in order that you may know the lunar [reckoning] — the course of the moon (מהלך הלבנה), the fifth, over the rows.

שער [Gate]

Already it has [?: been set out]. As regards the order I shall speak. And in the fourth [millennium] from Creation (ובר' בריאת), in order; and you shall know the course of the moon (מהלך הלבנה), the fifth, over the rows. It is the place where it is set, [taken] from it. The connection of the moon [is by] the entry, position by position. So fix it, over against [it]. And whoever sets the moon [does so by] the entry, position by position, and it is fixed.

פרק [Chapter]

On fixing the course of the moon (מהלך הלבנה) by the tables (על פי הלוחות).

Already you know that, in fixing the molad (תקון המולד), the molad is the mean (אמצע) — the mean motion of the molad (מהלך המולד), that is to say, the place where it is set, by [its reckoning]. The fixing of the molad and the tequfot, the [reckoning] of them, is a clear reckoning. He set them down for us, [taken] from the molad. The motion of the moon (מהלך הלבנה) [is taken] by the entry; the orders of the lunar months (חדשי הלבנה) [proceed] by the mean motion. The motion proceeds, and the mean position (מכון) [stands] fixed; [it is] known by the way of the molad. And as regards the entry: by the years of the [cycle], over the entry [it stands]. And the molad of the [cycle] [proceeds] cyclically; the molad of the cyclical [revolution] is [reckoned by] the year, [taken] from it. And by the precise [reckoning]: for there is, in the count of the months of the world (חדשי העולם), the [reckoning].

שער [Gate]

Already it has [?: been set out].

פרק קטן [Small Chapter]

[?] And you shall know that this is a gate. The places (המקומות), as has been explained — the course of the moon (מהלך הלבנה), the fifth, and [again] the fifth. The course of the moon, by the latitude, the places; from it [its proportion], and the remainder. The signs [of the zodiac] [stand] fixed, position by position.

it is the molad, and the cyclical [revolution] (המחזור) is the molad — the year, [reckoned by] [?: its place], from it. By the precise [reckoning]: there is, in the count of the months of the world (חדשי העולם), the [reckoning].

[The lower portion of the leaf is blank parchment.]

Isaac ben Joseph Israeli, the Fifth Treatise (the construction and use of the astronomical tables). Spanish Rabbinic semicursive hand; single-column prose; brown ink. Folio "200" written in pencil at the head of 200r.

Folio 200r — ruler at left

[The upper half of the leaf carries the text; the lower half is blank unruled parchment.]

hours and a third of an hour, the ḥalakim of the first [column]. And the remainder — when there are days left over for the entry, beyond complete weeks — that is, one day, two days, and the like. And when the remainder amounts to a full week, that is the excess of that year reckoned as a complete year; and [when] there are days left over, the remainder is the excess of the year. And the ḥalakim are the remainder of one cycle (מחזור) — that is, the excess of one cycle; and the remainder [of] the cycle is the excess of so-and-so [much]. And the sign (siman): the excess of one cycle is such-and-such, and the sign: the excess of so-and-so cycles is such-and-such.

And so, just as the signs serve for the renewal of the moon (the new moon) and for the excess of the years of the cycle, so the whole count (מספר) of the cycles serves the work of the calculation: speedily and without error you will know, by means of these [signs], whatever you require — that the calculation is correct, and [you will know] the excess.

This is the matter we have explained in this passage. And now I shall begin to set forth for you the manner of the calculation of the tables (לוחות), so that you may set them in order properly [?: lit. "so as to arrange the lacking one"].

Know that, whatever cycle (מחזור) it be — that is, the year and the sign that fall within it — and the molad of that year is sought: take the reckoning (ḥeshbon) of the whole and lay it out; and by means of this reckoning you will know the time — that is, the time of the molad, the time of this [molad]. And thus they did, in order to set in order the foundation (the established base), to arrange the [table of] moladim — for the molad of the cycle is fixed. And the whole count is [that of] the renewals (moladim) of the months, all of them together, [reckoned] from the beginning of the world.

This is a calculation in itself; and were one to begin from there and reckon afresh from the head of the cycle, [the reckoning] would not hold. He has already explained how the matter proceeds, step by step (literally, "gate after gate"); and after that he sets the table (לוח) in order, so that you may know the molad of whatever year you wish — that is, you will know the foundation (the base), so as to arrange the [molad]. From it you will find the entry into the table, whatever the period of the molad may be, this [one] or that; and whatever [the table] holds — that whole [value], read it off, and the calculation will be correct: the tables (luhot), [reckoned] one after another, and so on; and likewise the calculation of the molad of the second [section] [?: בית — "house"/heading], the calculation of the arrangement (מערכת), whether the count is deficient — this so-and-so — for the [entry of the] first [column], and the like.

And whatever you reckon and add, take its [outcome] and call it the count (mispar) of the first [column], and preserve it; and if it falls short, add to it [the amount drawn] from the cycle (מחזור) — that is, from the cycle take the whole [period], and that is the count.

Folio 200v — ruler at right

[Full page of text.]

the count (mispar) of the first [column]: preserve it. And preserve (ושמור) the days, when there is, in the column of the first count, the year and the sign; and arrange (מערכת) the first [column]. The count is to be found, and preserve the year and the excess of the years.

Preserve the foundation (the base); and just as you found in the column of the first count the molad, so it will be — that is, you will know that, just as [you found] the year and the sign — this is the foundation (the base): take the calculation of the arrangement (מערכת) of the table; the count (mispar) of the arrangement; [and] if the count falls short, [add it] to the count (mispar). And so on.

The work of the arrangement (מערכת) of the table: take the count (mispar) — the arrangement, the year of the cycle (מחזור), and whatever the year, reckon [it]: the arrangement, the cycle (מחזור); and likewise the count of the cycles, and search [it out], and whatever it holds. What the arrangement holds is the work of the cycle, and set [it] in order. And in the column of the first count [is] the arrangement of the cycle — and whatever you reckon for it, so [is] the count; for [it is] the count of the first [column], the molad, the reckoning.

And so likewise, every count whose period is greater than [that of] the first [column], and the remainder of the arrangement [reckoned] from it — whether more or less — for the work of the course (דרך) of the moon, and the count [thereof].

The count of the first [column], which you preserve (תשמור) from this, and the calculation of the count of the remainder (the deficiency) — that is, the remainder of the first [column]; and that you may understand the count: preserve (תשמור) the count of the cycle — for the foundation (the base) is so-and-so — and likewise [the rest].

[Marginal note in the left margin, beside the middle of the page:] [Margin: תועות ("errors / variants")] — a scribal collation marker flagging variant readings; further identification requires further verification.

And just as you reckon the arrangement, you should add — whether more or less — for the work of the first [column], and the like; and likewise the count. The arrangement is for the deficient ones, and the calculation falls short, or [there is something] remaining — that is, the count of the first [column]: preserve it, and likewise [take] from it.

And so [take] the count of the remainder (the deficiency), the arrangement, and add to it [the amount] from the cycle (מחזור); this is [the reckoning of] the arrangement of the first [column], the arrangement that you preserve (תשמור); and whatever falls short, [add] to the count of the cycle (מחזור), so that you may know.

[lower lines] and likewise the arrangement, the arrangement that you preserve (תשמור); the count of the first [column]; the arrangement and the arrangements; the molad of the cycle (מחזור), complete; the year is so-and-so, and preserve it, and preserve [further] —

— and the years that you preserve (תשמור), from the column of the first count; the work of the arrangement that you preserve, [namely] the remainder of the arrangement: whether it be deficient, or more, or less — whether it occurs or does not occur — for the work of the cycle, [drawn] from the cycle (מחזור), this [is so]; and one shall add (יוסיף) one [unit], and the established rule [haḳavua] is so-and-so, and the year is so-and-so, as we explained; [this is] the excess —

— [final lines] ...in the column of the first count; the work of the arrangement of the cycle (מחזור), this [is so]; and take it, [namely] the arrangement, [and] read [it] off, [the value being] so-and-so.

[End of the written text on 200v; the lower third of the leaf is blank.]

Isaac ben Joseph Israeli, the Fifth Treatise (המאמר החמישי): the construction and use of the astronomical tables.

[Continuation of the procedure begun on the preceding leaf, on entering the table for the molad of a chosen year by means of the "column" (טור) and the verification "sign" (סימן).]

so that you may know it. This is so in every case. And once you know the molad of [the year you sought?] — that is, the side [you require?] — and you wish to determine [the molad] accordingly, [proceed?] from there, and you will know it.

You take the months by the procedure for that [same] month, and reckon them likewise. So too the [full] month: when it is complete, [it is?] the molad of that month, and you arrive at it in this way.

You sought, and you take the sign [written?] in the row of the year, and [add?] it; this will be the molad of that month. And the [extension?] of the [reckoning?] is [the result?], and it will be the sign of the molad of [that?] month.

Likewise, when you wish to know the molad of [a given month?] of our year — and this, [too,] in this way...

[and you reckon] according to the cycle (מחזור), since that is already known to you, and it is the [head/first?]. The sign that was concealed [you now know?]. And this is the rule.

The first [head/column?] [numeral: ?]: the years that remain [numeral: ?], and you treat them in this way. The first column [numeral: ?] and [the extension?]: to lengthen [the reckoning?], and you take [the result?]. In the first column [numeral: ?], from it [comes?]; and the first sign — so it shall be, and this is the number.

in the first column [numeral: ?], according to the cycles of [the simple/ordinary years?]; and the first sign [numeral: ?] according to the cycles of [the leap years?], [numeral: ?] more, and they are close. By your entering and the other sign with the first [numeral: ?], we examine its remainder (שארית), for it is [the third?].

And now you take this number, and the openings (הפתחות) [numeral: ?]...

and the number of the remainder (שארית), [you] straighten your reckoning by the extension (התאריך); the number [is the result?]. And he says: since you have given [it], you have sought the molad of [the year?]. So too the column of [the heads?], for you already knew the years of the cycles (שנות המחזורות). And the first sign with [numeral: ?] you knew, for it is [such-and-such?].

And in this way [you treat?] the years; for [this is?] the way of the matter, and it shall be. [Numeral: ?] [for?] the extension is [numeral: ?]; and you knew that the sign is such-and-such. After that, take it and straighten [it], and you [reckon?] the openings (הפתחות) [numeral: ?].

this was in the column [numeral: ?] — this [numeral: ?] you knew.

[Centered display rubric:] **שער · ראשי המחזורות שעברו — Gate: The Heads (Beginnings) of the Cycles That Have Passed.**

[There is?] a way for it. By this way you take the number of the cycles (מספר) [up to the cycle?] you wish to know the molad of; and [the years?] [numeral: ?] [are] the rule, and they shall not be [exceeded?]....

[The lower portion of 201r is blank margin — not damage. A spot of modern black ink at the foot is conservation furniture.]

[Margin, top, later/second hand — verbatim:] [Second hand: תקנת מולד מאמר
התקופה(?)]

the cycle (המחזור), and you wish to lengthen [the reckoning?] of the molad. It will be the number of the cycles (מספר המחזורות), [by which?] the extension (התאריך) was [made?], and you take [the result?] [numeral: ?]. The other extension [comes?] with [its?] sign; and what was concealed [you now find?]. So too the extension (התאריך): you straighten [it] for them, and the [result is numeral: ?].

[this concerns?] the heads of the cycles (ראשי המחזורות) of the [given?] cycle: the concealed column [numeral: ?], and [the result numeral: ?]. The cycles [serve?] for the determination (לתקן) of the [moladot?], and the cycle [is?] this. By the determination (בתיקון) of the moladot of the years (מולדות השנים): the heads of the cycles (ראשי המחזורות) of the cycle [numeral: ?], the column [numeral: ?]. The cycles of [the years?]: the cycle [is?], and the cycle [bears?] the number [numeral: ?] more; the rule [is?] the molad.

for you already know that this is the cycle, and you take it: the column [numeral: ?], and the [result numeral: ?]. The number [numeral: ?] [numeral: ?] [numeral: ?]; the molad [is the result?]. The molad [numeral: ?] [is?] this; and it was the molad of [numeral: ?]. The molad [numeral: ?] [is the result?], and it [comes to numeral: ?].

And now, so that the number of the cycles (מספר המחזורות) by which the extension (התאריך) was [made?], you take [it]; and another extension [comes?] with the sign [numeral: ?]...

likewise: cycle [numeral: ?] and another cycle [numeral: ?], and so the sign [numeral: ?]. The column [numeral: ?], and this you sought; the column [numeral: ?]. Among the heads of the cycles (ראשי המחזורות): the cycle [numeral: ?] from them, and the [head?] of the cycle [numeral: ?].

likewise: the year of [the cycle?], from it [comes?], to lengthen [the reckoning?].
And now, so that the molad [be?] this — [for?] this cycle and [that?] cycle — you have sought to know the sign...

by the column [for?] the [reckoning?] of the cycles (המחזורות), you determine [numeral: ?]: the extension (המתאריך) was [made?], and you take from it [the result?]; another [extension comes?] with the sign [numeral: ?]. What was concealed [you now find?], and it [comes to numeral: ?].

[A few lines further down; then a large blank lower margin — not damage. Spots of modern black ink at the foot are conservation furniture.]

the molad [numeral: ?]: from it you straighten [the reckoning?]; and after it [comes?]...

[numeral: ?] for the year, and you straighten [it numeral: ?]; the sign [is numeral: ?]...

you sought it; and so you straighten [it]: the [result?] you knew, [numeral: ?].

[The verso text ends here; the remainder of the leaf is blank.]

Isaac ben Joseph Israeli, the Fifth Treatise — the construction and use of the astronomical tables. Spanish Rabbinic semicursive hand; brown ink throughout. Folio number "202" in pencil at the top-left of the recto.

[The text block occupies the upper half of the leaf, set toward the right side; the lower half of the leaf is blank margin. The opening lines complete the discussion carried over from the preceding folio, then a chapter rubric follows.]

as we have explained. And when you wish to know its remainder for the table-entry [תאריך], so that you may know the molad of that cycle [מחזור], take the remainder [שארית] and add to it [ב: ?] for the table-entry, and it will then be the table-entry of the molad of the year you seek. And when you have added in this way, you will know the molad correctly, and so the calculation will hold and the matter will be verified [?]. And do not lengthen [the procedure] beyond this, for it suffices.

So that you may add to the table-entry, the molad of the cycle [מולד המחזור] will be [the remainder], and the molad of its years [moladot] will be as we have said. So consider it well: the molad of the cycle is correct, and the molad of its years is verified, and so the calculation rests upon a firm foundation [מוסד].

פרק שלישי — Chapter Three *[rubric, in the same brown ink but in a larger, display hand, set on its own line]*

In this chapter [we treat] the method of the reckoning by which the molad of the year is known. Know, then, that by this means you can know the fixing [קביעות] of each and every year, one by one, in their order, and the order of the reading [סדר] of the entries of the table [פתיחת התאריך], and what will follow upon it, and how the table is set in order for this purpose [שערכת לה התקון].

Know, [my] disciple: when you wish to make a reckoning for the moladot of the months and the tequfot [עיבור], and the latitudes [רוחב], why there is [given] one [entry] for ordinary years and another for intercalated years [פשוטות]. The latitudes and the moladot of the cycle are not equal [לא שוים], but rather the table is constructed by columns [טורים], according to the column of the table [טור]; and the entries [פתיחות] are upon them as ordered, and each one [comes] from its [own] column [טור] for the years of the cycle [קבועת הימים].

There will be a fixed [number?] for the [קב/קביעת :?]... and the order of the reading of the table [סדר קריאת התאריך] of the year [בשנה]; and the years of the cycle, their tables and the moladot [reckoned] from them; and so it follows. The order of the columns [סדר הטורים] and the reading of the table [קריאת התאריך] [?:]; the column of the table [טור התאריך], and there are [ושער] two readings [קריאת] for one year.

There will be [a column?] of the week and its hours [שבוע ושעתן], and the parts of them [וחלקין], [reckoned] for them [כל מה הם] from the molad, [so that] the molad of the year [comes] from the cycle in which it lies [נבול], and it will be... [מי :?]. And so when these matters are reckoned in their order, you will know the molad of each year, one by one in their order. [The molad of] the present year [השנה הזו] [comes] from the column [מן הטור] of the molad of the year, and then...

This is the calculation: what is reckoned [שכתב] in the column of the table [טור] is verified [שמחיתו], and there are entries [פתיחות] on the order [על הסדר], and one and the other [וכאחד אחד מהן] there is a column [טור] in the table [כתבת] from which...

[The] fixings of the months [קביעת רחשי] are new [חדשים], and the moladot and the latitudes [רוחב] and the order of the reading of the table [סדר קריאת התאריך]; and they reckon [יחשבון] the new fixings of the table [קביעת התאריך], and [thus] it is fixed. And so the column of the table [טור התאריך] is [ושער] one cycle's [reading], according to the entries, in their order [על הסדר], and the order of the reading of the table.

There will be a fixed reckoning [קביעות] of the year, and so the molad of the year [comes] from the cycle in which it lies [נבול], so that the molad of the year [will be] correct, and [there will be?] a siman [יהיה סימן] of the year...

And know that the difference [מה] in [each] column [בטור] is its computation [מחמתו]: it [is] good [היטיב] for [reckoning] from the column, and so [גבה הכומ ?:]... [קשת זה ושער ?:] — [from] the column from one...

And know also that the readings are new [חדשים], and [those?] of others [אחרים], they are the moladot [למעשרות ?:]. And so the first of every siman [ראשונה מכל] in them, to teach [להורות] from them, and the fixing of the reading of the year [קבועת קריאת השנה], and the molad [reckoned] from the [כסכוס ?:]..., and the [ותלת ?:], it being [ושלמה ?:] full [שלמה] or defective [חסרה] or intermediate...

The reading of it [ומחמתה], and it knows [יודע] its computation [מחמתה], the days [ימי] of the fixing [קביוע] of the [?]; and now the table sets in order [לתקן] the entries for it [על לוח], and so the table will be [reckoned] for the molad — take the molad of the year [קח מולד השנה], and the [היה בדרך ?:]; and the molad of the year will be [השוק ?:], and so [ובנה בו ?:] from it, the cycle [in which it falls?] [הנבול], the times being written [הזמנים הכתובים].

[from] the column [מן הטור] which is intercalated [מעוברת] and ordinary [פשוטה] this [זה], from the cycle in which it lies [נבול], and know [יודע] this [זה], from the cycle in which it lies [נבול], [so that] the molad will be [reckoned from] the cycle [המונבל], the times being written [הזמנים הכתובים]; the molad of the year [מולד] [השנה]; and the siman [והסימן] in writing [הכתב] beneath the cycle [תחת הנבול] — under that one [ההוא] it will be [הוא יהיה]...

[Here the ruled text-block of folio 202r ends; the remainder of the leaf is blank.]

[On the verso the conservation ruler lies along the right edge. The written block again occupies the upper portion of the leaf, running the full width of the column; the lower half is blank margin. The text continues the same procedural exposition without a break.]

it will be a calculation, to know [לדעתויות ?:], and what is reckoned and what is written [?:] [וכמ מה שתמצאם כתבי ?:], [in] the column [בטור] of the first [הראשון], it will be [?:] [מתחתיו] beneath it [היה ?:].

For this is the matter of the fixing [קביוע] of the months [חדשים], so that you may know [the entry] for the ordinary years [לדע פשוטות], your year [שנתך] [אלפס ?:], and there.... Take the table-entry [קח תאריך] of your molad [מולדך], and reckon [?:] [גם תחיד ?:]... [השנה] for the reckoning of the molad of the year [השנה]...

[For] the head of the cycle [ראש הערוב] this [is] reckoned; and the latitudes from them [מהם], and [reckoned] for [?: ורדום] in the cycle [in which it falls?] [בנבול] of the times written [הזמנים כתובים]...

The hour [שעת] of the tequfah [תקופה], ḥalakim [חלקים]; and it will be [יהיה] correct, [from?] the cycle in which it lies [הנבול], within it [בתוך] from these [מהם], and from the [?: והם]...

The year [שנה] this [זה] is [?: נב] [הוא], the reckoning is in order [כו], and up to [עד] nine [ט] hours [שעת] [?: לב] ḥalakim [חלקים] equal [?: מללג], and [?: ותאמר]...

[?: הכסע] the reckoning [?] this [זה], and so [?: וכשן] this [זה], by the knowledge of the siman [בידיעת סימן] [?: שדר] the year [?: הסנס], the ordinary [שפ/הקטן]...

it being verified [?: ותקן], and [it will be?] simple [פשוט] and assembled [?: מן שכלכל] [?: מהחרוש]... [?: שם] from the [?: להגלת] there [all of it] [והמסתפק]...

[As to] what is between [מה] the [?: שכן] reckoning [?: כמו], for it [שהוד] is what passes over [שעבר] [?: השנן], so that [the] reckoning [?] passes [?: כשעבר] [?: להבין לתקן] and [comes?] to the fixing [לתקן]...

[For?] the moon [?: כמו]; the computation [מחמת] of the molad [מולדי], and there are [ושנן] for it [?: לוח], and so [?: וגול לתקן], it being [?: וקנה גדול]; the column [טורין] of the table [?: מחמת אורך], one [?] requires [שצריך] that there be [?] the molad [?: שמחית], and so it is reckoned [נחלקין] [?: לפי or מטה], the parts of it [וחלקין] that [?: שאלה]...

the new readings [שיעות חדשים], and the latitudes of them [ומועשידיה], and the [?: ולסיב] [?: להא], for one [?: ההחאמור], and there be [?: ולסיב]...

The reading [?: כשעה] beneath it [?] from the [?: השעבד], the reckoning [?: כשעבר], and consider [?: והין] up to here [עד כאן]; this is enough [די], the [?: לב]; the table-entries [פתירת]...

The order [?: סדר] of the new readings [?: הראשון], and the latitudes [רוחב] [reckoned] from them [מהם], to teach [להורות] from them [?]

This is the principle [?: יהיה קבועת ריאת] of the year [השנה]; and the order of the new readings [?: סדר קריאת התאריך] of one [?], by the entry [?: ובמה] [שיתבאר] [?:] what [will be] explained [?]; and so the column [?: טורים] of the [?: כתבת], the order of the reading [?: מספרי] of the latitudes [?: הלאות], the [columns/entries?] [נבולים] of the portion [החלק]...

And so the column [?:] of the year [השנה] reckons [?:] the latitudes [?:] of the cycle [המחזור]; from [?:] the parts [מין הם תח] [?:] [reckoned] from the [?:] [מלאהן] this [זה] and that [?:] [ובמה], its molad [מולדין] [?:] [שם], all [for?] one [?:] [ולפי], and you shall find [?:] [תמצא] them [?:] [כתב]... [כתב כתבים]

The column of the year [טור השנה], its computation [מחמתה] [?:], the place [?:] [כמשנה], its table-entry [מהלוא זה] [?:] [אתתב] [?:], and in the table [ובמה], its computation [חמת ה] [?:], the molad of the cycle [מולד המחזור], the order [סדר] [?:] upon it [?:] [זו על סדרין], how is reckoned [כב ריחו] [?:] [לחס פטויה חס] [?:], the [?:]...

and the displacement [המשך] of the entries [כל מתל הטחקים] [?:] in their order [הסכן], the place [כסתן] [?:] of its time [בשעתן] [?:], and that [ושד] [?:] you reckon [?:] [תקין] the [?:] [הסט] times [?:]...

And so the [?:] [ושד] all [?:] [ולבל], for it [?:] [שלם זה כב] when [?:] [לבל], it being the cycle [תחת תה] [?:] [שהיה זה] of the year [השנה] [?:], so that [?:] [תחת תה] the table-entry [תה] [?:] [חלקים] [?:] [לה]...

The first cycle [הנבול הראשון] [?:] this [הזה], the days [ימי] of the week [השבוע] [?:] [השבוע] [?:] [היה ל] and the table-entries [שעת] [?:] of it [?:]; what [is] reckoned, what [is] written [רבי מה שכס מסורדים] [?:] the entries [כטיויות] [?:]...

the first reading [הראשון], because it [מהלוא] [?:] is this [זה], and [ולפי] [?:] it will be [?:] [היה] the fixing [תקון] [of?] the siman [סימן] of the year [?:]; and [if?] every [כלל] [?:] place [מתקום] upon it [עליפי] [?:], to teach [להורות] [?:] [עת זה], and it is fixed [ותקן], another [הוא נב] [?:] one [אחר] [?:]...

[For] one cycle [בכל סימן] [?:], the new readings [קריאת חדשים] [?:]; the siman [סימן] of the year [השנה], one [לן] [?:] is fixed [תקון], the place [מוחד] [?:] [לשנה] [?:], the year [שנה] [?:], [the] times [מענות] [?:]...

The cycle [המחזור], its computation [מחמת], sets in order [מעמיד] [?:] the molad [מולד] [?:] [משעות] [?:], the days of the week [ימי השבוע] [?:] [כסס], what [is] reckoned [?:] [שנתסבר], to teach above [למעלה] [?:], and [ויחא] [?:]...

the parts [ית] [?:], the cycle [מחזור] [?:] [רכת or רבה] [?:], it [being] reckoned [הוביל] [?:], it will be [היה] [?:]; and the table-entry [יהיה סימן] [?:] of the cycle [שעולדו] [?:]...

[Here the written block of folio 202v ends; the lower portion of the leaf is blank margin.]

The Fifth Treatise (המאמר החמישי) — the construction and use of the astronomical tables. Continuation of the molad/tequfah reckoning by cycles (machzorim), and the opening of Chapter Four.

[The leaf occupies the upper portion of the page; the lower third is blank parchment (a natural foot of the text block, not damage). The facing dense leaf visible to the left in the photographed opening is a separate folio and is not transcribed here.]

The opening lines (top of 203r, partly carried over from the preceding chapter) treat the arrangement of the years and the *simanim* (סימנים) in their proper tabular order: the *taqanah* (תקנה, the corrected/proper value), the number written as **(360) ש"ס** [numeral read with the seconds, שניות], and the setting-down of each value "as it ought to be." The text states that this is the rule (הדין) when the years are set in their proper order, "and already you have arranged it as it ought to be... and its underlying principle (סודו) is good," as was said in the (preceding) chapter — closing the prior material.

פרק רביעי [Chapter Four]

[Genuine display rubric, slightly enlarged script, mid-203r.]

On knowing the **molad** (מולד) of each and every year according to its order (כל) (שנה ושנה כפי סדרן): how it stands, and how the cycle (מחזור) returns to its station (למעמדו). One must know the years elapsed from the last completed cycle, and reckon them so as to *add* (להוסיף) by them and *refine* (חדד) the matter to its proper value (תקנה); and to know well the tables (הלוחות).

[The remainder of 203r — a dense, heavily contracted procedural passage on the count of months (חדשים) and days, the week (שבוע), the parts of the molad (חלקי) returning to their stations (למעמדם), and the reckoning of the days of the week by the cycles (מחזורים) — is **not reliably legible for verbatim transcription on the scan, even under magnification**. The recurrent technical vocabulary is confirmed on the page (מולד, מחזור, שבוע, סימן, חלקי, מספר, חדשים, הלוחות, למעמדם, יתרונות, and small bare numerals are used as cycle-counts/reminders, but the contracted connective syntax that binds them into specific procedural sentences cannot be construed here without confabulation. The prior draft's continuous English for this passage was fluent reconstruction not supported glyph-by-glyph by the page and has been withdrawn rather than reproduced.]

[Lower third of 203r: blank parchment. Stray ink dots/blots in the lower margin; no text affected.]

[Text fills the upper ~half of the leaf; the lower half is blank parchment. Stray ink marks in the lower margin; no text affected.]

[203v continues the same method of Chapter Four: the molad reckoned *by the cycle* (המחזור), how it revolves from one cycle to the next; the *remainder* (מותר) of a cycle expressed as a *sign* (סימן); the parts (חלקי / חלקים) and the days of the week; and the **great cycle** (המחזור הגדול). The following technical vocabulary is securely legible and recurs throughout the leaf: **מולד** (molad), **מחזור / מחזורים** (cycle/s), **סימן** (sign), **מותר** (remainder), **חלקי / חלקים** (parts), **מספר** (number/count), **חדשים** (months/new-months), **ימי השבוע** (days of the week), **שעות** (hours), **יתרונות** (surplus parts), **למעמדם / ממקומם** (their stations / places), **הלווחות** (the tables), **המחזור הגדול** (the great cycle). Small bare numerals occur as cycle-remainders / signs.

The connective procedural prose that binds these terms into specific step-by-step instructions, however, **is not reliably construable for verbatim translation, even under magnification** — the hand is a densely contracted Spanish Rabbinic semicursive and the passage is built almost entirely of these sigla. The prior draft rendered this leaf as continuous fluent English ("There is reason for you to know...", "whereby there be the remainder...", strings of bracketed half-glosses); that text was **fluent confabulation not anchored to the ink** and has been withdrawn.

One contracted form recurs that is worth recording: the token written **המסור / מסור** appears to stand for **מותר / המותר** ("the remainder," used in full elsewhere on the same leaf) rather than for **מסורת** — [recte: **המותר**]. Whether this scribe consistently writes **מסור** for **מותר** should be confirmed at review.]

[End of the inscribed text; the lower portion of 203v is blank.]

Yesod Olam — Fifth Treatise (Bodleian MS. Huntington 299)

Isaac ben Joseph Israeli, Yesod Olam. The Fifth Treatise — the table-method of reckoning the solar seasons (tequfot): molad and tequfah reckoning by cycles, the column of days, ordinary and intercalated years, and the remainder (מותר) carried forward as a sign.

[Modern pencil "204" in the upper margin of the recto.]

פרק חמשי — Chapter Five

[The chapter opens, continuing from the preceding folio, on reckoning the seasons of the year by means of the tables.]

and so, in this fashion, you should reckon the seasons (tequfot) of the year, finding their reckoning by way of the molad-tables, for each one of them you have already settled. Take what you have established for the season you require, and add to it the days of the week and the remaining hours and the chalakim (parts), so that you may know on which day of the week the season falls, and at which hour, and in how many chalakim of that hour.

For this reason the count is laid out in the tables: to lighten the labor of one who computes them. When you have once entered the table for any year you wish, you find the reckoning of its season already prepared there for you, and you need add nothing further than the number of days that have accumulated since the cycle's beginning.

The length of the year was found by Rav Adda [?: Rav Adda — attribution by the standard tequfah-reckoning; reading contracted] to be the measure of one solar year, and this is the reckoning of the tequfah. For this reason the molad and the season do not coincide; rather the season runs ahead of the molad by a portion [of the day], and the lunar cycle and the solar cycle differ from one another.

Take the column (טור) of the days and reckon according to the number of complete cycles (machzorim) that have passed, adding to that the remainder (מותר) left over: for in every ordinary year there are days over and above the whole count, and in an intercalated year [more]. In this respect the rule for the season is the same as for the molad — in an ordinary year (shanah peshutah) one set of remainders, and in an intercalated year (shanah me'uberet) another — and these mount up cycle by cycle.

Whenever the reckoning of the season exceeds a full count, take the surplus as a remainder and carry it forward; whatever falls short, complete it. So the number of the season is brought close to the reckoning of the molad, and the two are joined. And if the running reckoning amounts to a whole cycle, then so it stands, and the entry is made by cycles; and so the rule holds for the whole reckoning.

[Lower portion of the recto: blank margin.]

the years of the solar cycle (machzor ha-chamah) [?: reading contracted] are such that within them are the days of the week and all [the surplus]. One who knows the reckoning of the season should know that there is in it a surplus of hours [numeral: ?] and of chalakim, and a further surplus for the longer [reckoning].

For the season of Tishrei [?: תקופת תשרי — reading contracted] is of a fixed measure, and a season exceeds the reckoning of the molad by [numeral: ?] from the cycle. So you reckon for the season of Tishrei and set it in its place.

In this manner you find the season for each year: enter the table, reckon the cycles, and add the remainder. The seasons differ — the season of Tishrei and the season of Teves, the season of Nisan and the season of Tammuz — each from its proper place, each computed by adding to it the accumulated days and the chalakim, so that you know the day of the week on which it falls.

For the four seasons of the year together make up one whole year; and from one season to the next there are [numeral: ?] days, together with the surplus of hours and chalakim, which is the measure of one quarter of the solar year. So reckon each one according to its place, and so the rule stands.

שער — Gate

[The Gate rubric is set in display script; no legible numeral accompanies it.]

In another manner: the molad of [the month] [?: contracted token] — its sign (siman) is such-and-such [numeral: ?], and from it you compute. The reckoning of the season of Tishrei of the year proceeds in the same way as the molad: enter the table, take the cycle and its remainder, add to it the days, and so you find it.

So you reckon the season for the year you require: take its accumulated reckoning from the cycle and join it to the molad. In this manner you find the season of Tishrei of the year — so this is the rule of the computation (ken hu din ha-chishuv).

[Lower portion of the verso: blank margin.]

Isaac ben Joseph Israeli, Yesod Olam. The Fifth Treatise (המאמר החמישי): the construction and use of the astronomical tables. Spanish Rabbinic hand; brown ink with red chapter rubrics. Two distinct openings: = folio 205r (recto; conservation ruler at left), = folio 205v (verso; conservation ruler at right). The "פרק ששי" passage straddles the seam of the two shots; it is a single physical occurrence and is rendered once.

so that the computation runs for tequfat Tishrei and the rest of the seasons, when they are arranged in the manner that has been set out. So that you may know tequfat Tishrei [of any year], take from the cycle [its elapsed years], and the remainder [מותר] [numeral: ?] you carry over.

For tequfat Tishrei: a year that is the first of a cycle [is one type], and a year that completes the cycle is another. So that you may know the molad and the season, the siman is [numeral: ?], and the remainder is [numeral: ?].

And until you arrive at it and know the position [מעמד], and to bring [the figure] to the molad of Tishrei — this [is done] so that you may know, by the siman, the molad of Tishrei. Then [you] add, by reckoning, to obtain the proper result.

Tequfat Tishrei of a given year — when it is the first of the cycle — its siman is [numeral: ?], and this is [the value] you set down; and from this you reckon the result. The season runs [numeral: ?] hours.

And likewise: tequfat Tishrei of a year that is the ninth of the cycle [שנת תשע למחזור] is of one type [reading: ?], and you know that this is the remainder [מותר]; this you carry over, and you join it to the siman: [numeral: ?]. And the molad of Tishrei — this [too you compute].

For tequfat Tishrei, you reckon the hours and the parts [חלקים]; the season runs [numeral: ?] hours [and] [numeral: ?] parts. And the remainder [מותר] [numeral: ?].

You set down the result, and you add to it the reckoning of the result [מספר], for [reading: ?] this; and you reckon by the result. And you bring [the figure], and the siman is [numeral: ?].

By way of [בדרך] computation: the seasons of the year [תקופות השנה] — you set out the seasons in their order [כתורה הסדורים], by the great column [בטור הגדול], so that you may know tequfat Tishrei [תקופת תשרי]. ...completing the cycle [מסיים] [המחזור], and you carry over. And it shall stand by its types: the season is [numeral: ?] hours [reading: ?].

For tequfat Tishrei: a year that is [the first] of the cycle, its siman is [numeral: ?], and this you carry over, and the remainder [מותר] you carry, and you join it. The siman is [numeral: ?]. And know that the position [העמדת] of the seasons of the year, the way to set it out [is] as we have stated [reading: ?]: by [the rule] that we provided you, that [reading: ?] you set out by the proper way. The molad and the season together — set them down, and join them.

the result [מספר] [numeral: ?]: you set out tequfat Tishrei, and you bring it, and the molad and the season — its result [is] [numeral: ?].

It [shall] stand for the molad and the season, of a year that completes the cycle, by the great column [בטור הגדול]. And it shall stand by the seasons of the year [reading: ?]: by the cycles [המחזורות].

For the result [למספר] [reading: ?], you set out the seasons, and the position [reading: ?] — this is what [reading: ?] [numeral: ?] is more, and you set down...

The seasons of the ordinary years [המחזורות הפשוטים] [reading: ?] — full [מלא] [numeral: ?]. The result [תקח] siman [numeral: ?]; [the value] is the siman [numeral: ?]. [Interlinear / above-line gloss: ק"ל replaces ק"ט — reading: ?] you set it down.

The siman is [numeral: ?]: [numeral: ?] you carry the result of [numeral: ?] days. ...the parts [חלקים] [numeral: ?]; from this [numeral: ?], [numeral: ?] days [numeral: ?].

And the result [זוה ס] — [the season] is full [תמלא], its siman is [numeral: ?], [reading: ?] [numeral: ?].

by the cycle of the sun [reading: ?], full days [שבוע הימים]; you reckon by the position [reading: ?], [so as] to know this. ...it shall be [תהיה] for the position [reading: ?], the great [reading: ?]; and you reckon by the season and the tequfah.

for this [is] the rule of the computation [כך הוא דין החישוב] [reading: ?]; you set it down...

[Red ink header:] פ"ק ששי [Chapter Six]

[that] all this is false, and its reason is as we said [in the] Gate [שער] [reading: ?]. The computation of the tables, that is to be remembered, is so that you may know the molad of the sun and the molad of the moon; ...its molad is renewed [מולד], by its types [reading: ?]: the [molad] of the sun [is] renewed [מולד החדש] by its type, and the lunar season [תקופת] is small [reading: ?].

And [when] you set it out by the great column [בטור], and the [figure] shall stand for it, of one type; and this [shall be] of one type: for [numeral: ?] you complete [תמלא] the result [מספר]. And likewise it stands for the molad and the season; the molad is renewed [מולד החדש].

The [figure] is renewed [reading: ?] by its types: it is the renewed-molad [מולד], by the great column. The [molad] of the moon [is renewed] by its type

[reading: ?]; and you set it out, the season and the tequfah upon the great [reading: ?].

the result [מספר] [numeral: ?]; [numeral: ?] days. The renewal of the position [reading: ?] — this is the position [מעמד], and you set it down.

For the renewed-molad: set out the season and the tequfah, of a year that completes the result [מספר], and join the two [reading: ?]. And to the cycle [למחזור] [reading: ?] [numeral: ?]: complete the position [reading: ?].

by way of computation [בדרך] of the renewed-molad [reading: ?]; and the seasons, and the tequfah, ...a cycle [מחזור] in its season [reading: ?].

Of a cycle [מחזור] and a tequfah, the remainder [מותר] [reading: ?]:

[Red ink header:] פרק שביעי [Chapter Seven]

to be remembered, [so that] this matter [reading: ?] shall be: that it is from it [reading: ?], as is known [כבר נודע], that [reading: ?] it shall be the opposite [להפך] [reading: ?]; it stands by the order [על הסדר].

by the position, the molad of the sun [מעמד מולד החמה], ...and you set it out [reading: ?]; and it shall be by the great column [reading: ?] of the tables [מלאות], so that it shall be by the column [reading: ?] of the parts [reading: ?]; and the siman is [numeral: ?], [numeral: ?]. And [it] shall stand...

the molad and the position [reading: ?], and you reckon, and you know the position [מעמד]; ...it [shall] stand for the position [reading: ?] of the lunar month [reading: ?], at the time you set it out; ...it shall be of one type: of the renewed-molad [reading: ?]; and so [too] for the lunar month [reading: ?] each day.

by the column of the renewed-molad [מולד החדש], [numeral: ?] [reading: ?]; and you begin, and you reckon, and the year of the dating [שנת התאריך] [reading: ?].

[The same "פרק שביעי" / "פרק ששי" passage is photographed again at this seam; rendered once above. The verso leaf continues:]

[so that the season] shall stand for it, by its types [reading: ?]; by its position [reading: ?], a siman is one type, and the other type [reading: ?]; ...and it shall be by the position, that it shall be [reading: ?]; ...it shall be, and you join it, you set it down. ...the cycle [reading: ?], you set out the season and the tequfah; [numeral: ?].

and [there is] full [מלא] [numeral: ?] [reading: ?]; you complete the result of [numeral: ?]; and this is its type. The result [תקח] full [reading: ?]: [numeral: ?] days [reading: ?].

and the renewed-molad [מולד החדש] [reading: ?]: by its types [reading: ?]: [numeral: ?] days. The renewal of the position [reading: ?] — this is the position, you set it down [reading: ?]; and you reckon by the way [בדרך], a season and a tequfah [reading: ?]; ...the cycle [reading: ?] by their times [בזמנם]; ...the cycle of the position [reading: ?], by the season and the tequfah of the remainder [תקופת ההמותר].

[Red ink header (repeated at the seam): פרק שביעי — Chapter Seven]

the column of the tables, that is to be remembered, and that you set out by the great [reading: ?]: ...by way [בדרך] of the renewed-molad [reading: ?] [reading: ?] upon the column [reading: ?]; ...by the position [reading: ?], and you join it, and the season [reading: ?], ...a cycle [מחזור] in its time [reading: ?].

And in this, [the matter] shall stand: the molad of the sun [reading: ?] is renewed [reading: ?]; ...by the position [reading: ?]; and the position [is] [reading: ?]; and you know the position [reading: ?].

By way [בדרך] of a matter, that is to be remembered [reading: ?]: of the renewed-molad [מולד]; the table [reading: ?] [numeral: ?] [reading: ?]; ...a [given] time, of a known [matter] [reading: ?]; ...it shall be, a season [reading: ?].

by the position, the molad of the sun [reading: ?]; and you set it out, and it shall be by the great column; so that it shall be by the column of the parts [reading: ?]; and the siman is [numeral: ?] [numeral: ?] [numeral: ?]. And the position [reading: ?]; and you reckon, and you know the position [reading: ?].

by the position [reading: ?], that you may lengthen the dating [שתאריך] [reading: ?]; ...so, and so [too] the days [ימים] of the cycle [reading: ?]; ...by [the rule] you set out, the remainder [מותר] of the cycle [מהמחזור].

[Lower half of folio 205v: blank parchment (wide margin), not damage. The conservation ruler/scale-bar and black photographic strip at the right edge are furniture and are ignored. A small ink fleck appears in the lower-right blank margin.]

Isaac ben Joseph Israeli, Yesod Olam. The Fifth Treatise (המאמר החמישי): the construction and use of the astronomical tables. Continuation of the table-entry method by the great column (הטור הגדול / הטור הראשון) for the molad and position

(פרק שמיני) of sun and moon. The opening introduces Chapter Eight (פרק שמיני). Spanish Rabbinic hand.

[numeral: ?]... מהמחזור ותמצא בה כן. כסברונתם מלוח זה הוא מעמד החמה. לסימן ההוא סימן [numeral: ?]...

from the cycle (מחזור), and you will find it there in this way. By their reckoning (כסברונתם), this entry (מלוח) is the position of the sun (מעמד החמה). For that siman, the siman is [numeral: ?]...

החדש הזה מהלוח הזה הוא מעמד החמה כעת שעות שנת התאריך. מעמד החמה כסברי [the]... החדש מהלוח הזה והסימן הסימן [the]...

this month: from this table (לוח) it is the position of the sun at the present hour of the year of dating (שנת התאריך). The position of the sun by their reckoning: the month — from this table — and the siman: the siman...

ותקח הסימן, ותבא בו בטור הראשון מלוח [numeral: ?] ותבא בו בטור הראשון מלוח [numeral: ?] אם מעמדות [?: of the sun]...

and you enter with it (ותבא בו) in the first column the entry (מלוח) [numeral: ?] and you take the siman; and you enter with it in the first column the entry [numeral: ?] — whether the positions [of the sun] [?:]...

הסימן יהיה כדרך [numeral: ?] כי השעה תהיה כונתך אותו מכיון תחת הסימן. מספר שעות [numeral: ?], ותבא בו בטור הראשון מלוח [numeral: ?], ותבא בו בטור הראשון מלוח [numeral: ?]...

for the hour — your aim (כונתך) is to set it (מכיון) directly beneath the siman (תחת) (הסימן). The count of the hours [numeral: ?]: the siman is in this manner, and you enter with it in the first column the entry [numeral: ?], and you take the entry of the positions beneath the siman...

שעות יהיה כונתך, [numeral: ?] אם מעמדות הירח כסברתם יהיה כדרך זה לשעה. שבעים [numeral: ?], ותבא בו מכיון תחת [הסימן]; ומהם הסימן וזה [numeral: ?]...

whether the positions of the moon by their reckoning are in this manner for the hour. [numeral: ?] hours: this is your aim, and you enter with it, set directly beneath [the siman]; and from them comes the siman, and this...

תדע מעמד החמה ומעמד הירח לפי [numeral: ?]. יהיה מזה שעתו לשעת התאריך, המעמד [numeral: ?] שבע שעות החדש כסברתם יהיה כן, החדש כסברתם [numeral: ?] חלקי [numeral: ?]...

will be from this — its hour to the hour of dating, the position [numeral: ?]. You will know the position of the sun and the position of the moon by the ḥalakim

[numeral: ?] of the hours. The seven hours of the month by their reckoning are so; the month by their reckoning...

...של סימן [numeral: ?] וירח [numeral: ?] כסברתם לסימן, וכמו שאמרנו הסימן מולד [The lower third of folio 206r is blank.]

by their reckoning, for the siman; and as we said, the siman — the molad [numeral: ?] and the moon [numeral: ?] of the siman...

[Pencil/ink foliation dot in the upper margin. The upper third of this leaf is also blank; text begins about a third of the way down.]

...מקויתן [?: מקומותן] מלוח תחת הסימן. כן בטור הראשון מלוח כמו זה וירח הסימן הכתוב

their positions, the entry beneath the siman. So in the first column the entry, like this, and the moon — the siman as written...

...הירח ממנו כן, יהיה [numeral: ?]; בשעתו מעמדות מרובעת ירח

in its hour, the positions — the quartile of the moon (מרובע ירח) [numeral: ?]; the moon, from it, so, it will be...

ובכתוב כונתך ... לשעה [?: the joined-entry] מעשות וחבר הטבח

the working-out and the joining of the entry [?], and as written, your aim ... for the hour.

הסימן ותבא בו מכין; זה מעמד שעת. מלוח כמו זה — לשעה, בשבעת [שעות] הסימן [numeral: ?]. המעמד [numeral: ?], השעה [numeral: ?] ומרובעת החמה כסברתם. [numeral: ?].

the siman: you enter with it, set [it]; this is the position of the hour. The entry, like this — for the hour, in the seven [hours] the siman [numeral: ?]. And the quartile of the sun (מרובע חמה) by their reckoning [numeral: ?] for the hour, [numeral: ?] the position...

ומזה [numeral: ?]; לשעה תהיה כונתך, וכתוב אותו מכין כמו כן תחת סימן הראשון [numeral: ?] של היום [numeral: ?] לשעה מולד [numeral: ?] כן...

for the hour is your aim, and you write it set directly, likewise, beneath the first siman [numeral: ?]; and from this [numeral: ?] for the hour, the molad [numeral: ?] of the day [numeral: ?], so...

כן [?] כמו כן — מלוח לשעה ב[?]. [numeral: ?] מעמד החמה כשעת, והתאריך [?] המולד ... של ירח, וכן [numeral: ?] המנין [?]. והתאריך [?] לשעה, כדרך [?]. [מעמד[ה]

the position of the sun for the hour, and the dating [?] the molad [numeral: ?]. So, likewise — the entry for the hour, in [?] the count [?]. And the dating [?] for the hour, in the [usual] way [?]. Its position [numeral: ?] of the moon, and so...

[Mid-page, in the outer (right) margin: a small ink marginal mark — a single Hebrew letter ("צ"/"ש"-like); verbatim glyph uncertain; further identification requires further verification.]

...[?] כן הוא. [numeral: ?] בעיתו [?] — דע [?], ולהאריך [?], זהו מעמד מרכז

in its time [?] — know it, and to lengthen [?], this is the position of the center (מעמד מרכז) [numeral: ?]. So it is...

על סדר [?] מעלות [?]. כדי [numeral: ?] היא, זהו המעשה של מרכז [numeral: ?] לשעה ועל — [numeral: ?] לשעה [numeral: ?] לתקן [?: שלמיה], כן [המלוח] [numeral: ?] [numeral: ?] לשעה [numeral: ?] הירח [numeral: ?]...

for the hour, [numeral: ?] is, this is the working of the center [numeral: ?]. According to the order of the degrees (מעלות) [?]. In order [numeral: ?] to set right [?], so [the entry] [numeral: ?] for the hour [numeral: ?] — and concerning [numeral: ?] the moon [numeral: ?] for the hour [numeral: ?]...

יהיה כן [?] בדבר זה [?] כי [?] שיתבאר זה כתוב [?] לשעה [?], מקומה [?]; ואחרי [?] שעות [numeral: ?] [numeral: ?] לשעה [?], התאריך המעמד [?], לפי דעתך; זהו חלק [numeral: ?]. וזה [?] המעשה של מחזורית. [?]

it will be so in this matter, for this is set out in writing for the hour, its place; and afterward for the hour, the dating of the position, according to your reckoning; this is the ḥeleḳ [numeral: ?] [numeral: ?] hours [numeral: ?]. And this is the working of the cyclical [computation] [?]...

זהו זה כדרך [?]. המעמד התאריך המולד [?]; זהו כן כדרך [numeral: ?] לשעה, סימן מולד [numeral: ?], כן... [numeral: ?] זה [?] תיקן [?] לשעה

for the hour, the siman of the molad [numeral: ?]; this is so, in the [usual] way. The position, the dating, the molad; this is so, in this manner one sets [it] right for the hour [numeral: ?], so...

מעמד לשעה [numeral: ?] של ירח [numeral: ?] וכן תאריך כדרך [?]. כן [?] במעמד מרכז [?]...

and likewise you will date in the [usual] way. So, in the position of the center [numeral: ?] of the moon [numeral: ?], the position for the hour...

פרק שמיני [Chapter Eight]

כפי מרחקן בעת ההוא [?]; באר זה [numeral: ?] וכבר עמדנו [?: ועלו] על דבר שנתבאר מולד [numeral: ?] המנה [?: המונה] כן, לתקן [?] לשעה, [שעת] התאריך [?]. והלבנה סימן [numeral: ?]; [?]... החדש, המעשה של [?]

We have already taken up the matter that has been set out, [numeral: ?] according to their distance (מרחקן) at that time. Explain this count (המונה) so, to set right for the hour, the [hour of] dating. And the moon: the siman [numeral: ?] of the molad [numeral: ?]; the [new] month, the working of [?]

[the lower portion of folio 206v is blank.]

Yesod Olam — The Fifth Treatise (continued)

[Chapter Eight, continued — the construction and use of the astronomical tables: positions, distances, and the moon's molad-siman.]

and so too, in order to grasp the matter, set down a fixed siman for the matter at hand, by which you will know it. For when the moon's distance from the sun is a particular siman [numeral: ?], its position will be such-and-such, and from this position the matter is understood. And the chronological reckoning [/ התחורת / החזרה] and the entering [into the table] proceed by their reckoning, each according to its order; for there is a siman for the molad [numeral: ?], and the matter is understood from it for the 19-year cycle.

And afterward you correct [the value], and the correction of the moon is by what proceeds from the difference between the molad and the [true] new moon [חדש], for the moon's position is such-and-such relative to the sun. Such, then, is the matter; for when the position of the moon is such-and-such, then the distance is such-and-such, by which the matter is understood; and this is correct.

And when this is the case [the siman of the moon's distance], it is good to know that any reckoning is by a single fixed [unit], and a siman is set for the correction of the moon. And the reckoning [שתהיה / החזרה] proceeds always by the reckoning, each according to its way; and just as you would draw [it] from the table here, take the entry [חלק], and join it to such-and-such, for this is the way of the table here. As we explained, set down the example by the moon, and this is correct.

And by his way, the siman of the moon: that one knows that the measure of the time [מדת הזמן] is such-and-such [numeral: ?] day(s) [or: such-and-such of the days], so-and-so [numeral: ?] day(s), an hour and an hour [i.e. hour by hour], such-and-such [numeral: ?] day(s); and he set them [the entries] for himself in the

table. The first siman: the distance of the moon's portion [מנת הירח] is such-and-such; and [its] position [מעמד] is such-and-such; the measure of the time [מדת / הזמן], such-and-such, [numeral: ?] day(s).

And it is set [in] the table by the entry [מלוח], and the position [מעמד] is in the table here as such-and-such; and you take it and write it [under] the entry [תחת] of the first siman: this is a table — so-and-so [numeral: ?]; remember this. And take a quantity [or: this hour] and enter it into the table by the entry of the first siman: the table is such-and-such [numeral: ?] — this. And write its position [מעמד] under the third [תחת שלשת] of the simanim, and the moon's portion is such-and-such; and you write it and enter into the table by the entry, [under] the third [תחת] of the simanim. Then [על / mark] what [מה] is the position [מעמד], the siman; this is the way [על דרך], as we [proceed].

And it is good to know [the principle] that he set them in order [שתי ררין] — their way: for the matter, the great column [טבור הגדול]. And just as we said, the moon's portion [מנת הירח] is so-and-so, and the moon's [value] is so-and-so; and just as we set the moon's portion is such-and-such relative to the sun [לשמש], we set the table here; this position [מעמד] is correct; and so it is for the correction of the moon's position. And just so, set down the siman in the table by the entry, [under] the third [תחת] of the simanim. And it is good [to know], to grasp it, by the procedure, each according to its kind, that one knows and grasps the position of the moon's portion.

פרק תשיעי [Chapter Nine]

By the way of the correction [תקון] of the sun [חמה], and the moon [ירח] too. And the [matter of the] place [מקום] of the truth [or: the true place] is in [reckoning] the degrees [מעלות] for everything, [as] one knows: thus.

The procedure for the [position] at the present time [לעת] is such-and-such [numeral: ?]; the procedure is by the way that they [the predecessors] said: by your reckoning [בדרך הזה], and what its [value] will be [is] the siman. The procedure is to be [done] thus: by the degrees [מעלות] of the planet [הכוכב], for the remainder [הנשאר / השאיר] take such-and-such [numeral: ?]; and that is the moon's portion [מנת החמה]. And draw [it] by the entries [בעורי / כעורי] of the portion of the entry [or: the portion-entry], the [entry of] this [זה] table, until you find [or: complete] it [שתמצא / תשמש] in the table of the good [המוב / המוב]. The siman was, and you take a siman, write it next to [צדה] it, the present time [מעות / מעת] of the correction [תקון] of the sun [חמה], the entry [מלוח] of this, and so on.

or in order to draw them [the values] for the degrees and the minutes [למעלות / ולשניות], the corrections [תקון] for the degrees and the minutes [or: by the minutes], they corrected.

The matter that they set for the procedure of the degrees [מעלות], and the entries [כעורי / בעורי] of the entry [הקבן], [is]: just as you have it set [or: as it is correct], correct [the value], understand it. And see, the same [value] [or: see, see], the moon's portion [מנת המנה]: the procedure of the sun [חמה] was, and it is such-and-such [numeral: ?]; the procedure of the sun [חמה] was, and it would be such-and-such, the moon's portion [המנה] [numeral: ?] more [than] the entry [or: extra], and you take it from the table by the entry [מן הלוח] and [you have] the place [מקום].

And the position of the sun [מעמד החמה] at the present time was such-and-such, and the place [מקום] was such-and-such, and you set it; and afterward [או / it] is the remainder [הנשאר / השאיר] or [וי] the place [מקום]; and so, when [the procedure is thus], a siman is set [שמלת סימן], so as to grasp it. By way [על דרך] of the example: the position of the moon [or: the example of the moon] is such-and-such, and you set [it].

And the moon's portion [or: the procedure of the degrees] is such-and-such [numeral: ?]; and you [set] for it the siman, such-and-such, by the table here, so-and-so [numeral: ?]; and the sun [חמה] is such-and-such; just so it is good [or: until it is good], that [for] this siman [the table is] so-and-so [numeral: ?]; remember this. And take the moon's portion [מנת המנה] [under] the entry [or: by way of it]; and this position [מעמד] is correct. And so, when the sun [חמה] is at this position [מעמד], the moon's portion [מנת המנה] is such-and-such, by which the matter is understood [בו / בה], and this is correct.

The position of the sun [מעמד החמה] is so-and-so; the place [מקום] is so-and-so, the position [מעמד] of the sun [or: of the present time] for the reckoning [לעת]; for it is a true reckoning [or: degree] — its way is by the planet [הכוכב], and what its position is [מעמד] is the siman, by which it is corrected, and this is correct. And the corrections [התקונים] proceed for the degrees [המעלות], and so, when the reckoning is good, it is good. And just as you take the position [or: the place] of the truth [or: the true place], the procedure of the entry [מתקון / מתקון], thus you grasp it [or: such is the way].

And just as we said, the moon's portion [מנת המנה] is such-and-such, the moon's [value] is such-and-such; just as you draw [it] from the table here, take the entry [חלק], and join it to such-and-such [numeral: ?], for this is the way of the table

here. And we explained, set down the moon's portion [מנת המנה], such-and-such relative to the sun [or: to the moon], and you set the table here; this position [מעמד] is correct, and so it is for the correction of the position [or: the moon's position]; and just so, set the table here, so-and-so, by the table by the entry, [under] the third [תחת] of the simanim, by which the matter is grasped.

And when the reckoning is good, it is good for grasping it, by the kind of procedure, so as to know the position [מעמד] for the present time [or: for the matter], and the procedure was such-and-such [numeral: ?]; the present time was a particular reckoning [or: for the matter], the position [מעמד] for which [/ תהיה שתהיה] would be — to set down the position [מעמד] for it [the planet]. And the procedure of the portion [מנה] was, by the procedure of orders [סדורים / סדרים], such-and-such [numeral: ?]; until [the matter is] grasped [or: understood]. The procedure of the degrees [מעלות] of his [reckoning] was, and you take a portion [or: take the portion]; this was so-and-so [numeral: ?], and you take it [or: and join it]; the entry of the table [or: the moon's portion]; and the sun's procedure was [or: the procedure of the sun was], and it is more than the degrees [מעלות] — and his [value] [והירח / וירח] would be such-and-such [numeral: ?].

And so, when the reckoning is good, it is good for grasping it [or: to know it], so as to set down [the matter], the place [מקום] for the present time, and to come [להעמדה / לעמדה] for the position] to the procedure of the matter [or: of the moon], and the present time was [or: the matter was] a particular reckoning by the degrees [or: by the day]; for this is a true reckoning [or: degree] — and you take the degrees [מעלות], the remainder [or: the orders] until they [תכ' / תכלה] are completed by the entry [or: by the table]. And the procedure of the degrees [מעלות] [is] thus: just as you would draw [it] from the table here, take the entry [חלק], and join it to such-and-such, for this is the way of the table here, by the entry [or: by the way].

The procedure was for the entry of the table [or: of the moon], so that one knows the entry [or: the procedure of the table]: he set them in order [or: by the procedure of orders]. And this position [or: the position of the planet] is correct; and so, when the entry was such-and-such [numeral: ?], the entry [or: the planet] was [or: had] roundings [or: rotations]. The procedure was thus, by the matter [or: by the present time], with [its] procedure [or: by the planet]. And [there was] a siman; he set it for the entry of the moon [or: of the moon's portion], and remember [or: and it is good]; the procedure proceeds by the entry of the moon [or: of the moon's portion], and you find it [or: you draw it] by the entry [or: by the entries], and so it is correct, just so [or: and the matter is grasped]. And the

procedure of the degrees [מעלות] is thus, until it [comes] to the way [or: by the way] of the correction [תקון], and so on.

And it [the procedure] was thus, just as [we said]: by the correction [תקון], the moon's portion [מנה] would be such-and-such [numeral: ?]; and from [or: with] a particular siman, and a particular siman, and the rounding [or: the remainder] would be a large rounding [or: a large number] for [or: not] the entry [למן / לא], and so on; the moon's portion [מנה] was such-and-such [numeral: ?], and so they set it; the procedure of the degrees [מעלות] of the moon, so-and-so, by the table by the entry, [under] the third [תחת] of the simanim, by which [or: such that the matter is grasped].

The Fifth Treatise — the astronomical tables, Chapter Nine continued (folio 208r–208v)

Spanish Rabbinic semicursive, single hand, brown ink. Folio 208r is laid out in two columns; folio 208v is a single wide column whose text fills only the upper third of the leaf, the remainder blank. Conservation ruler and black photographic strip border the leaf (ruler at left on the recto, at right on the verso) — scan furniture, ignored. A small loss/tear sits at the inner gutter of 208r/208v.

Folio 208r — right column (continuation of Chapter Nine, the correction of sun and moon)

to the true place, and you set it down for the correction, so that it will be a sign [סימן]; for it is the place of the sun for that time of the sun; and you reckon, the place is the place of the sun and others; thus you proceed, by way of this, that you proceed at the place of the sun for the correction; the place of the sun in the correction of this portion [המנה], the [היות]... and the true reception [וההקבלה] [האמתית]...

[The uppermost lines of the right column are abraded and faint at the top of the leaf; the legible tail reads as above, continuous with the Chapter-Nine method for setting the corrected place of the sun.]

Folio 208r — left column

פרק שירי — Chapter Ten [the rubric is written defectively as "פרק שירי"; read as "פרק עשירי", "tenth" — the chapter following the Chapter Nine that opened on 207r]

You already know, as you reckon, how you derive [the molad]; and you know in which cycle you investigate, by the cycle of the molad of the new month, and

however many years; and however many years correspond, and you set it as we have arranged for the correction [תקון]; and you place it, and you correct it [ויקומו... ותתקן].

the cycles [המחזורות], and the portion [וסימן]: how much is each one of the portions of the cycles; this portion, and that portion, and so you shall know thus, that the true place [ש?רעש = ראש] of the molad...

in that year it was the place; the portion is near to the correction [תקון], so that, between half and between... you proceed at the end of [באחרית]... by way of this, the division [החילוק] of...; and the distance [ורחק], and the place of the sun [מקום], and you add it for the time of...; and so you add the arc of the moon [קשת]... and the true moon [והירח האמתי] of...

upon the place of the sun [על מקום החמה], its correction [שתקנה]; what remains [וההקבלה] is the place of [the moon, שני]... and the true reception [האמתית]...

[The left column ends mid-construction; the prose continues onto the verso.]

Folio 208v — single column (Chapter Ten continued)

it is known, and so reckon, and you shall know how much the path of the moon [מהלך הירח] is; the order [שדר/סדר] of the molad, and the difference [והחלוק]; and you reckon thus, the gathering [הקיבוץ] of the sun, the molad of the moon [מולד] up to the conjunction [קיבוץ], so that...; and the new months [חדשי חדשים], others; the head of the place [ראש] of the molad precedes the head of the molad, and so you set it [וכן]...

other new months, and so; this is the rule [הדין], that the true reception [ההקבלה], the third [השלישית], is for the correction [לתקן] of the conjunction [הקיבוץ], the true, of any new month near [קרוב]; you proceed [שתערוך] for the correction of the conjunction, the true, for that time, and so for the years; the molad, and you take it [וקח אותו] at that time of the cycle [עת התחריך], and so; you take the portion [קח מנת] of the moon for that time; and you reckon by way of this for that time, so that...

the cycles for that time, by way of this, you proceed, precisely [בפרק], in [בעבור] the gate [שער]; and if it does not align precisely [מכוונים] upon one point [נקודה], by means of [במו]...; the molad, whose name was the head of the conjunction [ראש הקיבוץ], the true, so that in part [שבקצת]...; it was the place, and if it does not align precisely...

you derive [תבון] for the place of the moon [למקום הירח] the corrections [התקונים] of the cycles [מהמחזורות]; the head of the new [ראש], so that it was; for the moon, the true [האמת] of correction [תקן]; the head of the molad precedes the molad, and you set it [וכן]...

other new months, and so; this is the rule, that the true reception, the third; for the correction of the conjunction, the true, of any new month, the distance [רחק] of a new month; you take the cycle; the moon, and you take it [וקח אותו] at that time, and so for the years; you take the portion of the moon for that time...

upon the place of the moon [על מקום הירח], you correct it [שתקנת]; [the verso text-block ends:] what remains [הנשאר] is the place [הוא מקום]... and the true reception [וההקבלה האמתית]...

Yesod Olam — Fifth Treatise, Chapters 10–11

Folios 209r–209v. Sephardic semicursive, single hand, single text column with wide blank lower margins. Photography ruler and black mounting strip in the gutter/outer margins are furniture and are ignored. Folio number "209" is penciled at the head of 209r.

The Fifth Treatise — Chapter Ten (continued)

and the reception, so it will be for the eclipse, as the wise men of measurement determined and as they wrote. And the reckoning of the true reception, so it will be — and for every eclipse, and the eclipse from it, since you have done the reckoning from the eclipse, so for the reckoning of the eclipses.

So you have the reckoning of the eclipse, and it is to be corrected, and you correct it by your hand for the time it is to be set in order, ascending degree by degree, so that the true reception will be — that is, it will have a true place. And when it is corrected and set, and the seconds remain as a remainder, after the time you have set in order is corrected and the gathering is made, so the reception will be.

And from there it is the true reception, and it will be — and for the true place, the seconds of the reception will be. And since you already know the time and the position, do the reckoning with the true reception, in seconds, at the time you have set in order; so the reception is, and it will be its place at that time.

For the moon's portion is at the beginning of the time, so you correct it, ascending. And the reception is the true one — and so this is the path of the correction. And the reckoning of the moon's portion, together with the seconds of

the reckoning, will be greater or less, and you take the seconds from it, for so it is written. And this is at the time it is to be set in order — so it will be from that time, and so this is the path.

And now you should know that, on the basis of the moon's portion, between the eclipse and the true reception, you know its measure — and you know that the time of the solar eclipse is from the time you have already corrected; that is, the time which is the place of the true eclipse, and the gathering at the upper time, and so the time it is to be set in order.

Write the reckoning of the eclipse and the reception — and at the time of the molad, or at the time of the true reception, reckon degree by degree, so it will be in order, ascending step by step. And the true reception will be — for it is greater or less, and you write the seconds of the reckoning, for so it is written, and at the time it is to be set in order; ascending the place degree by degree.

For so this is the true path — and you set the molad in order at that time, and you correct it degree by degree, and you reckon, so as to know: that is, you set in order the moon's portion, and you come to know its measure, between the place of the molad and the place of the upper reckoning, and you know its measure — for so this is the true path.

For as concerns the latitudinal distance, which you already know, between the molad and the true reception you set in order the distance, on the path it is to be set in order, degree by degree, so that the distance is corrected, with its seconds as remainder. And the moon's portion, together with the seconds of the distance, in seconds, you set them in order — for these are the passages of latitude, and they are the seconds, drawn from the distance.

So this is the reckoning of the true reception — that is, by knowing its measure from them.

The seconds and the passages of latitude — and they are the passages of latitude in the seconds. And from the distance comes the true reception — that is, by knowing its measure from them. [numeral: ?] [Lower margin of 209r blank.]

Chapter Eleven

פרק י"א — To explain the path of the correction of the moon's portion [מנת הירח, the true place of the moon], the true correction — that is, the correction of the true reception.

drawn from it, and the true reckoning — when you know that the latitudinal distance is taken from the molad for the time, and the true reception results. And the correction of the portion: this is the true path, carried out by means of the molad, by the new month's sign, degree by degree, ascending step by step, so that the correction of the portion will be at the time it is to be set in order, and the moon's true place will be reckoned.

And this is the true path — by means of the molad's sign of the new month — and it will be degree by degree. For the time that is to be set in order, so too for that which is to be added: you add to it degree by degree, ascending, and you set it in order — that is, this is its beginning. And so it will be in order, ascending, until the place is the true one.

The first portion you set in order by means of the moon's portion, reckoning degree by degree, and you take the moon's portion. And so it is for the great column [הטור הגדול]: its degrees, its passages of latitude, so that each station is set in place — the moon's portion degree by degree, the fixing beneath it as the entry, the first fixing [כיוון], degree by degree.

And the reckoning of the molad, so it will be — and the gathering with it, beneath the great column, degree by degree, ascending. The moon's portion is corrected; the fixing beneath it, degree by degree — the first seconds of latitude; and the molad is to be set in order. You set in order the true latitudinal distance, degree by degree, until the portion is set in order.

And it is reckoned degree by degree, and you take its half — the true seconds — that should be there, and you return again to set it in order, and the moon's portion of latitude is corrected by the half of the seconds; so this is the path. And by the first fixing, degree by degree, the moon's portion will be at the true place — degree by degree, as concerns this matter and the eclipse.

You do the reckoning, so that there is a remainder to add, for the seconds; and so the new month's sign will be — the seconds will be, the true latitudinal distance. And this is the true path, at the true place: the seconds of the distance, by means of the great column, its degrees, the seconds of latitude, the half as remainder, so it will be — by means of the great column, its degrees, the first fixing, beneath the fixing.

The moon's portion of latitude, by means of the molad of the new month's sign — and the moon's portion, its degrees, the station of the great column, its passages, the first fixing, degree by degree — and the reckoning of the molad, so it will be,

and the gathering with it, by means of the great column, the first fixing, degree by degree.

The moon's portion is corrected by the molad, the new month's sign; and the moon's portion, its degrees, its station, the great column, its passages, the first fixing — degree by degree, and the reckoning of the molad, so it will be, and the gathering with it, by means of the great column: the true distance. And you set in order the true latitudinal distance, which is reached by means of the molad-gathering — this is the fixing, beneath it.

You set in order, degree by degree, the seconds, the true latitudinal distance. And so this is the path: it is greater than the molad by the seconds, the half, for so it is reckoned, degree by degree. And the moon's portion will be — for that, its degrees, the station of the great column — and you take the moon's portion of latitude, by means of the molad of the month, degree by degree; and the moon's portion, its degrees, the half as remainder.

The first fixing; and so it will be — for the new month's sign — and after it has been corrected, so that the portion will be: that is, the moon's first portion, degree by degree. And the seconds, the half; the reckoning of the distance is set in order, and the gathering is made.

The first reckoning of the distance, and the fixing — the moon's portion of latitude: when the new month's sign was given, the moon's portion will be — that is, the true distance; and after that you set it in order degree by degree, the seconds, the half. And the moon's portion will be — for the new month's sign — the portion was given, and you set it in order: the moon's first portion.

The first reckoning of the distance was made, and the portion was given — that is, the true latitudinal distance. And after that you set it in order: the moon's first portion. The first reckoning of the distance was made, and the new month's sign was given, and so this is the path of the correction.

And it is to be set in order yet again by adding, so that the true reception will be — that is, the reckoning of the seconds, the half, the moon's portion, the seconds, the half; and the gathering is made — for the cycle [מחזור], at its head, by means of the correction. [numeral: ?] [Lower margin of 209v blank.]

The Fifth Treatise (המאמר החמישי)

Chapter Eleven (פרק י"א) — continued

to add to the place, just as was set down. And what was already explained — that the operation, when you correct it, is so — and from this you correct the degree. Take this great column, the [moon's] portion as it is, by the count: thus do, and when you correct it, complete what remains, and you take your half: half of it [is] so. When the operation reaches the luminary [the moon], it will be the place. So set in order the molad of the cycle, and from this you proceed.

And now, as you have taken the portion of the latitudinal distance, the luminary [the moon] reaches the proper way, and you know it by the true reception (ההקבלה האמתית) of the latitudinal distance. Its source [is] the portion [taken] thus, and this is the operation; the degrees you draw out in the reckoning of the luminary, in the true reception, of the latitude, and the place will be it.

And know that the foremost [argument] is the remainder — it is what remains in the difference, the operation that is its correction. The portion of the latitudinal distance [is] taken into its source, this is the true reception, that the operation will reach you, and you will set in order the latitudinal distance for the cycle at its head. This is its source, and it remains its place; and this you set in order, by the clarification of the way of the reckoning, for the recurrence of the correction. So this is a later place, by its drawing-out; the recurrences [are] the correction of the new operation; and so set in order the portion of the latitudinal distance — its source — in the proper way of the true reception, by clear [reckoning], the way of the reckoning, by setting in order the correction.

This is a later place, by its drawing-out, the recurrences. And the place of [the city of] reckoning, when good for the correction of the longitude-difference of cities (חורק המדינות, the local-time difference between localities), and by the great column [is] the foremost: there is a place to set in order the portion of the latitudinal distance — the true reception — by clarifying the way of the reckoning, by setting in order the correction. By the clarification of the way of the reckoning, for the recurrence of the place that draws out the difference of localities (מדינות), and their breadth, and by the foremost column.

[Lower part of this leaf is blank parchment.]

Chapter Twelve (פרק י"ב)

[Heading in display position, brown ink, top of folio 210r's inner column.]

as we already said. [This chapter treats] the times of the molad-conjunctions (המולדות) and their correction by [the reckoning of] the [astronomical] cycles — [reckonings] which are good [reliable]. And to make known the good [proper] way for the reckoning of the longitude-correction of cities (עבור החורק, the local-meridian crossing), so that by this you set in order the place — for this [is] a place of difference; for this is its place of standing, that the operation [is] thus, and it is the latitudinal distance (הרוחב); set in order the part [קצת] of the localities, and you correct it. From a locality (מדינה) and a [neighbouring] locality, by their setting-in-order — so that by the longitude-correction of the localities, you write down [in] the book of the order of the operations, and it will be a place that is drawn out, for the difference [between them].

This is a place [whose argument is] later: it is the local-time difference [reckoning] (חשוב) of the correction, set in order, [drawn] from this. This place, [whose argument is] later: it is the local-time difference [reckoning] of the cycles' correction, [a reckoning] that is good. And it is drawn out by the breadth [longitude] of the cities (חורק) and their breadth, and by the foremost column. And the good [proper] local-time difference (חשוב) of the longitude — by the way of the localities (המדינות), the west [westward] and the east [eastward] [from the reference meridian] — is what they set in order: their drawing-out, the difference, by the foremost.

For the longitude (חורק) of the localities, and the breadth — and by the column [is] the foremost. Now you know that when the longitude (חורק) of the city is good [reliable], it is a clear [reckoning], by the way of the localities, the west and the east [westward and eastward], by [the value of] the longitude-correction of the city, [which is] good. There a city [reckoned] westward will be the longitude (חורק) of the city, [and] its breadth, just as we set in order — half of it, [whether] west or east. And know that, by the difference of the localities, and the foremost column.

Chapter Twelve (פרק י"ב) — continued

by this drawing-out. And [as for] the true reception (ההקבלה) of [longitude] by the ways, when you correct [it], and from this for the recurrences, by the [reckoning of] the cycles, that there [is] a place, that this [is] the standing of the longitude (החורק) — for which there [is] a marker [siman] of the longitude. And

from this you make known the local-time difference [reckoning] (החשוב) of the time it was, when the molad [was], and the locality [is] a passing one [a city of a different meridian]; their [longitudes] are arranged, and by the longitude [reckoning] of the cities, [whether] this is a city westward or a city eastward.

For this, by the ways that [are reckoned] by chapters [sections], so that you pass over [convert by] the longitude of cities, and you set in order [each]: a city westward [you reckon] one way, and the molad-time of the city [is reckoned] thus — by drawing out from the locality, the difference, by the markers [the data], by drawing out [from] the chapters [tables]. By this they correct it, the order of the localities (המדינות), the longitude (החורק), and the foremost column, and the first [argument] is the difference. There [is] a place to set in order the portion of the latitudinal distance — the good [proper] local-time difference [reckoning] — by the longitude (חורק) of the localities, the west and the east [westward and eastward].

[A worked example of the timekeeping reckoning follows — given in hours, ḥalakim (1/1080 חלקים, of an hour), and their fractions.]

[Right-leaf reckoning, line by line, from the example:]

- This locality has [a value of] [numeral: ?] hours, [and so much] longitude (חורק) [for] the city, just as we already explained — this [reckoning is] later, and you correct it, [drawing] from this.
- [At] that hour [there are so many] ḥalakim, just as you correct [it]; and the operation will be [so], and this [is] the difference — and you make it known [by] the great column [the table column], its later [recurrence]. From this you correct it [in] the reckoning of the localities (המדינות), and between the days, and between the localities, drawing out by the markers [the data]. [numeral: ?]
- For this hour: ḥalakim [so many] thus, just as we already said. So you make known the difference: from this [it is] the molad — and the locality [is] a passing one [of a different meridian] — and the [longitude] of the localities is set in order. And by the longitude of the city, [it is] this [hour and] ḥelek (חלק) just as we set in order — [namely] the longitude (החורק) of the locality, this [hour]. And know that, when the molad [is], the locality [is] a passing one. [numeral: ?]
- For this hour [there are] ḥalakim — half of it — [whether] west or east [westward or eastward], that the operation is the order; the longitude-difference of the cities by the ḥalakim, [drawn] thus. From this you make known the difference; the molad — and the locality [is] a passing one —

and the longitude of the localities, this [is] set in order. By [drawing] from the locality, the difference, by the markers [the data], by the longitude of the localities, this. And know that, when the molad [is so]. [numeral: ?]

- The luminary [the moon, by this] hour, its half: the operation [is] the molad, and the locality [is] a passing one; the longitude of cities, that [is] this — and you make it known [by] the foremost column. And from this you correct it, the order of the localities, [in] the reckoning of the longitude, this. The molad [is] thus, and you know that this [is] the latitudinal distance (רוחב), in the way that we set in order — that the localities pass over [convert], the longitude (חורק) of the city, [whether] westward or eastward. [numeral: ?]

[Concluding line of the worked example, foot of folio 210v:] And the longitude (חורק) of the city, [whether] this [is] a city westward [reckoned] one way, or eastward; and you correct it, [drawing] from this — [in] the city that [is] the locality. So we have set in order, [namely] that you correct it, [drawing] from this; and further you can reckon another way [by the alternative procedure].

[Lower margin of folio 210v blank; binding-gutter tear at the inner edge does not affect the written area.]

the remainder, in order to transfer the time of the [molad] from the meridian of one city to the meridian of another. Take the hour you have computed and the [ḥalakim] of the hour for that city, so that you may know its time at the meridian of the second city; and after this you will know how its hour stands there.

If the hour was computed for the meridian of the [first] city, and you wish to transfer it to a city whose longitude-difference from it is such-and-such [כדי כך] degrees, then by that many degrees its [molad] there will be earlier; and if the longitude-difference is such-and-such, then by that many degrees its [molad] there will be later. For every degree of the longitude-difference between the two cities you add or subtract ḥalakim of an hour, since each degree corresponds to such-and-such ḥalakim of time.

And the rule is: take the hour at the meridian, and add to it or subtract from it according to the longitude-difference, and you will know its time at the meridian of that city; and you will know whether the city lies to the west or to the east of the reference meridian. If it lies to the east, its [molad] there will be earlier by such-and-such [כדי כך] degrees, which are such-and-such ḥalakim; and if to the west, its [molad] there will be later by such-and-such degrees, which are such-and-such ḥalakim.

So-and-so degrees of longitude-difference, which are such-and-such of an hour and ḥalakim — by this amount the [molad] of that city will be earlier or later, as we have explained, like the manner of transferring [molad] time from one meridian to another. And the difference and the transfer go according to the longitude-difference, and according to it the [molad] there will be earlier or later.

And likewise, the rule for knowing the longitude of the cities, and their longitude-difference, and the transfer, in order to transfer the time of the [molad]; and you will know whether a city lies to the west or to the east, so that you may know the [molad] of the cities in their [proper] times. And you add to it or subtract from it according to its longitude-difference, and you place it [the result] upon the [molad] taken from the table, and preserve it [keep the count].

to know its [molad] at the meridian of one city and to transfer it to the meridian of another; and preserve [the count]. There is a watch [reckoned] toward the west and a watch [reckoned] toward the east, and the [molad] there will be earlier or later [accordingly]; and you will know it, and preserve [the count].

פרק י"ג — Chapter 13.

On the matter of knowing, by way of investigation, what is settled in the tables concerning the cycles of the sun and the weeks in them, so that you may know that the year will be of such-and-such hours and ḥalakim, [reckoned] in whole places [i.e., complete units].

After the cycles of the sun you reckon the longitude of the sun; and it will be a [matter of] degrees, such-and-such for that year — as we shall set down. When you place a day-and-night [period] from this, by giving each day such-and-such hours of the sun's mean motion, you derive the day's portion, and you preserve [the count]; and the whole [period] you join in the reckoning together, and they [the totals] will be such-and-such ḥalakim, and likewise such-and-such hours, in whole places.

After the cycle, the longitude-difference [carries over] to the length [of the year's course], and it will be [reckoned] by the portions, such-and-such, as is [the practice]; by giving each day such-and-such hours of the sun's mean motion. The days of the week are seven by their number — one [week] for the length of the course; and reckoning it thus, you will preserve [the count] toward the longitude.

If this [reckoning] is set down for the standard [solar] year, and the year will be of such-and-such hours and the tekufah is complete... the week is such-and-such in its number, one. With the small count [the abridged reckoning] it is such-and-

such, and the remainder [carries] by it; and the rule is: [add] year upon year, and you may add even by such-and-such [an amount], with the result that the longitude is fixed by the tables.

The days of the standard year are such-and-such hours by their number, [making] the cycle of such-and-such years; and from them [reckon] the great cycle of such-and-such years, which is the cycle of the sun. And every year of the cycle is such-and-such in its mean course, by giving each day such-and-such hours; and you preserve [the count] — and this is the way of this [computation], that the better [more accurate result] is obtained.

the length of the year [reckoned] by such-and-such; and the renewals of the sun for that year — the renewed-year [reckonings] of the cycle will be earlier or later than the cycle, as the count requires. By each degree such-and-such; and the rule is so that the longitude may be set down correctly by the tables, fitting [the result] to the course in order — the latter [computation] being the more correct one. And you order it accordingly, so as to set the longitude correctly by the tables. So-and-so [degrees of] longitude-difference, this being [computed] from the great cycle of the sun, [reckoned] for that year — and this is the way of investigation that is better, as we shall...

[Lower half of the leaf is blank parchment.]

The Fifth Treatise (המאמר החמישי) — the astronomical tables, Chapter 13 (continued) and Chapter 14

Folio 212r — recto, conservation ruler at left

[The passage continues directly from the foot of the preceding leaf — one forward flow, the procedure for finding the sun's place from the tables.]

the procedure stated above for the year, and you will know its place [מַעְלָב?]; and for the day take the year in question, and the sun, and place it in the cycle [בַּמַּחְזָר]. And the cycle [הַמַּחְזָר] is complete, and you enter for it [the value], and the column [וְהַטּוֹר]: thus it is. From there, take its place for the day [in question], and so forth.

For this is the manner of the day for the cycle [לַמַּחְזָר], and you will set it down in its year for the cycle [לַמַּחְזָר].

For all the days for the cycle [לַמַּחְזָר]: take the days of the great column [יָמִים לְטוֹר] [יום הטור הגדול], the day of the great column [הַטּוֹר הַגָּדוֹל]; and you will know the column

[והטור] for its place. What is the year of the sun [שנת החמה]? In the great column [בטור הגדול] [it is its value]; and the ḥalakim [וחלקים] above it, and the day is full [היום הוא]; for the value of the great column [הגדול] [is] the first [הראשון], its full value [מלוא?]; for the place of the day [מדת היום] is this. And you will know its place [מחמתו] — this — and you will know that the place of the day [מדת היום] is the chain [השלשלת] of [its] mean motion; the place of the day [מדת] is in the chain [השלשלת].

The place of the sun [מקום החמה] in degrees [במעלות]: and the procedure for the Christian [reckoning] [ותהריך הנוצרים]; take from this [its place] from the cycle [מהמחזור]; this is its place from this; [it is] its mean motion from another [its place from the cycle].

For if you find that the day is full [שזה היום הוא] — count it; and the procedure for the day [ולדרך תהריך] is full; the year [is full] for the cycle [from this].

The mean motion of the cycle [תנועת המחזור] in the day [is its value] — the mean motion of the procedure of the Ishmaelite [reckoning] [תנועת תהריך ישמעאל]; if this is the [place] of the sun [השמש] for the procedure of the column [לתהריך], take the year [קח שנה]: that this is the [first] year [שנה ראשונה]; the first year [שנה ראשונה].

The mean motion of the cycle [תנועת המחזור] is in the day [היום], the mean motion of the procedure of the Ishmaelite [reckoning] [מענות תהריך ישמעאל] — if this is the sun [for the procedure].

The mean motion of the procedure of the Ishmaelite [reckoning] for this: that the sun [השמש] is full for the procedure [for the cycle]; the procedure of the column for this is [its value], for the era of the Destruction of the Temple [חורבן בית], that this is the [year]; the first year for the cycle [למחזור] [שנה ראשונה].

[**Chapter heading**, last line of the recto:]

פרק י"ד — Chapter 14

[Opening words:] ...the year in question for the procedure [לתהריך]; we shall reckon by means of the tables [נחשב על פי הלוחות]; and you will know...

[The remainder of the recto below the chapter rubric is blank parchment (wide lower margin), not damage.]

Folio 212v — verso, conservation ruler at right

And you will set down [ותהריך] the place [השלם?]; this is its place [מחמתו?]; this [is the] new [moon], that it [should be] from its place [מחמתו]; and you will go and add to it; and as for the procedure of the months of the moon [תהריך... חדשי] alone — likewise, the months of the sun [חדשי השמש], the new moons [חדשים]; their reckoning [וחשבונם] and the [other]...

[As we have already informed you] [כבר הודענו] — the months of the moon [חדשי] alone: thus it is for the sun [השמש], that its months are [reckoned]; their reckoning [וחשבונם] and the...

the order [הסדר]; that this is the quarter [הרובע]; their months [חדשיהם]; the first is set down [נמסר].

The first set-down [נמסר]: take the quarter [הרובע]; their reckoning is set down [נמסר].

That their reckoning is set down [נמסר]; [rounded]; the first...

The first month [חדש ראשון] and the other; the deficient [one] [החסר] and the...

The year is full [השנה השלם]; it is deficient [חסר], and already...

[the five] intercalary months [חמשת חדשי העבור]; and that this [should be] the new month [חדש מחדש], the mean motion [מענת]...

The procedure of the Ishmaelite [reckoning] [תהריך ישמעאלי] [is] their reckoning; for if it is deficient [חסר]...

And you will set down [ותתבונן] for the new moon [לחדש], the deficient [one] [החסר]; if it is full...

And it is fitting that you know [וייתבקש לדעת] the new moon [החדש]; the procedure [הזמן] is the reckoning [המנין], for the new moons [הטעם?] [in question], that you set down for the new moons [חדשים]...

this is the procedure [המעבר]; and it is firm [כן? כן] [for the cycle?]; that the cycle [זמן] is [שהוא מחזור] [265] [רס"ה] [reading uncertain — possibly 235 = "רל"ה]; and as for the mean motion [וכשתצרף]...

The mean motion of the procedure of the Ishmaelite [reckoning] [מענות תהריך] [is] this; for if the procedure [המעבר], and you set it down for the new moon [לחדש מחדש]; and you will go: that it is full [חדש עבר], and it should be...

the place [the good?]; and it is firm [thus]; for the procedure [לתהריך] is full; that you set down [for]...

רס"ה [265 — uncertain; possibly 235 = רל"ה] this is the mean motion of the procedure [המעבר]; the mean motion of [its] place, and the mean motion of the Ishmaelite [reckoning] [תשעין]...

Ishmael's [reckoning] [ישמעאל], a complete column [לוח הכולל] — the procedure...

the procedure [לתהריך]; and you will set it down by the order of the reckoning [בדרך מספר] of the years [השנים], that you set them down [תשם]...

the column of the Christian [reckoning] [בטור הנוצרים], the mean motion [מענות]...

[The whole of both folio sides is the same continuous computational argument of Chapter 13 → Chapter 14: how to derive the sun's mean motion and place (מקום) from the great column (הטור הגדול) of the tables, day by day and year by year, taking the residual ḥalakim and the "chain" (שלשלת) of accumulated motion; then how to convert and align that reckoning to the Christian (נוצרים) and Ishmaelite (ישמעאל) calendar months and to the Jewish 19-year cycle of intercalation (העבור), anchored to the era of the Destruction of the Temple (חורבן בית). The hand is fully legible under magnification; the only genuinely faint readings are the two occurrences of the lunation/cycle count (רס"ה / רל"ה) and a handful of contracted technical tokens, individually flagged. No ruled לוח table-panel has yet begun on either side.]

The Fifth Treatise (המאמר החמישי) — the astronomical tables. Chapter 14 (פרק י"ד): reckoning by means of the tables, and aligning the count to the Christian and Muslim calendar months and to the 19-year cycle, anchored to the era. Continuous method prose; no ruled table panel and no diagram appears on either leaf.

from the residual-counts [המספרים השאריים] there is the principle, and it is the lesser [reckoning], more [than]... the count. Take the count [730 = מספר תש"ל?], set it down by your hand [כתב בידך], and keep it [ושמור אותו]; and after... from the count of the whole [מהמספר הכללי], complete it, and the residual will be the count [239 = מספר רל"ט?]. The count [רל"ט?] is a year [שנה], thirty [ל'] months [חרסים = חדשים, "new moons/months"]; set it down by your hand and keep it.

Set it down by your hand: a year [שנה] [numeral: ?] in them; in this way [reckon] the first [reckoning]... for the count; and a year, sixty-two [ס"ב] months [חרסים], set it down by itself, and reckon [ותדפן]... for the count. The whole [course] you do by your hand for the count [תש"ל? יט], a year and months [וחרסים]...

of the residual-counts there is the principle, and it is the lesser, more [than] the count. And after, in this way [reckon] the second [reckoning]... by the count. The whole [course] you do in this way [reckon]... for the count [תש"ל? יט], a year and months, and so it is [וכן הוא].

And by inversion [ובהפך] the reckoning runs [החשוב]. To know its calculation [לדעת חשבונו], from the count [מהמספר]: there is one month [חרס], and this [is] the lesser [reckoning]... I knew it: this month and... for the count. To know the count [numeral: ?] months and reckon [ותבין], complete it [תמלא?] for the month, and it was said [ונאמר]...

by the residual-counts, the chronology [תאריך] of [the people of] Ishmael [ישמעאל = the Muslims]: the mean motion [מהלך] of the whole [is] the principle, and it is... The count of Ishmael, set them down [נתם]... a year of provisions [שנת תשועות], the count [מספר] [numeral: ?] months. And to know the residuals [ולדעת ?השאירות]: the count [is] above [more] than [what is] set down by your hand; and so add the months, and reckon the residuals well, for it is the principle. And in the count of a month of Ishmael it was [Lacuna at line-end]...

the residual-counts of the months, years of provisions [שנים סדורות], and a single month; and for the Christians, set it down by your hand — all of it [is] the principle. And the residual of the month, this [is] for the chronology of the reckoner [העושה], that it be threefold [שלש]; and for the [19-year] cycle [מחזור] this [is] the principle, that it begin [תהיה?] for the [19-year] cycle of Ishmael; this [is] the reckoning [החשוב], how it [arises].

And it was said: from the year [numeral: 313(5) = תשי"ג?], the chronology of the world [העולם] was, in the [19-year] cycle, such-and-such [numeral: ?]; and from [the reckoning of] Ishmael, the chronology was for the [19-year] cycle, such-and-such [numeral: ?], a year [שנה], and the month was such-and-such.

Set it down by your hand: the chronology of the reckoner, that it be threefold; and for the [19-year] cycle this [is] the principle, that it be more, closer [than two-thirds] [יותר קרוב] for the count; from a single month [you arrive] at the month — the months of the count.

And [add] one more [ועוד אחד], set down by your hand, for this is for the count [לחם, perhaps לחשבון] of the month; and the month was such-and-such, the new moon of Tishrei [חדש תשרי]; for this is the principle, [as] the month [count of] two [numeral: ?]; and you will know it as is needed [וכצריך], and so it is [וכן הוא].

And the whole course [?] of the count is established [מכוון] thus; and observe carefully in the doing [העושה], for this is its rule [דינו], from the months. And the month [count of] thirty [ל'] and forty [מ']; and so [add] [numeral: ?]. The residual was reckoned, and for this [19-year] cycle, that it be... The thing established [העשויה] was thus; and within it [is] the column [הטור].

And here you will reckon by the year [בשנה], that it be... for the mean motions [solar]; the column [הטור] above [is] the column, and within it [is] the column — the first column [הטור הראשון]...

[Lower third of the page is blank parchment, not damage.]

[Conservation ruler and black strip along the right edge — photography furniture, ignored. Facing-leaf sliver at the inner (left) margin — ignored. Hand continues; same scribe. The text occupies the upper third of the leaf, the rest blank parchment. Two small marginal jottings in the inner margin (see below).]

the simple [degrees] [הפשוטות] of the mean motion [מעלות], this [is] the count; the year [השנה] was, the chronology should be... of the mean motions [solar], from them [מהם] it was; set it down by your hand — all of it [is] the principle. And a single [unit], a simple [degree] [פשוטה], the mean motion [המעלה], should be [numeral: ?]. The month [count], the count [numeral: ?] months, the mean motions [solar]; and you will reckon it, set it down by your hand; and this [is] the principle, and you will not err. For the month-residual was, the residual was, the new moon of Tishrei [חדש תשרי]; and within it [is] the column [הטור], the first column [הטור הראשון]; the count [is]... for this is the quarter [רביע].

This [is] the quarter; the month [count], the quarter [reckoning] [רביעית], this; and forty [מ'], and you will reckon a month. This [is the count of] the mean motions of the count, above [more] [numeral: ?]. The residual was [carried over], and you will pass it over [ותעבירו] by the method, in this way; and you will know that the mean motion of [the reckoning of] Ishmael — this [is] the mean motion, and this reckoning [החשוב] of the mean motion [is] above [more]. For from a month [you arrive] at the month, for this is the principle. And by the mean motion you derive the mean motion [solar] of the [19-year] cycle, established [מכוון], and you will not err.

For [each] month, [from] each separate count it was, and the count, this [should be threefold?]; and when you have set it down well [נכון], the count for Tishrei was, [numeral: ?] of the residual reckoning, established; and observe carefully in the doing [העושה] how this comes out [as] residual; and within it [is] the column, the first column. The remainder [השאר]: in this, the quarter; and the month, the

quarter, this; and a single month [the count of] the month, this; [numeral: ?] and you will reckon a month [count of] two, this. And from it derive the count of [numeral: ?] mean motions [solar], the count [is] above [more] [numeral: ?] — these are the mean motions of the [19-year] cycle, established, and you will not err.

For [each] reckoning is reckoned and runs by [its] method; and so [it] is reckoned and carries over [ונעבר], by the method, in this way [על פי זה]; and the chronology [תאריך] of the reckoner [העושה], it should be; and reckon the chronology of the Christians [תאריך הנוצרים], and know the way [ותדע דרך], for it is the mean motion of Ishmael; this [is] the mean motion, and the reckoning [החשוב]; and within it [is] the column [הטור]; for from a month of Ishmael, this [is] a year [שנה]...

the chronology, that it be for the chronology [numeral: ?]; set it down by your hand, that it be; and this, the chronology, on the era [על התאריך]; and this should be threefold; from the count [למספר] you arrive] at the mean motion [solar] of the mean-motion [reckoning]...

[Marginal note, inner margin, beside this line: a small contracted jotting; verbatim reading uncertain ("יקר" / "פ" form). Marginal note containing a brief jotting; further identification requires further verification.]

of the mean motion, this [is] for the count [is] above [more], closer [than two-thirds] [יותר קרוב] for the count, and the [other] residuals here [too]; and the count of the column [הטור]...

For each separately [כל בצד], take it and add it, set it down by your hand; and from it the count of [numeral: ?], six [ו'], and the mean motions, the count of the column [הטור]...

for each separately [כל בצד], take it, and within it [is] the column [הטור]; the mean motion of the year [is] such-and-such [numeral: מלא?, "full"], for the mean motion [solar] of the Christians [הנוצרים]; from the months, set it down by your hand; and from a month [מנחה?] — that is, a month of [numeral: ?]...

The three reckonings [שלושת החשבונות] are [numeral: 37 = ל"ז?] days, and so [too] [numeral: ?]; and so, just like the month, [the count of] a month [Lacuna], this [is] the mean motion. [Marginal note, inner margin: a brief jotting; verbatim reading uncertain; further identification requires further verification.]

set it down by your hand, this; and from it the count of [numeral: 37 = ל"ז], from another month [you arrive at the count]; the year [שנה] was, the count for the chronology [למספר התאריך] of the Christians [numeral: ?], and add it...

set it down by your hand, [for the] count, take it set down by your hand; and reckon, established [מכוון], take it; so too the residual, take it set down by your hand; the column [הטור]...

set it down by your hand: the chronology of the Christians [תאריך הנוצרים], and the count, and the count...

take it set down by your hand: the residual, take it, the column [הטור]...

[Remainder of the leaf — lower two-thirds — is blank parchment, not damage. Faint stains and a few small ink spots in the lower blank margin; ignored.]

Yesod Olam — Fifth Treatise, Chapter 15 (folios 214r–214v)

Hand: a single clean Sephardic semicursive; iron-gall ink, well preserved. No rubrication in color; structural rubrics (פרק, שער) are set off only by spacing and slightly enlarged script. No ruled tables on either folio side; wide blank lower margins. Folio "214" marked in pencil at the head of 214r.

the latitude-argument of the moon, together with the [other] elements of the tables. With these you will know whether the eclipse will be total or partial. From this, then, follows the rule for the eclipse [computation], and it is set out clearly so that you may reckon an eclipse of the moon and an eclipse of the sun.

[Chapter Fifteen — פרק חמשה עשר]

It has already been explained to you, in the preceding chapters of this treatise, and you have come to know, the way of reckoning the conjunction and the opposition; and you have understood how to determine the [time of the] true conjunction and the true opposition. Now, since the eclipse of the moon occurs at the opposition and the eclipse of the sun at the conjunction, we must explain to you the way of reckoning the eclipses.

Know that the eclipse of the moon is one and the same for all who dwell upon the earth, for it occurs to the moon itself in its own body — its light being withheld from it when the shadow of the earth falls upon it — and so it appears in a single manner to all observers, in every region, at one and the same hour, sooner or later only by what arises from the diversity of the [local] hours.

The eclipse of the sun, however, is not so; rather it differs according to the regions and according to the diversity of those who dwell upon the earth. For its eclipse

does not occur to the sun itself in its own body, but occurs to us [as observers] when the body of the moon comes between our sight and the body of the sun and screens it from us. Therefore one region will see the sun eclipsed while another does not see it eclipsed at all, or sees it eclipsed by more or by less [than the first], according to the difference of the lines of sight.

And it is further explained [ועוד נתבאר] that the measure of the eclipse — and whether it is total or partial — depends upon the latitude-argument of the moon, that is, its distance in latitude from the [ecliptic] node. For when the moon is near the node, so that its latitude is small, the eclipse will be the greater; and when it is far from the node, so that its latitude is great, the eclipse will be the smaller, or there will be no eclipse at all.

Accordingly there is, for every eclipse, a limit of latitude beyond which no eclipse can occur. The masters of the [astronomical] inquiry have already set these limits down: for the moon, the eclipse-limit in latitude is [numeral: ?] and somewhat more; and for the sun it is less than this. When the latitude of the moon is greater than the limit appointed for it, there will be no eclipse, neither at the conjunction nor at the opposition; but when it is less than the limit, there will be an eclipse, total or partial according to how small the latitude is.

[Gate — שער]

Know, then, that what is required — in order that the eclipse may be [reckoned] at the time of the [true] opposition or the [true] conjunction — is this: that every eclipse, whether it be remote or near, be reckoned according to the way set forth, and that in every case you take account of the latitude-argument [מנת הרוחב] and of the position of the moon, whether it stands at its most distant point [from the earth] or nearer.

For the size of the moon's body, and likewise the size of the earth's shadow through which it passes, differ according to the distance of the moon: at its most distant point its body appears smaller, and when it is nearer its body appears larger. The way to know this is by the entry-argument of distance; and the entries of the tables, for the body of the moon and for the [breadth of the] earth's shadow, are computed accordingly.

And it is further explained [ועוד נתבאר] that, for whatever pertains to the eclipses — whether of the sun or of the moon — when you wish to know the duration of the eclipse, how long the moon remains darkened, you must reckon by the [half-]durations: the time from the beginning of the eclipse until its middle, when

the eclipse is at its greatest, and the time from its middle until its end, when the moon returns to its [full] light.

The eclipse of the sun [is reckoned] at the [true] conjunction, and the eclipse of the moon at the [true] opposition; and each of these you reckon according to the diversity of the regions. For the eclipse of the moon will be at one and the same hour, the difference between regions being only by reason of the diversity of the hours, sooner or later [than at the meridian] of [each] region; whereas the eclipse of the sun will differ both in its hour and in its measure — sooner or later, by more or by less — according to the diversity of the regions and of the lines of sight.

It has already been explained to you that the eclipse of the moon is one [for all], since it occurs to the moon itself; and that the eclipse of the sun is not one, since it occurs to us by reason of the moon's body screening [the sun] before our sight. So you have come to know the [true] conjunction and the [true] opposition and the latitude-argument [of the moon], and now you may begin [to reckon] the eclipses.

And it is further explained [ועוד נתבאר] that there are two [matters to determine]: the eclipse of the moon and the eclipse of the sun. First you take the latitude-argument, for upon it the eclipse depends; and when the latitude is small the eclipse is the greater, and you take the [corresponding entries].

These, then, are the rules of the eclipses, and herewith you know the way of reckoning them and the entry-arguments of [the tables]. For the body of the moon was [reckoned at] one measure at its [mean] distance, and more or less than this according as it stands at its most distant point or nearer; and likewise the breadth of the earth's shadow differs according to the distance of the moon. The way to know the eclipses, both of the sun and of the moon — this you now understand.

By these, then, are the rules of the eclipses [completed], and you have come to know the way of reckoning them and the entries [of the tables]. For the body of the moon and the [earth's] shadow were [each reckoned at] a [given] measure, and you take account of the distance of the moon, whether it stands at its most distant point or nearer.

And it is further explained [ועוד נתבאר] that, when you wish to reckon the eclipse, you first take the latitude-argument; and afterward you take the position of the moon — its distance — and from these you compute the measure of the eclipse and its duration.

The way of [reckoning] the duration, and how long [the moon] remains [darkened] — that is, the rules of the eclipses — is set out clearly, by the way of the entries of the tables, so that you may reckon every eclipse, each in its proper manner: the breadth [of the shadow], and the latitude-argument of the moon, and its distance; and likewise the position of the sun, and [again] the latitude-argument — these you take, the one [first] and then the other.

And it is further explained [ועוד נתבאר] that when the latitude-argument is small the eclipse will be the greater, and when it is great the eclipse will be the smaller, or there will be no eclipse at all. In this way you reckon the eclipse, both of the sun and of the moon.

Know the [time of] true conjunction, and the latitude-argument, and the position of the moon — its distance — and afterward [reckon] the [measure of the] eclipse.

For the eclipse, when it occurs, occurs to the moon itself in its own body; and the way of the entries of the tables is as we have explained. And know the [time of] opposition, and the latitude-argument, and the position of the moon — its distance — and afterward [reckon] the [measure of the] eclipse, this one [first] and then the other.

the eclipse occurs in the region [in question]; and this is what is explained in [the following] Gate [נתבאר זה בשער].

[The remaining lower portion of 214v is blank margin.]

as we explained above. And keep this number, for it is the completed half [of the darkness]. The latitude-argument of the moon will then be drawn off, and from it the duration of the time will be found. Whatever you take that is at its correction will yield the magnitude, as we explained in the chapter [הפרק ?] before this one.

Take, then, this measure of the latitude-argument and keep it, for from it the eclipse will be reckoned. From the arc of darkness [קשת הקדירות] and from the moon's distance, you will know whether the eclipse occurs and how much it is. And so it shall be: if the moon is at its conjunction [the joined position, מחובר], then the matter is as we said for the sun, and if at its separation [the opposed position, נבדל] it shall be like this.

For in every one of the places where the great column [הטור הגדול] is set out for a region, you take the latitude-argument that stands at that distance, and what comes out is the half of the time [חצי הזמן]. And it will be the arc [קשת] from which the duration of the darkness is reckoned; the difference between them is the measure of the eclipse. So adjust [תקן] it accordingly.

And after this take the latitude-argument, and from it derive the time of darkness [זמן הקדרות]. The duration before mid-eclipse and after it will be equal, and what comes out is the time. And so it will be: take the latitude-argument and the time of the moon's revolution [השוב], and what comes out at its correction is the magnitude of the time. The time before [mid-eclipse] is its first half, and after it the second half, and this is the eclipse, completed.

[r1-r2] Take, then, the moon's distance [מרחק], and you will know whether the eclipse occurs and how much it is at that distance. In all the places where the great column is laid out for a region, the eclipse will be found at the region's distance, for there the arc of darkness stands. The corrected latitude-argument [מנת הרוחב המתוקן] will then yield the time, and you adjust it by it. And the moon's revolution [השוב] is reckoned at its correction, and the moon's revolution and what is added to it — take the latitude-argument and the moon's revolution, and adjust it.

And so it is: at the conjunction [the joined position] the matter is as we explained, and at the separation likewise. The time of darkness will be one moment before and the like after, and so the half is reckoned and adjusted, as we explained.

[r2-r3] Then add the latitude-argument, and adjust it, and what comes out is the time. And it will be: take the latitude-argument and its addition [ונוסיף עליו] thus, and what comes out at its correction is the magnitude — there shall be the place, at the end of the time, and the eclipse is reckoned, and if it is at the end of the eclipse it will be its half. And so the duration of the moon's darkness is reckoned at the time of conjunction, and what is added — the corrected latitude-argument of the region — is the truth at the region's distance. There the eclipse occurs, before mid-darkness and after it, and so the half of darkness is reckoned: take the latitude-argument and the moon's revolution [שתקע הירח], and at its correction is the duration. The time which it [the eclipse] reaches [יצא/ישלה] — at its correction is the beginning of the time of darkness, and the magnitude [רבע?] is the half, and this is [the eclipse].

[Bottom of 215r:] ...the time of darkness was upon it, and its revolution, and the moon's distance... [final line completes the period: at the corrected place the eclipse is, completed].

you will draw off the small [argument], the corrected latitude-argument [מנת הרוחב המתוקן]; and the small one [הקטן] gives the time of darkness [זמן הסיבוב — the revolution]. And it will be: take the end of the eclipse, for it [the moon] was joined [המחובר] and separated... [וכן...], at its conjunction and at its end, take the

moment [נקח קצת], so [the value] κύκλος [the cycle — קללקל? cf. סלקוס, Greek κύκλος] is fitting...

[r1] So you adjust the latitude-argument, and from it derive the time of the eclipse — the duration of the time, always at the moon's correction; and so it will be at its correction... And keep this measure of latitude-argument, and from it the eclipse is reckoned, at the region's distance. So it shall be: if the moon was at its conjunction [the joined position], it will be like this, and if it was at the small [argument] it will be thus, [for] there is six [שש] of them; and from it the time of darkness is reckoned, and the latitude-argument is adjusted, and what comes out at its correction is its magnitude. There the place is, at the end of the time, and the eclipse is reckoned, and its half-duration.

[r2 — the gathering recapitulation] As we explained, take the latitude-argument and derive from it the time, the duration of the eclipse and its measure; thus and so, this is the book [reckoning] — that it [the time] will be corrected. The corrected latitude-argument [מנת המתקון] is the moon's distance at the time of conjunction. And the calculation [חשבון]: the good [reckoning] is as we did — there shall be its correction, and there it [the eclipse] is.

The latitude-argument: take the half [קצת] at the moment as we explained, and there are six [שש] of them. The time of the moon's darkness stands at the region's distance — from there, by the way [דרך] of correction, the [value] of the cycle [κύκλος] is reckoned. Such is the practice: take the moment [קצת], a corrected number, set [נצב] in this manner — adjust it. The corrected latitude-argument [the truth] gives the beginning [תחילה]; adjust [שערו] it, and keep it.

When the eclipse occurs, the latitude-argument is reckoned at the region's distance, and the corrected latitude-argument [the truth] is at the region. There the eclipse occurs, also at this distance, at the place of the time-of-darkness which is upon... [it]; and the moon's revolution is reckoned at the end.

[r2, lower — entering the table-values] And keep the arc of darkness [קשת] and the measure, and reckon it by the moment [בו שעת] thus. And here: as it is written, six of them in this; the latitude-argument of the time of darkness, and... the first part of the eclipse — its beginning [its half] — from the time of the region as a whole, and the measure of the whole.

And adjust it [ושערו]: in every place where the first [argument] is set out, and you turn back and again take the latitude-argument with it, and so... [And know that] in the moment, in this manner — there are sixty [ס'] parts: six [שש] ḥalakim

[parts] are sixty [ס']. As we explained, and add: and the time of darkness, [from] the small [argument], the time of the revolution.

Take, then, the latitude-argument, and from it derive the time of darkness; the duration before mid-eclipse and after it [will be equal], the magnitude [מה חלקים] — how many parts] thus. [In] the moment, by the [value of the] cycle [κύκλος] it will be, and four ḥalakim of them, so the latitude-argument is adjusted, and keep it. There were three numbers of them, three latitude-arguments, the corrected ones; the magnitudes of the time were the joined ones, the conjunction-values.

[r2, foot — the closing recapitulation of the eclipse-reckoning] As we explained: take the latitude-argument and the time of darkness; the duration before mid-eclipse and after it [will be equal]. The latitude-argument is reckoned thus at the region's distance, in the manner of correction. Three latitude-arguments — and so the corrected latitude-argument [the truth] of the region: it [the moon] was joined [the conjunction] there. The number of moments of darkness will be one before [mid-eclipse] and one [after], the conjunction-value [the joined], the number of the book [reckoning].

The duration of the eclipse will be of one kind: three latitude-arguments — the corrected latitude-argument [the truth] of the region — the truth, and from it the correction. The number of moments of the revolution [קצת מספר השבוב]: the book-reckoning of the moon's revolution [מספר הצבעית/השבוב] will be in this — the eclipse occurs, and from it the eclipse and the duration are reckoned.

[Last two lines, r3 c2:] ...the moment, the latitude-argument, the book-reckoning [מספר], and from it the magnitudes [the parts]. [And so] from it the moon's eclipse is reckoned [מהלכים? from the courses].

[The Fifth Treatise — Chapter 15, continued: the reckoning of eclipses by the tables.]

so that you may align [the value]; take what comes out of the rectified [number], and place it [in its place]. Upon the degree [you obtained] from the table by which you entered, take what corresponds to it; what you have written down [שכירט] is in the column [of half-durations], and the time of its tarrying [duration of the eclipse] is determined by it; and what you correct [קיא — you read off], place it [there], and rectify it [התקן], so that the [two] half-durations [are equal].

That was the matter of this chapter; and from this Treatise [מהמאמר] you may learn the [reckoning of] eclipses, and through it [you will know] what their

portions are — how much they stand above [the standard measure] and how much they fall short. So you reckon it [נחשב] thus.

[The worked reckoning of the eclipse of the moon:] The eclipse of the moon and the obscuration: enter with the latitude-argument [מנת הרוחב] into the great column [הטור הגדול], and take what stands beside it; and for the conjunction [מחובר], this it will be; and the moon's distance in its revolution [מרחק הירח] — this it will be: [[?] 235 =] רל"ה firsts, [[?] 55 =] נ"ה seconds; and the latitude-argument of the half-duration [קשת השבוב] is so [much]; and likewise for the revolution of the moon [שוב הירח], by the reckoning that has been set out. And this is the reckoning of the eclipse of the moon; and likewise the eclipse of the sun [is reckoned] by the great column, and the matter is reckoned [thus].

[And take] what stands beside the latitude-argument [for] the degree; and the reckoning of the obscuration is by the half-duration of the revolution of the moon [שוב הירח], and [by] what comes out of the rectified [number].

The eclipse of the moon [is reckoned] when its latitude-argument is ל"ב [= 32] firsts, and [so many] seconds; and the latitude-argument of the obscuration [קשת העבוב] is so [much]; and likewise its rectified [number is taken] for [so many] firsts and seconds. The latitude-argument [is found] from the augmented [column, ההמרובה]; from it [מהם] is the half-duration, and likewise the latitude-argument of the eclipse [שדף]; and the latitude-argument of the obscuration [קשת] is [so many] firsts and seconds.

And the revolution of the moon [שוב הירח], when its latitude-argument is [such], will be [so many] degrees in the tables; the eclipse of the moon stands [so much] above [the measure] and not [more]; and what you reckon, [reckon] thus by the table.

[So many] firsts is this; and how much is the eclipse — enter the great column with the latitude-argument and take what stands beside it; this is the conjunction [מחובר]. And the latitude-argument is [such]; and the latitude-argument of the half-duration [קשת השבוב] is [so many] firsts; and likewise for the revolution of the moon and the time of the obscuration. The eclipse [לקות] is [so many] firsts; and from this [you obtain] the rectified [number] for [so many] firsts and seconds; and likewise the latitude-argument of the revolution [קשת השבוב] is this [much]; "and after this" — for the eclipse [of the moon], the time of the obscuration; and the latitude-argument of the half-duration [קשת השבוב]; and the moon's distance in its revolution [מרחק הירח בשבוב]: [so many] firsts.

[Closing of the procedure for the latitude-argument:] And the marker [וסימן]: the latitude-argument of the obscuration [קשת העבוב] is [so many] firsts. And the half-duration is [such]; and the eclipse of the moon — what it is — [is found] by the latitude-argument of the half-duration [קשת השבוב], [so many] firsts; and place [it] for the number of the rectified revolution of the moon [שובב מתוקן], [so many] firsts; and so the half-duration upon [the figure] one [אחד]...

[Foot of leaf — wide blank lower margin; the chapter continues onto 216v.]

[Chapter 15, conclusion of the worked eclipse-reckoning.]

one [אחד], for so the latitude-argument stands; and place [it] upon the degree; the obscuration [will be reckoned] by the revolution. When there is the half-duration and the latitude-argument of the half-duration, and the place of the conjunction [מקום הקבץ], the moon's distance in its revolution... the obscuration is [so many] firsts and [so many] seconds; and you will know the time of the eclipse, the half-duration before [mid-eclipse] and after it [אחר ... קודם], and the place of the conjunction [מקום הקבץ], the obscuration of the moon — [so many] firsts and seconds.

Enter [the table] with this and take what stands beside it; this is the reckoning of the eclipse it obscures, at the conjunction. The half-duration is [so many] firsts and seconds, and the time of the obscuration is [such]. The place of the conjunction [מקום הקבץ], the moon's distance — [so many] firsts; and from this [you obtain] the latitude-argument of the obscuration. The portions of darkness [חלקי הקדרות] are [so many], and its latitude-argument is [such], as the marker [סימן]: "before" and "after" [אחר ... קודם — the two equal half-durations]; and the eclipse falls short by [the figure] one in its rising [בעולה], and it does not exceed [more] in its rising; for the latitude-argument was "before" [קודם] and it reached its end [סוף]. So too [the half-duration] before [mid-eclipse]: its degrees and its seconds are [such]; and its latitude-argument is very near, one to the other [קרוב מזה ... מאד], [so many] firsts; and what was "before" at its obscuration is near [the half-duration] "after" it, [for so many] firsts.

The latitude-argument of the rectified [revolution] — understand its rectification [הבין] — for the obscuration is upon the table; and the wise have given a marker [נתנו החכמים ... סימן] for knowing the rectified obscuration. The latitude-argument [is taken] from the augmented [column, המרובה], and from it the half-duration; and the place of the obscuration is reckoned by the half-duration of the revolution, [for so many] firsts; and the latitude-argument of the eclipse — this [is

what stands] upon [table] [[?] 32 =] ל"ב, so [too in this] table. So [proceeds] the reckoning of the obscuration; take the reckoning of [its] portions [חלקיה מספר].

שער — Gate

[Display rubric in slightly enlarged ink: שער — Gate. No number legibly attached.]

There is [a case] in which the eclipse is by another rule [יש שבו ... מאחרים] — there is [a case] in which it is by the others], in its eclipse-portions [בלקות מנת] — concerning the eclipse, its latitude-argument].

This will be [reckoned] by the half-duration [על פי] — according to the half-duration]: in this [case] there is more — [table] [[?] 42 =] מ"ב is more by the half-duration; the small one [הקטן] of the obscuration is what it is, [for so many] portions [חלקים]; and so does [table] [[?] 32 =] ל"ב [stand], by its rule [בדינו]; and in it [the marker], by the column of the latitude-argument, [the eclipse] is reckoned, [for so many] firsts.

[Worked again, for the moon:] the distance of the moon [מרחק הירח], the place of the conjunction [מקום הקבץ], in the great column [בטור הראשון] — in the first column]; take what corresponds to it, what stands beside it; this is the conjunction, the moon's distance in its revolution; and so the half-duration upon [table] [[?] 32 =] ל"ב; and the moon's distance is [such]; the latitude-argument [is taken] from the augmented column [המרובה], and the half-duration of the eclipse of the moon is [so much]; and the latitude-argument of the obscuration is near it; and the place of the conjunction [מקום הקבץ], the moon's distance in its revolution, [for so many] firsts and seconds; and the moon's distance in its revolution — the obscuration [will be reckoned] by the half-duration [על פי], one [אחד] for each table; and the moon's distance is [such], near it [קרוב] is the half-duration; and so [proceed] by the column of the latitude-argument; and the marker [סימן] — "before" [קודם] and "after" — these are the [two equal] half-durations.

[Conclusion of Chapter 15:] And the place of the conjunction [מקום הקבץ] — what it is, by it [you will know] what the obscuration is, [and] its measure [שעורו] above [the standard measure].

פרק ששה עשר — Chapter 16

It is fitting to know the matter of the tables [הלוחות], their use [שמושן] and their arrangement; and likewise the law of the half-day [חק חצי היום] at every place;

and as we already explained at the beginning of this Treatise, [the matter] of this composition [מהחיבור הזה]: the reason that we [ordered] the order of the tables, and we set them out, the latitude-argument of the head [ראש — node]...

[The Fifth Treatise — the astronomical tables; Chapter 16 (פרק ט"ז): the use, arrangement, and rectification (תקון) of the tables — continued from the preceding leaf.]

the arc of the day was such-and-such [numeral: ?] and the night was such-and-such [numeral: ?], for any given region. And this is the procedure: to know the arc of the day and [its complement] you take the arc of the day, and one [argument] for the other you take from the [great] column [המסעד / הטור הגדול] — the cycle of the tens [מסבב המעשרים, the "tens"-table], and the rest of the rows by their reckoning [are obtained] from this. And in the rows of the day you have [the value], and the position of the moon [is taken] from its position.

Whenever you [wish] to know the arc of the day for a given region, take this [argument] and proceed [accordingly]; for the [great] column gives you the [tabulated] position, and the rest of the rows by their reckoning [follow] from it. And by the [number] of degrees that [the body] has risen, the [arc] is [determined].

And now, in the way I have shown you, [you] work with the arc of the day. The position [is taken] from the row of degrees and from the [tabulated] rows, [and] from there [you obtain] the moon's [position], by the rising-arc of the degree.

[Siman marker, margin] You take the position from the row of degrees; thirty-two [32 = ל"ב, numeral: ?] [is] for this. And the [tabulated] value [is read] from the row of the moon's [position]. [Then it] is the position, [for] the moon's [reading], [taken] from the column of degrees, and what is in it, [namely] the [tabulated] value.

[Siman marker, margin] And the moon — by [the number of] its degrees [that] have risen, [for] this — [you read] the rising-arc of the degree, and the [tabulated] value at [its] position. So [you have] the difference of the displacement [of] the [arc].

[Siman marker, margin] You [obtain] the [tabulated] position, the rising-arc, and the [last] of the degrees [from] the column; place and place, and likewise [for] all of them, [the] rising-arcs, [so] as to recognize [each] one, [for] the tens that are in them — so it [stands]. And [for] this, you [have] what [I] explained to you. And [as

for] the difference [of] the displacement [מהלך], by [reckoning of] the rising of the degrees, by which [the] motion [is found], [it is] divided.

Whenever you [wish to know] the [position], by the rising of the degrees, [enter with] the difference of the displacement at the rising of the degree, [taking it] from the column and the row of the [given] degree; [for it is] understood and given. And the column of the first [argument], the degrees [proceed] in order [as] in the [tabulated] reckoning. Ibn [Ezra / the author?] [recte: יבא — "comes/enters" — verb, not a name], by the column of degrees [the value enters], [for] this is the position, [namely] the cycle of the tens. The [tabulated] degrees [are] for this region...

and the moon — by [the count of] its degrees [that have] risen — [you take] from the column. [Said by] siman [סימן] the second [recte: numbered division "siman 2"], on [the topic of] knowing the arc of the day, and so [too] the [rest], from there [you obtain it].

[Foot of 217r, last visible lines:] ...and they enter [the body] by the [tabulated] reading, the rising-arc; [it is] a degree such-and-such. The [zodiacal] sign [מזל] is long [in rising], and what is in it [is] such-and-such [numeral: ?].

[Folio 217v — Same single-column hand; conservation ruler on the right edge (photography furniture, ignored); the text column sits left of the gutter. Continuous with 217r — no break of subject. Several marginal siman markers ("סימן [N]") stand against the lines.]

[The procedure continues:] ...the arc of the day [is] such-and-such [numeral: ?] hours, and the [zodiacal] signs [or: degrees] that [rise] — [the] rising-arc, [reckoned] from the [tabulated] degrees and the moon's [motion]. And [if] you reverse this — [if] the position [you seek] is computed [from the other argument] — the moon, [by] its risen [degrees], [is found] the same way; [for the] reckoning of the tens [gives the] tabulated [positions], whose [readings] are [as I] explained.

This [is the procedure]: by the cycle of the tens, [the] rows; and what is in them, [namely the] tabulated [values]; and [for] the rising-arc [you take] from them, [for] the moon — by the rising-arc of the degree. [Said by] siman [סימן] [N: ?], so [it stands]: the position [is read] by the column, by the row [of the moon? — recte uncertain]; and a [tabulated] value [is] at its position.

[Margin: siman] By [the count of] the risen degrees, [the body] enters by the [tabulated] reading; the rising-arc, [a degree] such-and-such. The [zodiacal] sign is long [in rising], and what is in it [is the value]. [The] cycle of the tens [stands as

the] tabulated [positions], for [these are the] known [arguments]; you take [each] difference of displacement, [and the] motion [follows]. [Said by] siman [סימן] [N: ?].

Whenever [you] enter by [the] rising of the degree — the position [is found] by the difference of the displacement, [namely the] cycle of the tens. The [tabulated] degrees [are] for [this] region, [for] all of them; [it is] the [argument] understood and given. [And you] take the column of the first [argument], [its] degrees in order, [for] this [is] the [tabulated] reckoning; the cycle of the tens, the [tabulated] positions, [whose readings I] explained.

[Margin: siman] By [the count of] the moon's risen degrees, [you read] from the column, by the row, [and] a [tabulated] value [is] at its position; [it is] the position. [Take] the difference of the displacement, [and the] motion [follows], by [reckoning] the rising of the degree; place and place. [The] reckoning [is] understood and given.

[Margin: siman] You [obtain] the column, [namely the] cycle of the tens; [the] tabulated [positions]; and the rising-arc [is read] from them; [for] the moon, by the rising-arc of the degree. And [as for] the difference of the displacement — by the rising of the degrees [it is found]; it is [thus] divided, and the [motion follows].

[Margin: "סימן" with a numeral the page abbreviates — siman [N: ?]] By the column, by the row [of] the moon — [you have its] cycle [of tens]; and what is in it [is the] tabulated [value]; [it is] the position, [a] degree such-and-such [numeral: ?], the [zodiacal] sign such-and-such. And so [too] the rest, from there [you obtain it].

[Foot of 217v, last two visible lines:] ...the rising-arc of the degrees, [taken] from the column, by the moon's [motion] — and [you] understand [it]; [it is] understood and given. [The] reckoning [was] arranged from [its] beginning, [the zodiacal] sign by sign — and [so it goes] until the end [of the table], thirty-two [22 = כ"ב? or כ"ב read as the closing index, numeral: ?].

[Lower half of 217v is blank parchment (wide lower margin — not damage). Gutter shows minor ink flecks from the facing leaf — ignored.]

[Reader-facing note on the rendering: the body of these two leaves is a tightly contracted, repetitive *method* passage that walks the reader through reading the astronomical tables — entering with a known argument (the "cycle of the tens," the column of degrees, the rising-arc of a zodiacal degree), reading off the tabulated position of the moon, and forming the "difference of displacement" (the

motion). The same six or seven technical terms recur in parallel positions; the specific tabulated sexagesimal magnitudes the scribe abbreviates with gershayim are flagged [numeral: ?] where the entry-value cannot be resolved glyph-by-glyph rather than guessed.]

Isaac ben Joseph Israeli, Yesod Olam, the Fifth Treatise (the astronomical tables) — Chapter 17.

[The leaf is photographed with its fore-edge (and the conservation ruler) on the left; the gutter is at the right. The text block sits in the right and central portion of the page; the lower third of the leaf is blank margin. A faint sliver of the facing leaf shows at the extreme right edge and is ignored.]

[The top of the leaf carries the closing lines of the preceding chapter:] ...twenty-four degrees of a zodiacal sign at the rising-point [or: of the rising degree]. The arc of the day [קשת היום] is so-and-so, and the rising [העולה] of the displacement [המעתק] is one... [numeral: ?] ...apart, for each... the arc of the day [קשת היום] of the sign, so much. [numeral: ?]

פרק שבעה עשר [Chapter Seventeen]

On the arc of the day [קשת היום] which we set out [to derive] by means of it. [That is,] you already [know how to derive it], and [now] you should likewise know the displacement of the moon [מעתק הירח] and... by this method.

Now that you know your way [in this], so as to know the [tabulated] position [מקום] of the moon by means of [its] displacement [מעתק], by the method [we set out]: take what stands [נכון] [in the column] at the degree which the moon occupies at that time, and stand it [opposite] the position [מכון]. [Then] take the [tabulated] degree [or: position], and [find] the part [חלק], for so it should be — that the position [מעלה] of the moon... so much by this displacement, and the part [is] so much. The position [מקום] is known: take the difference [מחמת] of the displacement [מעתק]... ...from the displacement [מהמעתק] which is owed [the deficit]; from this displacement, [find] the position [מקום]. And know also: this part [חלק] which arises [שתהיה] at the position [מקום], know, and [reckon] all the rising [העולה] of this displacement [המעתק]...

and there will be a number [נב] [for] every part of the rising [העולה] of the displacement [המעתק]. The first position [מעלה] [is] so much [טלה — Aries] by itself; the part [חלק] [stands] opposite this part [חלק]. So you take so-and-so [נב] hours that pass [שעברו] over them, and reckon the number of the hours [שעות] which... [numeral: ?]

The displacement [מעתיק] of the moon... so much, and... so much by it. And take the difference [מחמת] of the displacement [מעתיק] of the moon, the deficit [המחויב], so much by this displacement, and the part [is] so much. The position [מקום] [is] known: take the displacement [מעתיק]...

the position [מקום] of the sun [מקום החמה] [is] so-and-so, and so much, and they are reckoned... the position [מקום]... [The displacement, when] you derive it, [tells you] the position [מקום] of the moon [is] so much; the position [מקום] of the sun [is] so much. And the rising-arc [העולה] of the sphere [or: of this displacement]: at the position [מקום] of the sun [מקום החמה], the part [חלק] [is] so much; take, for the rising [העולה] of the position [מעלה], so much by itself, and the part [is] so much. And add the difference [מחמת] of the displacement [מעתיק]...

the position [מקום] of the sun [is] so much, and the part [חלק] [is] so much, and it [will be] the difference [מחמת] of the displacement [מעתיק] of the moon and the sun [הירח והחמה]. [numeral: ?]

and you should derive your figure [שיעורך] from the number [מספר] of the hours [שעות] which... [numeral: ?] hours that pass over them, [as] reckoned, and double them [וכפול אותם] [to convert] them to the number [למספר]... [numeral: ?]

[The remainder of the leaf is blank margin.]

[This is the facing leaf; it is photographed with the conservation ruler on the right, confirming a distinct opening from 218r. The gutter is at the left, with a small ink stain along the lower gutter. The text block sits in the central and left portion; the upper part of the leaf is blank margin.]

[The text continues the same worked procedure of reading positions from the tables:] ...a number [נב] for your figure [שיעורך], so-and-so, and the number of the [tabulated] positions of the displacement [מעלות מעתיק]...

they were [in] the west — the rising of the position [מזרח המקום] — [and the figure of] the positions [המעלות] [is] this, and your figure [שיעורך]... [numeral: ?] [and you] stand it opposite [the column of] the positions [מעלות]; the part [חלק]...

[Then the rule for the sun's position is restated:] ...know, and [find] the position of the sun [מכון] — that is — and add and double it [וכפלה] [to convert] to so much, and it is the position [מקום]. The figure of the moon [מעלה — i.e. its tabulated position] is so much, and the part [חלק] [is] so-and-so by this method.

[On the daytime hours and parts:] ...[from] the number, [find] the figure of the positions of the displacement [מעלות מעתיק]: at the time the moon was in the west

[מערב — i.e. setting], the rising of the position [מזרח המקום]... and the figure of the positions [המעלות] [is] this. Your figure [שיעורך], so-and-so [נב] hours that pass [שעברו] over them, [as] reckoned, and double [convert] this part [חלק]...

the position [מקום] of the sun [is] so much; the rising of the position [מזרח המקום] [is so much], for it [is] the [hour]-line [קו]... the deficit [המחויב] [is] so much by this displacement [מעטק], and the part [is] so much. And the rising-arc [העולה] of the sphere — this is its end [סוף] — [yields] the position [מקום] of the sun [המקום החמה] and the figure of the positions [מעלות מעטק] of the moon [מעטק הירח]...

[On the first sign and on doubling:] ...the position [מקום] of the sun [is] so much; the rising of the position [מזרח המקום] [is so much]. Were it not for the first sign [המזל הראשון], you would not derive... the figure of the day [or: the position-arc] of the displacement [מעטק], so much, and reckon and stand it [opposite] the positions [מעלות]; the part [חלק]...

[the position] near to this part [חלק], and add a sign [ומזל — i.e. a whole sign] to it, and you derive your figure [שיעורך], so-and-so [נב] hours that pass [שעברו] over them, reckoned, and double [convert] them to the number [למספר]...

on the line [קו] of the position [מעלה], the part [חלק] [is] so much; [find] the difference [מחמת] of the displacement [מעטק], the deficit [המחויב] near this part [חלק], and add a sign [ומזל] and a [tabulated] position [וסימן — siman/argument], so much, and the positions [מעלות] of the displacement [מעטק] [are] so-and-so...

[Margin, lower right of this band: א"ם (siman siglum / marginal letter — apparently an abbreviated note or cue letter; not securely resolvable).]

and the position [מקום] of the moon [is] so-and-so, the end [סוף] [is] so much [for] each [tabulated] position [מעלה], and the part [חלק] [is] so much. And the part [חלק] [stands] opposite [the column], the first siman [הסימן הראשון], and the remainder [והשאר]: take, for the number [מספר], so much by hours [שעות]...

the figure [or: position] of the displacement [מעלות מעטק], and the remainder [והשאר], this [is] for the table [לשלוש — perhaps לשלוש, "for the three"; or a contracted reference] [for] every hour [שעת], and it [is]...

[the rule] near this siman [הסימן] [is] not [the] first [הראשון], [but] another [אחר]; the remainder [שאר], so much [for] each [tabulated] position [מעלה], and... [numeral: ?] [for] every hour [שעה] [and] hour, so much, [as] reckoned, and double [convert] them [to] the number [למספר]...

this part [חלק] [is] so much; the position [מקום] of the sun [מקום החמה], the displacement [מעטק] of the moon [is] not [the] first [לא ים הראשון] — reading uncertain], [but] another [אחר]; the remainder [שאר], so much [for] each position [מעלה] of the displacement [מעטק]...

that the positions [המעלות] [yield] a [zodiacal] sign [מזל], the [hour-]line [קו], and a siman [סימן] [for] the positions [מעלות] of the displacement [מעטק]...

the position [מקום] of the moon, this [is] the deficit [המחויב], [and] this [is] its end [סוף]: a [tabulated] position [מעלה] of the displacement [מעטק] of the moon [מעטק הירח]...

and double [convert] them — and the part [חלק] near this siman [הסימן] [is] not [the] first [לא ים הראשון] — uncertain], [but] another [אחר] [for] the time [עת] of the figure [or: of the position]...

[On the worked example:] ...so-and-so positions [מעלות], so much [for] each position [מעלה], the part [חלק] [is] so much, [as] reckoned... [numeral: ?]

so-and-so [a number] [נב], and the remainder [והשאר], [for] the table [לשלוס] — "for the three"?, every part [is] so much; and so... [numeral: ?]

[the worked figure] [is] so much; the position [מקום] of the sun [is] so much; the position [מקום] of the sun [מקום החמה] [is]... [numeral: ?] [the] positions [מעלות]... so much, [as] reckoned, the displacement [מעטק] of the moon [is] so much; [and] near, [find] the difference [מחמת] and the siman [וסימן], the positions [מעלות]...

[the rising-arc] of the sphere [or: this displacement] [is] the deficit [המחויב], [and] this [is] its end [סוף]: a [tabulated] position [מעלה] of the displacement [מעטק], so much; the part [חלק] near this siman [הסימן] [is] not [the] first [לא ים הראשון] — uncertain], [but] another [אחר], so much [for] each position [מעלה]...

and double [convert] them: [for] the position [מקום] of the sun [מקום החמה], the part [חלק] [is] so much; near [is] the [hour-]line [קו], the figure of the positions [מעלות], so much, [as] reckoned...

and the part [חלק] [is] so-and-so; the positions [מעלות] [yield] a sign [מזל]... [numeral: ?]

[so much] hours, and [it is the] hours of the [day], so much; the positions [מעלות]... [numeral: ?] ...the number [מספר], [for] the hours [שעות], so much; the positions [המעלות] [are] so-and-so... and you should reckon them and double [convert] them [to] the number [למספר]...

[the position] near to this part [חלק], and add another sign [ומזל אחר] to the line [לקו]... [numeral: ?]

the number [מספר], [for] the hours [שעות], so much; and the parts [והחלקים] [are] so-and-so [שד שיט — reading uncertain] [for] each whole [position] [טלה — Aries / or "the lamb," i.e. the first sign as unit]...

[the position] near to this part [חלק], so much; another sign [מזל אחר] [for] the [hour-]line [לקו]...

[for] the number [מספר], [for] the hours [שעות], so much; and the parts [והחלקים] [are] so-and-so, [for] each whole [position] [טלה]...

[The remainder of the leaf is blank margin.]

The Fifth Treatise — the astronomical tables. Chapters 17–18.

Script: Spanish Rabbinic (semicursive) hand, brown ink throughout. Both leaves are distinct openings: f. 219r has the conservation ruler at the left and the pencilled foliation "219" at the upper outer corner; f. 219v has the ruler at the right. Wide blank lower margins on both leaves (not damage); a small ink-splash cluster sits in the gutter at the foot of both leaves (offset/transfer marks, not text loss).

Folio 219r — end of Chapter 17

[Margin: רע"ד (siman 274)]

and the day on which the place of the sun stands [is] the very day whose [computed] position falls at the end of the fifteenth degree [numeral: ?]. The [argument-]line that you enter against it [is] this sign and this [degree]. And the displacement [מעתיק] — the ḥelek [part] that you accumulate from it [is] to be set down, and [so on]. And add to it [numeral: ?] and [proceed] accordingly, until you reach the [great] column. There the number falls; and the [argument-]signs that you take from it are this [number].

For there is also there [numeral: ?] [parts], and what comes out: the number [is] this [numeral: ?], and you add to it [numeral: ?]. And against it falls a [further] number; and add to that [the] number [of] minutes [שניות]; and so [on] until [you reach] the position; and what comes out from that [is] the displacement, this. And take [numeral: ?] degrees; and there is the day on which [the position] falls. And the difference of the displacement, this [is] upon [the rule].

The number [is so-and-so] [numeral: ?]; and the difference [is] this [numeral: ?]. And the displacement, the parts, and the minutes — and the hours [are] this [numeral: ?]. And what comes out [is] this number; and what is required [המחויב] of this number [is] the hour, [and] half a part, this. The hours, this; and what is required of them [is] [numeral: ?] hours, and one half; this hour. And what these books [say], when you correct it according to the position — [as so-and-so] hours [and] parts, this [is] the position, this.

פרק י"ח — Chapter 18

[Margin: רע"ה (siman 275)]

Chapter 18. On the manner of correcting [computing] the eclipse of the sun [לקות] [החמה] according to the tables of the cities [לוחות הערים].

[The means] to correct the eclipse of the sun according to the tables of the cities [is] this [numeral: ?]. And [proceed] according to the reckoning [heshbon]. There is a long [interval] up to [the] one [numeral: ?], and how many minutes; and the six [numeral: ?] [argument-]signs that you take from the tables [are] for the cities. The reckoning [heshbon] [is] all of it [in] reckoning, [from] its tables; and this falls against [the] line of [the] number [numeral: ?]. As for the difference of the displacement and the difference [between the positions]: a [further] number [is] taken there; and what is required of this [is] [numeral: ?], and so [it] will be set.

The position of the moon: [you] correct it; what it is [numeral: ?] degrees, and how many minutes; and you make twice [doubling] their fractions [refraction] for the cities; and from there you reckon. Their account [is] thus [numeral: ?] [parts], and so [it] will be set. and the difference of [the] place: a number; and against it [there is] there [numeral: ?] of the moon [numeral: ?], either by addition or by subtraction; and [it] has fractions [refraction] this [numeral: ?] minute. The remainder [המנא] [is] this [numeral: ?] [parts]; and so [it] will be set. And the difference of the place of the moon, the difference [bein, between them]: as for [what is] required of the moon — what [are] the minutes of the difference [numeral: ?]?

And the lines of the moon's account, and the moon's account, in this manner [is set down]; and the moon [is] [numeral: ?]. And the moon's account, this [is] the difference, the place — by addition or by subtraction; and [it] has fractions this [numeral: ?] degrees, and so [it] will be corrected. As the eclipse of the moon is corrected according to the tables of the cities, so [is] the eclipse of the sun corrected according to the tables of the cities. And what is required, when [you]

correct it according to the position [is] the eclipse of the moon, and so [it] will be corrected.

And take [numeral: ?] [parts], in the manner of the books of the [seven] planets [המשׁרתיׁם, the servants/planets]; and the order [is set down]: the great [column] [numeral: ?] [is] set down; and the third [numeral: ?] — its account — is set down. As for the center [merkaz] of the moon at the time the conjunction falls: the great [column] [numeral: ?] either by addition or by subtraction, this; and the lines of the [computation] —

the signs of the great column [are] set down, [and] this account [is] this. The moon [is] [numeral: ?] of the [argument-]signs [numeral: ?]; and this [is] this; and so [it] will be set. The [argument-]line — [you] reckon — there [it] falls; what is required of the moon [is] [numeral: ?] minutes, and what is near [it]; and what is required of the eclipse of the sun [is] this [numeral: ?], and [it] has fractions this [numeral: ?] of the way [to be corrected]; and there is on the line —

the moon, [in] this manner, [is] for the conjunction. The [argument-]line of the moon: a number; and the moon — what it is [numeral: ?] degrees, and a half? And against the great column [there falls] a number; and the moon — what it is [numeral: ?] degrees, and what is near [it]? And it follows that [the] eclipse of the sun [is] [numeral: ?] degrees, and you double them; and this [is] the great column. As for the moon, what it is [numeral: ?] degrees, and how many minutes? And against it [there falls] a number; and the moon, what it is [numeral: ?] degrees? And it has fractions this [numeral: ?] degrees; and so [it] will be set.

[Following lines continue at the foot of 219r as headers of the per-row template; see continuation on 219v.]

Folio 219v — Chapter 18, continued

Also there they said: how much was it, and that the [whole] eclipse of the sun [is] in all this [is] the position [ma'at]; the breadth [רוחב] of the eclipse [is] [numeral: ?] at the time the position rises from [numeral: ?], from the place [of the] degree against [the] number; and up to one third [numeral: ?], either more than [a certain measure] [numeral: ?], [or] up to [it].

[As for] their meaning: [numeral: ?] degrees, [numeral: ?] [parts] — what comes out [is] this; and if it falls deep [far], [it] will be doubled. The more [numeral: ?] is, and what comes out [is] that the eclipse of the sun is doubled, and if [it] is left over [as a remainder], it does [thus]; and after the eclipse is corrected — to be set

down. For he said: when you correct the eclipse of the sun according to the lines [tables] — [you] correct it on the way that [is set down]; this [is] correction.

[He] corrected the half of [the] eclipse[s]; the place [ma'at] of the conjunction [is] in the place of the [moon] [numeral: ?]; in its [whole] rising, [there is] nothing [more] to be set on the way of [the computation]. The order [is set down] in the manner of the books; for he said the difference [is] this, and [it] is understood; and you double a half-hour, and how much an hour, this hour.

Its difference: how much [is] the reckoning, if it falls — there is no place upon it[s] rising; for the place of the sun [is] for [its] rising, [or] [it] will fall [outside] from [it]; either [it] is doubled by the eclipses [תקליפות?], [or] there is in this the breadth of [the] eclipse, and so [it] will be set, [in the] account of the [whole] account [up] to [numeral: ?]. Either [add] to it the difference of the place, and reckon the lesser [smaller] [numeral: ?]; and know the [argument-]sign, and [proceed] accordingly. And know the place — [it] passes the place of the great column, [either] addition [or] subtraction; and [it] is set down, and know — the line stands against the moon, this [numeral: ?].

[There is a long interval; and] what is required of the moon [is] this [numeral: ?], and so [it] will be set; and [the] difference of the breadth of the position [is], the difference, thus [the position] —

as it was. What [were they]? — the place [ma'at] there [numeral: ?]; and the difference of [it] [is] this great column, this; the half of [the] [eclipse] — and up to the part [ḥelek], that [it] should be from the place where the conjunction's [moon] [is]; and [in] its rising, in the [eclipses]; in [the] account of the place, [in the manner of] [the] correction; and there is on it, [in] the order [set down] —

The [argument-]line of the moon: a number; and you make twice [double] the moon, the difference; and there falls there the place [ma'at], and reckon it; and what is required of the moon [is] [numeral: ?] minutes, and how many [numeral: ?]? — a year [שנת], and on it from [the place] —

the difference, upon the lines [tables] of the time the moon's account [is] set down. And take the [argument-]signs of the moon — what they are [numeral: ?]? And reckon them, and so [it] will be set; and you double them, [from] the place where [numeral: ?], on the way of —

the seven [argument-]signs at the time the position [ma'at] [is set] for the rising; and the lines [tables] of the time [ma'at]; and the difference [of the place] —, [you]

reckon them, and take them from there; the [argument-]signs [are] this [numeral: ?], and so [it] will be set; the moon, this [is] —

and others, the difference. When [you] hear [follow] the [argument-]sign[s], the moon — what it is [numeral: ?]? — all of it, this; how much [numeral: ?] degrees, all of it, of the first [position]; and it stands [thus] (and the fifth [numeral: ?]) — and how much [numeral: ?], either from [the place] of the [near] [numeral: ?], and from there the difference, this [numeral: ?] degrees, and the breadth [numeral: ?] —

[in] this manner, [you] take the [argument-]signs of [the] moon — what they are [numeral: ?], the way the moon [follows]? And how much [is the] account, all of it, [in] the manner of the difference — either subtraction [or] addition? And [it] has fractions this [numeral: ?]; and [it] is set down, and [there] [you] add to them; and the [argument-]signs of the moon [are this] —, the first position [מצב הראשון] [is] this; either the [fifth] is the fifth, [or] [it] opens it [numeral: ?]; and the more [numeral: ?] is, for [there] was the [near] [numeral: ?] from this [numeral: ?] —

either by addition, or [by] what is left over [as a remainder] from the position [ma'at]; and you take it [from] the moon, the difference [numeral: ?].

[Lower margin of both leaves blank.]

The Fifth Treatise (המאמר החמישי) — the astronomical tables. Chapter 18 (פרק י"ח): computing the solar eclipse by the tables of the cities. Continuation of the solar-eclipse procedure begun on the preceding folio.

Spanish Rabbinic semicursive, brown ink; single text column, conservation ruler at the left edge (photography furniture, ignored). The text block occupies the upper portion of the leaf; the lower margin is blank parchment. The pencil foliation "220" appears at the top of the leaf.

[The scan of this leaf captures only the left (gutter-side) portion of each line; the right-hand start of every line runs off the right edge of the frame and is not photographed. What follows transcribes the legible left-of-line fragments verbatim; the unphotographed right-hand head of each line is a genuine out-of-frame gap, not lost ink.]

שמרת [you guarded] ... זו / ... [?] קתל [this]

והקבץ [and gather] ... מנת [?] סית [the portion / value]

דע אותה [know it] — מרחק הירח [the moon's distance]

היה [and there] פרידו [?] ... ושם ... [the distance was] המרחק היה

ויקה [and he takes] ויקח [the solar eclipse] לקות החמה

[contracted token, numeral: ?] צת השכוב [?: השכוב] — קטעי"ס

[The remaining lines of this leaf continue the same out-of-frame pattern: legible left-of-line fragments naming the recurring procedural terms — the corrected value (המתוקן / המתוקנת), the moon's distance (מרחק הירח), the parts of breadth and length (חלקי הרוחב / האורך), and the verbs "guard" (שמר) and "add/posit" (יסיף) — but each line's right-hand head is cropped out of frame and cannot be committed. Withheld rather than confabulated.]

[Lower portion of the leaf is blank parchment.]

Same hand and ink; conservation ruler at the right edge (photography furniture, ignored), text block at the center-left of the leaf. The written text fills roughly the upper third of the leaf; the lower two-thirds are blank parchment. A small worm/stitch hole and the binding strip appear at the gutter foot — codicological, not text loss.

[As on the recto, the scan shows this leaf with the right-hand head of each line out of frame, and several mid-line tokens are heavily contracted and abraded. Legible left-of-line fragments are transcribed verbatim below; the cropped line-heads and unresolved contracted tokens are genuine gaps, not confabulated into fluent prose.]

מרחק [the distance / from the distance] קח פדינו שד [?] מרחק

זה [this] זה [contracted, numeral: ?] "חסם תענה מלח [?] ל

... [?: the foregoing] לק סת השכוב הקדם

[guard it, and again he takes] בו רגש סת השכוב [?] ... שמור אותו ושוב ויקח

[and he takes] מלח הקדיק [?] ולקח

[contracted tokens, numeral: ?] טעי"ס רעש"ל [contracted, numeral: ?] עבסם [?] זצל

[?: take it first from ...] קחנו תחלה מהעיוב

[?] זקסטן [?] מאמסר [and gather] שניו והקבץ

[?] זאבע [contracted, numeral: ?] לוקסון [?] קלן ל" יב

לק אותו על מבסם [?] תשעא [contracted, numeral: ?]

זמן השבוב שגבה [the time of the return ... (?)]

שיופל [?: knows; thus] [?] יודע ענדי כן

בוב חיה היה מרית הוית [?]

משכסון החמה [the eclipse] ת הלוקה [?: of the sun]

טיתן מספר הטבעות [the table of value(s)]

והה לקות [the solar eclipse] לן לקות החמה [and the eclipse ...]

לר מעל מדרכי החישוב [from the procedures of the computation]

... [?] משעתה הבן לתחרך

[?] יחן עוסן סיד על

[?: the position ...] טוב לסיין מקום קקיכן

[?: there was ... or it was there] טעה היה או היה שמה

[?: the true ..., this] הקימן האמת הוה

ס משעה אחר תתויט [contracted, numeral: ?]

[The remaining lines of this leaf continue the same out-of-frame, contracted pattern and are withheld rather than confabulated; then the leaf is blank parchment over its lower two-thirds. The token previously read as a proper name (יצחק המתוקן, "Isaac the corrected") is not legibly present on the leaf and is removed — there is no author self-reference to commit.]

The Fifth Treatise (המאמר החמישי) — the astronomical tables. Conclusion of Chapter 18 (פרק י"ח) on the solar eclipse by the tables of the cities, then the opening of Chapter 19 (פרק י"ט = פרק תשעה עשר).

[Marginal foliation: "221" at top-left, modern pencil hand.]

[The page opens partway down the leaf — the upper third is blank margin, then the text column runs to the foot. Continuing the iterative correction procedure of Chapter 18, on the solar eclipse computed from the tables of the cities. The prose is genuinely terse and abbreviation-dense astronomical-table instruction; verbatim Hebrew is given for clauses whose full procedural sense is elliptical, and contracted in-line magnitudes are flagged [numeral: ?] rather than committed.]

one day according to the mean motion [מהלך]; and the moon's displacement [מעטק הירח] will be such that you should know it. By contrast, if the table you have differs, then [proceed] accordingly. Since it differed in this, the moon's longitude will be [thus]; and know that, if the displacement comes out [a given amount] [numeral: ?], you will examine it once more, as we explained at the outset, so that the second [computation] comes out exactly equal to the first; and if anything still remains, you will repeat the operation a third time.

Therefore, when the moon's distance [מרחק] from the sun has been determined, the eclipse will be [of such a magnitude]; and once you have determined its breadth [רוחב] and length, you will know its time exactly. Hence the moon's displacement at the moment of conjunction [קבוצ] is itself the cause, and from it the eclipse follows; so you should reckon by this rule.

[Then, joining the displacement at conjunction to the moon's distance and to the equated [המתוקן] value, comparing the corrected longitude of the sun against that of the moon — the difference between them being the eclipse's measure of breadth:] so it is — [verbatim: כן תעשה י"ב טנ"ס] thus you do [for] twelve [numeral: י"ב] minutes [שניות = טנ"ס, "minutes/seconds"].

And in order to verify the moon's distance, you will repeat [the operation] and add to it [a given amount], for you have already set it down and corrected it [וכבר]; thus what comes out is the measure of the breadth, and this is its sign [סימן]. From the corrected measure of the breadth and the length you will obtain its sign; then bring its degree to the [given] degree [numeral: ?] — and these are twelve [numeral: י"ב] minutes [טנ"ס].

[The reckoning continues, on whether the obtained breadth comes out deficient [חסר] or whole [שלם], and the consequence for the eclipse and for the cycle [המחזור]:] the measure of the breadth that you determined, if it be deficient, so much the more [is the case]; for if it be deficient, [in the other reckoning] it is whole — and these are clear matters. Therefore know the measure of the breadth of the longitudes and arrive at a clear understanding; for it was deficient in the [reckoning] by [a given amount] [numeral: ?]. And this will hold for the eclipse and the cycle [המחזור]; the sun's course [הילוך] [proceeds] by [a given amount], and the moon's distance from it is thus. [Several further clauses of the same reckoning — joining the corrected first values, examining and equating them, and obtaining the eclipse's measure — lead to the close of the chapter.]

פרק תשעה עשר

Chapter Nineteen. [Enlarged script, mid-page; the rubric is in the same brown ink, merely larger. Spelled out in words — *tish'ah 'asar*, 19 — not in gematria.]

In the reckoning of the broken [fractional] computation [החשבון השבור] and its examination: [know that] the [reckonings] are in it, and the broken [fractional parts] of the tables [שברי הלוחות]. The measure of [a given] degree by [a given] course you will reckon at the end of the table [בסופה]; and you should know that the cities are in it, and the broken [reckoning] is such-and-such [numeral: ?], and these [are] thus in the table. [Several elliptical clauses follow on how the fractional reckoning of the cities is carried out.]

[Then:] in the fractional reckoning [חלק שבור] of [a given] degree, the [reckonings] are thus in the corrected [table] [המתוקן]; the mean [motions] [proceed by] so many [numeral: ?], and the breadth is sixty [numeral: ס'] minutes [שניות] by the fractional reckoning; and a hundred [numeral: ק'] minutes are equal to ninety [numeral: צ']. [End of the recto.]

[The leaf again opens partway down; upper third blank margin, text to the foot.]

you will multiply [תרבע] the fractional [reckonings] that are broken; and the broken fractional [part] is [a given amount] [numeral: ?] minutes [שניות], and another minute. And you will set it down thus: [a given amount] [numeral: ?]; and you will multiply the broken [reckonings] by the number of the broken [parts of the] tables. The fraction adds to it, and beyond it [there is yet a further fraction]; for they multiply [the fractions] by these [reckonings], and accordingly [you proceed] just as you did, so as to know [the result].

And know that the mean motions [מהלכי] [of] the fractional [parts] — according to the day, and according to the mean motions of the constellations [המזלות], either to the north or to the south, or in [a given] degree of [the zodiac] [מזל] — [are] those from it [that fall] in the mean motion [מהלך]: if to the south [it is] thus; if to the north, the mean motions [are] in the south [in the complementary sense]. [These are the differences of the mean motions, north and south.] Thus far the particulars [הפרטיות]. [The mean motion of the fractional reckoning will be such-and-such — this is the rule — and the reckonings are recorded in the table, this and its paired entries set in their places; and know this.] Thus far the matter; and already —

If your distance [מרחקך] is deficient [חסר], so it is; and likewise if [the entry] is deficient by [a given amount] [numeral: ?], so it was. And the fractional measure of the breadth that you obtained, by [a given amount] [numeral: ?], thus [proceed]: add to it the mean [motion] of the [planet's] place [מקום] in [a given]

degree [numeral: ?] — for it was thus. Accordingly know whether it is in a degree of breadth [numeral: ?]; and according to the day it will be thus. For if the [body] is whole [שלם], then [it follows]; and you should know its place exactly: that there be no breadth at all to it.

Thus, had it remained whole [שלם], it would have been in its place; but in fact it is deficient, and so it is in [a given] degree [numeral: ?] — this is the case. And know its place exactly, for there is breadth to it. [Further clauses examine the deficiency of the breadth and equate it.]

And know exactly whether the [body] is whole or deficient, so it is; for if it is deficient by [a given amount] [numeral: ?], thus [proceed]. The breadth of [a given] degree at the moment of conjunction [קבוץ] is thus: at the time of conjunction it is in a degree of breadth, by [a given amount] [numeral: ?] — for if [the body is] whole, then [it follows]. And you should know the matter exactly: for what you have is the deficiency [המחסר] of the mean motions of the deep [העמוק], the whole [circuit].

The fractional [reckoning] of [a given] degree at the end of the table [בסוף] is [a given amount] [numeral: ?]; and according to the day it will be thus; and you should know the matter exactly, for there is breadth to it. And know exactly that there is breadth at all, [in a given] degree [numeral: ?] — for if [the body] is whole, then it [follows].

And it is thus: know exactly the time of its conjunction [קביצתו], and the displacement [מרחק] is thus; you should equate [תשוה] the [time of] conjunction's completion [תשלום], whether it falls in the north or in the south; for [you proceed] by the eclipse. And know exactly that all the eclipses [המאורות] and the conjunctions [והמולדות] are clear, and the breadths; for [know] also from this — and the sign [וסימן].

[Then a passage naming the matter explicitly:] The matter is thus: there are [reckonings] within the broken [fractional] [reckoning] [השביר]; and accordingly you may reckon all the [eclipses], and to them — for the matter is so. The cause is that the deficient [computations], the [comparisons] [והקרובים], and the eclipse-magnitudes are recorded in the sixth [table] [השישית]; and this [is] the new [moon] [החדש], and you should know it exactly. [End of one paragraph.]

And to them: thus [proceed]; [for] now its [course] is set down in the table, and you will reckon and obtain [it] [ותפשט ותפקט]. And so it is; for the matters are clear within the broken [reckoning] — the matter of the broken [table] — the

eclipses [המאורות] are clear; and you may say of the broken reckoning: from there all [follows].

It is thus; and accordingly it was set down in the table; for there is no eclipse [שום] in it, just as we explained; and so this is sufficient [יספיק] for the knowledge of the matter — by the cycle of the [moon's] return [מחזורית], its [phase], and the conjunction [וּקְבוּץ], for it is established; and another [matter] that is in it. [End of the chapter / page.]

Script: Spanish (Sephardic) Rabbinic semicursive, single hand, brown ink. No ruled astronomical-table panel (לוח) appears in this batch. **This leaf is the END of the book:** folio 222v carries the author/scribal colophon, a decorative closing flourish, and a six-couplet closing poem. The expected culminating astronomical tables do **not** begin here.

Single-column prose; conservation ruler/black strip down the left edge is photography furniture (ignored). The text occupies roughly the upper two-thirds of the leaf; the lower third is blank parchment (wide margin, not damage). A three-line marginal note sits in the left margin beside the upper text.

[Margin: a three-line marginal note in the same hand, left margin: " וזה שבט ואיר... ותריס ויום פסח ושבוע[ת] / וזה[?] חרטין[?] חשבן ולכאעית אל שלזות[?] א[?] / מסימן הש"א — verbatim text uncertain at several glyphs; it appears to be a constructive helper listing months (Shevat, Iyar) and feast-days (Pesach, Shavuot) keyed to the reckoning. Further identification requires further verification.]

The opening lines complete the discussion carried over from the broken-reckoning chapter (Chapter 19). The method is set out plainly, so I render the legible prose and flag only genuinely lost glyphs.

by this slight amount it will be, and it will be upon the cycle [?]; for it is the residue, by the [completed] cycle. By the way of this calculation, you will find the first [?]; and the remainder is the residue of the cycle, which is the [residual] sign [?]. And by this calculation you will know in which year of the cycle you stand, and from it you will know the molad [?]. And so too you will know the residue of the [?] from the day of the conjunction, and from there [you reach] the day of the next conjunction [?]. So you will know in which day [of the week] the molad falls, and likewise in the [?].

[The argument continues: by knowing the residue of the cycle and the count of complete cycles, one derives the position within the current 19-year cycle, and

from that the molad and the day of the conjunction. Several mid-line magnitudes are contracted and not separately legible — flagged below.]

the cycles, the months, and the [?]; and you must also know the residues of the cycle that remain [?]. And he who [?] will know [?]; for the residue of the cycle and the residue of [?] [numeral: ?]. The books [authorities] reckon [?] by this way, and there are those who reckon by another way [?]. And this is set down for the time [period] [?], and there is [?] — to make known to the wise [למשכילים] the residues, and their establishment [קבועתם] is clear [ברורים]; and that which they passed down [?]. These are the principles [העקרims] of the calendar [?] and [?].

[The closing lines of 222r:] ...our predecessors, of blessed memory [קדמונינו ז"ל], to make it known to the wise [למשכילים], in their being [במהותם] and their establishment [?] clear [ברורים]; and the matter [דבר] of [?] life [חיים]; and they learned [ולמדו] from you [מתוך]; so [כך] [?] and [?] in parables [ובמשלות].

[The remainder of folio 222r is blank parchment.]

Conservation ruler is on the **right** edge here (opposite side from 222r), confirming a distinct leaf. Gutter/binding-thread damage and a facing-leaf sliver appear at the left (spine) edge — no text lost. The leaf has: (1) a short upper prose block completing the preceding passage; (2) a wide blank band; (3) the colophon paragraph; (4) a decorative closing flourish; (5) a six-couplet closing poem in two columns.

Upper prose block (completion of the preceding passage)

[the principles?] and their establishment [?], and their fixing [?]; and in this [?] [?] from the principle [?], according to that which you [?]. There is no [?] in this — the calculation of the months [?], which you should set up [שתיקים] for yourself [לעצמך]; and we have returned [?] and set it down [?] [?]. And we have already explained [?] the matter [?], and after this [ואחר זה] [?]. And he who calculates [?] [?] the conjunction [המולד], the moon's course [המהלך] [?]; and afterward [ואחר] [?] he calculates [יקרא] [?] when the moon [הלבנה] [completes its] course [ההלוך], so that the conjunction [המולד] is great [?] and easy [ונקל]; and there is in this [no?] [?] beyond [?] [?] upon them, my voice [עליהם קולי] "...".

Colophon

[The book-closing colophon, in the copyist's hand. Reading right-to-left; proper names and the date letters are flagged where the glyphs are not securely resolved.]

This book, which is *Yesod Olam*, was completed [נשלם זה הספר שהוא יסוד עולם] in the year five thousand two hundred and thirty[?] [ה' אלפים ומאתים ושלשים?] of the Creation of the world [לבריאת העולם], in the town of [במתא — place-name: "פרקושה" Perpignan / a Provençal-Languedoc locality; [?]], upon [?] the book [?] [?] the labor [הטלאות?] [?] [numeral: ?] [כונ? בי"ה? כו?].

And I, Samuel [שמואל] son of the honorable Rabbi [בכ"ר] Raḥm[?] [? — רחמ? — patronymic not fully legible; [?]] [of?] Marseille [מרסאי? — Marseille / a Provençal place-name; [?]], wrote it [וכתבתי אותו]; and I copied it [וכתבתי אותו] [for?] [?] [?] [?], the honorable Rabbi [בכ"ר] Solomon [שלמה] [?] of Jerusalem [ירושלמי] — i.e., bearing the byname "Yerushalmi" / "the Jerusalemite"; [?]].

May the Lord let him live to read it [ה' שם? יחייהו לקרותו], he and his offspring and his offspring's offspring [הוא וזרעו וזרע זרעו], and may they read it [ויקראוהו] forever, as it is written [עד מקרא דכתיב]: "...they shall not depart from your mouth, nor from the mouth of your offspring, nor from the mouth of your offspring's offspring, says [the Lord], from now and forever." [Yeshayahu 59:21] Amen, and so may it be [אמן וכן יהי].

תם ונשלם תהלה לאל עולם — "Finished and completed; praise to the eternal God." [Above the cartouche: a small **תם** ("completed"); beside it a small **כנ** / **יהי**.]

Closing poem (two columns, six couplets)

A rhymed closing poem follows the flourish, set in two columns; each line closes with a double-stroke rhyme mark ("). The hand is small and the rhyme-words are contracted; this allusive verse is genuinely hard, so I transcribe the visible Hebrew verbatim and flag uncertain glyphs rather than reconstruct the poem.

Right column (read first, RTL), top to bottom:

1. [?] ונסתר נעלם מהקן אמרהו "
2. [?] ספוט[?] בן יחזה אך לנשגל "
3. [?] יבול[?] עלל[?] בקראו בו וישכל "
4. [?] ותעשתקן[?] יהי נהר[?] ושמר "
5. [?] ואם יזרע לחק ינב[?] וירע "
6. [?] כעץ יבא[?] גה[?] לו ושאון "

Left column, top to bottom:

1. [?] ולדבה[?] מטרתו חזק כשער "

2. "[?] אשר טס[?] תק[?] על לבו והחמר "
3. "[?] כלעלדו[?] ויקם[?] על כאמר "
4. "[?] לבל יחלוף באהוביהו[?] וימר "
5. "[?] ולא יצרח[?] לבב שיר[?] ושער "
6. "[?] כנשונו[?] כלהיר[?] אש בשער "

[Below the poem, centered: a small final marker — appears to be **תם** / a closing squiggle. The lower half of the leaf is blank parchment.]

Both leaves of this opening are blank, unruled parchment. Folio 223 is a blank leaf between the concluding scribal colophon (on the preceding folio 222v, completed earlier) and the start of the appended astronomical tables (לוחות). No ruled לוח panel, prose, rubric, or table heading appears on either side.

The only marks present are:

- A modern pencil foliation "223" in the upper area of folio 223r [Librarian note: pencil foliation "223"].
- Scattered modern pencil arithmetic jottings on folio 223r (graphite figures such as "396", "625", "12", "14", a fraction stroke, etc.) — a later reader's scratch calculations, not part of the manuscript text [Librarian note: modern pencil arithmetic jottings, recto].
- Light foxing and faint water-staining at the lower margins of both leaves (not text loss).
- Faint show-through / bleed-through banding on folio 223v from the text of the facing (subsequent) leaf — ignored per scan-artifact convention.
- A thin sliver of the facing-leaf's prose visible at the gutter edge of folio 223r (belongs to the adjacent leaf, not to 223r) — not transcribed here.

The conservation ruler/scale-bar and black photographic strip along one side of each leaf are scan furniture and are ignored.

Script: primary manuscript hand is Sephardic semicursive (the appended astronomical tables proper, which begin on the *facing* leaf). The inked content actually present on these two leaves is in a later, flowing cursive hand (graphite/brown ink) plus pencil foliation and pen-trial jottings. The ruled astronomical tables (לוחות) themselves are NOT on either of these two leaves: this opening sits immediately before the table panels, whose first ruled leaf is visible only as a thin facing-leaf sliver at the inner edge (transcribed with the next leaf, not here).

folio 224 (one side)

Pencil foliation in the upper-left margin: **224**.

Two later-hand cursive ink jottings are written diagonally in the upper-left quadrant (the rest of the leaf carries no text):

- [Margin, upper area, later hand, set diagonally: a short cursive note of ~one line. The hand is a small flowing cursive and the words do not resolve at this resolution — [?].]
- [Margin, just below the first, later hand: a ~two-line cursive note, likewise unresolved — [?].]

folio 224 (other side)

This leaf carries a block of rhymed cursive text in the left-center of an otherwise blank leaf (the large right portion is blank parchment bearing only faint bleed-through, foxing, and later pen-trial scribbles). The text is laid out as short couplets/hemistichs separated by colon dividers (:), a metrical/poetic layout rather than running prose. The hand is a later flowing cursive, distinct from the manuscript's careful book hand.

Top of the block (rubric / gloss letters):

- Rubric word at the head of the block: **אִירְמִי**].
- Two small gloss-letters above the couplets, each apparently a doubled letter cluster (לאל לאל-type marks) — function uncertain (siman/sequence marks?), [?].

The metrical block (rhymed couplets, read right-to-left, colon-divided):

The couplets are written in a small, ligature-heavy cursive and only fragments resolve securely glyph-by-glyph. The recoverable layout and securely-legible words are recorded below; the connective text between them does not resolve at this resolution and is flagged rather than reconstructed. ()

- Couplet 1: ... יחל ... הוא לנו [?] : ... [?] ...
- Couplet 2: ... שלח לכם ... [?] : ... [?] ...
- Couplet 3 (a three-part group): ... [?] : ... [?] : end-word ואחזת [?]
- Couplet 4: ... [?] נשבע [?] : ... [?]
- Couplet 5: ... [?] : ... [?]
- A short centered word/refrain between groups: [?]

- Couplet 6: ... [?] כל סלסלם [?] : ... [?]
- Couplet 7: כל ... דור ... [?] : ... [?]
- Couplet 8: ... [?] תור [?] ... : [?] שעה [?]
- Couplet 9: ... [?] אשר ... : ... [?]
- Couplet 10: ... [?] כל ... יד [?] : ... [?]
- Couplet 11: ... [?] : ... [?]

[Recurring rhyme-syllables that are securely legible at the hemistich ends include the cluster **-נם** (e.g. דנם / כנם) and **-ל**; these confirm the rhymed-couplet structure even where the body words do not resolve.]

In the blank right portion of the leaf (later additions, not original text):

- A short standalone cursive note set off in the upper-right whitespace: קנא [?] נשבע[ת?] — later hand, not securely legible.
- Faint graphite pen-trials / pen-test scribbles (stray strokes and Latin-numeral-like marks "3 / 6 / 4") in the right-center — later doodles, not text.

Appended astronomical tables (לוחות). The ruled tabular section of *Yesod Olam* begins here. Both leaves are entirely given over to ruled calendar tables — the **molad-correction tables** (לוחות תיקון המולדות) — with brief explanatory prose set beneath the upper panels and a closing note at the foot of each leaf. Primary hand throughout (Sephardic semicursive); brown ink, with the panel titles in a heavier display rubric. Wide blank lower margins (not damage). Conservation ruler/scale-bar furniture along the outer edge is ignored.

The page is signed at the top center with a quire/leaf mark: f. 225r is marked א (circled, superscript), f. 225v marked ב (circled, superscript).

f. 225r

Overall section title (display rubric, centered, with circled "א"): לוח תיקון — "Table of the Correction of the Moladot."

This leaf carries four ruled panels: two across the top and two across the bottom.

Panel 1 — top right

Title (rubric): ערכי / עינת recte [ערונת המחזורות הכפוליות] "values/equation of the doubled cycles" — i.e. the accumulated molad-remainder per (paired) 19-year cycle]. [?]

Type: **molad accumulation table** — argument = number of cycles; value = accumulated time (degrees/hours) and a running serial.

Columns, right→left (logical order): **מספר השנים** ["number of years (from the era-start)"] · **מעלות** ["degrees"] · **שעות** ["hours"] · **חל"ק** [חלקים, "ḥalakim"] · **מספר ההתחלות** ["number of the beginnings/serials"].

Dimensions: 5 columns × ~22 data rows.

The panel as ruled carries an argument column at far right (the serial/leaf-count fragment, largely abraded), then a narrow **מעלות** (degrees), then a narrow **שעות** (hours) strip, then the running **מספר ההתחלות** (serial). Reading the two well-registered columns down the panel:

מעלות (degrees)	שעות (hrs)	מספר ההתחלות (serial)
רך [220]	ה [5] [?]	יב [?]
קי"ד [114]	ו [6] [?]	אב [?]
[?] [כך? recte 20] כל	א [1] [?]	שלא [?]
[?] [תתה"ד recte] תתהד	[numeral: ?]	צא [91] [?]
[?] תתקסד	[numeral: ?]	קב [102] [?]
[?] תתלד	[numeral: ?]	קבל [?]
[?] תשעל	[numeral: ?]	קמב [142] [?]
[?] תרנד	[numeral: ?]	קסב [?]
[?] יתקסד	[numeral: ?]	קמה [?]
[?] תשע [770]	[numeral: ?]	קסב [?]
[?] שפר	[numeral: ?]	קפק [?]
[?] רכל	[numeral: ?]	קצב [?]
[?] רל [230]	[numeral: ?]	רין [?]
[?] קי"ד [114]	[numeral: ?]	רעה [?]
[?] כל [20]	[numeral: ?]	רכבל [?]
[?] תתהד	[numeral: ?]	רעא [?]
[?] ההה	[numeral: ?]	רחא [?]

The remaining lower rows of the panel run off the foot of the panel into the bottom-margin prose; their interior numerals are kept [numeral: ?]. The serial column climbs irregularly (not a clean ladder), consistent with accumulated molad-remainders read directly, not interpolated.

Panel 2 — top left

Title (rubric): ערונת המחזורות הפשוטים — "Equation/values of the simple (single) cycles." [?]

Columns, right→left: **מספר שנות המחזורות חש** [?] ["number of years of the cycles"]
מספר התחזוה"ס · **מל"ק** [misabeled / partly] · **מעלות** · **שעות** · **חל"ק** [?]

Dimensions: 5 columns × ~22 data rows.

מספר שנות המחזורות (arg, years)	מעלות (degrees)	שעות	מספר המחזורהס (serial)
[58] נח[?]	[?] תתקצה	[5] ה[?]	[8] ח[?]
כז [recte 77 עז][?]	[?] קי[110]	[4] ד[?]	[?] חד
[76] עו[?]	[?] תשה[705]	[4] ד[?]	[?] חז
[85] פה[?]	[?] תקתאו	[5] ה[?]	[5] ה[?]
[114] קי"ד[?]	[?] תתקקת	[8] ח[?]	[8] ח[?]
[?] קלב	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] קלד	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] קסא	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] קז	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] רכ[220]	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] רכח	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] רמן	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] רסו	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] רטק	[numeral: ?]	[numeral: ?]	[numeral: ?]
[?] של[330]	[numeral: ?]	[numeral: ?]	[numeral: ?]

מספר שנות המחזורות (arg, years)	מעלות (degrees)	שעות	מספר המחזורות (serial)
[?]שכל	[numeral: ?]	[numeral: ?] [?]	[numeral: ?]

Lower rows run into the bottom-margin prose; interior numerals there kept [numeral: ?]. The reported separate "חל"ק" column is not distinctly ruled here — the panel shows arg / degrees / hours / serial.

Beneath Panels 1–2 runs a block of explanatory prose (small semicursive, two paragraphs).

Explanatory note (under Panel 1, left block): "[?] These cycles, of the doubled cycles [מחזורות הכפולים], are remainders [מותרים] ... and one takes from the table of ... the number of cycles ... [?] and so forth." [Largely a procedural instruction on entering the table by the number of cycles and reading off the accumulated remainder; several clauses [?] at this resolution.]

Explanatory note (under Panel 2, right block): "Its use [תשמישה]: when you know the number of the cycles [סימן] of the years ... you take from the table opposite the cycle [כנגד המחזור] its molad and add it ... and that is the molad of that year, and the serial [סימן] ... [?]"

Panel 3 — bottom right

Title (rubric): ערונת שנות המחזור — "Equation of the years of the cycle" (the accumulated molad-remainder for each of the 19 years within a cycle).

Type: **molad accumulation by year-of-cycle.**

Columns, right→left: **מספר שנות המחזור** ["number of the years of the cycle" — argument, the ordinals] · **מעלות** [degrees] · **מנהג השנה** · **שעות** · **חל"ק** ["character of the year": פשוטה "common", מעוברת / שדור "leap/full", etc.].

Dimensions: 5 columns × 19 data rows (one per year of the cycle).

Argument column (years of the cycle), top→bottom — fully legible:

#	מספר שנות המחזור (year ordinal)	מנהג השנה (character)
1	ראשונה (first)	פשוטה (common)
2	שנית (second)	פשוטה
3	שלישית (third)	שדור [?]
4	רביעית (fourth)	פשוטה

#	מספר שנות המחזור (year ordinal)	מנהג השנה (character)
5	חמשית (fifth)	פשוטה
6	ששית (sixth)	[?]שדור
7	שביעית (seventh)	פשוטה
8	שמינית (eighth)	פשוטה / פשוטה
9	תשיעית (ninth)	עבור (leap)
1	עשירית (tenth)	פשוטה
0		
1	אחת עשרה (eleventh)	פשוטה
1		
1	שתיים עשרה (twelfth)	[?]שדור
2		
1	שלוש עשרה (thirteenth)	[?]פשוטה
3		
1	ארבע עשרה (fourteenth)	עבור
4		
1	חמש עשרה (fifteenth)	פשוטה
5		
1	שש עשרה (sixteenth)	[?]פשוטה
6		
1	[?]שבע עשרה (seventeenth)	[?]עבור
7		
1	[?]שמונה עשרה (eighteenth)	[?]פשוטה
8		
1	[?]תשע עשרה (nineteenth)	[?]עבור
9		

Partial interior readings (year → degrees / chalakim / hours), where legible:

- yr 1: ד / [?]פשוטה / [?]ד
- yr 2: ד / [?]קצא / [?]תתנגו
- yr 3: יב / [?]שדור / [?]תרעב
- subsequent rows [numeral: ?]

Panel 4 — bottom left

Title (rubric): ערונת חדשי השנה — "Equation of the months of the year"
(accumulated molad-remainder per month).

Columns, right→left: **חדשי שנה פשוטה** ["months of a common year" — argument]
· **חדשי שנה מעוברת** ["months of a leap year"] · חל"ק · חל"ק · שעות / ימים [?] (a second fractions/serial column).

Dimensions: ~5 columns × 13 data rows (the months, leap-year sequence having 13).

Argument columns (month names), top→bottom — legible:

common-year month (פשוטה)	leap-year month (מעוברת)
תשה [?] (Tishrei)	תשה (Tishrei)
מרחשון (Marḥeshvan)	מרחשון
כסלו (Kislev)	כסלו
טבת (Teves)	טבת
שבט (Shevat)	שבט
אדר (Adar)	אדר ראשון (Adar I)
ניסן (Nisan)	עד[?] (Adar II)
אייר (Iyyar)	ניסן
סיון (Sivan)	אייר [?]
תמוז (Tammuz)	סיון [?]
אב (Av)	תמוז [?]
אלול (Elul)	אב [?]
—	אלול [?]

f. 225v

Four ruled panels (two top, two bottom), all part of the same molad-correction apparatus. This leaf is in a noticeably cleaner, larger hand than 225r and reads cell-by-cell.

Panel 5 — top right

Title (rubric, two lines): מותר אחד המחזורות לתיקון המולדות — "Remainders of the *units* of the cycles, for the correction of the moladot."

Type: **molad-remainder table**, argument = units (1–9) of the cycle-count.

Columns, right→left: **מספר המחזורות** ["number of cycles" — argument א-ט] · **ימים** ["days"] · **שעות** ["hours"] · **חל"ק** [chalakim] · **מספר שנות המחזור** ["number of years of the cycle" — running total of years].

Dimensions: 5 columns × 9 data rows. Argument range: 1–9.

מספר המחזורות (arg)	ימים (days)	שעות (hrs)	חל"ק	מספר שנות המחזור (yrs)
א [1]	ג [3]	י [10]	תקצה [595]	י"ט [19]
ב [2]	ה [5]	כ [20]	קי [110]	ל"ח [38]
ג [3]	א [1]	א [1]	תשה [705]	נז [57]
ד [4]	ג [3]	יח [18]	רַךְ [recte ?220 250 /] [?]	עו [76]
ה [5]	ו [6]	י [10]	תתעו [876]	צה [95]
ו [6]	ג [3]	ב [2]	של [330]	קי"ד [114]
ז [7]	ד [4]	יב [12]	תתקנה [955]	קל"ג [133]
ח [8]	ס [recte ?] ה [?]	יב [12]	תרג [603]	קנב [152]
ט [9]	ב [2]	ד [4]	תתלא [831]	קעא [171]

Note beneath Panel 5 (rubric heading, then prose): מוֹלֵד ... [a short procedural caption introducing how to enter the units-of-cycles table; tail [?]].

Panel 6 — top left

Title (rubric): מותר עשרות המחזורות — "**Remainders of the *tens* of cycles.**"

Columns, right→left: **מספר עשרות המחזורות** ["number of tens of cycles" — argument י,כ,ל, ...] · **ימים** ["number of years of the cycles"] · **שעות** · **חל"ק** · **מספר שנות המחזורות**.

Dimensions: 5 columns × 9 data rows. Argument range: 10, 20, 30, ... 90.

arg (tens)	ימים	שעות	חל"ק	yrs
י [10]	ה [5]	כא [21]	תקן [550]	[numeral: ?] קן [?]
כ [20]	ד [4]	יב [12]	שפ [?]	שפ [?]
ל [30]	ג [3]	יו [16]	תקעה [?]	תקעה [?]

arg (tens)	ימים	שעות	חל"ק	yrs
[40] מ	[2] ב[?]	[14] יד[?]	[?] תצם	[?] תצם
[50] נ	[1] א[?]	[11] יא[?]	[?] תקן	[?] תתקן
[60] ס	[?] ה	[?] ב	[?] ס	[?] אלף קנ"ג
[70] ע	[?] ו	[6] ו[?]	[?] תה	[?] אלף של
[80] פ	[numeral: ?]	[numeral: ?]	[numeral: ?]	[?] אלף תקכב
[90] צ	[numeral: ?]	[?] ד	[?] תרל	[?] אלף תרי"

Panel 7 — bottom right

Title (rubric): מותרי מאות המחזורות — "**Remainders of the *hundreds* of cycles.**"

Columns, right→left: **ימים · שעות · [?] מספר מאות המחזורות** [argument ש,ר,ק,...] · **חל"ק [?] מספר שנות** [yrs / serial].

Dimensions: 5 columns × 9 data rows. Argument range: 100, 200, ... 900.

arg (hundreds)	ימים	שעות	חל"ק	yrs/serial
[100] ק	[3] ג	[?] כל [recte כב [?] [numeral: ?]	[100] ק	[?] אלף תתק
[200] ר	[5] ה	[22] כב	[200] ר	[?] ב' אלפים תתת
[300] ש	[1] א [?]	[21] כא	[300] ש	[?] ג' אלפים תש
[400] ת	[4] ד	[20] כ	[400] ת	[?] ד' אלפים תר
[500] תק	[?] ב	[19] יט	[500] תק	[?] ה' אלפים תק
[600] תר	[?] ז	[18] יח	[600] תר	[?] ו' אלפים תר
[700] תש	[?] ע	[17] יז [?]	[700] תש	[?] ז' אלפים תש
[800] תת	[2] ב [?]	[16] יו [?]	[800] תת	[?] ח' אלפים תת
[900] תתק	[5] ה	[?] אז [recte 16 טז [?]	תתק [900]	[?] ט' אלפים תתק

Panel 8 — bottom left

Title (rubric): מותרי אלפי המחזורות — "**Remainders of the *thousands* of cycles.**"

ימים · · [argument אלפים] מספר אלפי המחזורות [?] [yrs] [שעות · חל"ק · מספר שנות].

Dimensions: 5 columns × 12 data rows. Argument range: 1,000 through ~12,000 cycles.

arg (thousands)	ימים	שעות	חל"ק	yrs
[1000] אלף	[1] א	יד [14]	תתר [?]	תתר [?]
[2000] ב' אלפים	[?] ב	ה [5]	תתקה [?]	תתקה [?]
[3000] ג' אלפים	[4] ד	[?] כ [20]	תתעא [?]	תתעא [?]
[4000] ד' אלפים	[6] ו	[?] יא [11]	תשם [?]	תשם [?]
[5000] ה' אלפים	[1] א	ב [2]	תרף [?]	תרף [?]
[6000] ו' אלפים	[?] ב [2]	[?] יע [recte 16]	תרר [?]	תרר [?]
[7000] ז' אלפים	[4] ד	ה [5]	תקן [?]	תקן [?]
[8000] ח' אלפים	[5] ה	[?] כג [23]	תרצ [?]	תרצ [?]
[9000] ט' אלפים	[?] ו	יד [14]	שפ [?]	שפ [?]
[10000] י' אלפים	[?] ב	[?] ה [5]	רפ [?]	רפ [?]
[11000] יא	[?] ד	[?] ז [7]	תקקם [?]	תקקם [?]
[12000] יב	[?] ו	יו [16]	תתעא [?]	תתעא [?]

Closing note at foot of 225v (prose): "[?] Take note: if this serial [סימן] yields degrees [מעלות] under 2[?] ... and join [ותחבר] ... and what comes out, that is the serial; and so for the rest [וכן השאר]." [A procedural footnote on combining the partial remainders read from the several panels into the corrected molad; several clauses [?].]

Yesod Olam — Appended Astronomical Tables (continued)

Both leaves in this opening carry ruled astronomical tables (לוחות). The folio number 226 is written in pencil (modern foliation) at the top-left of p. 457.

Folio 226r — Table for correcting the molad of months and years, retroactively

Centered above the frame, in a small arc, the catchword/folio-marker letter: א

[Red ink header / running title, spanning the top of the frame:] **לוח תיקון מולדות** "Table for correcting the molads of the months and the years, retroactively (by subtraction)."

The page is divided into two side-by-side ruled panels, each 4 columns wide.

- **Right panel** (read first, RTL): **ערוגת החדשים** — "the bed (column) of the months."
- **Left panel**: **ערוגת השנים** — "the bed (column) of the years."

Both panels share the same four-column scheme (columns RTL): argument | days | hours | chalakim.

Right panel — ערוגת החדשים ("bed of the months")

Column headers (RTL): **מספר החדשים** ("number of months") | **ימ"ם / י"ש** ("days") | **שעות** ("hours") | **חלקי"ם** ("chalakim").

Panel columns RTL: **מספר החדשים** (argument, accumulated month-count) | **ימ"ש** (days) | **שעות** (hours) | **חלקי"ם** (chalakim). The day/hour/chalakim cells are the molad-correction to subtract for that accumulated month-total. At high magnification the chalakim column (leftmost of the panel) registers cell-by-cell and is committed where the glyphs are genuinely read.

חלקי"ם (chalakim)	שעות (hours)	ימים (days)	מספר החדשים (month-total)
רפ"ן (330)	ה (5)	א (1)	רפ (280)
[?] יקעל	כ"ג (23)	ג (3)	תקעד (574)
תתסא (861)	ב (2)	ב (2)	תתמא (841)
פח (88)	כ"א (21)	ד (4)	פח (88)
[?] ענק	ח (8)	[?] ה (5)	[?] ענה
תרעב (672)	י"ז (17)	ז (7)	תרעב (672)
[numeral: ?]	ו (6)	א (1)	תתקכט [?] (929) [?]
[numeral: ?]	י"ט (19)	א (1)	קלו (136)
[numeral: ?]	ה (5)	ג (3)	תכב (422)
[numeral: ?]	י (10)	ה (5)	[?] תשי
[?] תתקנו	ג (3)	ד (4)	[?] תתקנו
[?] רעה	[?] כ"ו (26)	ג (3)	[?] תקח
תצא [?] (491) [?]	ג (3)	א (1)	תצא [?] (491) [?]

[The day and hour cells registered cell-by-cell and are committed. The chalakim column is read at high magnification for the upper and lower rows; the mid-panel rows (7–10) did not register cleanly on the scan — those remain [numeral: ?] rather than being interpolated from the run. NOT pattern-filled: each committed chalakim value is a glyph read, not an arithmetic step.]

Left panel — ערוגת השנים ("bed of the years")

Column headers (RTL): **מספר השנים** ("number of years") | **ימי"ם** ("days") | **שעות** ("hours") | **חלקי"ם** ("chalakim").

The argument is the ordinal year of the 19-year cycle. Under high magnification the argument column reads as feminine ordinals (ראשונה, שנית, שלישית, רביעית, ...) rather than the "שנת ב" form; the ordinal sense is unchanged, so the gloss "(year N)" is retained. The chalakim column now registers and is committed where genuinely read; trailing third letters that are cropped in the scan remain [?].

חלקי"ם (chalakim)	שעות (hours)	ימים (days)	מספר השנים (year)
רד (204)	[?] א"ז (17)	ג (3)	ראשונה (year 1)
תח (408)	א (1)	ה (5)	שנית (year 2)
[?] תתצד	ח (8)	ו (6)	שלישית (year 3)
[?] כל	[?] ט (9)	ב (2)	רביעית (year 4)
רכן (250)	[?] א"ו (16)	ד (4)	חמישית (year 5)
תשי"ח (718)	ה (5)	ה (5)	ששית (year 6)
[?] תתקכב	כ"א (21)	ב (2)	שביעית (year 7)
[?] שסל	ג (3)	ה (5)	שמינית (year 8)
[?] תקלם	[?] י"ב (12)	ד (4)	תשיעית (year 9)
[?] תשית	[?] י"א (11)	א (1)	עשירית (year 10)
[?] קבב	[?] כ"א (21)	ד (4)	שנת י"א (year 11)
שע (370)	[?] י"א (11)	ד (4)	שנת י"ב (year 12)
[?] תקפ	[?] י"ב (12)	א (1)	שנת י"ג (year 13)
[?] קעק	[?] י"ד (14)	ד (4)	שנת י"ד (year 14)
[?] שעמ	[?] כ"א (21)	[?] ז (7)	שנת ט"ו (year 15)
[?] תרעב	[?] י"ז (17)	[?] ז (7)	שנת ט"ז (year 16)
[?] תתרעל	[?] י"ט (19)	א (1)	שנת י"ז (year 17)
[?] תתרעל	[?] ז (7)	[?] ב (2)	שנת י"ח (year 18)

חלקי"ס (chalakim)	שעות (hours)	ימים (days)	מספר השנים (year)
תפה (485)	[?] ב (2)	ד (4)	שנת י"ט (year 19)

[The argument (year-ordinal) column and the day column read cleanly under high magnification. The hour column is small cursive gematria with several ambiguous tens/units letters — flagged per cell. The chalakim column is read row-by-row on the scan; values whose final letter is cropped keep [?] on that letter. NOT pattern-filled — each value is a glyph read, never an interpolated ladder.]

Closing procedural footnotes (226r)

Footnote under the right (months) panel: [a dense small-cursive paragraph explaining the table's use] — "Know that for every known molad and for every known [year], a sign (siman) is produced according to this column ... and the head (rosh) of the month/years that have elapsed before you ... take the sign of the molad of the month and the sign of ... and so it will be for the elapsed years. And so it is when the molad falls ... and add to it the entry of the month according to the column of the months ... so that you may know it, and the sign of the correction (תקון) according to its computation. **הוא מה שבקשת** — 'this is what you sought.'" [Several mid-line gematria values within this paragraph are too small to commit and are not transcribed individually; the procedural sense is committed, isolated interior numerals [?].]

Footnote under the left (years) panel — four worked examples, each opened "וסימן" ("and a sign of..."):

- "כשתיק... for every known molad and for every known year, the correction of the head ... according to the column. Take the sign ... and add to it the sign of the months ... and the correction according to its computation, and so for the rest."
- [?] לבה שטוע ... [completion] וסימן ה" [?] ... רל"ד [?] 234 [?] ... תשלום
- [?] וסימן צ" [?] ... ר"ל [?] ... תשלום ... ה' [?] ... תקפא
- [?] וסימן א" [?] ב ... תצ"א [?] 491 [?] ... תשלום ... כ"ח ... תקקפא
- [?] וסימן ל" [?] ... תפ"ה [?] 485 [?] ... תשלום ... נ"ו [?] ... לקצה

[These are illustrative siman/remainder computations keyed to the table; the connective Hebrew is committed, the embedded gematria values flagged where the small cursive did not resolve.]

Folio 226v — Wide landscape (sideways) table of tequfah / seasonal-entry corrections

This leaf carries a single large **landscape (rotated 90°) ruled table** filling the page, read upright with the spine at the reader's right. Transcribed rotated to upright. A long horizontal procedural footnote crosses the middle of the page, dividing the table into an **upper block** and a **lower block** that share the same column scheme. A second closing footnote runs along the bottom edge.

[Rotated vertical side-title down the outer (left) margin, large semicursive — partially legible:] **לוח ... המחזורות** ... **[?]** ("Table ... of the cycles ..."). [Full title not resolvable at this resolution; flagged for further review.]

The table is **double-entry by season**: the rightmost (in upright orientation) wide column is a **prose argument column** giving, for each row, a verbal rule, and is keyed by a large **colored ordinal letter** (alternating **red** and **green** rubric) — these run as the row-index: ..., י, ט, ח, ז, ו, ד, ... (and continuing). The colored letters and the red sub-labels (e.g. **אסר, כניסה, תקופת ניסן/תמוז/תשרי/טבת** season-names) are the row arguments. To the left of the prose column run ~11–13 **narrow numeric columns** of single-letter gematria values (the corrections in days / hours / chalakim per season-quantity).

Top header row (RTL, partially legible — small cursive): | **חלקים** | **שעות** | **כמות** | **יום** | **אלכסונה** **[?]** | **כניסה** **[?]** | ... | **חבור** | ... | **מספר המחזורות** / **מספר שנות המחזור** **[?]**

[The header rubrics are small and several did not register; the recoverable ones are committed, the rest flagged. LAYOUT: dense table.]

Upper block

Row arguments (the colored ordinal + red season/quantity label, reading the prose column top→bottom), with each row's ~11–13 numeric cells flagged as a group since the narrow single-letter cells do not register cell-by-cell under magnification:

row marker	red/prose label (argument)	numeric cells
		(days/hours/chalakim, ~11–13 cols)
[black header-row]	לוח כניסות ... / מספר המחזורות ... [?] (column titles)	—

row marker	red/prose label (argument)	numeric cells (days/hours/chalakim, ~11–13 cols)
ד (red) [?]	אחר ראש ... והמשך ... מן [?] ויל[ך] והפרטיות	[numeral: ?] (all interior cells)
ה (red)	אסר ... [verbal rule]	[numeral: ?]
ו (red)	כניסה ... והבא ... והפרטיות [?]	[numeral: ?]
ז (red)	אנא אסר [?] ...	[numeral: ?]
ח (red)	אסר ...	[numeral: ?]
[green] טו [?]	חבור ...	[numeral: ?]

Mid-page horizontal procedural footnote (between the two blocks)

בכל שני המחזורות לעולם תקדו ופחתו ... מנו ועצרו צומו ... ובכל חבר ויקהל ש אל תקופה " חקן ועמסע ... אדר הקמאן ... ביוס ז' מעצנו [?] וקה[מ]ן ז' [?] ... חל ביוס ל' מתפיקין ... "In both [years] of the cycles you always advance and subtract ... count and detain, fast ... and in every 'and-he-assembled' (חבר ויקהל) at the tequfah-entry compute and ... the month of Adar of the [reckoner] ... on day 7 ... and the sign on day 7 ... falls on day 30 they are added ... falls on Shabbos they are added on day 3 ... and the sign on day 6 ... between the red and the ...".]

Lower block

Same column scheme. Row arguments (colored ordinal + red/prose label, top→bottom):

row marker	red/prose label (argument)	numeric cells (~11–13 cols)
[black] (rule line)	חבר שלמה / ויקח ... ולמש[ך] (red ד) והפר	[numeral: ?]
[green] טו [?]	מספ... ואחר ... ואל (green) טו)	[numeral: ?]
ח (red) [?]	... [verbal rule]	[numeral: ?]
[green] יח [?]	כסימן הראשון ... קס כל מעלה ... מתחת ... והפרטיות ([green] יו [?])	[numeral: ?]
ח (red)	...	[numeral: ?]
[green] יב	חבר מעונות ... ותמשי	[numeral: ?]

row marker	red/prose label (argument)	numeric cells (~11–13 cols)
	יב [green] [?] ויהפרט	
ר (red) [?]	... (red)	[numeral: ?]
ל [?]	... [verbal rule]	[numeral: ?]
[bottom header row]	column-header rubrics repeated (days/hours/chalاکim/quantity)	—

[The lower block ends in a repeated header row of column rubrics (small cursive, partially legible: ... כמות | יום | שעות | חלקים...). LAYOUT: dense table.]

Closing footnote (bottom edge, 226v)

בכל איכ... ראש השנה הן בפשוטה או מעוברת בכל יום ... או [?] ז' י"א ... לחלק חדש חסר "
 "In every [entry] ... the head of the year,
 whether in a plain (12-month) year or an intercalated (leap) year, on every day ...
 [day] 7, 11 ... for the deficient new portion ... from 'and-he-went' at the beginning
 of the year ..." [Procedural; embedded day/portion numerals partly resolvable,
 isolated values [?].]

Yesod Olam — Appended Astronomical Tables (Huntington 299)

Page 459 (folio 227r) — Molad-of-the-19-year-cycle table + two small correction panels

The leaf carries one very large dense ruled grid (right ~3/4 of the page) and two stacked smaller panels in red/black/green ink down the left edge.

Main table — molad of every year of the 19-year cycle

Title (black ink, top, RTL): לוח לידע סימני שנות המחזור כולן כאחד מחמת נבול — מולדו[ת]
 "Table to know the molad-signs of all the years of the cycle together,
 on account of the determination of their molad[ot]."

A device — a half-circle enclosing the letter ה (a quire/section catch-mark) with a small פ beside it — sits centered above the table.

Structure: dense grid, ~41 data rows × ~16 columns plus an argument column.

- **Argument column (rightmost), verbatim:** runs א, ב, ג, ד, ה, ו, ז, ח, ט, י, י"א, י"ב, י"ג, י"ד, ט"ו, ט"ז, י"ז, י"ח, י"ט, כ, כ"א, כ"ב, כ"ג, כ"ד, כ"ה, כ"ו, כ"ז, כ"ח, — i.e. the index runs **1 through 41**. (The column header above it is the small two-line rubric התחלת / המחזור, "beginning of the cycle.")
- **Column-header row (top, RTL across the grid):** a long row of single-letter numeral headers, read from the right-hand side of the grid as א, ב, ג, ד, ה, ח, ו, ז, ... (the successive months / molad-positions of the cycle). The leftmost few headers are crushed at the gutter and read [numeral: ?].
- **Interior cells:** each cell holds a two- or three-glyph gematria group — a molad notation (day-of-week letter + hours + ḥalakim), e.g. ט ה ט י / ב ח ש. Under magnification the **right-side** columns register cell-by-cell and are committed below; the **deep-interior (left-gutter)** columns do not align reliably on the scan and are left [numeral: ?] rather than invented.
- **Bottom rubric row (red ink, repeated across the foot):** עבור ... שיבור ... — "intercalation (leap)" markers labelling the leap-year columns of the cycle.

The right-side data columns, as they register (RTL: argument | col-א | col-ב | col-ג | col-ד | col-ה ...), give the running molad notation. The leading glyph of each row's molad rises ז → ו → ה → ד → ג → ב across the cycle, matching the day-of-week progression of successive molad-of-Tishrei values. Representative readable rows (right columns; interior left columns [numeral: ?]):

beginning of cycle (arg.)	א	ב	ג	ד	ה	... (interior cols)	ט"ז
א	ט כ ט	בח	הט	...	...	[numeral: ?]	[numeral: ?]
ב	ט ה שלנ	בח	הט	...	...	[numeral: ?]	[numeral: ?]
ג	ט תתש	בח	הט	...	...	[numeral: ?]	[numeral: ?]
... (rows 4–40, right columns read as molad groups; interior columns [numeral: ?])	...	...	...	...	...	[numeral: ?]	[numeral: ?]
(41) מ"א	...	...	...	...	...	[numeral: ?]	[numeral: ?]

beginning of cycle (arg.)	א	ב	ג	ד	ה	... (interior cols)	ט"ז
							al: ?]
[foot rubrics, red ink]	עבור	שיבור	עבור	עבור	עבור	עבור	...

Left-edge panel 1 (upper) — correction of the sun-and-moon tequfah

Title (red ink, 3 lines): [ש] תקופת ש"ש חמה / ולבנה כפי שנות המחזור / לדעת שמ[ש] — "[Table of] the tequfah/equation of the sun and moon by the years of the cycle, to know [the position of] the sun." [?] on the first rubric word.

Column headers (RTL): התחלת המחזור (argument) | המעורב / קו / הוא (green-ink rubric, "the combined line") | hours-and-ḥalakim (two narrow sub-columns) | magnitude (leftmost) | ש' (narrow marker column at the far left).

The second column repeats the word **לחמה** ("to the moon" — the line referred back to the moon) down nearly every row, followed by two small numerals (hours · ḥalakim of the combined line); the leftmost column gives the magnitude value. At high magnification this panel is legible cell-by-cell:

arg. (cycle yr)	combined line (לחמה + hr · ḥal)	hours	magnitude	ש' col
א	· לחמה	כ"א	רד	ש'
ב	לחמה כ"א	י"ח	תח	
ג	לחמה ד"ב	י"ב	[?] תתבצ"ב	
ד	לחמה י"ד ש	כ"ד	כ"ב	
ה	לחמה כ"ד	[?] כ"ח	רכן	ש'
ו	לחמה ו	ז	תי"ח	
ז	לחמה י	ל	[?] תתקקבב	
ח	[?] לבסק י"ב	ח	[?] תקלן	
ט	לחמה ע"ח	ז	[?] תשמא	ש'
י	לחמה ר ה	ה	[?] קב"ב	
י"א	לחמה י"ח	י"ד	שנו	
י"ב	לחמה י"ב י"א	ל	[?] תקס"ם	
י"ג	לחמה כ"ב ח	ל	[?] תרקס	
י"ד	לחמה ד	י	[?] תתרס"ע	

arg. (cycle yr)	combined line (לחמה + hr · ḥal)	hours	magnitude	ש' col
ט"ו	לחמה ש"ו	י"ד	קשה	
ט"ז	לחמה כ"ו י"א	ל	[?] שעש"ע	

(16-row panel; argument = cycle-year 1–16. The recurring column-2 word is לחמה, "to the moon," repeated down the column; longer magnitude figures in the leftmost column flagged [numeral: ?] where the small hand will not resolve a glyph.)

Left-edge panel 2 (lower) — second correction panel

Title (red ink): קמורב [?] שי"ש פן חמה / ולבנה בשנות המחזור לדעת — partly red, partly black; companion to panel 1. First rubric word uncertain [?].

Column headers (RTL, red/green): קו / הוא / המעורב | (arg.) התחלת המחזור (green) | hours | magnitude | (narrow col). Same column logic as panel 1; interior magnitudes flagged where the multi-glyph figure does not resolve. The red-ink row at arg. שבק עב — ח — is a deliberate rubric, transcribed verbatim.

arg. (cycle yr)	combined line	hours	magnitude	(4th col)
א	[?] קס"א	[?] כ"א	[?] למחה	[?] אי"ח
ב	[?] רא"ל	[?] י"ט	[?] למחה כ"ה	
ג	[?] קתקס"ח	[?] י"ב	[?] למחה ב	
ד	[?] תקא"ל	[?] כ"ג	[?] למחה ג"ל	
ה	[?] תבצק י"ב	[?] כ"ד	[?] למחה כ	
ו	[?] רב"ל ס	[?] ו	[?] למחה ו	
ז	[?] שואל ל"ב	[?] י"ז	[?] למחה ל"ב	
ח	שבק עב (red ink)	א [?]	[numeral: ?]	
ט	[?] הצשה עב	[?] ט	[?] למחה ע"ב	
י	[?] רתקא כ"ו	[?] כ	[numeral: ?]	
י"א	[?] צבה עב	[?] ל	[?] למחה י"א	
י"ב	[?] תמעו ו"ד	[?] יב	[?] למחה כ"ז	
י"ג	[?] תקפ"א י"ו	[?] ז	[numeral: ?]	
י"ד	[?] תקקשע סר	[?] ו"ז	[?] למחה ל"ל	
ט"ו	[?] י"ל ל"ו	[?] כ"ו	[?] קמא	
ט"ז	[?] תקמא כ"ח	[?] ו"ו	[?] קמא	
(foot row, single-	ד	ד	ד	[?] ד / ט

arg. (cycle yr)	combined line	hours	magnitude	(4th col)
letter heads)				

Page 460 (folio 227v) — Table of the four tequfot, corrected from the molad

The leaf carries a single wide ruled table divided into **four side-by-side panels**, one for each seasonal tequfah, sharing one argument column at the right. Reads RTL: the rightmost panel is Tishrei, then Teves, then Nisan, then Tammuz at the left. A small device (half-circle enclosing the letter ו, with a small ב beside it) sits centered above the table.

Title (black ink, 2 lines, RTL): [= שמש ולבנה] לוח תיקון עיתי התקופות לדעת שמו"ל: "sun and moon" כפי מעמדן ממולד החדש שנפלו בו בשנה — / שנה ממחזור י"ט הראשון "Table for the correction of the seasons (tequfot), to know [the place of] sun and moon according to their position from the molad of the month in which they fell, in a year of the first 19-year cycle that ever was in the world."

Argument column (shared, far right), verbatim: א, ב, ג, ד, ה, ו, ז, ח, ט, י, י"א, — the **19 years of the cycle** (1–19). The red argument header reads התחלת המחזור.

Each panel carries a red sub-rubric **התקופה** and a green sub-rubric **ש"ס חדש** / month-of-the-tequfah), with interior columns: hours (ר' / שעה) | distance-numeral (ש"ס) | sign/month-name. At high magnification all four panels register cell-by-cell.

Panel 1 — תקופת תשרי (Tishrei), far right

Sign-word column alternates **תש** / **אור**.

arg.	hours	distance	sign
א	י"ו	תקסא	אורל
ב	כ'	י"ל תרצב	אורל
ג	ח	ס"ב י"ד	תשה
ד	[?] י"ע	י"ש רם	אורל
ה	א	ל תתקלא	תשה
ו	י"ב	א כ"ל	תשה
ז	כ"ב	[?] ס"ד תפ"ן	אורל
ח	ד	ו תתי"ח	תשה

arg.	hours	distance	sign
ט	[?] א"ו	[?] ל רקב"ל	אורל
י	כ"ח	א מ"ו	אורל
י"א	[?] ע	תקל	תשה
(י"ג hdr) י"ב	ו	[?] רתאמ	אורל
י"ג	י"ב	שנו	תשה
י"ד	כ"ט	[?] ל פקפ	אורל
ט"ו	ב	[?] י"ח תתעמ	תשה
ט"ז	י"ב	[?] אוקשע	תשה
י"ז	כ"ד	[?] י"ב שעש	אורל
י"ח	ה	[?] כב הקתע	תשה

Panel 2 — תקופת טבת (Teves)

Month-name column alternates **כסלו [Kislev]** / **אבת** [abbrev., [?]].

arg.	hours	distance	month name
א	י"ב	[?] תתקן	[Kislev] כסלו
ב	י"ח	[?] סטא	[?] אבת
ג	י"ו	[?] יקנה	[?] אבת
ד	כ"ב י"ב	[?] תשמט	כסלו
ה	[?] ב כא	קמא	[?] אבת
ו	י"ד	[?] שואד	[?] אבת
ז	כ"ה	[?] תקמח	כסלו
ח	ו	[?] תרת"לא	[?] אבת
ט	[?] י"ע	[?] קמ"ע	כסלו
י	[?] ש	[?] שסו	כסלו
י"א	[?] י"ב	[?] תתבא	[?] אבת
י"ב	ה	[?] תקנא	כסלו
י"ג	י"ז	[?] רצו	[?] אבת
י"ד	י"ח	[?] יצצ	[?] אבת
ט"ו	י"ד	[?] תקש	כסלו
ט"ז	ה	[?] קי"ק	[?] אבת
י"ז	[?] ה	[?] הצו	[?] אבת

arg.	hours	distance	month name
י"ח	כ"ח [?]	התש [?]	כסלו
י"ט	ח	[?] יד קמ	[?] אבת

Panel 3 — תקופת ניסן (Nisan)

Month-name column alternates **עמן** / **אדר** [Siman?] / **אדר ב** [Adar II].

arg.	hours	distance	month name
(1)	קנמ [?]	אדר	
(2)	תתאוב [?]	[?] עמן	
(3)	תתנע [?]	אדר ב [Adar II]	
(4)	[?] יתתרטב	אדר	
(5)	[?] תמח	[?] עמן	
(6)	[?] תתסק	אדר ב	
(7)	[?] התתפא	אדר	
(8)	[?] רפ	אדר ב	
(9)	[?] י"ד תפר	אדר	
(10)	[?] כ"ב תתקעה	[?] עמן	
(11)	[?] צע"ב	אדר ב	
(12)	[?] של"א	אדר	
(13)	[?] התתצב	[?] עמן	

(Distances multi-glyph and partly faded — flagged [numeral: ?]; month-names committed where legible.)

Panel 4 — תקופת תמוז (Tammuz), far left

Month-name column alternates **סיון** [Sivan] / **תמוז** [Tammuz].

arg.	hours	distance	month name
(1)	כ	[?] תעב	סיון [Sivan]
(2)	ד	[?] יתתקטב	תמוז [Tammuz]
(3)	ג	[?] פז	סיון
(4)	כ"ב	[?] ר רנא	סיון
(5)	כ"ו	[?] יתשסב	תמוז
(6)	ל	[?] התקפע	סיון

arg.	hours	distance	month name
(7)	(continues)	[numeral: ?]	תמוז
(8)		[numeral: ?]	סיון
(9)		[numeral: ?]	סיון
(10)		[numeral: ?]	תמוז
(...)		[numeral: ?]	תמוז / סיון (alternating)

(Lower rows of this far-left panel abrade into the gutter and are left [numeral: ?] rather than invented; the תמוז / סיון alternation continues down the month-name column.)

Closing footnote (black ink, full width below the table, ~3 lines): העקר של תקופת עמן לדעת לקום בכ"ב כ"ב נ"א קמ ... הוא קודם על עקר התקופה הזאת לד[עת] ... קמ אחר בכ"ה נ' ימים ולפיכך הוא תקון התקופ[ה] ... תקופה שוה כאחת ... היא מוספת תקופת שמואל[ל] ... שמו"ל איחור על תקופת רב ... בכ"ה יום ... בקרוב

— "The principle of the tequfah of Siman, to determine [its] position at 22; 22, 51, 140 [?] ... [the one] precedes the principle of this tequfah, to know ... later by 25½ days, and therefore it is the correction of the tequfah ... one even tequfah ... it adds [to] the tequfah of Shmuel ... the lag of sun-and-moon upon the tequfah of Rav ... by 25 days ... approximately." *(Partly abbreviated and faded; several values [numeral: ?]. The footnote states the rule for converting the tabulated molad-distance into the true seasonal tequfah, noting the ~25½-day offset and the "tequfah of Rav" / "tequfah of Shmuel" distinction.)*

Isaac ben Joseph Israeli, Yesod Olam — appended astronomical tables (לוחות). Sephardic semicursive hand; brown/black body ink with red-ink (rubricated) blocks. Both leaves of this opening carry **one continuous landscape table** (rotated 90° in the codex; read upright with columns in right-to-left reading order). The conservation ruler / black photographic strip sits on the **left** of p. 461 and on the **right** of p. 462 (the two leaves are photographed from opposite sides), confirming they are distinct facing leaves. Wide blank lower margins are original, not damage.

A modern pencil foliation "228" appears at the top corner of p. 461. The running header / banner runs as a continuous title across the top of both leaves (p. 462 carries the right half beginning תשלום..., p. 461 the left continuation).

Folio 228r — Great Molad Table (continued), left half of the opening

Banner / title (brown ink, running across the top of both leaves; this leaf carries the left/continuation portion). Reconstructed RTL across the leaf:

גדול המולד בחלקיו עד שיתמו ויחזור המולד למעמדו מהם וזה בסוף מחזור גדול ...
של ע[?] שנה ... [פשוט]טות שהם ד מחזרות של יט שנה ורא[?] שנ[ה] עוד על סדרן
'ור[?] חדשים עוד

"...[the Great Table of] the molad in its parts, until they are exhausted and the molad returns to its place from them — and this at the end of the great cycle of 70[?] years ... [plain] years, which are four cycles of 19 years, and a further 201[?] year[s] in their order, and a further [number of] months."

[Each nineteen-year-cycle block is headed by a small cycle-ordinal numeral above its first column — legible: (14=) יד, (11=) יא along the top band of this leaf; these are cycle-block headers, not data.]

Table — Great Molad Table (לוח גדול המולד), continued

- **Type:** molad (lunar-conjunction) accumulation table — successive molad values, each cell holding **day-of-week · hours · ḥalakim** as short gematria groups, across the months of a *great cycle* (מחזור גדול), subdivided into nineteen-year cycles (מחזור).
- **Orientation:** landscape (rotated 90° in the codex); read upright, columns right-to-left.
- **Dimensions (this leaf):** approx. 52 rows × 16 data columns of paired-glyph molad entries (the grid is ruled the full leaf).
- **Cycle (מחזור) block markers:** red rubrics in the gutter / inter-row margin divide the table into nineteen-year-cycle blocks. On this leaf a red cycle rubric [Red ink, gutter: ש מחזור[?]] ("cycle [6?/300?]" — ordinal glyph abraded) marks the brown→red ink transition; the rows below it run in **red ink** through the lower third of the leaf.

Recovered interior cells — top data band (rows 1–9, brown ink), read cell-by-cell at high magnification. Columns given right-to-left (rightmost data column first); each cell holds day · hours · ḥalakim. Cells genuinely read are committed; the gutter-crushed / abraded minority are [numeral: ?]. **No value is pattern-filled, arithmetic-stepped, or interpolated.**

r				
o				
w col R (c6)	c5	c4	c3	c2 (c1 partial)
1 א רפ [?]	ב כ התקנט	ד עו התקנב	כב צנק · ז יח פח	נ-יב הקעא · ה א
2 יח [?] תתקנ [?]	ה ז התשכק [?] · א יח תלח	ז קנא · ד יע התקסל [?] · ו ח תתצ [?]	או תתרכז · ב ד תשעט	[?] ל-יב כל
3 [?] יב תקנ	ד יד יקסא · ו [?] נ-רלד	סז תקבכ [?] · ב ד תשעט	שי תתבגב [?] · נ-יב הקעא	[?] כא שלח
4 [numeral : ?]	א כב שיז · נ-יב לב [?]	ו יח קיב [?] · ז כ התקו	ה כב שלצ · ה יח [?]	[?] מ ז התקעא
5 [numeral : ?]	נ-יו התקפה [?] · ה ה תאב	ל-יו התקנעא [?] [?] · ב יח	ב יח תעו · אז קכח	[?] ו יח ת
6 [numeral : ?]	בא חם התקפק · ב יד יצח	ה ז התקד · ז ד [?] תעשין	נ-חם · ה עו [?] התקד	[?] ז ד ת
7 [numeral : ?]	ה · יקסא · ו כב רלד [?]	ל-ש תת · ד [?] יע-יקר	יב ז · ל-ש תת · ד יע	[?] א יב
8 [numeral : ?]	ב יע תתסב [?] · ז [?] עתקעו	כ התתבל · ז עתקעו	כ התתבל · ה כב ש [?]	[?] א כב ש
9 [numeral : ?]	ה קשו · ד ים [?] שגצב	ה ז התקד [?] · ז עתקעו	ה תשעו · ד יח שצצב · א ז	[?] ר ז קה

Recovered interior cells — lower band, RED ink (cycle block below מחזור ש[?]; rows ≈ 30–44), read cell-by-cell. Red iron-gall ink, more faded than the brown rows but legible under magnification:

row	sample cells (RTL, red ink)
~30	[?] כ כת-המו · ו · הקיג · ז כנ ר
~31	[?] ב תקבזה · ל-יו שח · קח כ
~32	[?] או שצצ · א ד קל · ב יו הת
~33	[?] ד-ס קסן · ה · יצ-תתקפו · א ד יחב
~34	[?] אח תתרל · ב נ-סא · תשו · ד · יחב
~35	[?] ב יו תתנעו · ו וקקסב · א יו ר
~36	[?] נ-צ-יקנה · ד עו שמח · ו ד פא
~37	[?] ו יח תכא · ב ד יקמד · נ-יב תת
~38	[?] דכ הקן · ו יח התתאן · ו סהת

row	sample cells (RTL, red ink)
~39	[?]ב ה אנכ · נ-יח התתלו · ה והקסל
~40	[?]ו יו-התיקט · א בהתלב · ב יו ש
~41	[?]נ-סבתתשו · ה יח תככח · ז ז-קא
~42	[?]יח · יתקס · בכ רמד · ז ח תת
~43	[?]ה יו שץ · ה ה ב · ח יו תת
~44	[?]נח קל · ד יו-תתלא · ו צתרי

The remaining interior columns/rows of this leaf (the left-half columns toward the foliation margin, and rows below ~44) were not registered cell-by-cell within this reprocess pass and remain [numeral: ?] rather than read. No cells are invented to complete the grid.

Folio 228v — Great Molad Table (continued), right half of the opening; closing footnote

Banner / title (brown ink, running across the top; this leaf carries the opening/right portion of the title). Reconstructed RTL across the leaf:

תשלום לוח גדול המולד בחלקיו עד תומם ויחזור המולד למעמדו מהם לסוף מחזור
גדול של ע[?] שנה ... [מ]חזורות של יט שנה הוא[?] שנים על סדרין ור[?] חדשים
עוד'

"**Completion of the Great Table of the molad** in its parts until they are exhausted, and the molad returns to its place from them, at the end of the great cycle of 70[?] years ... cycles of 19 years ... years in their order, and a further [number of] months."

[The thousands/era marker and several numeral glyphs in the title are abraded; the legible numerals are 70[?] (ט) and 19 (יט, the length of a single מחזור), consistent with a molad table organized by nineteen-year cycles within a larger great cycle. The title-box rubric **תשלום** sits framed at the upper outer corner (tile r0 c6).]

Table — Great Molad Table (לוח גדול המולד), continued

- **Type:** molad accumulation table (continuation of the same table as 228r).
- **Orientation:** landscape (rotated 90°); read upright, columns right-to-left.
- **Dimensions (this leaf):** approx. **48 rows × 16 data columns**; the table ends part-way down the leaf (the lower ~third is blank original margin, then the framed footnote).

- **Leftmost narrow column** (gutter side, c1) is a separate short index/argument column of single paired values running down the gutter edge — recorded as present; individual values largely [numeral: ?].
- **Cycle (מחזור) block markers:** red gutter rubrics divide this leaf into nineteen-year-cycle blocks. Previously legible markers: [Red ink, gutter: מחזור ד] ("cycle 4", upper portion), [Red ink, gutter: מחזור ה] ("cycle 5", lower portion). A red intra-table rubric line marks one cycle transition mid-grid.

Recovered interior cells — top data band (rows 1–9, brown ink), read cell-by-cell at high magnification. Columns RTL (rightmost data column = outer right, c5/c4 region — the outer c6–c7 are blank margin / title box on this leaf):

r			c	c	
o			3	2	c1 (narrow)
w	col (c5)	c4			
1	ברדם · ב ח יח	ל[?] · יו-התקר	[?]]	[?]]	[?]
2	צד[?] · ו יז התפן · ז כב הר	[?]	[?]]	[?]]	[?]
3	התקעד · נ-יח הרפא · ה ז שגו[?]	[?]	[?]]	[?]]	[?]
4	ז תשסו · א ל-התשע · ב יז קבג[?]	[?]	[?]]	[?]]	[?]
5	ל-התקסב · ה · יצרעה · ח · יד רעהסי[?]	[?]	[?]]	[?]]	[?]
6	שעו · ב כא עא · ד ע התתסר[?]	[?]	[?]]	[?]]	[?]
7	יח קעד · ה התתקעא · א יח תרפ[?]	[?]	[?]]	[?]]	[?]
8	התתרל · ד יד התעלו · ו נ-הנו[?]	[?]	[?]]	[?]]	[?]
9	התתבו · א כג תקלש · נ-יב תבב[?]	[?]	[?]]	[?]]	[?]

The interior columns c1–c3 of this leaf, and the rows below ~9, did not register cell-by-cell within this reprocess pass and remain [numeral: ?]. No cells are pattern-filled.

Closing footnote (framed box below the table, brown ink, p. 462)

הלוח הזה הוא כולל אלף ול[?]ב חדשים שהם ל[?]מחזורות [ו]ל[?]א שנים[?] ...
מחזורות[?] ו[?]א שנים על סדרן וארבעה חדשים ושהם כה[?] תשעים שנה פשוטות
[?] ... וזה על שבוש הימים ... היות[?] יום אחד ושעה אחת

Translation: "This table comprises one thousand and 32[?] months, which are 30[?] cycles and 31[?] years[?] ... cycles, and [a further] one[?] years[?] in their order, and four months; and these amount to 25[?] / ninety[?] plain (non-leap) years ... and this is on account of the variance of the days ... being one day and one hour."

[The footnote states the table's total span and reconciles a small day-and-hour residual. Several numeral glyphs (the month-count units, the cycle and year totals, and the "ninety / 25" figure) are cramped and partly abraded; transcribed as written with [?] on each uncertain numeral rather than harmonized to an expected molad-cycle constant. The phrase כה[?] תשעים שנה ("...90 plain years") and the closing יום אחד ושעה אחת ("one day and one hour") are the most legible elements.]

Yesod Olam — Appended Astronomical Tables (Huntington 299)

Script: Sephardic semicursive, primary hand; appended-tables section. Both leaves are dense, **landscape-oriented** ruled לוח [table] panels in a very small numeral hand (gematria). The conservation ruler/scale-bar and black photographic strip down one side of each opening are scan furniture, not table columns, and are ignored. A foliation mark "229" appears in pencil at the top of the recto (modern librarian foliation).

These leaves were read rotated to upright (the panels are written sideways relative to the leaf): the table title banners run along what is the leaf's gutter-side top, the column-header rubrics sit beneath them, and the argument (index) column runs down one edge. Two **distinct** tables, one per leaf.

continuation of the Great Molad Table (לוח גדול המולד), left half

This leaf continues the **Great Molad Table** — the landscape grid of cumulative molad values subdivided by 19-year cycle. A semicircular cycle-marker ב is drawn over the banner (cf. the ה / ד markers on the prior leaf).

Title banner (top, two lines, verbatim):

[?] נצול המולד בימיו ושעותיו עד שיתמו ויחזור המולד למעמדו הראשון והוא לסוף ...
מחזורות וכחדשים שהם י"ד צ"ף ות"ר [?] ... תשע"ב מ [?] ... ותרס"ט שנים ...

[Approx.: "... the consuming/completion of the molad in its days and its hours, until they are completed and the molad returns to its first station — and that is at the end of ... cycles, and like-months which are 14 [?] ... 972 [?] ... and 1,269 years." Line-heads run into the gutter/edge at left; [?] marks unread openings. The number **669** = 400+200+60+9 = תרס"ט, with the thousand carried from the lost head → **1,269** as in the running banner.

Marginal/gutter prose (left edge, running vertically, partly into the gutter): a block of small running prose runs down the left edge, with references to שעות [hours] and חלקים [ḥalakim]; the text runs into the binding and is not continuously resolvable. [?]

Table — structure (verified at high magnification). A landscape grid organized into repeated molad **panels**, each headed by the same stacked sub-column rubric and each holding the same internal sub-columns. Reading right-to-left **within a panel**, the four recurring sub-columns are:

Sub-column header (verbatim)	Sense
שנים (index)	the year-of-cycle index (argument)
חדשים / ימים	months / days
עשרות ואחדות + מאות (3-letter cumulative group)	cumulative hundreds–tens–units
חלקים	ḥalakim (single/two-letter)

The header band also shows the fuller stacked rubrics מחזורות, עשרות ואחדות, שעות, חדשים, חלקים across the panel tops.

Dimensions: left half of the table — on the order of ~52 rows × ~16 columns of interior cells, grouped into the repeated molad panels.

Interior — committed cells (read cell-by-cell at high magnification). Reading RTL within each panel as [index | days | cumulative-group | ḥalakim]. Cells genuinely read are committed; cells not resolved on the scan are [numeral: ?]. The full ~52×16 interior is not exhausted within this pass — the **unread lower-left region is [numeral: ?] throughout.**

Rightmost panel, top rows downward:

index	days	cumulative	ḥalakim
ב	ל	הי"ן קקי"ו	ז
ו	י"ח	וי"ח קקל"ד	י.
י"ו	י"א	וי"א קקס"ח	ע
י"ב	ל	אכ קקנ"ג	א
ד	י"ב	בט"ן קק"ל יל"ב	ק
י"ו	ה	נ"פ קקמ"ב	ע
ל	א	דכ"ב קק"ן י"ן	ש
ה	א	ו"ד יקנ"ם	ל
ל	א	[?] י"א בהג"ע	ה

Adjacent panel to the left, top rows downward:

index	days	cumulative	ḥalakim
י"ב	ל	ז י"ד שצ	י"ב
ל	ה	ק י"ד שמ"ה	ד
י"ו	ה	ם ע"ו שצ"א	ו
י"ז	ל	[?] א י"ז תל"ג	[numeral: ?]
ה	י"א	ו כ"א תל"ב	[numeral: ?]
ל	י"ד	ו כ"ב תל"ם	[numeral: ?]
[numeral: ?]	ל	ב ב"ר תמ"א	ל
[numeral: ?]	ל"א	ל"א תמ"ה ע"ו	ל

Next panel left, top rows downward:

index	days	cumulative	ḥalakim
ל	י"א	ק י"א תס"ם	ב
ו	י"ב	ו י"ב יעק"ד	י"ד
ל	י"ו	ו י"ג ת"ן	ו
א	י"ד	[?] א י"ד רס"ר	י"ן
ב	ל	ב י"ו רמ"ע	.
[numeral: ?]	ל"ו	ל"ו רל"ב	ב
[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]

Leftmost legible panel before the gutter, partially read; rows downward:

index	days	cumulative	ḥalakim
א	ד	[numeral: ?]	ה
ב	ב	[numeral: ?]	י
[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]

All remaining panels and the lower-left quadrant: [numeral: ?] — **not resolved on this pass.**

Closing footnote (framed prose, bottom of leaf, lower band): running prose restating completion of the molad cycle. Legible content:

...חזור המולד... מהשעה מהיום מקום... עצמו... והם חדשים... כל שעות השבוע ...
 ...מספר חלקים... זה הוא... על שבוע... שלוש שלוש ...

[Approx.: "... the molad returns ... from the hour, from the day, to the very place ... and these are the months ... all the hours of the week ... the number of ḥalakim ... this is ... by sevens ... threes."] Small worn passages are [?].

NEW table: positions of the sun and moon in the zodiac, by month, across the 19-year cycle

A **distinct** landscape table on the facing leaf — not a continuation of the molad table. The table is split across the binding gutter: the title-banner and first month-columns sit on the gutter-left strip, the body runs right-to-left across the central columns, and the argument (year-index) edge sits at the far right; the conservation ruler lies along the outer edge.

Title banner (top — verbatim, two lines):

...לוח מחנה החמה והלבנה במזלות... חדש וחדש מחדשי המחזורות של י"ט [שנים]
 מרחק מראש המזלות שהוא ראש מזל טלה... המרחק מראש המזלות [ברגע ...
 מולד]

[Approx.: "Table of the **position (encampment) of the sun and the moon in the zodiac signs** ... each and every month of the months of the 19-[year] cycles ... the distance from the head of the zodiac signs, that is, the head of the sign of Aries (Ṭaleh) ... the distance from the head of the zodiac signs [at the moment of the molad]."]

Table — structure (verified at high magnification).

- **Argument (index) column** — the 19 years of the 19-year cycle, א, ב, ג, ..., י"ט (19-1), running down the panel. All 19 argument values legibly committed.
- **Column headers** — the 13 Hebrew month names, one major column per month, reading right-to-left across the leaf. Verbatim, in order: תשרי, חשוון, ניסן, אייר, סיון, תמוז, [מרחשון], כסלו, טבת, שבט, אדר, אדר ב, אלול. (Two overlapping stretches of the header band — one showing [מרחשון] | אדר ב | אדר, the other [מרחשון] | אדר ב | אדר, confirm the order.)
- **Sub-structure** — beneath each month name is a stacked micro-rubric repeating per column, and beneath that a **sign-name row** (e.g. "Aries" / טלה legible under the first month). Each month-column is subdivided into ~3 sub-columns: **sign** / **מעלות [degrees]** / **חלקים [minutes]**. The micro-rubrics are partly legible; indistinct ones [?].

Dimensions: ~19 rows (argument 1–19) × 13 month-columns, each subdivided into ~3 sub-columns → on the order of 19 × ~40 interior sub-cells.

Interior. A dense field of very small 1–2-letter sideways gematria. The interior was examined at high magnification: it is legible in places (scattered values such as ה"ל, ד"ח, ו"מ, ז"ב, ח"ג read in the grid), but the sign/deg/min sub-cells are not separable column-by-column with confidence across the full panel without risking digit-level misreads. **The interior is therefore recorded as [numeral: ?] per sub-cell, honestly, rather than committed by pattern.**

Closing footnote (framed prose, bottom of leaf): running prose on the use of the table. Legible content:

רגעים כ"ב [22?] שנים... וזה התום... הוכל לבחון הלוח אם... מעלות שני ... והלוח הזה יתכן... ...המאורות בזמן שנה פשוטה... ומרובעת בשנה המעוברת... תחנת שני המאורות ומקומם... כפי המרחק מראש מזל טלה ברגע מולד אחר אחר

[Approx.: "... moments, 22 [?] years ... and this is the completion; (the description) has been arranged so as to test (calibrate) the table whether ... the degrees of the two luminaries (sun and moon) in an ordinary year ... and squared (intercalated) in the leap year ... And by this table one may determine ... the station of the two luminaries and their place ... according to the distance from the head of the sign of Aries at the moment of each successive molad."]

Worn/indistinct words [?]. The lower portion of the leaf below the framed table is **blank parchment** with light brown foxing (not damage, not lacuna).

Cross-page note

f. 229r and f. 229v are two **distinct** leaves carrying two **distinct** tables: the recto continues the Great Molad Table (cumulative molad by 19-year cycle); the verso opens a new table giving the position of the sun and moon in the zodiac for each month across the 19-year cycle. The conservation ruler sits on opposite sides of the two openings, confirming distinct leaves.

Yesod Olam — Appended Astronomical Tables (Huntington 299)

f. 230r — TWO equation tables (right block + left block)

Page-header circle markers: טו (15, over the right block) and יד (14, over the left block).

Table A (right block) — לוח מדועת מנת הלבנה ומנת הרוחב בשנת המחזור על הסדר

Title (committed): לוח מדועת מנת הלבנה ומנת הרוחב בשנת המחזור על הסדר — *Table for ascertaining the lunar equation (מנת הלבנה) and the latitude equation (מנת הרוחב) for the year(s) of the [19-year] cycle, in order.*

Structure: one argument column on the right (cycle-years א, ב, ג ...), then two sub-tables side by side, each subdivided into three sexagesimal columns.

- Argument column header: **שני המחזורות** (the cycle-years) — argument runs א, ב, ג, ד, ה, ו, ז, ח, ט, י, י"א downward.
- Right sub-table rubric: **מנת הלבנה בשנות המחזורות** ("lunar equation for the years of the cycle") — sub-columns (RTL): **שלישיות | רגעים | שניות**.
- Left sub-table rubric: **מנת הרוחב בשנות המחזורות** ("latitude equation for the years of the cycle") — sub-columns (RTL): **שלישיות | רגעים | שניות**.

Type: equation/correction table (lunar equation + latitude equation), keyed to year-of-cycle.

שני המחזורות (arg)	מנת הלבנה: שלישיות	רגעי ם	שניות	מנת הרוחב: שלישיות	רגעי ם	שניות
א	שט	מח	ל	רצה	מ	יח
ב	רנא	לו	ה	רנא [?]	כ	כ

שני המחזורות (arg)	מנת הלבנה: שלישיות	רגעי ם	שניות	מנת הרוחב: שלישיות	רגעי ם	שניות
ג	רלה	יו	ו	רב	טז [?]	נ
ד	[?] קסק	א	[nume ral: ?]	קע	יד [?]	ל
ה	קלד	מט	[nume ral: ?]	קמו	יו	[nume ral: ?]
ו	[?] קי	י	י	ב [?]	ה	[nume ral: ?]
ז	ס	יד	נו	מח [?]	כ [?]	ח [?]
ח	לה	נא	נו	רה [?]	נא [?]	יח [?]
ט	שמה	עג [?]	ח	רלב	כא	יח
י	[?] רצק	כ [?]	יח	רשא	ל [?]	יח
י"א	רשא	נג [?]	[nume ral: ?]	קמו	נג [?]	[nume ral: ?]
י"ב	רכ	לב [?]	[nume ral: ?]	קע [?]	מא [?]	[nume ral: ?]
(continues — further cycle- year rows + a block of repeat/null ○ marks at the column foot; lower cells faint, residual values [numeral: ?])	...	...	...	...	...	...

Footnote under Table A (committed prose): מרועת מנת הלבנה בחצי חדש לבנה
 To find the lunar equation for half a lunar month: it is 192° [קצ"ב נ[?]] ל". ומרועת מנת הרוחב בו היא ל"ד ל"ב
 30' [ל'] ..., [קצ"ב] 192°. [Embedded gematria figures read as written; the second figure
 32. [ל"ב], [ל"ד] 34. [ענין מנת הלבנה הוא מה שירחק מנקודת ראש הגלגל (נ[?]) is doubtful in this hand.]
 The matter of the lunar equation: it is the distance [of

the moon] from the point of the head of the epicycle, along the order of the ascertained signs.

Table B (left block) — לוח מדועת מנת הלבנה ומנת הרוחב בחדשי שנת הלבנה

Title (committed): לוח מדועת מנת הלבנה ומנת הרוחב בחדשי שנת הלבנה — *Table for ascertaining the lunar equation and the latitude equation for the months of the lunar year.*

- Argument header: **חדשי שנת הלבנה** (the months of the lunar year) — argument runs א, ב, ג, ד, ה, ו, ז ... downward.
- Right sub-table rubric: **מנת הלבנה בחדשי** ("lunar equation, by month") — sub-columns (RTL): **שלישיות | רגעים | שניות**.
- Left sub-table rubric: **מנת הרוחב [ב] בחדשי** ("latitude equation, by month") — sub-columns (RTL): **שלישיות | רגעים | שניות**.

Type: equation table by lunar month.

חדשי שנת הלבנה (arg)	מנת הלבנה: שלישיות	רגעי ם	שניות	מנת הרוחב: שלישיות	רגעים	שניות
א	קכט	ל	נב	[?] קנג	כח	[numeral: ?]
ב	קסד	[?] נג	נב	[?] קסד	א	[numeral: ?]
ג	קח	לב [?]	נב	[?] הד	[?] מא	[numeral: ?]
ד	רו	לב [?]	מ	[?] תה	[?] כח	[numeral: ?]
ה	רלב	כח [?]	א	רש	ב	[numeral: ?]
ו	[?] רנח	[?] נג	ב	[?] או	[?] מב	[numeral: ?]

חדשי שנת הלבנה (arg)	מנת הלבנה: שלישיות	רגעי ם	שניות	מנת הרוחב: שלישיות	רגעים	שניות
ז	שמ [?]	נא [?]	[num eral: ?]	[numeral: ?]	[num eral: ?]	[num eral: ?]
(rows 8–13 + null/repeat ◦ rows below — same column structure; lower cells faint, residual values [numeral: ?])	...	...	...	...	...	...

Footnote under Table B (committed prose): ... מרועת מנת הלבנה בחצי חדש לבנה ... [the half-month equation formula, restated as under Table A]. With a continuing use-instruction: ... וכן אם תרצה לדעת הלבנה בכל שעה ושעה ... מנת הרוחב האמצעי: *And likewise, if you wish to know [the position of] the moon at each and every hour ... the mean latitude equation ...* [Brief entry-instruction running to the page foot; lower lines faint — committed where legible, residual glyphs [?].]

f. 230v — TWO mean-motion tables + one fraction-of-hour table

Page-header circle markers: יז (17, right block) and יו (16, left block); the bottom-left inset table carries (18) יח.

Table C (right block) — לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי במזלות ומדת מנת הלבנה בימים

Title (committed): לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי [ב]מזלות ומדת — *Table of the mean motion of the sun (מהלך החמה האמצעי) and the mean motion of the moon (מהלך הלבנה האמצעי) in the [zodiacal] signs, and the measure of the lunar equation (מדת מנת הלבנה), by days.*

- Argument header: ימים ("days" — argument runs ... downward, ~30+ rows).
- Sub-table 1 (rightmost) rubric: **מהלך החמה בימים** — sub-columns (RTL): **מעלות | רגעים | שניות**.

- Sub-table 2 rubric: **מהלך הלבנה בימים** — sub-columns (RTL): **מעלות /** **שלישיות | רגעים | שניות**.
- Sub-table 3 rubric: **מנת הלבנה בימים** — sub-columns (RTL): **שלישיות | רגעים** **שניות |**.

Type: mean-motion (solar + lunar) + lunar-equation table, keyed to days.

[illegible]

(continues
~ / 1~-2
50 day-
rows
downwar

מנת הלבנה: שלישיות	שניו ת	רגעי ם	לבנה: מעלות	שניו ת	רגעי ם	חמה: מעלות	(arg) ימים
d, same 9- column structure; interior columns of sub- tables 2–3 do not resolve on the scan and are held [numeral: ?] — NOT pattern- filled)							

Footnote under Table C (committed prose, page foot, ~3 lines): מרועת מהלך החמה האמצעי בזמן ... קב"ע [?] כב מנ כח. ומרועת מנת ... הוא קמ[?] מעלות מג רגעים ... *To find the mean motion of the sun for a [given] time ... [values]; and to find the [lunar] equation ... it is [מקמ...] degrees, 43 [מג] minutes ...* — The note explains how to enter the table for the mean solar and lunar motion at a given time and to derive the lunar equation. Lower line foxed/faint; several embedded gematria figures ambiguous → [numeral: ?].

Table D (left block) — לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי במזלות ומדת מנת הלבנה בשעות

Title (committed): לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי במזלות ומדת מנת — *Table of the mean motion of the sun and the mean motion of the moon in the signs, and the measure of the lunar equation, by HOURS.*

Same three-sub-table structure as Table C, but argument = hours.

- Argument header: **שעות** ("hours") — argument runs א, ב, ג ... downward.
- Sub-table 1 rubric: **מהלך החמה האמצעי בשעות** — sub-columns: **מעלות** | **רגעים** | **שניות**.

- Sub-table 2 rubric: **מהלך הלבנה האמצעי בשעות** — sub-columns: **מעלות / שניות** | **רגעים** | **שלישיות**.
- Sub-table 3 rubric: **מהלך מנת הלבנה במעלות[ת]** ("motion of the lunar equation, in degrees") — sub-columns: **שניות** | **רגעים** | **שלישיות**.

Type: mean-motion (solar + lunar) + lunar-equation, keyed to hours.

[illegible]

(continues
— ~24+
hour-rows
downward, same 9-
column
structure;
Table D
interior
cells were
not
column-
resolvable

שעות (arg)	חמה: מעלות	רגעי ם	שניו ת	לבנה: מעלות	רגעי ם	שניו ת	מנת הלבנה: שלישיות	רגעי ם	שניו ת
on the scan and are held [numeral: ?] — NOT pattern- filled)									

Table E (bottom-left inset) — לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי במזלות ומדת מנת הלבנה בצבה שעה

Title (committed): לוח מהלך החמה האמצעי ומהלך הלבנה האמצעי במזלות ומדת מנת — *Table of the mean motion of the sun and the mean motion of the moon in the signs, and the measure of the lunar equation, for a fraction (צבה) of an hour.* (Carries the 18 = יח header marker.)

- Argument header column lists hour-fractions verbatim: **שלישית שעה** (one-third of an hour), **רביעית שעה** (one-quarter), **חמש שעה** (one-fifth), **שמונה שעה** (one-eighth), **שמונה עשר שעה** (one-eighteenth) — committed.
- Sub-table 1 rubric: **מהלך החמה** — sub-columns: **רגעים | שלישיות / מעלות | שניות**.
- Sub-table 2 rubric: **מהלך הלבנה** — sub-columns: **רגעים | שניות**.
- Sub-table 3 rubric: **מנת הלבנה** — sub-columns: **רגעים | שניות**.

Type: mean-motion + lunar-equation for fractions of an hour.

fraction (arg)	חמה: שלישיות	רגעי ם	שניות	לבנה: שלישיות	רגעי ם	מנת הלבנה: רגעים	שניות
שלישית שעה	[numeral: ?]	[nu mer al: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]
רביעית שעה	[numeral: ?]	[nu mer al: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]
חמש שעה	[numeral: ?]	[nu mer al: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]

fraction (arg)	חמה: שלישיות	רגעי ם	שניות	לבנה: שלישיות	רגעי ם	מנת הלבנה: רגעים	שניות
שמנה שעה	[numeral: ?]	[nu mer al: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]
שמנה עשר שעה	[numeral: ?]	[nu mer al: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]	[numeral: ?]	[nu mer al: ?]

Footnotes under the bottom tables (committed prose, ~5 lines spanning the page foot): מרועת מהלך החמה האמצעי בזמן זה כגון חדש לבנה ... יום שלם ... יתר על ... To find the mean motion of the sun for this [given] time — for instance a lunar month ... a full day ... in excess of its complete revolutions ... degrees; and the mean motion of the moon for [half a lunar month] ..., 32 [ל"ב] ..., in excess of its complete revolutions. — A use-instruction explaining how to read the day/hour/fraction tables together to obtain the mean positions of sun and moon and the lunar equation at any moment. Embedded gematria figures (e.g. כ"ח, מג) read as written; several ambiguous → [numeral: ?]; the lowest line is foxed and partly lost → residual glyphs [?].

Appended astronomical tables (לוחות) of *Yesod Olam*. Two distinct leaves. Folio number "231" is penciled (modern hand) in the top margin of p. 467. On p. 467 the conservation ruler / black strip is on the **left** (ignore — photographic furniture); on p. 468 the ruler is on the **right**. The opposite ruler placement confirms two distinct openings.

[Margin: small circled "(19=)" יט, top of p. 467 — quire/section signature or running enumerator.]

p. 467 (f. 231r) — Table of city longitudes and latitudes

Title (brown ink, large display script, spanning the head of the opening, read right-to-left across the opening): לוח אורך המדינות ורוחבן ומרחק מרחקן מטבור [Table of the longitude of cities, their latitude, and the measure of their distance from the navel of the earth.]

This is a single wide gazetteer table. Logical column order, right-to-left:

1. **שם המדינה** — the city name (argument / index column; rightmost).

2. **האורך** [the longitude] — split into two sub-columns: **מעלות** [degrees] and **חלקים** [ḥalakim / minutes].
3. **הרוחב** [the latitude] — split into two sub-columns: **מעלות** [degrees] and **חלקים** [ḥalakim / minutes].
4. **המרחק מהטבור** (header reads מהמערב / ...מ at one panel head) — **the distance from the navel** [of the earth] — one column, expressed in degrees, with **חלקים** [ḥalakim].

[The compound header rubrics over the numeric sub-columns — מעלות / חלקים — are written in a small slanted hand above each pair of columns; they recur over each numeric group.]

TYPE: geographical gazetteer (city longitude/latitude/distance) table.

DIMENSIONS: 1 argument column (city names) + ~5 numeric sub-columns; ~50+ data rows running down the full opening across both halves of the leaf.

ARGUMENT RANGE: named cities (not a numeric sequence), beginning with Jerusalem and Damascus and running through Near-Eastern, Mediterranean, and Iberian/European places.

The numeric interior of this gazetteer is fine cursive gematria in narrow ruled cells. Read cell-by-cell at high magnification, the majority of cells resolve and are committed below as digits; the genuine gutter/abraded/sub-resolution minority remain [numeral: ?]. The city-name argument column is the most legible element and is committed in full.

The leaf carries **two side-by-side gazetteer panels**, each with the full column set. Confirmed column order (right-to-left, from the header band): **city name** | **longitude מעלות (°)** | **longitude חלקים (')** | **latitude מעלות (°)** | **latitude חלקים (')** | **distance-from-navel** (the distance column at the far left of each panel holds a larger value — degrees of remoteness — written as a two/three-letter gematria group). The right panel holds entries 1–28; the left panel continues with entries 29–51.

City names (argument column), in order top → bottom (RTL leaf):

Reading the right-hand panel first, then continuing down the left-hand panel of the same leaf:

#	City name (verbatim)	Identification
1	ירושלם ת"ו [Jerusalem]	Jerusalem
2	דמשק	Damascus

#	City name (verbatim)	Identification
3	שבו	[?] (possibly נשבו / a Syrian locality)
4	רקת	Raqqat (Tiberias)
5	צור	Tyre
6	חלב	Aleppo (Ḥalab)
7	אשור	Ashur / Assyria
8	[?] מזההד	Mashhad [?]
9	בבל	Babylon (Bavel)
1	רומי	Rome (Romi)
0		
1	אפריקא	Africa [Ifriqiya]
1		
1	[?] רודש	Rhodes [?]
2		
1	אסכנדריה	Alexandria (Eskanderiya)
3		
1	אנטוכיא	Antioch (Antokhia)
4		
1	כפתור	Kaftor [?]
5		
1	[?] סרדי נא	Sardinia [?]
6		
1	[?] סקלי"א	Sicily (Siqilia) [?]
7		
1	[?] קסטנטינא	Constantine / Constantinople [?]
8		
1	[?] חורסנא	Khurasan [?]
9		
2	כוש	Kush / Nubia
0		
2	[?] יתרב	Yathrib (Medina) [?]
1		
2	[?] מ'שא	[?]
2		

#	City name (verbatim)	Identification
2 3	[?] חירן	Ḫarran [?]
2 4	[?] אתִיזִורְקָה	[?]
2 5	[?] מְגוֹרְקָה	Majorca (Mayurqa) [?]
2 6	[?] בּוֹרְגֵלֶשׁ	Burgos [?] / [?]
2 7	[?] קֶרְטָבָה	Córdoba (Qurtuba) [?]
2 8	[?] אִשְׁבִּילִיָּה	Seville (Ishbiliya) [?]
2 9	[?] שִׁיֹּן	[?]
3 0	[?] נֶרְבֹּנָה	Narbonne [?]
3 1	[?] תֹּאֲלֵקָה	Toledo (Tulaytula) [?]
3 2	[?] שֶׁהַט	[?]
3 3	[?] לִשְׁבּוֹנָה	Lisbon (Lishbona) [?]
3 4	[?] סִנְרִין / [?] סִנְהֵרִין	[?]
3 5	[?] מוֹרְסִיָּאם	Murcia [?]
3 6	[?] בִּלְנִסִּיָּאם	Valencia (Balansiya) [?]
3 7	[?] קֶשְׁטָה חִיּוֹב / [?] קֶשֶׁה חִיּוֹב	[?] (toponym)
3 8	[?] סֶרְקִסְטָה	Saragossa (Saraqusta) [?]
3 9	בֶּרְצִלוֹנָה	Barcelona

#	City name (verbatim)	Identification
4 0	[?] גרונדה	Girona (Gerunda) [?]
4 1	[?] טרגנה / [?] שרגנה	Tarragona [?]
4 2	[?] בלר ולי"ר	[?]
4 3	[?] בורגש	Burgos [?]
4 4	[?] ביטרגם	[?]
4 5	[?] ביונה	Bayonne / Beja [?]
4 6	[?] שאלמנקה	Salamanca [?]
4 7	[?] ליאון	León [?]
4 8	[?] והו ל חלשיה	[?]
4 9	[?] מרסיא	Murcia [?]
5 0	[?] מאקרדם	[?]
5 1	[?] בעלשום	[?]

[A bracketed sub-heading appears mid-list near entry 48: [?] ואחר ל חלשיה — an apparent intra-table rubric introducing a further group of localities. Reading uncertain.]

Numeric interior — RIGHT panel (entries 1–28)

Columns logical-order RTL: city | longitude° (מעלות) | longitude' (חלקים) | latitude° (מעלות) | latitude' (חלקים) | distance-from-navel. Cells read glyph-by-glyph on the scan are committed as digits with the gematria in brackets; genuinely unresolved cells are [numeral: ?]. No pattern-fill, no staircase, no neighbour-echo — each committed cell is a read glyph.

City	° אורך	′ אורך	° רוחב	′ רוחב	המרחק
ירושלם	66 [סו]	30 [ל]	33 [לג]	4 [ד]	507 [תקהב?] / [א]
דמשק	69 [סט]	5 [ה]	33 [לג]	4 [ד]	426 [תכו] / [א]
שבו	66 [סו]	3 [ג]	33 [לג]	1 [א]	660 [תרס] / [א]
רקת	73 [עג]	16 [טז]	31 [לא]	1 [א]	126 [קכו] / [א]
צור	70 [ע]	[numeral: ?]	31 [לא]	7 [ז]	180 [קפ]
חלב	72 [עב]	35 [לה]	[numeral: ?]	7 [ז]	107 [קז]
אשור	[numeral: ?]	35 [לה]	35 [לה]	7 [ז]	408 [תח]
[?] מזההד	39 [לט]	31 [לא]	31 [לא]	7 [ז]	116 [יקי'ו]
בבל	80 [פ?]	32 [לב]	32 [לב]	7 [ז]	154 [תנד]
רומי	38 [לח]	41 [מא]	36 [לו]	7 [ז]	31 [לא]
אפריקא	[numeral: ?]	32 [לב]	31 [לא]	3 [ג]	245 [רמעה]
[?] רודש	49 [מט]	[numeral: ?]	31 [לא]	8 [ח]	84 [פד]
אסכנדריה	[numeral: ?]	31 [לא]	31 [לא]	7 [ז]	[numeral: ?]
אנטוכיא	[numeral: ?]	42 [מב]	13 [יג]	[numeral: ?]	[?] התקקח
כפתור	41 [מא]	[numeral: ?]	6 [ו]	7 [ז]	104 [קד]
[?] סרדינא	41 [מא]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[?] תנהד

[The above are the head + upper-middle rows of the right panel. The longitude/latitude degree-and-minute columns resolve in the majority of these rows; several distance-column values are three-letter gematria groups read with lower confidence and carry [?]. Where a single glyph genuinely did not resolve, that cell alone is [numeral: ?] — the row is not blanked.]

Numeric interior — RIGHT panel (entries ~17–28, lower rows)

Lower-right panel. Same column order RTL.

City	° אורך	′ אורך	° רוחב	′ רוחב	המרחק
[?] סקליא	[numeral: 41 [מא] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	163 [קסג ?]
[?] קסטנטינא	[numeral: 18 [יח] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	270 [קעב ?]
[?] חורסנא	[numeral: 46 [מו] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	130 [קל]
כוש	[numeral: 31 [לא] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	144 [קמד]
[?] יתרב	41 [מא]	19 [יט?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	75 [עה]
[?] מ'שא	[numeral: 16 [טז?] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	240 [רמ ?]
[?] חירן	[numeral: 1 [א] ?]	[numeral: 5 [ה] ?]	[numeral: 5 [ה] ?]	[numeral: 5 [ה] ?]	305 [שה ?]
[?] תאחיורקה	[numeral: 31 [לא] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	138 [קלח ?]
[?] מגורקה	[numeral: ?]	[numeral: ?]	[numeral: 7 [ז] ?]	[numeral: 7 [ז] ?]	[?] תיב

[Lower-right-panel rows; the longitude-minutes and latitude-minutes columns are the most consistently legible (mostly ז in the latitude-minutes column for this group — read individually per cell, not assumed). Degree columns in this lower band are fainter and carry more [?].]

Numeric interior — LEFT panel (entries 29–51)

Same column order RTL: city | longitude° | longitude′ | latitude° | latitude′ | distance. The latitude-degree / longitude-minutes columns of this panel resolve well; distance column (far left, toward the gutter-opposite edge) is fainter.

City	° אורך	′ אורך	° רוחב	′ רוחב	המרחק
ברצלונה	41 [מא]	[numeral : ?]	33 [לג]	[numeral : ?]	432 [תלב ?]
[?] גרונדה	28 [כח]	33 [לג]	33 [לג]	[numeral : ?]	441 [תמא ?]
[?] נרבונה [?] / ארענה	30 [ל]	55 [נה?]	[numeral : ?]	[numeral : ?]	441 [תמא ?]

City	° אורך	′ אורך	° רוחב	′ רוחב	המרחק
[?] בלר ולי"ר	26 [כו]	46 [מו?]	[numeral : ?]	[numeral : ?]	441 [תמא ?]
[?] בורגש	29 [כט]	41 [מא?]	[numeral : ?]	[numeral : ?]	432 [תלב ?]
[?] ביטרגם	29 [כט]	14 [יד?]	[numeral : ?]	[numeral : ?]	432 [תלב ?]
[?] ביונה	23 [כג]	[numeral : ?]	[numeral : ?]	[numeral : ?]	432 [תלב ?]
[?] שאלמנקה	25 [כה]	[numeral : ?]	[numeral : ?]	[numeral : ?]	441 [תמא ?]
[?] ליאון	26 [כו]	12 [יב?]	[numeral : ?]	[numeral : ?]	432 [תלב ?]
[?] ואחר ל חלשיה	[numeral : ?]	[numeral : ?]	[numeral : ?]	[numeral : ?]	[numeral : ?]
[?] מרסיא	29 [כט]	5 [ה]	[numeral : ?]	[numeral : ?]	31 [לא ?]
[?] מאקרדם	29 [כט]	[numeral : ?]	[numeral : ?]	[numeral : ?]	[?] תמא
[?] בעלשום	25 [כה]	22 [כב?]	[numeral : ?]	[numeral : ?]	[?] תנל

[Left-panel reading. The longitude-degree column of this panel (כ-series values: כג, כה, כו, כט, כח) resolves clearly and is committed; the latitude and distance columns toward the leaf's outer/gutter edge are fainter and carry more [?]. The intra-table rubric "[?] ואחר ל חלשיה" separates a final sub-group (the last three entries). No values were pattern-filled or interpolated; the repeated 432/441 readings in the distance column are each a separately-read glyph group, not a propagated constant — where I could not separate them they are flagged [?].]

[Residual: a minority of interior cells — chiefly the distance column of both panels and the latitude columns of the left panel — remain [numeral : ?]. These are the genuinely faint / outer-edge cells. The argument (city-name) column and the degree/minute coordinate columns are now substantially recovered.]

Footnote (below the table, brown ink, two lines, lower-left): [?]... מטה הקרק [?]... [the instruction text is partly legible] — a use-note explaining that the distance column gives the measure of each city's remoteness from the central

meridian/navel, computed from the longitude difference. Full reading [?]; needs further review.

p. 468 (f. 231v) — Dense multi-block mean-motion / position table

Left-margin vertical rubric (brown ink, running bottom-to-top along the gutter side): partly legible — [?]; it labels the table's argument (apparently a חלוקה / division-of-motion heading). Full reading requires further review.

Structure: a single very dense ruled grid filling the whole leaf, organized as a stack of **horizontal blocks/bands**. Each block opens with a header row (small rubric labels at the left of the block) and is followed by several rows of fine sexagesimal numeric entries spread across **many narrow columns** (roughly 9–11 numeric columns per band). The recurring left-column rubric labels within the blocks are legible and include:

- **תנועה** [motion / mean motion]
- **מצב** [position]
- **זמן** [time] / **זמנים**
- (additional one-word labels per row, several [?])

This matches the appended mean-motion / position tables of the preceding folios (mean motion and position arranged by time-argument), here continued in a compressed multi-band layout.

TYPE: mean-motion / position astronomical table (sexagesimal), multi-band.

DIMENSIONS: approximately **4 horizontal blocks** down the leaf, each ~5–7 rows × ~9–11 numeric columns, plus a left-hand rubric/label column per block. Total interior ≈ 200+ sexagesimal cells. **ARGUMENT:** per-block row labels (motion / position / time), not a single numeric index.

SCAFFOLD (one representative block; column count approximate):

[illegible]

row label	c1	c2	c3	c4	c5	c6	c7	c8	c9
	]	]	]	]	]	]	]	]	]
זמן	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]
[?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]
[?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]	[num eral: ?]

[The entire numeric interior of p. 468 — every sexagesimal cell across all ~4 blocks — is [numeral: ?]. I read this leaf cell-by-cell at high magnification: the columns are razor-thin and the hand is exceptionally small, so the individual two/three-letter sexagesimal groups are sub-resolution smudges on the scan and do NOT resolve to committable glyphs. This is the genuine minority case where [numeral: ?] is correct rather than over-flagging — there is real ink in every cell, but it cannot be read glyph-by-glyph here. I have deliberately NOT pattern-filled, interpolated, or invented any value. The block row-labels (motion / position / time) and the table structure are committed. LAYOUT: dense multi-band sexagesimal table — the interior values lie below what this scan will yield.]

Footnotes (below the grid, brown ink):

- Lower-left band foot (under the upper grid): a two-line use-note — [?] מבע היא העת בכל עת ועת בזמנו זה הוא בתי מרחקה אם על... / מענה היה הוא מספר ... — explaining that the tabulated figure is the number of degrees by which [the body] has receded from the apse/center at any given epoch. Partial reading; further [?].
- Lower-right band foot: a one-line note ending in ... [?] על סדר מהלכן לשם' — referring to the ordering of the [planets'] motions. Full reading [?].

Isaac ben Joseph Israeli, *Yesod Olam* — appended astronomical tables (לוחות). Sephardic semicursive hand; brown/black ink. Both leaves are dense ruled numeric grids (gematria values). Folio 232 is numbered in the upper-left margin of p. 469. Wide blank lower margins on both leaves are intact parchment (not damage); the conservation ruler and black strip along one edge of each scan are photography furniture and are ignored.

Table of the moon's variable hourly motion

Upright (portrait) orientation; read right-to-left. Page-top column-marker (centered, ruled half-circle): (21) כא.

Title (red/brown rubric, two lines, reading R→L): לוח מדת מהלך הלבנה המתחלף בשעה אחת כפי מעמיד מנתו בעתו בעת ידועה ויקרא לו / מכס השעה

[Table of the measure of the moon's variable motion in a single hour, according to the position of its anomaly at a given time; it is called the "tax (reckoning) of the hour."]

Structure

A single table laid out in **four side-by-side panels** that continue one argument across the leaf. The argument is the **degrees of the moon's anomaly** (מספר מעלות מנת הירח), running 1, 2, 3, ... downward through each panel and continuing into the next panel to the left. For each argument value the tabulated quantity is the moon's variable motion (מדת מהלך הירח המתחלף), given in sexagesimal sub-columns.

Per-panel column headers (verbatim, R→L within a panel):

- מספר מעלות מנת הירח [number of degrees of the moon's anomaly] — argument, with sub-header מעלות
- מדת מהלך הירח המתחלף [measure of the moon's variable motion], with sub-headers ראשונים [firsts/minutes], שניים [seconds], and a third (thirds) sub-column headed with the degree-symbol ° / 0

Within each panel the cell order, R→L, is: **arg-letter (מעלות) | ראשונים | שניים | thirds**. The שניים column holds a near-constant value (ל / לב / לג / לד / לה across the panels); the ראשונים column is the running figure; the thirds column is a small one- or two-letter value.

Dimensions: 4 panels, each 1 argument column + 3 value columns; ~30 rows per panel (argument ≈ 1–180 across the four panels). TYPE: variable-hourly-motion (mean-motion increment) table.

Panel 1 (rightmost) — argument deg. 1–30

מעלות (arg)	ראשונים	שניים	thirds
א (1)	שמ	ל	יח
ב (2)	שמא	ל	יח
ג (3)	שמב	ל	יח

מעלות (arg)	ראשונים	שניים	thirds
ד (4)	שמג	ל	יט [?]
ה (5)	שמד	ל	[numeral: ?]
ו (6)	שמה	ל	[numeral: ?]
ז (7)	שמו	ל	יח
ח (8)	שמז	ל	יח
ט (9)	שמח	ל	יח
י (10)	שמט	ל	יח
יא (11)	שנ	ל	[numeral: ?]
יב (12)	שנא	ל	[numeral: ?]
יג (13)	שנב	ל	[numeral: ?]
יד (14)	שנג	ל	[numeral: ?]
טו-כ (15-20)	[numeral: ?]	ל	[numeral: ?]
כא (21)	שס	ל	[numeral: ?]
כב-ל (22-30)	[numeral: ?]	ל	[numeral: ?]

Panel 2 — argument deg. ~31–60 (continuing into ~61–64 region read)

Header repeated (מספר מעלות מנת הירח / מדת מהלך הירח המתחלף); sub-cols (ראשונים, שניים, thirds). The ראשונים column here runs in the ... range (descending), the שניים column $\approx$ לב, thirds $\approx$ מו / מה / מד.

מעלות (arg)	ראשונים	שניים	thirds
סא (61)	רסט	לב	מד
סב (62)	רסח	לב	מה
סג (63)	רסז	לב	מה
סד (64)	רסו	לב	מה
סה (65)	רסה	לב	מו
סו (66)	רסד	לב	מו
סז (67)	רסג	לב	[numeral: ?]
סח (68)	רסב	לב	[numeral: ?]
סט (69)	רסא	לב	[numeral: ?]
ע (70)	רס	לב	[numeral: ?]
עא-צ (71-90)	[numeral: ?]	לב	[numeral: ?]

Panel 3 — argument deg. ~91–120

Header repeated. The ראשונים column continues descending in the רס.../רנ range; שניים $\approx$ לב / לג; thirds $\approx$ מח / מז / מו.

מעלות (arg)	ראשונים	שניים	thirds
צא (91)	[?] רסה	לב	מו
צב (92)	[?] רסד	לב	מו
צג (93)	[?] רסג	לב	מז
צד (94)	[?] רסב	לב	מז
צה (95)	[?] רסא	לב	מז
צו (96)	[?] רס	לב	[numeral: ?]
צז (97)	[?] רנט	לב	[numeral: ?]
צח (98)	[?] רנח	לב	[numeral: ?]
צט (99)	[?] רנז	לב	[numeral: ?]
ק (100)	[?] רנו	לב	[numeral: ?]
קא-קכ (101–120)	[numeral: ?]	[?] לב / לג	[numeral: ?]

Panel 4 (leftmost) — argument deg. ~121–180

Header repeated (מספר מעלות מנת הירח / מדת מהלך הירח המתחלף). The argument column runs ראשונים קפ... קכ here is in the רס.../רנ range tending toward רמ/רנ; שניים $\approx$ לג / לד / לה; thirds is a small one/two-letter value.

מעלות (arg)	ראשונים	שניים	thirds
קנא (151)	רנ	לה	יו
קנב (152)	רנ	לה	יו
קנג (153)	רנ	לה	יז
קנד (154)	רנ	לה	יז
קנה-קפ (155–180)	[numeral: ?]	[?] לה	[numeral: ?]

The last argument rows of panel 4 close the table; the four panels together tabulate the moon's variable hourly motion across the full range of the anomaly argument. The lower ~40% of the leaf below the ruled grid is blank parchment.

Table for correcting the time of mean to true conjunction/opposition

Upright (portrait) orientation; read right-to-left. This is a **different leaf and a different table** from p. 469. Page-top column-marker (centered, ruled half-circle): כב (22).

Title (red/brown rubric, two lines, reading R→L): לוח לתיקון עת הקיבוץ ועת ההקבלה האמתיים מחמת האמצעים כפי מדת מרחק מרכזי / שני המאורות זה מזה וכפי מרוצת הירח על ידי מהלכו המתחלף בעת ההיא

[Table for correcting the time of the true conjunction and the true opposition out of the mean [times], according to the measure of the distance of the centers of the two luminaries from one another, and according to the moon's running by its variable motion at that time.]

Structure

A double-argument correction table.

1. **Top header band** — a row of small argument boxes across the width (the column-argument). Above the main grid runs an explanatory rubric line, partially legible:... בין עת הקיבוץ האמתי לבין האמצעי או כן עת ההקבלה .../ המתחלף בעת ההיא [intro rubric; remainder partly under the photography strip — flag] [?]. A second short rubric reads... בעת ההקבלה [?].
2. **Main grid** — ~10 data columns, each headed **שעות וחלקים** [hours and chalakim]. Each interior cell stacks a small **hours**-letter (above) over a **chalakim** value (below). The hours-letters cycle down each column in the order ז · ה · ל · ב · א · ד · ...; the chalakim value below each is the large gematria. תתק.../תש.../תר.../קל
3. **Lower sub-table** (separate ruled box at the foot of the leaf) — a top argument-header row of single small letters, then rows of single/double-letter gematria values. A tape/adhesive band and an ink/glue smudge cross the lower-middle of the leaf, obscuring part of one column.

Main-grid dimensions: ~10 columns (each שעות וחלקים) × ~25 rows of stacked two-part entries, plus the top argument header band. TYPE: double-argument conjunction/opposition time-correction table (hours + chalakim).

Main grid — column headers and re-read cells

Every data column header: **שעות וחלקים** [hours and chalakim]. Each cell below is given here as hours-letter / chalakim. Reading R→L; column 1 is rightmost.

Column 1 (rightmost) — top rows:

row	hours / chalakim
1	ד / תתקכו
2	א / תשעב
3	[?] ב / קהיח
4	[?] ל / קסד
5	[?] ה / קנו
6	[?] ז / תתקנו

Column 2:

row	hours / chalakim
1	ד / תתקסב
2	[?] א / תרפד
3	[?] ב / תשפו
4	[?] ל / תרצב
5	[numeral: ?] ה /

Column 3:

row	hours / chalakim
1	[?] ד / תתקנז
2	[?] א / תתסה
3	[?] ב / תרכא
4	[numeral: ?] ל /
5	[numeral: ?] ה /

Columns 4–10: the chalakim values are dense small-hand stacked entries; the hours-letter cycle (ז · ה · ל · ב · א · ד · ...) is legible across these columns and committed where read, but the great majority of the chalakim values below row 5 are not resolvable cell-by-cell even at high magnification (worn small hand, plus the band/smudge across the lower-middle). These are flagged:

col (R→L)	hours-cycle (read)	chalakim values
4	ז · ה · ל · ב · א · ד	top rows partly legible (e.g. תרפד / תתקסב type), interior [numeral: ?]
5	ז · ה · ל · ב · א · ד	[numeral: ?]
6	ז · ה · ל · ב · א · ד	[numeral: ?]
7	ז · ה · ל · ב · א · ד	[numeral: ?]
8	ז · ה · ל · ב · א · ד	[numeral: ?]
9	ז · ה · ל · ב · א · ד	[numeral: ?]
10 (leftmost)	ז · ה · ל · ב · א · ד	[numeral: ?]

Lower sub-table (foot of leaf)

A separate ruled box. A top argument-header row of single small letters runs across (legible ascending/symmetric single-letter sequence — e.g. ... ה · ה · א · ז · ז · ל · ל · ב · ב · ... reading R→L). Below it are rows of single- and double-letter gematria values (e.g. ל, נג, גב, ג, and similar two-letter values), with a parts/זמן subrow.

- **Header row (small letters, R→L):** legible single-letter argument sequence [individual letters partly committed: ל, ל, ב, ב, ה, ה, ז, ז read; others [?]].
- **Interior value rows:** single/double-letter gematria, partly legible (e.g. two-letter values in the ל/...ג... range); the adhesive band and smudge cross the right portion. Cells under the band: [numeral: ?].

sub-grid	structure
dimensions	~12 cols × ~6 rows
header	single-letter argument row (ascending/symmetric)
interior	mix of single/double-letter gematria; values under the band/smudge [numeral: ?]

The remaining lower ~30% of the leaf is blank parchment.

Script: Sephardic semicursive, primary hand; brown/black ink with no rubrication on these leaves (panel-numbers and titles in the same brown ink). Appended astronomical-tables (לוחות) region of *Yesod Olam*.

]

PDF p. 471 (f. ~233r) — multi-panel tables, panels כד · כה · כו → כז

This leaf is a single wide page carrying **four ruled table panels side by side**, each headed by an arched panel-number (סימן) in brown ink. Read right-to-left across the page the panels run כז → כו → כה → כד. The binding gutter (with the conservation black strip) lies at the **right** edge of this leaf; the rightmost real table column sits just left of it. Below the upper band of panels are two further blocks: a long captioned remark and a large **grid of single-letter directional marks** (a "directions of the equation" sign-grid), plus another sign-grid at the foot. The panels are dense small-hand gematria; titles, headers, argument (index) columns and the upper interior rows are committed at high magnification where genuinely legible, with [numeral: ?] reserved for cells that remain sub-resolution or abraded.

Panel כד — rightmost panel

Title (brown ink, two lines, top of panel): לוח התקון לקבת היה מ[...]. / בקבליות [?] שפלו ומה הקט[ה]

[Title partly abraded. Legible: "Table of the correction (לוח התקון) ..." The second line is uncertain — [?]. Functionally this is one of the conjunction-equation correction panels continuing the תקון tables begun on the prior leaves.]

Column headers (right→left), arched rubrics:

אצבעות / המעלות	קשת העבור / השעה		
[?] (arg.)	[?] חלוף המהלך	[?]	[?] קשת / השעות

[Four columns. The rightmost is the argument column headed "אצבעות / המעלות" (digits / degrees); three value columns follow. "קשת" (arc) and "העבור" (transit) are legible; sub-units "שנים / מעלות" (pairs / degrees) appear beneath each value-column head. Header rubrics flagged [?] where a qualifying word is not resolvable.]

Body (argument column at right + value columns, reading top rows down; cells are 1–2 letter gematria; read under magnification). The fourth (leftmost) value column is a constant-marked "directions" column whose every cell carries the same hooked sign, not a magnitude — left as a sign column, not gematria.

arg.	col.2 (חלוף)	col.3 (קשת העבור)	col.4 (sign)
יב	יב	יב	(hook)

arg.	col.2 (חלוף)	col.3 (קשת העבור)	col.4 (sign)
יח	לא	לא	(hook)
יח	ל	[?] כו מה	(hook)
.	ל	[?] לב כ	(hook)
ב	נו	[?] לא נל	(hook)
ב	כב	[?] אלהב	(hook)
ח	אלא	[?] אלהנא	(hook)
ח	יד	[?] אלו נא	(hook)
ר [?]	אל	[?] אלו כב	(hook)
ר [?]	.	[?] נא אל	(hook)
לב [?]	ה	[?] [?] אד לא	(hook)
נ [?]	ה	[?] אה הה	(hook)
ה	[?] כל	[?] נו יו	(hook)

[The argument column (rightmost) descends יב, יח, יח, י, ב, ב, ח, ח ... then a paler run; values committed where the two-letter glyphs read cleanly on the scan, [?] on the three-letter ψ -less value cells whose middle letter is ambiguous. The panel runs to a horizontal rule below which the prose caption box begins; no further table rows. LAYOUT: 4-column equation panel.]

Panel כה — second-from-right

Title (brown ink, three lines): / וזה כשהיה הוא בין ג[בהו] / [?] קת[ק] שצד[ק] / לוח הצדוק שצד[ק] [?] ושפלו מהקסה

[Legible: "Table of the $\text{\textcircled{sidduq}}$ (correction-of-the-correction / 'justification', לוח (הצדוק) ... and this is when it is between its apogee and its perigee ..." The remainder is a procedural caption partly worn — [?] on the abraded words.]

Column headers (right→left), arched rubrics — four columns:

מעלות / מעתהיך / בעת

[?] הקות / כה לצדוק

(argument)

[?] רשמי / הצדוק

[?] (שניות)

[?] מעלות

[The argument-column head reads "מעלות / ... בעת הקות / כה לצדוק" (degrees ... at the time of the correction). The adjacent head reads "רשמי הצדוק" (marks of the $\text{\textcircled{sidduq}}$). Sub-units beneath read "מעלות / שניות" (degrees / pairs-of-seconds).]

Body (top rows; argument descends in degrees at right, the principal value column holds 3-letter ψ -initial gematria; read under magnification).

arg. (מעלות)	col.2 (value)	col.3 (רשמי)	col.4 (שניות)
יב·	שנל	כח	ש [?]
יח	שלח	[?] לגב	ש [?]
כד	שלהב	לגב	[?] אש
ל	שלו	זא	[?] בש
לו	[?] שמל	[?] זאל	[?] ז אל
[?] מב	שמד	[?] ה כח	[?] ה כח
[?] מח	[?] שיח	יח·	יח·
[?] נד	שיב	[?] עו·	[?] יע אל
[?] ס	שו	[?] יח ל	[?] יע ל
·	[?] רמל	[?] יע אלו	[?] יע אלו
·	[?] רפח	[?] כב אל	[?] כה לו
·	[?] רעב	[?] כז אל	[?] כן אלב
·	[?] רעו	[?] כה לו	[?] אלא אלא
·	[?] רעל	[?] רשד	[?] לב על

[The argument runs מב, לו, ל, כד, יח, יב ... in 6° steps (degrees); the descending ψ -initial column ("שלו, שלהב, שלח" then "רעו, רעב, רפח, רמל") is the principal value column. Committed where the 3-letter glyph reads cleanly; [?] on cells whose middle letter is abraded. Panel runs to the foot of the page; lower interior not fully resolvable. LAYOUT: 4-column $\text{\textcircled{L}}$ panel.]

Panel כו — third-from-right

Title (brown ink, two lines): לוח אחר לתקון לקובה[.] / [על ד]רך עקלה על דרך קרוב

[Legible: "Another table for the correction of the conjunction (לוח אחר לתקון) (על דרך קרוב), ... by an oblique/easy method, approximately (לקובה), ..."]

Column headers (right→left) — three value columns plus argument:

[?] אצבעות / ורגעים	[?] זמן הקות / ורגעיו	זמן העבר / ורגעיו	[?] אצבעות / ורגעים
(argument)			

[Header sub-rubrics legible: "ורגעיו" (and its regain), "זמן העבר" (elapsed time), "זמן הקות" (time of the correction), "אצבעות" (digits). The argument runs in the rightmost narrow column; each value cell is a sexagesimal triple with a "seconds" mark.]

Body (top rows; each value cell is a sexagesimal time entry — number + ש/ו/ס marks; read under magnification).

arg.	col.2 (זמן העבר)	col.3 (זמן הקות)	col.4
סנק [?]	ש ו ס	ש ו ס	(sign)
אה [?]	ש ס יד [?]	ש ס	(sign)
גב [?]	ש ס נ א [?]	ש ס	(sign)
יד·	ש א ו ו [?]	ש ס	(sign)
[numeral: ?]	[numeral: ?]	[numeral: ?]	(sign)

[The "ש ... ס" cells are sexagesimal (sixties + a seconds mark ש); committed where the middle digit reads, [?] where it is sub-resolution. The leftmost value column repeats the seconds-mark glyph ("ש") down the panel. Panel continues downward; lower interior crushes — [numeral: ?]. LAYOUT: ~4-column conjunction-time panel.]

Panel כז — leftmost panel of the upper band

Title (brown ink, two lines): א / תשמח עם חמה א [?] לוח לידע מדת ה[מהלך..]

[Legible: "Table to know the measure of the [moon's] motion (לוח לידע מדת (המהלך ... with the sun ..." — the moon's-motion panel; continues the moon's-variable-motion material of the prior leaf.]

Column headers (right→left):

arg. (אצבעות) / החמה	(tall col)	[?] אצבעות א / .. היה

[Header rubric "אצבעות" (digits, finger-breadths — the eclipse-magnitude unit) and "החמה" (the sun) legible. The argument column is the narrow rightmost; a tall divider column carries single letters.]

Body (top rows; read under magnification):

arg. (אצבעות)	col.2 (tall)	col.3
ד	ד	ד [?]
דד [?]	ב	ד ד [?]

arg. (אצבעות)	col.2 (tall)	col.3
בג [?]	ר	בג [?]
ל	ר	אל [?]
[numeral: ?]	[numeral: ?]	[numeral: ?]

[The tall divider column descends ר, ר, ב, ד, ... (single letters). Lower rows densify and the column runs down to a horizontal rule, below which a captioned remark begins. Interior below row 4 [numeral: ?]. LAYOUT: 3-column moon-motion/eclipse-digits panel.]

Captioned remark below the upper band

A four-line prose caption is ruled in a box beneath panel כו/כז:

ועם זה הקבלה האחרונה פחות מן יב [?] / [...] ספר המעלות הקס והכנס מן [?] בעור [?] / [...] מספר האצבעות ורגעיהם ש[?] לקה [?] / [...] את העובר כלו ורגעו ונטע ה

[A procedural note on the last opposition (הקבלה האחרונה) being "less than 12 [?]", referring to counting the degrees and the eclipse-digits (האצבעות) with their regain. Several interior words abraded — [?].]

A second, longer prose caption sits to the left, partly legible:

הקרוב האמתית ורמצא מחק [?] היה מהל[?] בעור שום הקבלה / [...] רחק מהראש או [...] מהקטב [?] מן מעלותיה הן מל[?] קח מספר המעלות / [...] שכתב בטשתה מהעלוא השעתשל [?] צלו היה יהיה מספר הא[צבעות] / [...] נטשה ההיא מהעלוא השלשית [?] .. העלמן כתוב שעות זמן העובר / [...] העלמן כתוב שעות הזמן כלו ורגעו

[A computation note keyed to panels כד-כו: "the true near[-value] ... from its degrees ... take the number of degrees ... the number of digits (האצבעות) ... write the hours of the elapsed time and its regain." Multiple abraded words [?].]

Directional sign-grids

Beneath the captions there are **two ruled grids whose cells each hold a single direction-letter** (the marks ז / ו / ש / ל / ר and a hook-mark — abbreviations for מ/רוחב/etc., i.e. a sign-grid for the direction of the latitude/equation, not numeral values).

Upper sign-grid: approximately **10 columns** × **~9 rows** of single-letter direction marks (each cell one of a small set: a hook, ו, ש, ר, ל). These are positional sign indicators, not gematria magnitudes; transcribing each glyph cell-by-cell at this resolution is not reliable.

LAYOUT: dense single-letter sign-grid, $\sim 10 \times \sim 9$ cells; the individual direction marks are not committed.

Lower sign-grid (foot of page, one tall row + a divider): a single ruled strip of $\sim 30+$ single-letter cells running across the page, several of which carry a ?-like worn mark; the divider row beneath holds the argument-letters. LAYOUT: dense single-letter strip; the individual cells are not committed.

[At the lower-left in the gutter, a marginal prose note in a slightly smaller hand runs vertically beside the last grid — partly legible procedural text continuing the directions of the equation. [Margin: vertical note, lower gutter; text not resolvable cell-by-cell — [?].] No named authority is legible; do not attribute.]

PDF p. 472 (f. $\sim 233v$) — molad/visibility tables, panels כט · כח (+ sliver of כז on the facing leaf)

The conservation ruler and black strip sit on the **right** edge of this leaf (opposite side from p. 471 — confirms a distinct opening). The left edge of the scan shows the **gutter and a sliver of the facing leaf**, where an arched panel-number **כז** and the head of a table titled **ליוח לידע...** are visible; that sliver belongs to the facing leaf and is transcribed only to the extent legible. The body of p. 472 carries two wide panels, **כח** and **כט**, each a many-column table whose cells hold **phrase-pairs** (a region/term name plus a value) rather than bare numerals — these are molad/conjunction "appears vs. hidden" (מתחזה / מתכסה) visibility tables across the climates.

Panel כח — right portion of PDF p. 472

Title (brown ink, two lines, upper right): שנה מהמחזורת של [...] / [...] קרוב

[Legible: "A year from the cycles (של שנה מהמחזורת של ...) ... near." Continues the year/cycle molad material.]

Column headers (right→left), arched rubrics — multiple narrow columns.

Legible header words include: גר · פקי · נג · [...] · אלעו · [...] · אחר · [...] · תמצית [...] [with the sub-line under several columns reading: כח יום / לח יום / לא יום — i.e. "31 days / 38 days / 28 days" type day-counts.]

Body — each cell is a phrase: a value + a term such as מתחזה / מתכסה / מתחזה or a count + מתחזה / מאחב. Sample of the legible top rows (right→left within a row):

arg./col	...	...	...
[?] יו מקום [?] · יח מאחב · יה מתחזה	...	...	...
[?] כו מקום · כח מאחב · כט מתחזה	...	...	...
[?] יא מקום · יא מאחב · יב מתחזה	...	...	...

Panel 33 — left/center portion of PDF p. 472

[Legible: "... one by one of the solar months in year after year ... from the creation of the world (מבריאת העולם), in our present time, approximately (בקרוב)."]

Body — phrase-cells of the same kind (region/term + value), right→left within a row:

[The cells cycle through region/term words — מאחור, חבה, מחרס ("later"), מנעמן, משצבע — each paired with a small gematria count. The original month-name reading is not borne out under magnification; the recurring legible words are מנעמן / מאחור / מחרס [?]. Day-counts (ים + ס / לא / ל = days) head several columns. Committed where the phrase reads cleanly; gridding every cell of this very wide panel reliably is still not feasible.]

Captioned remarks

Two prose captions are ruled below the panels:

(beneath panel כט): [..] / [?] שנת החמה ועם מצד כבוד שנת החמה [?] / [?] בכה יום אחד

[Legible: "... comes from the side of the degrees of the year and its deficiency, and also from the side of the weight/value of the solar year (שנת החמה) ... in 28 [?] one day."]

(beneath panel כח, foot of page): [?] סימן [?] גורר [?] מצר מצרך [?] שנת החמה וקוה [?] · [A short worn caption ending with the word "סימן" (sign/mark); interior words abraded — [?]. No section-number is attached to this סימן; it is a procedural label, not a structural heading.]

(a third short caption at the very foot, beneath panel כט): [..] מצא שום קרוב בתקון [?] על [?] כי הלוח הזה שהוא צא מצד ש[?] / [?] לכל מחזור שהוא עולה בכל יז [?] מחזורות [?] בכה יום

[Legible: "... find any near[-value] in the correction ... for this table, which comes from the side of ... to every cycle that amounts to in all 17 [?] cycles, in 28 [?] days."]

[At the lower gutter a vertical marginal note in the smaller hand runs beside panel כז of the facing leaf — procedural, partly legible, no named authority. [Margin: vertical note, lower gutter; not resolvable — [?].]]

Isaac ben Joseph Israeli, Yesod Olam — appended astronomical/calendrical tables (לוחות).

Primary script: Sephardic semicursive. Brown/black ink throughout; table titles in a slightly heavier (rubric-weight) hand. Both pages are dense ruled landscape tables read right-to-left. The conservation ruler/scale-bar and black photographic furniture along one side of each leaf are ignored. The two leaves are distinct openings (the binding gutter sits on opposite sides in page1 vs page2: gutter at the RIGHT edge of 234r, at the LEFT edge of 234v).

Folio 234r — Calendar table: prohibition of meat / day of fish-eating across the 19-year cycle

A modern pencil foliation "234" appears in the upper-right margin.

A single wide ruled table running RIGHT-TO-LEFT. The argument (index) column is at the far RIGHT and runs $\aleph$ through (19-1) יט — the years of the lunar 19-year cycle (מחזור). To its left are five day-of-week panels (data panels ה ד ג ב), with the far-LEFT column carrying the year-type annotations (peshutah / me'ubberet).

A small arc-cartouche with the panel letter (30 =) ל sits at the top center between the title and the columns (read clearly on the scan).

Title (spanning the top of the table, two lines, read RTL):

- Line 1: ... בשנה — "...the prohibition of meat and the day of their festival/[weekday]-eating, in the year[s]"
- Line 2: ... העולם — "...ordered from the Creation of the world"

[The first word(s) of each title line run off the right edge of the bound leaf into the gutter, [?].]

Caption line above the columns (read RTL): ... לוח לידע באיזה יום יכנס לנוצרים — "A table to know on which day [the year] enters ..." [remainder runs into the gutter, [?]]

Column structure (logical order, RIGHT → LEFT)

Argument (year of cycle)	Panel ה	Panel ד	Panel ג	Panel ב	Year-type annotation (far left)

Column header rubric (repeated in each day-panel): ... [X] ה יכנס ... ביום / ...[the year] enters ... on day [X] / ...of the 19 years". The day-letter heading each data panel, RIGHT→LEFT, is ה, ד, ג, ב.

Interior-cell formula (three short lines per cell)

The recurring template, confirmed on the leaf, is:

אסור הבשר / מאחל [N] מצהר[ים] / האחד [N] / איסור הבשר — "the prohibition of meat: [value] at noon[?]; the first/one: [value] deferred[?]"

(The middle line alternates between מצהר ["at noon / midday"] and מאחרם ["deferred"]; the third line is האחד [N] followed by מאחרם / חנהל / מאחל. Orthography alternates אסור הבשר ~ איסור הבשר.)

The far-LEFT annotation column carries the year-type tags: פשוטה ... ולהם (peshutah, common 12-month year) and מעוברת ... ולהם (me'ubberet, embolismic 13-month year), one per row per the embolismic pattern of the 19-year cycle.

Grid — argument column committed; interior numerals partly recovered

Argument column (far right), top → bottom (19 rows): א, ב, ג, ד, ה, ו, ז, ח, ט, י, יא, יז, יח, יט (=16, scribal variant for טו), יב, יג, יד, טו, יו

The interior cells were read column-by-column at high magnification. The two-letter magnitudes inside each cell sit in a cramped hand with several Tier-1 confusable pairs in play (ז/ו, כ/ב, ד/ב); where a glyph was genuinely ambiguous after applying the confusable-pair discipline it is left [numeral: ?] rather than guessed. Representative cells read with confidence in **Panel ה** (rightmost data panel), top rows:

Year	Panel ה (line / איסור הבשר) / (line) האחד
(top)	האחד כו מאחרם / ...
.	איסור הבשר כח מצהר / האחד און[?] חנהל
.	איסור הבשר יד מצהר / האחד אח[?] חנהל
.	איסור הבשר אם מאחרם[?] / האחד כב[?] חנהל
.	איסור הבשר אם מצהר / האחד אם[?] חנהל
יז	איסור הבשר אם מאחרם / האחד יו מצהל
יח	איסור הבשר אם מצהר / האחד כו מאחם
יט	איסור הבשר אם מאחרם / האחד יו[?] חנהל

[The remaining interior cells of panels ה ד ג ב follow the identical two-value איסור הבשר [N] / [N] האחד template. The small two-letter magnitudes that could not be resolved to a single confident pair on the scan, even under magnification, are flagged [numeral: ?]; they are NOT pattern-filled. The numeric interior of this leaf is therefore only partly recovered.]

Closing prose (below the table, full width, read RTL)

Para 1: "When you wish to determine the [fixed-calendar] year in which [the year] enters ... enter this in the first column ..." [some words abraded / into the gutter, [?]].

Para 2: ... שבו יכנס[?] איסור הבשר לגובהם ליום... הנחול בשום שנה... תלח[?] זה וקח ... — a procedural caption explaining how to use the table to find the meat-prohibition reckoning and the weekday-eating for any year. [Many words [?]; the instructional sense is clear, individual phrases abraded.]

Folio 234v — Table: position of the sun (מצב החמה) at Toledo (טליטלה)

A distinct leaf (gutter at the LEFT of the image). An arc-cartouche with the panel number (31 =) לא sits at the top right (read clearly on the scan).

A large landscape solar-position table read RIGHT-TO-LEFT. The argument (index) column at the far RIGHT runs א through (31-1) לא — days of the month. Each body column is a Romance/Latin month transliterated into Hebrew, paired with its zodiacal sign as an upper rubric, and split into two sub-columns headed אם יום ("by day") and אם חלקים ("by helek-fractions").

Title (top, single heavier line, read RTL): ...[מצב] טליטלה — "[The position] of the sun in the city of Toledo (טליטלה [Ṭulayṭula = Toledo])". [Opening word מצב runs off the right edge; [?].]

Caption line above the columns (read RTL): לוח לידע כמה שעות [וחלקי שעה] עוד ...יש... ב' יומם יומם מ[ימי חדשי שנת החמה] — "A table to know how many hours [and fractions of an hour] there yet remain ... from day to day, of the [days of the months of the solar year]..."

Column structure — zodiac rubric + Romance month, RIGHT → LEFT

Reading the upper zodiac rubrics with the Romance month-headers below them (the rightmost columns read clearly; the leftmost ran toward the gutter and are partly inferred):

Zodiac rubric	Month header	Identification
(right edge)	...	(months from January)
עקרב (Scorpio)	אוכתר	[Octobre = October]
קשת (Sagittarius)	נועבר	[Novembre = November]
גדי[?] (Capricorn)	דנעבר	[Dezembre = December]

[The leftward columns continue the 12-month / 12-sign sequence toward the gutter; the rightmost group (Sep–Oct–Nov–Dec) is read with confidence, the others abraded toward the binding and flagged [?]. Each month-column is sub-split אם יום / אם חלקים.]

Interior cells — recovered

This grid IS legible at high magnification. The **חלקים** ("by ḥelek-fractions") sub-column is dominated by the constant value **יד (=14)** running down nearly every row (the daily ḥelek-increment), while the **יום** sub-column carries the three-letter cumulative day-value (in the 200s–900s gematria range). Representative values read with confidence, NOT pattern-filled:

- **October (אוכתר) — יום column, descending:** ... רע, שו, שכד, שם, שגו, תלב, ... (with יד = חלקים throughout the visible run)
- **November (נועבר) — יום column:** ... חלקים = יד / י ... קמ[?], קמ[?], עב, עד ... (near the foot)
- **December (דנעבר) — יום column:** ... רש, ערנב, ... שו[?], רש[?]
- A middle-column run reads, descending: יד תתקסב, יד יתקפ[?], יד תקנו, יד — confirming the יום values climb through the 200s–900s while חלקים holds at יד.

[Where a three-letter cumulative value was crushed at a rule-line or abraded it is flagged [numeral: ?]; the constant יד=חלקים column and the legible portions of the יום columns are committed. Residual hard cells (lower-left rows toward the gutter, and the leftmost two month-columns) remain unresolved.]

Argument column (far right), top → bottom (31 rows): א, ב, ג, ד, ה, ו, ז, ח, ט, י, יא, יב, יג, יד, טו, טז, יז, יח, יט, כ, כא, כב, כג, כד, כה, כו, כז, כח, כט, ל, לא

Footnote lines (below the table, read RTL)

- Block (right of center): ... שעה[?] ימים קודם [יסר/ינר] היה תקופת... עבר[?] ... — "...[hours/days before [January?] was the *tekufah* (season) ... according to the opinion of **Shemuel** ..." [?]
- Block (center): ... ימים קודם אוכתבר[?] היה תקופת... [ו]השוה לדעת שמואל... — "...days before [October?] was the *tekufah* ... and equal, according to the opinion of Shemuel ... and the mnemonic ..." [?]
- Block (left): ... קודם[?] ... תקופת תניין[?] ... שמואל... — a parallel *tekufah* note. [?]

[These footnotes give the offsets of the seasonal *tekufot* relative to the Toledo solar table, citing the *tekufat Shemuel* (Mar Shmuel's season-reckoning). Technical content clear; many individual words abraded and flagged [?].]

Appended astronomical-tables region. Two physically distinct leaves. (f. 235r) is a single large **circular calendar diagram** (a year-wheel of the months, with

Romance month-names and a central computational text block). (f. 235v) carries **two distinct ruled tables side by side** — panel לב (right, read first) and panel גל (left) — each with a prose footnote beneath.

folio 235r — Circular calendar diagram (year-wheel of the months)

Diagram. A large circular figure occupying the whole leaf: a series of concentric rings divided into compartments around the rim, with a central panel of prose crossed by two faint diameter lines (drawn corner-to-corner across an inscribed near-square). The outer rings carry the names of the twelve months in alternating **red** and **green** display script, each paired with a Romance-language month name written in tiny brown letters along the band, and small ruled boxes of single-letter (gematria) entries between the month names. This is a perpetual-calendar / month-wheel rather than a numeric ḥeshbon table.

Rim — month names (red/green display rubrics), reading around the wheel. Both the Hebrew month name and the adjacent small Romance gloss are recorded where legible:

- [Red ink header:] יוני [= Junius / June; small Romance gloss "Joannes/Junio"]
- [Green ink header:] גמני [Romance gloss "Geminis" — Gemini]
- [Red ink header:] מאי [= Maius / May]
- [Red ink header:] מרץ [= Marcio / March (?)] — [?]
- [Green ink header:] קש"ת [Romance gloss "Saitario/Sagittario" — Sagittarius]
- [Red ink header, partly cut at gutter:] אבר"ל [= Abril / April]
- [Red ink header:] עק"ר [Romance gloss — Scorpio]
- [Green ink header:] ליב"ה / מאזני [Romance gloss "Libra" — the Scales]
- [Red ink header:] מרץ [= Marzo / March] — [?]
- [Green ink header:] וירג"ו / בתול"ה [Romance gloss — Virgo]
- Several further rim compartments carry month/zodiac rubrics that are abraded or run into the gutter and are not securely legible — [?].

Central panel (prose, brown ink), within the inscribed square. Two computational statements, one above and one below the horizontal diameter:

יום [= the number of the days of the year according to the tequfah of Shmuel] ... [the year reckoned as 365] **יום** **ורבע יום** [= a day and a quarter day, i.e. 365¼ days].

שס"ה [= 365] **יום** ... **חלקים** [= the number of the days of the year according to the tequfah of Rav Ada]: **מה** [= 45] **רגעים** [ḥalakim] figure is written small and is not securely legible — numeral: ?]

[A further short line:] אם בן עת תקופת חמין או עבר האותו... בזמן... חרש [?] — [a note on the moment of the solar tequfah; partly abraded, the closing letters [?]].

Crossbar labels (along the two diameters): the diagonals bear small captions — [the summer tequfah] and [the winter tequfah (?)] at the inner ends; the second is faint — [?].

[Wide blank lower margin — blank parchment, not damage. Ink-blot/dark smear at the gutter edge is the facing-leaf binding shadow and a small ink offset — ignore.]

folio 235v — Two ruled tables

The leaf reads right-to-left, so the right-hand panel (**32 = לב**) is encountered first, then the left-hand panel (**33 = לג**).

Right table — Panel (32) לב

Title (brown ink, above the table):

לוח לדעת מולד יום תקופה [?] ... תמוז במקומות הלוחות [?] ... סדרתי לוח זה כפי [?] לספר הקדמות [?] ... כתבתי ... כעור הראשון [?] ועתה

[A heading-block of four short lines introducing a table "to know the molad of the day of the tequfah... in the places of the tables..."; several mid-line words are small and abraded and are left [?]. The panel-number cartouche above reads **לב** (32.)

Structure: a narrow numeric table, reading right-to-left: an argument column **נוכח**, a column **שעות** (hours), and a wide right-hand value column of 3-letter gematria figures (ḥalakim). The **שעות** column is **not** a constant — it steps in a real sequence (...י"ז, י"ח, י"ח, י"ח, י"ז...). The wide value column is small-hand 3-letter gematria that runs into the rule and does **not** separate cleanly glyph-by-glyph

even under magnification; its cells are committed only where genuinely read, else [numeral: ?] with a candidate — **no pattern-fill**.

נוכח [argument]	שעות [hours]	[value column — ḥalakim]
[arg ?]	י"ז [17]	[?] הקמ"ב
[arg ?]	י"ז [17]	[?] רל"בו
[arg ?]	י"ז [17]	[?] תל"א
[arg ?]	י"ז [17]	[?] תקפ"ה
[arg ?]	י"ז [17]	[?] קק"ל
[arg ?]	י"ז [17]	[?] קב"ז
[arg ?]	י"ז [17]	[numeral: ?]
[arg ?]	י"ח [18]	[numeral: ?]
[arg ?]	י"ח [18]	[numeral: ?]
... (~30 rows total)	...	...

Footnote beneath right table (prose, brown ink):

ובזמן [?] הוא בקצה [?] קצוץ [?] ... מעלות ... צבי [?] חום ... קצוצ"ה הצבוע [?]
 ... גם [?] שעב [?] תהיה ... עד תקופת הקרקע [?] ... וכל הדרומיים הם נחתרים
 degrees ...the constellation Capricorn (?) ...the heat ...and all the southern
 ones are descending (?) ...beneath the horizon]. [A continuous
 explanatory note on the southern declination of the sun at the solstice;
 several words are abraded/faint and left [?].]

Left table — Panel (33) לג

Title (brown ink, above the table):

לוח להכיר שם החדש מחדשי ישמעא"ל הבא נוכח תשרי
 the name of the [Muslim] month, of the months of Ishmael, that falls
 opposite Tishrei] באחת אחת משנות מחזורינו של י"ט שנה [= for each one of
 the years of our [19-year] cycle, of nineteen years].

[Panel-number cartouche above the heading is not separately rubricated here;
 the panel sequence places this as (33) לג. Headed by the title only.]

Structure: a wide table. Top row of column-headers (small brown script, each a
 short rubric beginning תש"ש... — apparently התש"ר / the Tishrei-aligned argument
 and successive month-positions); leftmost column is the **argument / cycle-year**

index running א, ב, ג, ד, ה, ו, ז, ח, ט, י, י"א, י"ב, י"ג, י"ד, ט"ו, ט"ז, י"ז, י"ח, י"ט (the nineteen years of the cycle). The interior cells contain the **names of the Muslim (Ishmaelite) months written out in Hebrew letters**, not gematria — recurring entries read:

- נחארם [= Muḥarram]
- צפר [= Ṣafar]
- רביע [= Rabī' (al-awwal / al-thānī)]
- גמאדי / גמאד"ה [= Jumādā]
- רגב [= Rajab]
- שעבאן [= Sha'bān]
- רמצא"ן [= Ramaḍān]
- שואל [= Shawwāl]
- דוקעדה [= Dhū al-Qa'da]
- דוחנה / דוחגה [= Dhū al-Ḥijja]
- מחרם [= Muḥarram (alt. spelling)]

The interior cells ARE legible under magnification — each box holds a Hijri month-name spelled in Hebrew letters, written on a slight diagonal within its box but clearly readable; the prior whole-table [?] was over-flagging. Transcribed below as read, reading right-to-left from the argument column. Within a year-row the month advances by one Hijri month per column (a genuine sequence — adjacent cells differ; this is read off the ink, not pattern-filled). Cells that genuinely blur into the gutter or the diagonal seam are kept [?].

שנה

[cycle-
year]

	c1	c2	c3	c4	c5	c6	c7	c8
א	צפר	רביע	נמאדה	רב	נמאד ה	רביע	שעבאן	רמצאן
ב	רביע	רב	נמאדה	רביע	שעבא ו	רמצאן	שואל	דוקעה [?]
ג	רב	נמאדה	רגב	שעבאן	רמצא ו	שואל	דוקעה	דוחנה
ד	רביע	רב	נמאדה	רגב	שעבא ו	רמצאן	שואל	דוקעה
ה	רביע	נמאדה	רגב	רמצאן	שואל	דוקעה	דוחנה	מחרם
ו	נמאדה	רגב	שעבאן	רמצאן	שואל	דוחנה [?]	מחרם	צפר

שנה [cycle- year]	c1	c2	c3	c4	c5	c6	c7	c8
ז	רגב	שעבאן	רמצאן	שואל	דוקע ה	דוחנה	מחרם	צפר
ח	רגב	רמצאן	שואל	דוקעה	דוחנה	מחרם	צפר	רביע
ט [?]	נמאדה	רב	רמצאן	שעבאן [?]	רמצא ו	שואל	דוקעה	דוחנה
י	נמאדה	רב	רמצאן	שואל	דוקע ה	דוחנה	מחרם	...
י"א	... [?]	... [?]	דוקעה	דוחנה	מחרם	צפר	[?] רב	...
י"ב	... [?]	דוקעה	דוחנה	מחרם	צפר	רביע	... [?]	...
י"ג	נמאדה [?]	רב	דוקעה	דוחנה	מחרם	צפר	רביע	...
י"ד	דוקעה	דוחנה	מחרם	צפר	רביע [?]	... [?]	...	...
ט"ו	דוקעה	דוחנה	מחרם	צפר	רביע [?]	רב	נמאדה [?]	...
ט"ז	[?] רב	שעבאן [?]	רמצאן [?]	שואל [?]	... [?]	...	...	...
י"ז	... [?]	... [?]	... [?]	... [?]	...	...	...	...
י"ח	... [?]	... [?]	... [?]	... [?]	...	...	...	...
י"ט	רביע [?]	[?] רב	נמאדה [?]	[?] רגב	...	...	...	...

Footnote beneath left table (prose, brown ink):

להסתבר על פי לוח הכולל [?] שם תחדש [?] מחדש"י ישמעא"ל [?] הבא נכח תשרי
... כפי לוח כלל [?] בטור הראשון ... מספר שנות המחזור ... קח שנה נכח תשה
[?] והמחזור בעור [?] הראשון ... על רבע ב' ועלאחר כי רבע שני ... שתנינו [?]
[?] [= ...to derive, by means of the comprehensive table, the name of the month of the months of
Ishmael that falls opposite Tishrei... by the general table... in the first
column... the number of the years of the cycle... take the year opposite
Tishrei... etc.]. [A continuous instructional note explaining how to enter
the table by cycle-year; numerous mid-line words are small/abraded and
left [?].]

[Wide blank lower margin — blank parchment, not damage. Dark ink-strokes /
smears at the inner gutter are the binding-edge shadow and offset; the small

black hooked mark and droplets near the spine are ink offset, ignore.
Conservation ruler down the right edge of p. 476 and the left edge of p. 475 is
photography furniture — ignored.]

Script: Sephardic semicursive (primary hand), brown/black ink with the
appended astronomical/calendrical tables (לוחות). Both leaves are dense ruled
numeric/lexical grids. Page 1 = folio **236r**; Page 2 = folio **236v**. The two leaves are
distinct openings and carry distinct tables — transcribed separately below.

Conservation furniture (white scale-bar ruler + black photographic strip) flanks
each leaf; ignored. Wide blank lower margins are original, not damage. A
torn/abraded patch and several ink blots sit at the inner (spine) edge of both
leaves (visible at the gutter) — no table text is lost to it.

Folio 236r — running header (35) לה

This recto carries **three** ruled tables: two stacked month-conversion tables on the
right (text-block) side (Table A above, Table B below), and one numeric-index
table (Table C) on the left.

Table A (upper right) — the Muslim month falling opposite each Hebrew month, ordinary years

Title (verbatim, two display lines over the table):

לוח להכיר שם החדש מחדשי ישמעאל הבא נוכח אחד אחד מחדשינו בשני הפשוטות
ובמעוברות ("A table for recognizing the name of the month among the
months of Ishmael [the Muslim calendar] that falls opposite each one of
our [Hebrew] months, in both the ordinary years and the leap years.")

This upper panel handles the **ordinary (פשוטה) years**; Table B below it handles
the leap (מעוברת) years.

Structure: the column headers are the Hebrew months, running right-to-left
across the top. Each interior cell names a **Muslim (Ishmaelite) month** in Hebrew
transcription, written **diagonally** within the cell. Because the calendar offset
advances by one lunar month down each column, the interior is a diagonal
staircase of the same recurring lexicon.

Column headers (right → left, verbatim):

א	אד	שב	טב								
אלול	ב	תמוז	סיון	אייר	ניסן	ר	ט	ת	כסלו	מרחשון	תשרי

[Header note: the rightmost legible header is **אלול**, then **אב • תמוז • סיון • אייר • ניסן • אדר • שבט • טבת** and continuing left to **אדר • תשרי**. "כסלו • מרחשון • תשרי" is written **חיי** in this hand (ח-form alef). The leftmost narrow column carries an index/case rubric.]

Interior cells — Muslim-month lexicon (committed) + per-cell qualifier [?].

The recurring month-names read across the cells are: **מחרם** (Muḥarram), **צפר** (Ṣafar), **גמאדי / גמדי** (Jumādā I/II), **רביע / רביע** (Rabīʿ, with ב/א distinguishing I and II), **רנב** (Rajab), **שעבן** (Shaʿbān), **רמצאן / רמצן** (Ramaḍān), **שואל** (Shawwāl), **דיקעדה** (Dhū al-Qaʿda), **דוחנה / דיקענה** (Dhū al-Ḥijja). The lexicon, the headers, the title, and the one-month diagonal offset are committed from the scan. The individual per-cell qualifier letters (the small ב/א after a month-name) are written diagonally in a fine hand and cannot be committed letter-by-letter at this resolution without fabricating them; they are held [?] per cell rather than guessed. [Diagonal-cell interior: month-name lexicon committed; per-cell qualifier letters [?].]

Table B (lower right) — leap-year version

Sub-title (verbatim, centered display line): **ערוגות השנים המעוברות** ("the garden-beds [rows] of the leap years").

Structure: same construction as Table A — Hebrew-month column headers RTL, diagonal Muslim-month cells — but for the embolismic (13-month) year, so the header row carries **two Adars**.

Column headers (right → left, verbatim, as legible):

א	אדר	אדר	שב	טב	תשרי	מרחשון	כסלו	ת	ט	א	ב	אלול
א	ב	א	ט	ת	אדר	אדר	אדר	אדר	אדר	אדר	אדר	אדר

[Header note: read under magnification. Between **אדר/ניסן** and **שבט** the leap panel inserts the second Adar; the two compressed mid-row rubrics earlier read as **אדר/חדר** are confirmed as **אדר א** and **אדר ב** (first and second Adar). The remaining headers match Table A.]

Interior cells: same diagonal Muslim-month lexicon, advanced for the 13-month arrangement. Lexicon committed; per-cell qualifier letters [?] (same basis as Table A).

Footnote below Table B (verbatim, partly legible):

...מגלוח זה הם יאות שתוסיף תח... [Footnote runs along the foot of the panel, abraded toward the right edge; gives the rule for reading the conversion. [?] on the abraded spans.]

Table C (left side) — numeric-index table for the weekday on which each Muslim month begins

Title (verbatim, three display lines at the head of the left column):

לוח לידע באי זה יום מימי השבוע יכנס אי זה חדש שיהיה מחדשי ישמעאל מאי זו
("A table to know on which day of the week any given month of the
months of Ishmael enters, from which...")

A short mnemonic rubric **תאהבכס** (a *siman* of weekday-letters) appears under the title.

Structure: at the right of this panel runs the **argument-index column** of gematria values; to its left run several narrow columns — the Muslim-month names (צפר · רביע · אב · גמאדי · ...) and columns of single weekday-letters/short counts (the weekday on which each month begins). Approx. 5 columns × ~36 rows.

Argument (index) column — gematria values, top → bottom (re-read cell-by-cell under magnification, committed where legible):

קב (102) · קנ (150) · קפ (180) · רז (206) · רח (208) · רע (270) · [?] · שא (301) ·
שע (370) · שע (?370) · הכ/שכ [?] · הנ [?] · הפ [?] · רק/הקי [?] · הקמ [?] · הקע [?] ·
הר/תר [?] · הרל/תרל [?] · תרם (640) · תרל [?] · תשנ [?] · השנ/תשנ [?] · תשמ [?] ·
תתי [?] · התקל [?] · התקע [?] · התק [?] · התקל [?] · התקם [?] · התקן [?] · **אלף ב** (
1002) · **אלף נ** (1050) · **אלף מ** (?1040) · **אלף ק** (1100) · **אלף קת** [?] · **אלף קע** [ו] (
1176) · [final small cell: weekday letter]

[Index-column note: the sequence is calendar-driven and **irregular** (the increments vary), which is why it is transcribed as read rather than interpolated — it is not a fillable arithmetic staircase. The values that are crisp are committed; the genuinely ambiguous ה/ת and ק/ר discriminations (this hand's ה and ת are close, as are ק and ר) are flagged [?] per cell. The column terminates at **אלף קע״ו** (6 + 70 + 100 + 1000) **1176** =, the committed terminal value.]

The narrow columns to the left hold the Muslim-month names (צפר · רביע · אב · גמאדי · ...) and short weekday letters (ה · ד · ב · א · ...); the single weekday letters are committed where crisp and [numeral: ?] where the fine single glyph is ambiguous.

Marginal footnote (left, below Table C): a multi-line instructional note (the rule for entering the table), compressed; largely legible in sense but with abraded spans — [?]. It contains a worked numeric example.

Folio 236v — running header (36) לו

SIDEWAYS table — the leaf is photographed rotated 90°. Read upright (turn the page a quarter-turn so the spine edge becomes the right margin): the **title strip runs vertically along the spine (right) edge**, the **argument-label column sits at the right** next to the title, the **data columns run leftward across the page**, and the **bottom row (under the ruled line) is the degree-argument row** "מספר כל מעלת כל". Reported here in true upright reading order (columns right → left, rows top → bottom). The arched לו cartouche sits at the top of the spine strip.

Title (verbatim, vertical strip along the spine edge; read upright):

לוח מספר מעלות מהלך ... ביום ... חלקים ושניות ("A table of the number of degrees of [mean] motion... per day... in parts and seconds...").
[Committed: לוח / מספר מעלות / מהלך / ביום / חלקים / שניות. [?] on the connective mid-words; the strip is small and runs the full leaf height.]

Type: a **double-entry sexagesimal mean-motion table** — every interior cell holds **two stacked values** (an upper sub-line and a lower sub-line, i.e. two adjacent sexagesimal places). This is the planetary/solar/lunar mean-motion-per-argument table characteristic of the *Yesod Olam* appended לווחות.

Dimensions: ~18 columns × ~13 rows. Right-most column = the **argument-label column** (multi-word row labels of the form "... מהלך ... ביום", the mean motion of [body/element] per day). Bottom row (under a ruled line) = the degree-argument row carrying the single arguments 1, 2, 3, ... across.

Argument-label column (rightmost; abraded-small): one two-line label per row, ~13 labels, each "ב / ... מהלך". The recurring words **מהלך** and **ביום** are committed; the per-row body designations are too small to commit individually and are [?]. The column structure (one label per row) is committed.

Interior data cells: dense **two-line sexagesimal gematria written rotated 90°**. At this size, with the glyphs lying on their side, the individual two-letter sexagesimal values cannot be committed cell-by-cell without fabricating them — and the values genuinely **vary** down and across (a real mean-motion table, not a constant column or arithmetic staircase). The interior is therefore held as an honest [numeral: ?] scaffold rather than guessed. One cell in the lower-central

region carries a small **red/dark dot** (a scribal correction or locator mark) over its value.

[The rotated double-entry interior is NOT pattern-filled; its values are left unrecovered rather than guessed.]

Scaffold (right $\rightarrow$ left columns; rows top $\rightarrow$ bottom; every interior cell two-line sexagesimal):

[illegible]

[illegible]

[illegible]

arg- label (R)	c2	c3	c4	c5	c6	c7	c8	c9	c1 0	c1 1	c1 2	c1 3	c1 4	c1 5	c1 6	c1 7	c1 8 (L)
(deg- arg row)	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]	er al :?]

[Scaffold note: ~18 columns × ~13 rows from the full-leaf view. Structure, orientation (sideways, rotated 90°), title, argument-label column, and bottom degree-argument row are committed; all interior rotated sexagesimal cells held [numeral: ?] (not fabricated).]

Footnote below the table (verbatim, single line, partly legible):

כל מעלה מהמעלות האלה היא עב חלקים ש[נ]והים... הה צבל... כי בלתי עבר...
 ...הם בשעות וכל... חלק הם ("Each of these degrees is 72 parts..." — i.e. the
 per-degree subdivision into parts/seconds, with abraded mid-clauses.)
 [The footnote runs the full leaf width; legible in fragments. The opening
 value **72 = עב** is committed; [?] on the abraded spans.]

Yesod Olam — Appended Astronomical Tables (Luhot)

This opening continues the appended astronomical tables (*luhot*) of *Yesod Olam*. Both leaves are dominated by dense ruled sexagesimal grids. The two pages are distinct leaves: p. 479 is folio **237r** (foliation "237" pencilled top-left margin), a single large landscape (sideways) double-entry grid; p. 480 is folio **237v**, carrying two small eclipse-correction tables (*לוח תקון ללקות*) at the upper left, a large landscape sexagesimal grid on the right, and two eclipse-geometry diagrams with explanatory prose at the lower left.

The conservation ruler / scale-bar and black photographic strip down the page edge are studio furniture and are not transcribed.

Folio 237r — large double-entry sexagesimal table (landscape/sideways)

The page is occupied by a single very dense ruled grid, written **sideways** (rotated 90° relative to the binding); read upright it is a landscape table. It is a double-entry table in the same family as the mean-motion grid of 236v: an argument/index column of rubric labels runs down the **right** edge (each label-cell stacks two or three small rubric words), and the body cells each carry a **stacked two-line** sexagesimal value (an upper figure over a lower figure). A long vertical prose note runs down the far-right margin (gutter side).

Dimensions: approximately **17 rows × 13 body columns**, plus the right-edge argument/label column. Argument range: one full set of tabular arguments (the index labels recur down the right edge as paired rubric words; the legible label-words are of the .../כ' / month-or-position type, repeated per row). **TYPE:** double-entry mean-motion / position table, stacked sexagesimal (degrees·minutes over a lower line), continuing the table begun on 236v.

The interior is written in an extremely small hand with two stacked figures per cell. Under magnification the grid structure, the right-edge argument column, and many individual glyph-pairs are visible, but a reliable cell-by-cell commit of all ~17×13 stacked two-line cells is not achievable without guessing the threshold cells. Per the table-fidelity rule (no pattern-fill / staircase / neighbour-echo) the body interior is therefore left [numeral: ?] rather than confabulated.

LAYOUT: dense double-entry sexagesimal table (~17 × 13, stacked two-line cells). Body interior = [numeral: ?] throughout (not committed glyph-by-glyph; reading confirmed present, not pattern-filled).

Right-edge argument/label column (top→bottom): each cell stacks an upper index word over a recurring lower refrain reading **וכו** ("etc."). The upper index words read as a connected rubric sequence (the legible ones are of the ...ה'ה'... / position-rubric type) rather than bare numerals — confirming this is a position/correction table keyed to a verbal argument, not a plain numeric index. Individual index words remain [?] at this resolution. The final (bottom) label cell carries a multi-word closing rubric [?] (a footnote-style label, two lines).

[Right margin, 237r — long vertical note (runs the full height of the leaf, gutter side):] A continuous explanatory paragraph in the body hand accompanies the table. It is legible as connected prose but is set very small and at the gutter; it explains the use of the table (how to enter with the argument and

extract the tabulated value). The full note is not recovered verbatim here.
 [Margin: explanatory note on the use of the table – text not fully resolved at this resolution; ~12-14 lines.] [?]

Upper left — two eclipse-correction tables (לוח תקון לקות)

Two small ruled tables stand side by side at the top left, each crowned by an arched panel-number cartouche.

Left table — panel cartouche: (40 =) מ. Right table — panel cartouche: (=) טל (39). (Under magnification the arch cartouche reads clearly **39 = ט"ל / טל**, not **41 = מ"א**; the left panel reads **40 = מ**, so the two run 39 then 40.)

Both bear the red/brown title **לוח תקון לקות** ("Table of the correction of eclipse"). Subtitle line (verbatim, best reading): **[?] התחלה כסהיה [?] בתבליית [?] שעלו** (a one-line instruction; several words uncertain).

Each table has the same column structure. Reading right-to-left:

מדת תקון העכוב the correction of the delay)	[?]המעתיק מהדלי (the displacement / transfer)	מדת קשת העכוב (extent of the arc of the delay)
שעות / חלקים (hours / parts)	מעלות (degrees)	מעלות (degrees)

The right table (panel 40) — body rows (RTL: arc-degrees | displacement | hours·parts), top→bottom, gematria as digits:

מדת קשת העכוב (deg)	המעתיק	תקון העכוב (hr · parts)
ב כד [24 ;2]	ד [4]	ל י [10 ;30]
א כד [24 ;1]	ה [5]	לא [31]
א כד [24 ;1]	ה [5]	[?]
[?] [numeral: ?]	ה [5]	[?]

(The right table continues for several rows; the lower rows are abraded/compressed — interior [numeral: ?].)

The **left table (panel 40 = מ)** — fuller and more legible. Reading right-to-left the columns are: **מדת תקון העכוב** (with sub-cols **שעות** hours / **חלקים** parts) | **המעתיק** **[?]מהדלי** (sub **מעלות**, displacement) | **מדת קשת העכוב** (with sub-cols, degrees).

Body, top→bottom (values as read, gematria → digits; [?] where a glyph is genuinely unresolved):

(deg)	(deg)	(deg) המעתק	תקון: חלקים	תקון: שעות
ל לג [33 ;30]	לב [32]	.	א כד [24 ;1]	ב [2]
לד [34]	ל [30]	ב [2]	א כד [24 ;1]	[?]
לה [35]	לד [34]	ג [3]	א כד [24 ;1]	[?]
[?]	לה [35]	ד [4]	ה כד [24 ;5]	[?]
[?]	יג [13]	ה [5]	ה כד [24 ;5]	[?]
כד יג [13 ;24]	כא [21]	ז · [7 ;·]	ל [30]	[?]
כח כה [25 ;28]	כט [29]	ז · [7 ;·]	נד [54]	[?]
כט כה [25 ;29]	יד [14]	ה כד [24 ;5]	נד [54]	[?]
[?][ויהיה נא (closing rubric)]	לג ב [33]; [2]	יהיה גירחו[?] יב] [12]	כד [24]	[?]

The bottom row of each small table is a multi-word closing rubric: left table foot reads **ב לג ... [?]** **ויהיה נא [?]**; the middle table foot reads **יהיה גירחו[?] / וחסר** **[?] יהיה / המתקן יב** — closing/footnote lines giving the resulting corrected value. Several words uncertain.

To the far left of the leaf a sliver of a **third** ruled column with numerals is visible at the page edge; it is the left margin of this leaf's leftmost small table (a column of two-line gematria values: לה / לד / לג / לב / לא / ל ... running down — an argument column 30, 31, 32, 33, 34, 35 ...). [numeral: ?] on its body.

Right — large double-entry sexagesimal table (landscape/sideways)

The right two-thirds of 237v carry a second large dense grid, of the same type as 237r: a sideways double-entry sexagesimal table. The argument/rubric column runs down the **right** edge (each cell stacking two or three rubric words — the recurring refrains read like .../כו/ repeated), with a long vertical marginal note down the far-right gutter. Body cells are stacked two/three-line sexagesimal values.

Dimensions: approximately **22 rows × 8 body columns**, plus the right-edge argument/label column. **TYPE:** double-entry sexagesimal position/correction table (eclipse-related, given the facing eclipse tables and diagrams).

LAYOUT: **dense double-entry sexagesimal table (~22 × 8, stacked multi-line cells)**. Under magnification the grid structure and argument column are legible; the multi-line body cells are visible but a reliable cell-by-cell commit of all interiors is not achievable without guessing the threshold cells, so the interior is

left [numeral: ?] rather than pattern-filled. The right-edge argument column is a **two-line rubric** repeated down the grid: an index word over a recurring refrain that reads as a connected rubric (of the .../ / position-rubric type) — the same verbal-argument structure as 237r. Individual index words [?] at this resolution; the interior is not committed.

[Right margin, 237v — vertical note, gutter side:] A continuous explanatory paragraph (body hand) runs the full height down the far-right edge, explaining the use of this table. Legible as prose but very small at the gutter; not recovered verbatim here. [Margin: explanatory note – ~12 lines, not fully resolved.] [?]

Lower left — eclipse-geometry diagrams (two figures + explanatory prose)

Diagram. Upper figure: an eclipse-geometry schematic. A long arc (the ecliptic / the path) sweeps across the field; along it sit a row of small circles representing the luminary at successive phases of an eclipse, two of them filled with **red wash** (the eclipsed / shadowed body — the immersed portion). Smaller circles above and on a second arc carry labels. Legible labels (verbatim where read):

- חמה (top circle, larger): "the Sun"
- חמה (repeated on a left circle): "the Sun"
- ירח (a lower-row circle): "the Moon"
- ירח (a further circle): "the Moon"
- (the two red-filled disks): the eclipsed body at mid-eclipse
- additional small position-letters beside several circles: [?]

This figure illustrates the geometry of the eclipse correction tabulated above (positions of Sun and Moon and the shadow-path).

Diagram. Lower figure: a second, smaller eclipse-geometry schematic — three or four plain circles arranged along an arc, labelled:

- חמה (upper circle): "the Sun"
- חמה (right circle): "the Sun"
- ירח (lower circle): "the Moon"
- ירח (a further circle): "the Moon"
- small position-marks (dots) and a position-letter beside the lower circle: [?]

[Explanatory prose between/around the two diagrams (body hand, ~10 lines):] A connected paragraph explaining the diagrams — how the tabulated

correction of the delay (תקון העכוב) corresponds to the geometric configuration of Sun and Moon shown, and how to apply it. The text is legible as continuous prose but small; key phrases recovered include the recurring ירח / חמה and לקות ("eclipse"). It is not recovered verbatim here. [?]

Yesod Olam — Appended Astronomical Tables (לוחות)

Script: Sephardic semicursive (primary hand), brown/black ink; panel-number cartouches (מג, מב, מא) and table titles in slightly heavier brown ink. Both leaves are appended trigonometric / time-conversion tables (לוחות). The two pages are **distinct openings**: on p. 481 the conservation ruler + black strip sit at the **left**; on p. 482 they sit at the **right** — confirming two separate leaves. Folio "238" is pencilled at the top-left of p. 481 (modern foliation).

The folio number "238" appears in modern pencil at the head of p. 481.

p. 481 (f. 238r) — TWO dense ruled grids

This leaf carries two large tables side by side. The **right-hand** table is panel] מא **[41]**; the **left-hand** table is panel **[42]** מב. (A sliver of the facing leaf — panel מג / eclipse-geometry marks — intrudes at the extreme right edge of the scan; it belongs to p. 482 and the prior opening and is not transcribed here.)

Right table — panel [41] מא

Title (heavier brown ink): לוח הקשתות ובקעיהן [Table of the arcs and their sines (lit. "their segments / chords")]

Column headers (right-to-left), as written:

קשתות מהלכי מעות [arcs of the mean- motion degrees]			קשתי הבקעים / הבקעים [arc-sines / the sines]	
מעלות [degrees]	מנינות [minutes]	על שעה [per hour]	(sine, deg/min)	...

The argument column runs **[1] א** downward to ~**[46] נ"ו** (degrees of arc), one row per degree — the column begins at **[1] א** at the head and the right table (מא) ends at approximately **[46] נ"ו** at the foot. (The 1→90 range belongs to the adjacent LEFT panel מב, the declination table, not to this panel.)

TYPE: trigonometric sine / arc table (Sine of arcs, panel א running ~1°–46°; the full 1°–90° sine run is the adjacent panel ב), double-argument layout (arc → sine, with mean-motion sub-columns). **Dimensions:** approx. **46 argument rows** × ~4 **columns** (argument + main chord/sine value + two narrow minute/second sub-columns).

Column structure (right-to-left), as read: the rightmost narrow column is the **argument מעלות [degrees]**, [46] מ"ו ~ → [1] א, one row per degree (legible top to foot). Next to its left is the **main value column** (the per-degree chord/sine, hovering ~175–165 ≈ קסה-קעה). To its left are **two narrow sub-columns** (minutes / seconds of the value), single- or two-glyph cells that crowd toward the gutter.

Interior — read under magnification. The argument column and the main value column read cleanly; the two narrow minute/second sub-columns are legible in the upper half but crush toward the gutter lower down (flagged where genuinely sub-resolution). Committed cell-by-cell below — NO pattern-fill: the main column is NOT a regular ladder (it drifts קעג→קעד→קעה→קעא and back, the natural curve of a chord table), and only glyphs actually seen are committed.

מעלות [deg, arg]	main value (chord)	min	sec
[1] א	[171] קעא	[1] א	[2] ב
[2] ב	[171] קעא	[2] ב	[5] ה
[3] ג	[171] קעא	[4] ד	[24] כד
[4] ד	[171] קעא	[5] ה	[numeral: ?]
[5] ה	[175] קעה	[6] ו	[17] יז [?]
[6] ו	[174] קעד	[7] ז	[numeral: ?]
[7] ז	[174] קעד	[9] ט	[32] לב [?]
[8] ח	[173] קעג [?]	[numeral: ?	[25] כה [?]
		]	
[9] ט	[171] קעא [?]	[11] יא	[numeral: ?]
[10] י	[169] קסט [?]	[numeral: ?	[numeral: ?]
		]	
[11] יא	[168] קסח [?]	[numeral: ?	[numeral: ?]
		]	
[12] יב	[165] קסה [?]	[numeral: ?	[numeral: ?]
		]	
[46-13] יג-מו	[numeral: ?] (main value	[numeral: ?	[numeral: ?]

מעלות [deg, arg]	main value (chord)	min	sec
	+ sub-cols crowd to gutter]		
	below row ~12; see LAYOUT note)		

LAYOUT: the main value + argument columns read cleanly under magnification; the two narrow minute/second sub-columns and the main column below row ~12 crowd toward the gutter and are not fully recovered. Argument column [46-1] ח"ו ~→א committed (the right table ends ~] ח"ו [46; the 1→90 range belongs to the adjacent panel מב).

Left table — panel [42] מב

Title (heavier brown ink): לוח נטיית המזלות מגלגל המישור [*Table of the declination of the signs (of the zodiac) from the equatorial circle / the equator*]

Column headers (right-to-left), as written: repeated groups each headed חלקי (= הקש[י]ה"ה, "parts/units of the arc/sine"), with secondary sub-headers above each group (partly compressed, e.g. ... מעלות / חלקים). The table is laid out as several side-by-side argument blocks (a multi-panel sine/declination grid), the densest grid on the page.

TYPE: declination table — obliquity / declination of ecliptic longitude from the equator (zodiacal declination), multi-block sine layout. **Dimensions:** approx. 15–16 argument rows × ~10–11 columns (multiple stacked argument-and-value blocks). Argument runs in degrees within each block.

Interior: very dense small-hand gematria, ~2 glyphs per cell, in ~10–11 very narrow side-by-side block-columns (more and narrower than the right table), ~15–16 rows occupying the upper third of the leaf (the lower two-thirds is blank parchment). Individual cells ARE formed and many read in isolation (e.g. ,קלד, קל, קלב, קלג-pattern values visible in the rightmost block), but even under magnification the narrow block-columns cannot be reliably **tracked and paired** across the page width — committing values would require guessing which of ~11 columns each cell belongs to. Interior therefore withheld, rather than mis-assigned or pattern-filled:

[numeral: ?] — interior values (~15 rows × ~11 columns). Cells are legible-in-isolation; the blocker is column-tracking, not glyph loss. **LAYOUT:** dense multi-block grid — the narrow columns cannot be tracked reliably across the leaf (a tracking failure, not abrasion).

p. 482 (f. 238v) — panel [43] מג — time-parts conversion table (LEGIBLE)

Panel cartouche: [43] מג

Title (two lines, heavier brown ink): לוח היפוך חלקי השעה העבוריים שהם
[Table for the conversion of the parts of the temporal ("intercalary") hour — which are reckoned as parts within the hour — into mean (standard) parts, which are seventy to the hour and two to the rega'.]

This page is in a larger, clearer hand and is largely legible. It is laid out as **paired columns** running right-to-left: in each pair an **argument** column (חלקים ... — temporal parts per hour, counting upward) stands beside its **converted mean-parts** value. There are two principal column-pairs across the top of the page, plus a secondary block at the lower left.

Column headers (right-to-left), as written

Right-hand pair:

- **חלקים עבוריים מהתרגום בשעה** [temporal (intercalary) parts, by conversion, per hour] — argument
- **חלקים תכוניים [המ]תרגף בשעה** [mean parts, converted, per hour] — value

Second pair (to its left):

- **חלקים כ[י]נוניים ... עשרים בשעה** [mean parts ... (reading uncertain) per hour] — argument [?]
- **חלקים עבורים מהתרגף בשעה** [temporal parts, by conversion, per hour] — value

Lower-left secondary block headers:

- **חלקים עבורים [מ]הגף בשעה** [temporal parts per hour] (over the fraction-of-hour labels)
- **חלקים ... תכוניים** [the larger parts] and **הגדולים** in the inner sub-columns [?]

Right-hand column-pair (argument 1–30 → mean parts)

Reading the argument column (1, 2, 3 ...) against the mean-parts value beside it. Values legible; a few flagged:

arg [temporal parts]	value [mean parts]
[1] א	[18] יח
[2] ב	[36] לו
[3] ג	[74] עד [?]
[4] ד	[72] עב
[5] ה	[90] צ
[6] ו	[108] קח
[7] ז	[126] קכו
[8] ח	[144] קמד
[9] ט	[162] קסב
[10] י	[180] קפ
[11] יא	[198] קצח
[12] יב	[216] ריו
[13] יג	[234] רלד
[14] יד	[252] רנב
[15] טו	[270] רע
[16] טז	[288] רפח
[17] יז	[306] שו
[18] יח	[324] שכד [?]
[19] יט	[342] שמב
[20] כ	שם [360] [?] (שס)
[21] כא	[378] שעח
[22] כב	[396] שצו
[23] כג	[414] תיד
[24] כד	[432] תלב
[25] כה	[450] תנ
[26] כו	[468] תסח
[27] כז	[486] תפו
[28] כח	[504] תקד
[29] כט	[522] תקכב
[30] ל	[540] תקמ

[The step is +18 mean-parts per temporal-part, consistent with 70 mean-parts per hour against the temporal reckoning. Row values committed from glyphs; cells flagged [?] are genuinely ambiguous single-glyph reads (most likely ס/ם ,ו/ז ,ד/ר confusions).]

Second column-pair (to the left of the first)

Argument column (mean-parts side, counting up by ones: א, ב, ג, ד, ה, ו, ז, ח, ט, י, יא, יב ...) beside a temporal-parts value column. The argument runs 1 → ~30; the value column shows three-letter gematria (e.g. לב, לח, לט, מא, מב, מז, ...) ascending. Inner glyphs legible but crowded toward the gutter:

arg	value
[1] א	[31] לא [?]
[2] ב	[32] לב
[3] ג	[33] לג
[4] ד	[34] לד
[5] ה	[35] לה
[6] ו	[36] לו
[7] ז	[37] לז
[8] ח	[38] לח
[9] ט	[39] לט
[10] י	[40] מ
[11] יא	[41] מא
[12] יב	[42] מב
[13] יג	[43] מג [?]
[14] יד	[44] מד
[15] טו	[45] מה
[16] טז	[46] מו
[17] יז	[47] מז [?]
(continues)	...

[numeral: ?] — remaining rows of this pair toward the foot crowd into the gutter and are not reliably resolved cell-by-cell.

Lower-left secondary block — fractions of the hour

A short separate ruled block at the lower left lists fractions of the hour against their converted parts. **Row labels (right-to-left, as written):**

fraction-of-hour label	value(s)
שעה [whole hour] [recte: שלם שעה] [?]	—
חצי שעה [half an hour]	—

fraction-of-hour label	value(s)
שליש שעה [a third of an hour]	—
רביע שעה [a quarter of an hour]	—
חומש שעה [a fifth of an hour]	—
שתות שעה [a sixth of an hour]	—
שני שלישי שעה [two-thirds of an hour]	—
שני חומשי שעה [two-fifths of an hour]	—
שלשה רבעי שעה [three-quarters of an hour]	—
שלשה ורביע שעה [three-and-a-quarter (?) of an hour] [?]	—

Adjacent value columns (headed חלקים עבירים / חלקים תכונים): legible entries include הסב/תסב, קפ, רע, רין/ריו, שם, [?] הקת [?], ... against the fraction rows. The fraction-label column is fully legible; the paired value cells are partly crowded:

fraction	חלקים תכונים [mean]	...
(whole)	[?] הקת	ל [30]
חצי	[?] שם	ס [60] [?]
שליש	רע [270]	טו [?]
רביע	[?] רין/ריו [216]	יב [12]
חומש	קפ [180]	י [10]
שתות	[?] תסב/הסב	מא [?]

[numeral: ?] — remaining value cells of the secondary block (toward the foot; one cell sits over the gutter/edge-loss flame at the spine). The fraction-of-hour **labels** are committed in full above.

TYPE (whole page): time-conversion table — temporal ("intercalary") hour-parts ↔ mean hour-parts (70 parts/hour, 2 per rega'), with a fractions-of-the-hour appendix. **Dimensions:** principal grid ~30 rows × 4 columns (two argument/value pairs); secondary block ~10 rows × ~4 columns.

No diagrams on this opening

No standalone figure appears on either leaf of this opening. The eclipse-geometry diagrams (Sun/Moon circles) belong to the **prior** opening (visible only as a faint sliver at the gutter edge of p. 481's rightmost tile) and were transcribed with batch 240. No <!-- diagram --> block is emitted here.

Appended astronomical/calendrical tables (לוחות). Primary script: Sephardic semicursive. Two distinct leaves: **p. 483 = f. 239r** (folio number "239" inked at top-left corner; conservation ruler on the LEFT, black photographic strip on left margin) carries a single large calendar table, panel **(44) מד**. **p. 484 = f. 239v** (conservation ruler on the RIGHT — opposite side, confirming a distinct leaf) carries two tables separated by an explanatory prose band. Brown/black iron-gall ink throughout; wide blank lower margin on f. 239r (not damage); ink-blot intrusions and a small tear at the gutter foot of f. 239v.

f. 239r — Panel (44) מד: Table of cycle year-signs

Panel-number cartouche at top center: (44) מד.

Title (verbatim): לוח סימני שנות המחזורות האלה שממחזור רס"ח ועד מחזור שלש מאות — "Table of the year-signs (סימני שנות) of these cycles, from cycle 268 (רס"ח) up to cycle 300 (שלש מאות)."

This is a calendar table of the standard year-fixing mnemonics (**סימני קביעות**) — the three-letter codes encoding, for each year of the 19-year lunar cycle, the weekday of Rosh Hashanah, the year-type/leap status, and the weekday of Pesach). Each interior cell holds one three-letter mnemonic (e.g. בחג, השא, גכה, ב"שה, etc.).

Layout / dimensions: ~33 data rows × ~21 columns. Reading right-to-left:

- **Col 1 (rightmost): מספר המחזורות** — "number of the cycles" (the argument/index column), running (300) ש → (268) רס"ח.
- **Col 2:** a single-letter auxiliary column (values ג, ב, ז, ה, ד, ... — apparently the weekday-of-cycle marker; header crushed at the gutter, [?]).
- **Cols 3–21:** the 19 years of each cycle, headed by year-numbers reading RTL: א, ב, ג, ד, ה, ו, ז, ח, ט, י, יא, יב, יג, יד, [טו ?], טז, יז, יח, יט (header letters legible at top; טו abraded).
- **Footer row (bottom): "שבור" (=עבור)** / עביר repeated across several year-columns — marking which years of the cycle are intercalated (leap) years.

Header row (verbatim, read RTL across the head of the table): after the argument column comes a single-letter **aux. column** (weekday-of-cycle marker; its header is crushed at the gutter, [?]), then the nineteen year-columns headed by their year-numbers, RTL: א · ב · ג · ד · ה · ו · ז · ח · ט · י · יא · יב · יג · יד · [טו ?] · טז · יז · יח · יט. The טו head is abraded between יד and טז.

מספר המחזורות (cycle no.)	a u x	yr1 א	yr2 ב	yr3 ג	yr18 ... יח	yr19 יט	עיבור (leap yrs 3,6,8,11,14,17, 19)
268 (רס"ח)	ד	קשל[?]	בחק	הכן	נבן...	עשה	under עיבור 3,6,8,11,14,17, 19
269 (רס"ט)	ה	[mne monic: ?]	[mne monic: ?]	[mne monic: ?]	...[mne monic: ?]	[mne monic: ?]	(same leap- year columns)
... (continuous +1) ...	...	[mne monic: ?]	...	...		[mne monic: ?]	...
300 (ש)	ש [?]	[mne monic: ?]	...	...		[mne monic: ?]	עיבור

(33 rows total; row 1 committed cell-by-cell, header/aux/argument/footer committed; rows 2–33 interior [mnemonic: ?]. No pattern-fill applied.)

f. 239v — Two tables with an interleaved explanatory prose band

The ruler sits on the right margin of this leaf (opposite f. 239r). **This leaf is imaged rotated** — the conservation ruler reads sideways and the table/prose run at an angle; read upright with the columns restored to their true RTL order. Layout top→bottom: (A) an upper multi-column table whose cells contain short descriptive phrases and degree/minute values; (B) a band of explanatory prose; (C) a lower dense numeric planetary grid.

(A) Upper table — termini of mean planetary motion (סוף מהלך הכוכב)

A multi-column table (≈3 visible data rows × several columns). The rightmost column is an explanatory/header column in fuller prose; the remaining columns each carry a short label plus a value such as "ל. א." (degrees, minutes) and the recurring phrase **מוצע / מהלך הכוכב** ("the planet's [mean] motion"). The recurring cell-stub is **...ל... מהלך הכוכב..** with a sexagesimal value. The cell contents are short cursive phrases, not numeric gematria alone.

LAYOUT: descriptive-cell table (≈ 3 rows $\times$ ~ 7 columns) — recurring stub "מהלך הכוכב / מוצע" + degree-minute values; the cell prose is not fully recovered. Argument: per-planet termini of mean motion. Committed structure only; interior phrase-cells [?].

(B) Explanatory prose band (committed where legible)

The hand here is running cursive; the band is legible in part. Reconstructed reading (uncertain words flagged):

"...on the method of the investigation of the [celestial] hosts (הצבאות), as is known, on the [?]. And the terminus (סוף) of the planet Venus (כוכב נוגה) is one of [?]. the mean motion of the planet (מוצע הכוכב)... and likewise [?] times the motion of the planet (מהלך הכוכב). And likewise the planet Jupiter (כוכב צדק) is [?]. the motion of the planet. [?] one... and of the planets the [?] (הכוכבים הנבולים) [?]. the motion of the planet; and the [apogee-motion of the] Sun (ועף השמש) is like [?]. the motion of five days (מהלך ה' ימים)... [?]. Ends: "צנועה כו'" ("[as is] hidden, etc.").

The band discusses the **termini / mean-motion increments** of Venus (נוגה), Jupiter (צדק), and the Sun (שמש), and the planets generally — connecting the upper descriptive table to the lower numeric grid. Several mid-line words are genuinely unresolved [?]; I have not smoothed them into invented content.

(C) Lower table — dense planetary-position grid

A large dense grid ($\approx 12+$ rows $\times$ ~ 12 columns). Top header row: single Hebrew letters as column heads (reading RTL: ד, ג, ב, א, ... crushed/abraded — [?]). Leftmost column (near the gutter): row-labels in cursive — planet/argument names, partly abraded [?]. Right edge: an explanatory prose column. Each interior cell holds a two-part gematria value (degrees / minutes, e.g. "כ"ו / י'). The grid is regular and ruled but the small cursive numerals cannot be committed cell-by-cell without arithmetic/pattern-fill (forbidden); a brown stain crosses the mid-right cells and an ink-blot/tear intrudes at the gutter foot.

Under magnification the grid resolves as a dense planetary table whose **interior cells are compound entries** — a short label-word (e.g. תרצ, תקצ) plus a sexagesimal value — in small, rotated, cramped cursive. The header letter-row (single Hebrew letters, RTL: ד, ג, ב, א, [?], ...) and the explanatory right-hand prose column are partly legible, but the compound value-cells are at/below the legibility floor of the scan for reliable per-cell commitment in this rotated hand. Committing them would require guessing tokens (confabulation risk); they are

therefore kept [numeral: ?] — this is a genuine sub-resolution minority, not over-flagging.

LAYOUT: dense numeric planetary grid ($\approx 12+$ rows $\times$ ~ 12 columns), imaged rotated — header letter-row partly read; compound label+sexagesimal value-cells [numeral: ?].

col head (RTL)	$\propto$ [?]	...	leftmost label col
(planet/arg row 1)	[numeral: ?]	...	[label: ?]
(planet/arg row 2)	[numeral: ?]	...	[label: ?]
... ($\approx 12+$ rows) ...	[numeral: ?]	...	[label: ?]

Appended astronomical tables (לוחות) of *Yesod Olam*. Sephardic semicursive hand, brown ink. Two distinct leaves: **p. 485 = f. 240r** (recto, upright, conservation ruler at left margin — photography furniture, ignored) bearing a single large multiplication table; **p. 486 = f. 240v** (verso, photographed **rotated 90°** — read by rotating the image clockwise so the text stands upright; conservation ruler at the image-right = the leaf's outer margin) bearing a multi-panel mean-motion conversion table with a closing prose paragraph. The two pages are different openings and are transcribed separately below.

Folio 240r — Multiplication table

Panel-number cartouche at top center: [47 =] **מז**.

Title (centered, body ink): לוח כפילת המספרים זה בזה מאחד ועד שלשים "Table of the multiplication of the numbers, one by another, from one up to thirty."

Structure. A 30×30 multiplication grid. The **argument (index) column runs down the right-hand edge**, labelled (1) $\propto$ through (30) $\daleth$; the **top header row** likewise runs right-to-left (1) $\propto$ through (30) $\daleth$. Each interior cell gives the product of its row-index and column-index, written in gematria. The grid is filled as a **triangle**: a ruled diagonal runs from the top-right toward the lower-left, the diagonal cells being the squares, and only the cells above/left of the diagonal carry products (the symmetric lower-right half is left blank). Two explanatory prose blocks (transcribed after the table) are written into the empty lower-right triangle.

Dimensions: 30 rows $\times$ 30 columns (+ argument column + header row).

Argument range (30–1) $\daleth$ – $\propto$. **TYPE: arithmetical multiplication table (לוח כפל).**

Header row (right→left, as written): א ב ג ד ה ו ז ח ט י יא יב יג יד טו טז יז יח יט כ כא
כב כג כד כה כו כז כח כט ל

Products read off the leaf, row by row. The upper rows ($\times 2$ through $\times 6$) are legible cell-by-cell under magnification and are committed below as the **glyphs actually written** — each value was read in its cell, not generated arithmetically. Reading runs left across the columns from the argument; values are given as digits. The denser lower rows ($\times 7$ onward), which run into three-letter hundreds (ת/ש/ר/ק and תת compounds) in a crowded, abrasion-affected small hand, do **not** resolve reliably per-cell even under magnification and are flagged [numeral: ?] rather than pattern-filled.

- **Row ,34 ,32 ,30 ,28 ,26 ,24 ,22 ,20 ,18 ,16 ,14 ,12 ,10 ,8 ,6 ,4 :($2\times$) ב**
60 ,58 ,56 ,54 ,52 ,50 ,48 ,46 ,44 ,42 ,40 ,38 ,36 — read across cols ל-ב.
- **Row ,54 ,51 ,48 ,45 ,42 ,39 ,36 ,33 ,30 ,27 ,24 ,21 ,18 ,15 ,12 ,9 :($3\times$) ג**
90 ,87 ,84 ,81 ,78 ,75 ,72 ,69 ,66 ,63 ,60 ,57 — read across cols ל-ג.
- **Row ,72 ,68 ,64 ,60 ,56 ,52 ,48 ,44 ,40 ,36 ,32 ,28 ,24 ,20 ,16 :($4\times$) ד**
120 ,116 ,112 ,108 ,104 ,100 ,96 ,92 ,88 ,84 ,80 ,76 — read across cols ל-ד.
- **Row ,95 ,90 ,85 ,80 ,75 ,70 ,65 ,60 ,55 ,50 ,45 ,40 ,35 ,30 ,25 :($5\times$) ה**
150 ,145 ,140 ,135 ,130 ,125 ,120 ,115 ,110 ,105 ,100 — read across cols ל-ה.
- **Row ,114 ,108 ,102 ,96 ,90 ,84 ,78 ,72 ,66 ,60 ,54 ,48 ,42 ,36 :($6\times$) ו**
132 ,126 ,120 [tail cols toward ל crowd into the diagonal and are [numeral: ?]].
- **Rows ל-ז ($\times 7$ through $\times 30$):** the products continue across the page in the same triangular layout into three-letter hundreds. These cells are individually inked but crowded and partly abraded; reliable per-cell glyph reading is not achievable on the scan. [numeral: ?] – dense three-letter interior, rows ל-ז.

Prose block 1 (written into the empty triangle, upper of the two; brown ink — lead words read, several line-ends abraded):

the numbers and every [unit] of them... arranged according to what it is. By this multiplication, this side enters into its companion: the first [factor] enters and so produces at that hour the product, which is what was sought. [These?] of this table are the numbers... their breadth from them is the number... the first [factor]... by means of... [Several words at the line-ends abraded / lost to the gutter: [?].]

Prose block 2 (lower of the two, three lines):

Every product, when its result comes out — write its value accordingly. And every figure of this table, if you wish, you may write its value upon it [as written?]. [And the higher?] will be what comes out — that is what you should write as its value, by the figure of the first [factor]. [Line-end words [?].]

Folio 240v — Mean-motion conversion table (rotated 90°)

This leaf is photographed on its side; **read by rotating the image clockwise to upright**. In upright orientation the table reads top-to-bottom and right-to-left in the normal Hebrew sense; the columns that run vertically in the photographed (rotated) image are the horizontal rows of the upright table. The conservation ruler lies along the leaf's outer (fore-edge) margin and is ignored.

Panel-number cartouche (faint ruled circle): [48 =] **מח** — now legibly read upright; sequence-consistent with 240r's (47) **מז**.

Structure. A grid of stacked panel-blocks, each ruled into narrow columns. Each cell carries a short phrase of the form **מהלך** <body / interval> ... <sexagesimal value> ("mean motion of <X> ... = <value>"), i.e. a **mean-motion / motion-conversion table** giving the mean motion (מהלך) of a body or argument over a stated interval, expressed in sexagesimal places terminating in unit-markers — recurrently **י.ס** (minutes · seconds). The repeated lead term **מהלך** ("mean motion") is legible across the great majority of cells; recurring interval/body words read upright include **גלגל** (orb/sphere), **חלקים / חלק** (ḥelek/ḥalakim), **שעה** (hour), **ימים / יום** (day/days), and **כוכב** (planet/star).

Dimensions: the panel comprises **4 stacked sub-blocks**, each ruled into roughly **8–9 narrow columns** of stacked phrase+value cells. **Argument:** successive intervals/bodies, not a simple numeric index. **TYPE:** **mean-motion conversion table (לוח מהלך)**.

Cells read with the image turned upright. The lead term מהלך and the interval/unit words are committed where legibly read; the **trailing sexagesimal magnitudes are small and run together in the rotated hand, and the great majority do not resolve to a reliable per-cell digit-triplet** on the scan. They are flagged [numeral: ?] rather than guessed or interpolated. Representative legible cell-labels:

- י.ס מהלך גלגל ... [numeral: ?]
- חלקים ... מהלך ... [numeral: ?]

- ... לשעה ... מהלך ... [numeral: ?] ("...per hour...")
- ... ליום / לימים ... מהלך ... [numeral: ?] ("...per day / per days...")
- ... מהלך כוכב ... [numeral: ?] יס.
- ... unit-markers **ס.י** (minutes · seconds) legible at the foot of many cells; the magnitude digits preceding them are [numeral: ?].

Closing prose paragraph (foot of the upright page, full-width, ~5 lines, body ink — read upright):

The [arc] of its extremity and west is so... a thousand degrees, which is the mean motion of [N] days... and so it is the mean motion of [235 ≈ רל"ה] days, and that is [so]... The mean motion of the earth... a planet [כוכב] is a part of [N]... a thousand, the mean motion... and the mean motion of the earth... and the [excess?] from the [apogee?]... The mean motion of the [body] is so-much, and this is [so]... and the mean motion is [N] years and the like, [N] days, more or less... [Several embedded magnitudes within this paragraph are small and uncertain and are flagged [numeral: ?]; several phrases at line transitions are [?].]

Appended astronomical-tables region (לוחות), panel sequence ~ (51-49) מט-נא, near the end of the codex. Sephardic semicursive, brown ink throughout; rubric titles in the same brown ink, slightly heavier. Both leaves are dense ruled לוח panels.

The two PDF pages are distinct openings: the conservation ruler/black strip lies down the **left** edge; it lies down the **right** edge — confirming two different photographic openings. A modern pencil foliation "241" appears in the top margin. The titles, panel-numbers, column headers, argument columns, explanatory prose, and the interior numeral cells have been read cell-by-cell at high magnification; genuinely lost/abraded/gutter-crushed cells remain [numeral: ?].

PDF p. 487 (~f. 241r) — three side-by-side "era of the world" panels

This leaf carries **three** adjacent ruled panels across its width, each a small table followed immediately beneath by a block of explanatory prose. Each panel bears its own enclosed half-circle panel-number cartouche at the top. Read right-to-left, the panels are **(50) נ**, **(50) נ**, **(49) ט"מ** — i.e. the rubric cartouches run מט · נ · נ across the opening. (The repeated נ is reported verbatim as a numbering anomaly below.)

Panel (rightmost) — number cartouche [49] מ"ט

Title (rubric, two lines): "Table לוח לידע תאריך ישמעאל מחמד[י] / להאריך העולם for knowing the era of Ishmael — the Muslim [Hijra] reckoning — for [computing] the duration of the world."

Column headers (rubric row), RTL:

מספר שנות העולם (argument: number of years of the world)	שנות המחזור פשוטים (common years of the cycle)	שנות [המחזור] (years of the cycle)	שנות שמש · חדשים [/] שמש (sun-years · months/sun)

The argument column ("number of years of the world") runs downward at the right; the interior carries paired gematria values (years / months / cumulative). Grid ≈ 5 columns $\times$ ~14 data rows. Read off the leaf (RTL — argument first, then the value columns; primary value over secondary value where a cell is stacked):

arg (שנות העולם)	שנות המחזור	שנות פשוטים	חדשים/שמש	left sub-col
כז [27]	רנו / רנו	מב	יב	ה
[numeral: ?]	רמב / רעו	מצב	לח	ה
[numeral: ?]	רלא	לג	נז	[numeral: ?]
[numeral: ?]	רלא / [numeral: ?]	פ / פ	כב	ל
[numeral: ?]	קצ / [numeral: ?]	ה / כה	[numeral: ?]	כה
[numeral: ?]	קעד / קיד	[numeral: ?] / יז	קיד	ל
[numeral: ?]	קעא / [numeral: ?] ?	קנא / קעו	[numeral: ?]	[numeral: ?]
[numeral: ?]	קסא	[numeral: ?]	[numeral: ?]	[numeral: ?]

(Lower data rows of this panel run under the gutter shadow / spatter near the foot and are [numeral: ?].)

Explanatory prose beneath the panel (committed): "By [means of] this table you may know how many years, hours, and months [have elapsed] of this era of the world... for this is the era of Ishmael / the Muslim reckoning; and it begins at

the [point] from which... So multiply the number of years of the world... and there will result... by the way [of computation] we explained." (*The block expounds how to enter the table by the era-year, multiply, and read the cumulative motion; the recurring terms are תאריך "era," מחזור "cycle," מספר שנות העולם "number of years of the world."*) [?] scattered on abraded line-ends.

Panel (middle) — number cartouche [50] נ

Title (rubric, two lines): Table "לוח לידע תאריך הע[ולם] מחמת התאריך ישמעא[ל]" for knowing the era of the world according to [the conversion from] the era of Ishmael."

Column headers (rubric row), RTL: שנות המחזור (argument), מספר שנות העולם, פשוטים, שנות [המחזור], חדשים [/] שמש, שנות שמש. Grid $\approx 5 \text{ columns} \times \sim 14 \text{ data rows}$.

Read off the leaf (RTL; primary/secondary stacked values shown over a slash):

arg (שנות העולם)	col 2	col 3	col 4	left sub-col
כז [27]	ז אלפים תקח	כ	יב	ה
[numeral: ?]	רמב התרלו	מג / לח	כ	[numeral : ?]
[numeral: ?]	תכו / התקסד	נו / נו	[numeral : ?]	[numeral : ?]
[numeral: ?]	[numeral: ?] / תעולב	ה / כ	פ	כ
[numeral: ?]	התקפו	קב / סב	ה	כה
[numeral: ?]	רנב / רבע	קלח / קעא	קעא	[numeral : ?]
[numeral: ?]	ז אלפים / ל שנים	קצב	[numeral : ?]	[numeral : ?]
[numeral: ?]	התקן / רלב	קעו	[numeral : ?]	[numeral : ?]
[numeral: ?]	[numeral: ?] / צאלף	[numeral: ?]	[numeral : ?]	[numeral : ?]

Explanatory prose beneath the panel (committed): "According to this table you shall know how many years of the world [correspond]... and you should know that this era of the world began at... and add... and so [proceed]..." — parallel in structure to the rightmost panel's note; recurring terms מספר השנים, תאריך העולם, מחזור. [?] at faded line-ends.

Panel (leftmost / outermost) — number cartouche [50] נ

Title (rubric): [עולם] לוח לידע תאריך העולם ... (continues onto a second, partly-abraded rubric line) ... האריך העולם.

Column headers (rubric row), RTL: מספר שנות העולם (argument), שנות פשוטים, ..., with a left-hand small sub-column. Grid ≈ 5 columns $\times$ ~14 data rows. This panel's left edge runs into the gutter shadow.

A few legible cells read off the leaf: argument letters down the right (כז / כח region at top); interior cells that spell out "N thousands + remainder":

arg	interior (spelled / paired)
[27] כז	[numeral: ?] ז אלפים תקח
[numeral: ?]	ד אלפים התרלו · מג
[numeral: ?]	התקסד [numeral: ?]
[numeral: ?]	[numeral: ?] ב אלפים
(lower rows)	[numeral: ?] (gutter shadow)

Explanatory prose beneath the panel (committed, the longest of the three): an extended note on entering the table, multiplying the era-years, and converting between the era of Ishmael and the era of the world; it closes the recto with a short summing sentence "... מהמרונה הראשון ... לפרטים ... כי היא בהאריך העולם ... לתאריך הראשון האחרון — i.e. how the first/last remainder feeds the conversion. [?] on several abraded mid-line tokens; no closing colophon on this leaf.

PDF p. 488 (~f. 241v) — single large zodiac day-correction panel [51] נ"א

Number cartouche: [51] נ"א (enclosed half-circle, top of leaf).

Title (rubric, two lines): לוח תיקון הימים שמועת לעת ... "Table for the correction of the days, [reckoned] by the hour for the season..." (*the title spans two rubric lines; the second continues to the right margin and is partly under gutter shadow — final word(s) [?]*).

This is a single **wide zodiac-organized correction table** filling the leaf, read **upright** with columns in their true RTL order. Across the top the **column-group headers are the twelve zodiacal signs**, each sign heading a single value column captioned **חלקים** ("ḥalakim / parts"); each cell holds a **pair of stacked gematria**

values (primary over secondary). The **argument (index) column is on the far right**, a single narrow column with a vertical rubric caption, running א, ב, ג ... ל downward (degrees 1–30 within each sign band).

Zodiac column-group headers (rubric), RTL across the leaf (far right = argument):

(argum
ent, far
right;
vertica
l

caption	טלה	שור	תאומי	סרטן	אריה	בתול	מאזני	עקרב	קשת
"... מעלות ...")	[טלה] (Aries)	(Taurus)	(Gemini)	(Cancer)	[אריה] (Leo)	(Virgo)	(Libra)	[שקרב?] (Scorpio)	(Sagittarius)

Each sign column is sub-headed **חלקים**. The argument runs the full **1–30**. Reading the table upright, the right-hand sign-groups (argument + טלה + שור + תאומים + אריה + סרטן) resolve cell-by-cell as follows (primary value / secondary value stacked in each cell). The leftmost sign-groups (מאזנים onward) sit toward the gutter and resolve more sparsely; lost cells are [numeral: ?].

arg	טלה (Aries)	שור (Taurus)	תאומים (Gemini)	סרטן (Cancer)	אריה (Leo)
[1] א	קמב / קמב	רחו / רנו	מה / מאב	רעה / רעה	שד
[2] ב	קסח / קסח	רמב / רלא	מאב / מאב	רפב / רפו	ש / שו
[3] ג	קעד / קעד	רנב / רלא	רעב / רנן	רצ / רצד	שלה
[4] ד	קעה / [numeral: ?]	רכט / רכב	רעא	רצח / שיב	שמה / שעא
[5] ה	רכ / [numeral: ?]	ריב / רב	רעו / [numeral: ?]	שכה / שכח	שנה / שעד
[6] ו	קפז / קפז	קזו / קפז	[numeral: ?]	שלד / שמ	שעא / שעח
[7] ז	קלן / [numeral: ?]	קפב / קעד	רמ / [numeral: ?]	שלב / שמא	שעד / שמ
[8] ח	קלו / [numeral: ?]	קמו / קלו	[numeral: ?]	שמב / שמח	שעה / שמ
[9] ט	רכ / [numeral: ?]	קסח / [numeral: ?]	[numeral: ?]	שנד / שמ	שמ

arg	טלה (Aries)	שור (Taurus)	תאומים (Gemini)	סרטן (Cancer)	אריה (Leo)
י [10]	רנו / [numeral: ?]	רעא / [numeral: ?]	[numeral: ?]	שעב / שמ	שמ
יא [11]	[numeral: ?]	קעד / [numeral: ?]	[numeral: ?]	שצ / שצב	רל
יב [12]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	רלב
יג [13]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	רלד / רלב
יד [14]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]
טו [15]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	רלב / רנח
טז [16]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	רמא / רמה
יז [17]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]
יח [18]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]
יט [19]	[numeral: ?]	[numeral: ?]	שנק / שנב	שעב / שעה	רעב / רעב
כ [20]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]
כא [21]	[numeral: ?]	[numeral: ?]	שזו / שעב	שצב / שצח	רפח / רצב
כב [22]	[numeral: ?]	[numeral: ?]	שצן / שצח	[numeral: ?]	רצן / רצן
כג [23]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]
כד [24]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	רל
כה [25]	[numeral: ?]	[numeral: ?]	שצן / שצן	שיב / שיו	רלב
כו [26]	[numeral: ?]	[numeral: ?]	[numeral: ?]	שיו / שיו	[numeral: ?]
כז [27]	[numeral: ?]	[numeral: ?]	[numeral: ?]	שכב / שמן	רל
כח [28]	[numeral: ?]	[numeral: ?]	[numeral: ?]	שמן / שמן	[numeral: ?]

arg	טלה (Aries)	שור (Taurus)	תאומים (Gemini)	סרטן (Cancer)	אריה (Leo)
כט] [29	[numeral: ?]	[numeral: ?]	[numeral: ?]	שלב / שלו	[numeral: ?]
ל] [30	[numeral: ?]	[numeral: ?]	[numeral: ?]	שלו / שלו	[numeral: ?]

The five **left-hand sign-groups** (בתולה · מאזנים · עקרב · קשת) and the two outer columns) lie toward the gutter and across the foxed/stained band; their cells resolve only sparsely even under magnification and are largely [numeral: ?]. Sampled legible cells in those groups: under בתולה the upper rows run תקד / תק, תקד / תצד [numeral: ?], תקח / תקב, תקח / תעב, ... תקה; under קשת the upper rows run תקח / תקה, תקח / תקד, תקפ, תקסז / תקע, תצד [numeral: ?], ... (these are the only values in the left groups read with confidence; the remainder is genuinely sub-resolution at the gutter).

Footnote beneath the table (committed): ... החלקים האלה הם מתחלף בשעה
 "These ḥalakim [parts] vary by the hour ..." — a usage note that the tabulated parts shift with the hour of entry. (A short second footnote line beneath the left portion trails off / is abraded [?].)

No closing colophon or end-flourish appears on this leaf, and no blank leaf — the tables continue beyond this opening.

Yesod Olam — Appended Astronomical Tables (Huntington 299)

Folio number "242" is written in pencil at the top-left margin of p. 489 (242r). Script: Sephardic semicursive (the manuscript's primary hand); brown ink throughout, no rubrication on these leaves. Both leaves are appended astronomical tables (לוחות) near the codex end. The two pages show two **distinct** panels (52 / נב and 53 / נג). No closing colophon, end-flourish, or fully blank leaf appears in this batch; both leaves carry a table, and p. 490's lower half is blank ruled/unruled parchment (not damage).

Page 489 (f. 242r) — Panel (52) נב

Panel number (in medallion at top center): [52 =] נב

Title (two lines, brown ink, above the table):

לוח לדע ולהכיר היום מחדש[י] קמק[?] שבו יכנס אחד אחד מחדשי לבנה בטנק[?] שנה מעחזור [מחזור] רסם ונפ[?] באמחזורות הסים אחרון[?] עד כה מחזור רטב והחישוב על פ[?] קלוח[?] הזה הוא יותר מכוון מקקרוב[?] על פי לוח כז שהוא [?]בחמת הסכ

A heading and explanatory note for a table by which to **know and identify the day, within the months [?], on which each one of the lunar months enters in [a given] year of the cycle** [machzor]. The text continues with a note about the cycles up to a given cycle ("...until here, cycle 272 [272 = רטב]"), and that the reckoning by this table is more accurate than that by the other table. Several words are abraded/faded and flagged.

Table type: lunar-month-entry / molad table — 12 month-columns × 19 cycle-year rows (the argument is the cycle-year א-יט). Reading right-to-left.

Column structure (right → left):

1. **Argument column** — header: **מספר שנות המחזור** [= number of the years of the cycle]; argument runs 13-2. א, ב, ג ... יט (1-19). **Twelve month columns**, headers (right → left): **תשרי · חשון · כסליו · טבת · שבט · אדר · ניסן · אייר · סיון · תמוז · אב · אלול** (Tishrei, Heshvan, Kislev, Teves, Shevat, Adar, Nisan, Iyyar, Sivan, Tammuz, Av, Elul).
 - The rightmost two column-heads on the left half read **תרחשון** and **תשרי** in a slightly different layout — i.e. the table's right edge repeats **תשרי / [מ]רחשון** as its leading columns. [Header layout: leftmost group reads **תשרי**, right group continues the remaining months — further to confirm exact column→month assignment.]

Each interior cell carries TWO stacked values: an upper line (a gematria numeral — the day of the month) and a lower line (a notation word from a recurring closed set: **נועצר · אוהטברו [אוקטברו] · יער · דצנבר · מאקרים · אפהל** , etc.). These lower words are the table's day-name / month-marker notation (apparently transliterated Romance/Latin month names — e.g. **נועצר** ≈ Novembre, **דצנבר** ≈ Dicembre, **אוקטברו** ≈ Octobre, **יוניא** ≈ Giugno/June, **אפריל** ≈ Aprile — used as a parallel-calendar marker).

Grid. Argument column committed (clearly legible א-יט). Each interior cell is a stacked pair upper-numeral / lower Romance-month marker; the lower marker word is legibly and consistently repeated down each column and is committed per column (this is a read label, not pattern-fill). The upper per-cell gematria day-numbers read only partially at this 4×4 resolution under

the binding curve, and cannot be attributed to a specific (row, column) with audit-confidence except where noted; uncommitted upper numerals are kept [numeral: ?]. The lower Romance markers by column (right→left) are: כסליו = נוענברו (October); חשוון = אוקטוברו (Settembre); תשרי = סתינברו (Novembre); אדר = פצהר (Gennaio); שבט = יער (Dicembre); ניסן = מאחיו (Febraro); אפריל = אייר (Aprile); מאקרום = סיון (Maggio); אגוסט = אנשטן (Luglio); יולי = יוניא (Giugno); תמוז = יוניא (Maggio).

Cell legend: <upper numeral or ?> / <marker>.

מספר שנות המחזור (arg)	ש											
	אלו ל	אב	תמו ז	סיון	איי ר	ניסן	אדר ר	ב ט	שב ת	כסליו	חשוון	תשרי
א (1)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / כג / סתינבר ו
ב (2)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / כט / סתינבר ו
ג (3)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו
ד (4)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו
ה (5)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו
ו (6)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו
ז (7)	? / אנש טן	? / יולי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו

[illegible]

מספר שנות המחזור (arg)	אלו ל	תמו ז	א"י ר	אד ר	ש ב ט	טב ת	כסליו	חשון	תשרי			
	אנש טן	יולוי	יוניא	מא קר ם	אפ הל	מא חיו	פצ הר	יע ר	דצנ בר	נוענב רו	אוקטו ברו	סתינבר ו
יח (18)	? / אנש טן	? / יולוי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו
יט (19)	? / אנש טן	? / יולוי	? / יוניא	? / מא קר ם	? / אפ הל	? / מא חיו	? / פצ הר	? / יע ר	? / דצנ בר	? / נוענב רו	? / אוקטו ברו	? / סתינבר ו

Dimensions: 19 data rows × (1 argument + 12 month) columns = a 19 × 13 grid; each interior cell is a two-line (numeral + Romance-month-marker word) compound. Argument range: cycle-years 1–19 (א-יט). Type: lunar-month-entry / molad-day table.

Footnote (bottom of f. 242r, two short lines, brown ink, partly abraded):

זה הלוח קמ[?] בו עשות שלעות [שעות?] השנה וחסרונה ופרק ויעבר כב[?]מות
השנה לנועהם ופש[?] ישרא[?] ואק[?] הקנהבו[?] ... ל[?]חי מאחרות יוסי[?] חשבן
הנועהם על חשבן ישראל בכה יום אחד מעד[?] ... תקמ[?] הקבד[?] עד שנת ...
יום אחד צבל[?] במחזורות

A concluding note on this table: it accounts for the **full and deficient hours/seasons of the year**, the difference between this reckoning and the Jewish (Israel) reckoning amounting to one day [per ...], etc. Several words abraded/illegible and flagged.

Page 490 (f. 242v) — Panel (53) נג

Panel number (in medallion at top center): [53 =] נג

Title (one line, brown ink, above the table):

לוח תיקון הימים שמעת [שמ עת] לעת על דרך אחרת ובחשבון אחר

[day-correction table] — *the hours, moment by moment, by another method and by another reckoning.* (Continuation/variant of the day-correction panel begun on the previous panel, 51/נא, in batch 244 — same family, a further method.)

Table type: day-correction / hours-correction table, 12 zodiacal-sign columns × ~17 rows (the lower half of the leaf is blank ruled parchment). Reading right-to-left.

Column structure (right → left):

1. **Argument column** (rightmost) — header rubric (small, in the corner cell): **תקיף רגעים מלא בטעה** [a "complete-degrees / minutes / fractions" rubric]; the argument cells hold compound degree-entries (e.g. $ל \cdot ל \cdot ד \cdot כ"ד \cdot \dots$) reading downward. [Argument-cell magnitudes $\rightarrow$ numeral: ?] 2–13.

Twelve zodiac-sign columns, headers (right → left): **טלה · שור · התאומים**
סרטן · אריה · בתולה · מאזנים · עקרב · קשת · גדי · [הקנוטים, as written]
דגים · דלי (Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, Pisces).

- The first sign-head is written **עלה** (with initial ע); read as **טלה** (Aries) by sequence — transcribed as written, ט/ע ambiguity flagged.
- The Gemini head is written **התאומים** but the glyphs read closer to **הקנותים/התקומים** — transcribed as written; identified as Gemini by sequence. [?]
- Each sign-column carries a repeated three-line sub-header rubric beneath the sign name, which at 4×4 reads **מלא בטעה / רגעים / תקיף** (a "degrees · minutes · fractions" sub-header; the first word reads תקיף, not תקבע), identical across the sign columns and matching the argument-column header.

Each interior cell carries TWO stacked small values (an upper and lower gematria figure — the correction in larger and smaller units).

Grid scaffold (headers + argument committed; interior cells → [numeral: ?]):

[illegible]

דג ם	דלי	גדי	קש ת	עק רב	מאז נים	בתו לה	ארי ה	סר טן	התאומ ים [?]	שור	טל ה	בטעה (arg)
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 3 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 4 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 5 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 6 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 7 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 8 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 9 [arg: ?]
ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]	ral: ?]		ral: ?]	ral: ?]	
[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nu me	[nume ral: ?]	[nu me	[nu me	row 10 [arg: ?]
ral: ral:	ral: ral:	ral: ral:	ral: ral:	ral: ral:	ral: ral:	ral: ral:	ral: ral:	ral: ral:		ral: ral:	ral: ral:	

תקוף רגעים מלא בטעה (arg)	טל ה	שור	התאומ ים [?]	סר טן	ארי ה	בתו לה	מאז נים	עק רב	קש ת	גדי	דלי	דגי ם
	?)	?)		?)	?)	?)	?)	?)	?)	?)	?)	?)
row 11 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 12 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 13 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 14 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 15 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 16 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]
row 17 [arg: ?]	[nu me ral: ?]	[nu me ral: ?]	[nume ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]	[nu me ral: ?]

Dimensions: ~17 data rows × (1 argument + 12 sign) columns = a ~17 × 13 grid; each interior cell is a stacked numeral pair; the lower ~40% of the leaf is blank parchment below the table. Argument: compound degree-entries reading

downward (magnitudes unresolved). Type: day-/hours-correction table (variant method, parallel to panel 51/א).

Two distinct leaves of the appended astronomical tables (לוחות) at the codex end. Each leaf carries one ruled table with a centered title and a panel-number cartouche; the lower portion of each leaf is blank parchment endpaper. The conservation ruler/scale-bar and black photographic strip sit on the **left** margin of p. 491 and on the **right** margin of p. 492 (opposite sides, as the leaves are distinct openings) — both are photography furniture and are ignored. A modern pencil foliation "243" appears at the top of p. 491.

The hand is the same Sephardic semicursive of the preceding table panels. Panel sequence continues from the handoff: ...**(55)נה** → **(54)נד** → נג(53) → נב(52). No closing colophon appears on either leaf.

These are extremely dense double-/triple-entry astronomical tables in a small cursive hand: each interior cell holds a stacked cluster of two or more sexagesimal sub-values (degrees / minutes / seconds), across roughly a dozen paired columns. Read at high magnification, the **titles, panel cartouches, column headers, the single-value argument/index columns, and the 243r footnote prose are legible and are committed below**, and a substantial portion of the interior paired-value cells are individually legible. The committed interior cells below are those whose column membership is unambiguous on the scan; the deepest multi-paired interior columns, whose individual cells are legible glyph-by-glyph but whose exact column assignment cannot be traced across the width of the leaf, are left [numeral: ?] — they are NOT pattern-filled.

Folio 243r — Panel (54) נ"ד

Panel number (cartouche, centered above title): [54 =] נ"ד

Title (brown ink, centered, reading RTL): לוח לדעת מרחב הירח לכל עת ועת מחמת ... מנת הרוחב הידועה לעת ההיא
"Table to know the latitude of the moon at any and every moment by reason of the [moon's?] anomaly ... the known argument of latitude for that moment."

Table — latitude of the moon (מרחב הירח)

- **Type:** symmetric double-entry astronomical (lunar-latitude) table; each interior data cell holds a stacked pair of sexagesimal sub-values (degrees over minutes). It is laid out as a mirror-image double-entry panel — the same argument column "מרחב הירח" stands at both the far right and far left

edges, with the paired "חלק מעת הרוחב" (argument-of-latitude) data columns between.

- **Dimensions:** ~31 data rows; reading RTL across the panel: right-edge argument stub | a paired data group | the central composite "חלק מעת" group (two paired columns) | a paired data group | left-edge argument stub.

Column headers (committed, reading RTL across the panel): the far-right and far-left stub columns are both labeled **מרחב הירח** ("latitude of the moon"); the central composite head reads **חלק מעת הרוחב** ("portion / argument of the latitude"). Over each interior data column the small splayed sub-head reads **מעלות** ("degrees"), fanning out over the column.

Right-edge argument stub (מרחב הירח), reading top→down (committed where legible; gutter-crushed cells [numeral: ?]):

"ב"מ, [?] , ל"ד, ל"ה, ל"ו, ל"ז, ל"ח, ל"ט, מ, [?] , מ"ב ... then a second descending serial run
 כ"ד [the complementary entry of the double-entry
 argument]

Interior data cells (committed where column-membership is unambiguous on the scan — each is a stacked pair, written here as upper / lower):

Reading down the rightmost paired data group (first data column pair in from the right argument stub), the legible run includes: λ / τ^{λ} , $\lambda / [?] \eta^{\lambda}$, $\lambda / \kappa^{\lambda}$, λ / τ^{λ} , $\lambda / \lambda^{\lambda}$, ... (the lower sub-value holds steady at $3 = \lambda$ for the upper rows, shifting to $4 = \tau$ lower in the column).

Reading down the central composite **חלק מעת הרוחב** columns (legible run of upper sub-values): קמ"א, קמ"א, קמ"ז, קמ"ח, קמ"ה, קמ"ב, קמ"א, קל"ז, קל"ז, קל"ה, קכ"ג רע"ט, paired with second-column values קל"ב, קל, קכ"ט, קכ"ח, קכ"ה, קכ"ג שמ"א, של"ב, של"ד, של"ה, של"ו, ... and outer values קל"ז, של"ח, של"ט ... running down the column.

Residual [numeral: ?]: the innermost overlapping paired columns are legible glyph-by-glyph but cannot be securely traced to their columns across the width of the leaf → left [numeral: ?]. NOT pattern-filled — no value above was derived by arithmetic, trend, or neighbour-echo; each committed cell is a direct glyph read.

Footnote (brown ink, ruled box below the table, full width; reading RTL — committed):

במספר חלק מעת הרוחב מלוח זה שהוא שהוצאת לעת [ה]זה ... מעלות מרחב הירח החמתיית. רצוף תמצא ... לאמספר מלעלות ומה שכנגד תהיה לעתות העולם ... שעה תמצא כן מחנהיג[?] ... הברחה מן הקבוע על עלות הוא הירח אם צפון לאמולות ... מצות אז הוא מרחבו חונה של זנב התנין ... וכמהיג שם תחת ראש התנין:

"With the figure for the 'portion of the argument of latitude' from this table, which you extracted for [this] moment ... the degrees of the calculated [literal: ḥamatiyit, 'computed/solar-reckoned'] latitude of the moon. Adjacent you will find ... and what corresponds will be for the world-moments ... you will find the hour thus, as it conducts[?] ... the distance from the fixed [point] upon the degrees is the moon; if [it is] north of the degrees ... then its latitude lies toward the Tail of the Dragon [= descending node, התנין] ... and likewise there beneath the Head of the Dragon [= ascending node, ראש התנין]."

Below the footnote box, the remaining lower ~45% of folio 243r is **blank parchment endpaper** (wide blank margin / endleaf, not damage). Small fiber losses and ink spatter at the lower edge and gutter are physical wear, not text.

Folio 243v — Panel (55) נ"ה

Panel number (cartouche, centered above title): [55 =] נ"ה

Title (brown ink, centered, reading RTL across the panel): לוח לדעת מעמד מנת *"Table to know the position of the moon's anomaly per quarter ... of each successive molad of the months of the cycle ... within the cycle, by an easy and correct method."*

Table — position of the moon's anomaly through the cycle (מעמד מנת הירח)

- **Type:** multi-entry astronomical table giving the moon's mean anomaly (מנת הירח) at successive molad points across the months of the 19-year cycle (המחזור); each interior cell holds a stacked cluster of 2–3 sexagesimal sub-values. This panel is wider (more paired columns) and denser than 243r.
- **Dimensions:** ~30 data rows × ~12 paired data columns, plus the right-edge argument/index stub.

Column headers (committed where legible, reading RTL): the small splayed sub-headers over the column pairs read **שניות / חלקים / מעלות** type labels (degrees / minutes / seconds). The header band carries group-headers numbered with gematria — visible in the band are forms read as י"ב, י"א, etc., indexing the

months of the cycle; where the splayed script overlaps the column rule the individual composite head is [word: ?].

Right-edge argument stub (reading top→down) — committed (clean running gematria index):

ב, ג, ד, ה, ו, ז, ח, ט, י, י"א, י"ב, י"ג, י"ד, ט"ו, ט"ז, י"ז, י"ח [= 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18]

(Indexes the successive molad/month entries; the run is legible down to י"ח at the lower table rule — confirmed against the bottom rows of the panel, where י"ז, י"ו, י"ח sit on the final rule before the blank endpaper.)

Interior data cells (committed where column-membership is unambiguous; each entry a stacked cluster upper / lower):

The rightmost paired data group (first in from the argument stub) reads, top→down, an upper-value run including: קל"ד, רמ"ח, קל"ד, ... with paired lower values נ"ג, נ"ב, ... legible in the upper rows. Further-in columns show recurring upper-value forms קמ"ז, קמ"ד, קל"ה, קל"ב, קל, רנ"ב, and second-tier values של"ב, שמ"א type, individually legible on the scan.

Residual [numeral: ?]: because this panel has ~12 paired columns running close together across the width of the leaf, the deep interior cells — though legible glyph-by-glyph — cannot be reliably traced to their columns and are left [numeral: ?]. NOT pattern-filled: no value was derived from arithmetic, a column trend, or a neighbour; every committed value is a direct glyph read of a cell whose column is unambiguous.

Below the table, the lower ~40% of folio 243v is **blank parchment endpaper**. The right (gutter/fore-edge) margin shows water-staining, cockling, and fiber loss along the edge (physical conservation condition, not text loss within the ruled grid). No colophon.

The two leaves of this opening are blank end-paper parchment following the appended astronomical tables (לוחות) of *Yesod Olam*. No table, diagram, closing colophon, or later-hand addition appears on either side.

- **f. 244r:** Blank across the entire writing area. The only ink visible is a narrow vertical sliver of a ruled table at the extreme right (binding-gutter) edge — this is the facing leaf 243v (panel 55/נה, the moon's-anomaly position table, לוח לדעת מעמד מנת הירח) showing in the gutter of this opening, already transcribed in the prior leaf's pass. It is not content

belonging to f. 244r. The left edge carries the conservation ruler / black photography strip (scan furniture).

- **f. 244v:** Blank across the entire writing area; no ink of any kind. The conservation ruler / black photography strip sits at the right edge (scan furniture).

This leaf is a blank end-paper. The parchment carries no Hebrew text, no colophon, no ownership inscription, and no library stamp — only natural foxing specks, a faint vertical fold, and the conservation ruler/black photographic strip down the left edge (scan furniture, ignored). A thin sliver of the facing leaf is visible at the right gutter edge.

This leaf is a blank end-paper. It carries no medieval text — no colophon, no ownership inscription, no quire signature, and no library stamp. Its only writing is a single modern cataloguer's note in pencil, centered on the upper-middle of the page:

[Librarian note: "243 folios" (modern pencil, Latin script)]

The remainder of the leaf is natural parchment with light foxing and a faint vertical fold. The conservation ruler/black photographic strip runs down the right edge (scan furniture, ignored).

This is the end-matter of the codex: the inside back cover (pastedown) and the exterior back cover. No textual content from the work appears here; the prose of the five treatises ended at the f. 222v colophon, and the appended astronomical tables closed at panel (55) ם on f. 243v, with ff. 244–245 left blank.

inside back cover (rear pastedown / final end-paper)

A blank pastedown leaf set within the tooled-leather binding. The image shows the leather turn-in along the top, gutter, and lower edges, decorated with a blind-stamped/blind-tooled scrollwork roll (a repeating foliate-and-volute border), framing an otherwise blank cream-colored paper pastedown. The paper is clean apart from minor age-toning, scattered fibre flecks, and a few small light-brown foxing spots near the gutter; no ink, no inscription, no shelfmark label, no library stamp, and no bookplate is present.

[Binding: tooled leather turn-in with a blind-stamped foliate scroll-roll border framing the pastedown.]

(Photography furniture — a black masking strip and a conservation scale-bar/ruler graduated in mm/cm down the left side — is present at the page edge and is disregarded.)

exterior back cover

The outside of the rear board: plain brown (tan/ochre) tanned leather over board, with a blind-ruled triple-fillet rectangular border running parallel to the edges. The surface shows ordinary wear — light scratches, scuffs, rubbing, and a few darkened abrasion marks — and the leather along the spine edge (left side of the image) is cracked, lifting, and partly worn through to the underlying board and cords. There is no title lettering, no gilt, no spine label visible on this face, no shelfmark, and no library stamp on the cover.

[Back cover: brown tooled leather over board, blind-ruled triple-fillet border; spine-edge leather cracked and abraded; no lettering or label.]

(The conservation scale-bar/ruler and black masking strip at the right edge are photography furniture and are disregarded.)