Midrash ha-Ḥokhmah

מדרש החכמה, "The Exposition of Wisdom"

[The Exposition of Wisdom]

(c. 1247 (Hebrew self-translation from the author's earlier Arabic; this is a 14th-c. manuscript copy))

by Judah ben Solomon ha-Kohen (Ibn Matḳah) of Toledo (יהודה בן שלמה הכהן), c. 1215–c. 1274

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Ars Astronomica

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Translator Version 2

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

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

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

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A note on the work

[Description not yet written.]

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

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[Front cover / binding — no text.]

** (right half of the imaged spread).** The outer edge of the volume's red-orange (pasteboard/leather) cover board, photographed against a gray studio backdrop. To the right of the board is a photographic reference scale: a reproduction ruler numbered (partly mirrored/upside-down in the image) with visible tick numerals "12 13 14 15 16 17 18 19 …", together with an "A4" size-reference marker and printed corner registration brackets. No Hebrew text, shelfmark, ownership note, or foliation appears on this half. The scale, brackets, and "A4" marker are the digitization studio's photographic apparatus, not part of the manuscript.

[Librarian note: photographic reference scale and "A4" size marker with corner registration brackets in the backdrop — digitization apparatus, not manuscript content.]

** (left half of the imaged spread).** The front cover of the binding: a plain red-orange board with a leather spine along the left edge. The spine is tooled in gold with raised bands dividing it into compartments and bears a small dark (black or dark-brown) label near the top. No legible lettering can be resolved on the spine label or gold tooling at this resolution; no shelfmark, title, ownership inscription, or foliation is legible on this half. [Spine label and gold tooling present but not legibly resolvable if title/shelfmark recovery is wanted.]

Midrash ha-Ḥokhmah (Parma, Cod. Parm. 2769) — front matter

PDF p. 3 (spread, right side)

No manuscript text. The page shows the book's spine and fore-edge of the red-leather binding, photographed alongside the imaging laboratory's reference apparatus: a gray photographic reference card printed with blue registration marks, an "A4" size indicator, and two centimeter scale rulers (numbered ~11–19, appearing mirror-reversed in the scan). A small white archival label is affixed near the foot of the spine; its printed text is too small and low-resolution to read at this scan resolution.

The spine bears raised bands with gilt tooling and two dark lettering-pieces whose gilt-stamped text is not legibly resolved.

[Librarian note: white archival/shelfmark label at foot of spine — text illegible at this resolution]

No body text is present.

PDF p. 4 (spread, left side)

Plain red inner cover / pastedown. No text, no ownership note, no foliation, no diagram. Surface shows scuffing, light staining, and abrasion typical of a leather cover, but carries no writing.

[No manuscript text on these pages. Both PDF pages are photographs of the bound volume's leather **spine**, showing gold-tooled decorative compartments, fragmentary gilt lettering on inset black title-labels, and printed modern library labels. No Hebrew leaf, incipit, color-chart, or body text is present. The lettering is Latin/library cataloguing matter, transcribed below.]

Spine photographs (binding, not manuscript leaves)

** — spine, left-side raking view.**

Gilt lettering on the black title-labels (fragmentary, letters cut off at the visible edge):

- `[Librarian note: gilt spine label, fragmentary: "…-COEN" over "…S CHOCM[A]"]` — i.e. *[R. Iehuda] Coen / Medras Chocma* (Judah HaKohen, *Midrash ha-Ḥokhmah*).
- `[Librarian note: gilt spine label, fragmentary: "…S-BOMA" / "ED." / "XIV"]` — apparently a place/date band; "…XIV" (with the "SEC." visible on the facing view = *saeculo XIV*, 14th century).

Printed paper library label at the foot of the spine (fragmentary, edges cut):

- `[Librarian note: "…TINA" | "…S." | "69" | "…ENSE" | "…MA"]` — the Biblioteca **Pala[tina]** / **Parm[ense]** shelf label; the numeral fragment "69" and "…MA" (Par[ma]) belong to shelfmark **Parm. 2769**.

** — spine, right-side raking view (same binding).**

Gilt lettering on the black title-labels:

- `[Librarian note: gilt spine label, fragmentary: "R. IEH[UDA]" over "MEDRAS[…]"]` — *R. Iehuda / Medras[ha-Ḥokhmah].*
- `[Librarian note: gilt spine label, fragmentary: "COD-M[EMBR.]" / "IN" / "SEC[.…]"]` — *Codex membranaceus … in … saeculo …* (parchment codex, dated by century).

Printed paper library label at the foot of the spine (fragmentary):

- `[Librarian note: "PALA[TINA]" | "M[EDRAS…]" (red) | "27" | "PARM[ENSE]" (red) | "PAR[MA]"]` — Biblioteca **Palatina**, **Parm[ense]** shelfmark; the numeral fragment "27" here, joined with the "69" fragment on the facing view, gives the shelfmark **Cod. Parm. 2769**.

These two pages are **body text, not front matter**: they belong to the geometry section of the science half of *Midrash ha-Ḥokhmah*, treating the inscription of regular figures in a circle and of a circle in those figures (equilateral triangle, square, pentagon). Each page carries an opening block of geometric construction diagrams in the outer margin/column alongside the prose.

PDF p. 7 (recto)

At the top of the page, two lines of prose run left from the diagrams before disappearing under the chart:

[?] a triangle, and the circle א-ב-נ [?]… [Occluded by color chart]

Diagram. A small equilateral triangle standing alone at the top of the outer margin, with a single letter-label set to its right.

- [?] (right of figure): single label, illegible glyph

Diagram. A circle with an inscribed equilateral triangle; the apex sits at the top and the two remaining vertices at the base. A straight line runs diagonally across the upper-left, cutting past the circle (a secant / line of reference). Only the apex label is confidently legible.

- א (apex): reference letter
- [?] (base-left, base-right): two further vertex labels, not legibly resolved

Diagram. A large equilateral triangle with an inscribed circle (the incircle), the circle touching all three sides. Corner labels present but not legibly resolved at this resolution.

- [?] (three vertices): labels not resolved

Diagram. A very small equilateral triangle set to the right of the preceding figure, with a letter-label alongside.

- [?] (beside figure): label not resolved

The prose column to the right of the upper diagrams is legible only in fragments:

lines from it [?]… thirteen [?]… in three, four [?]… an angle in the third [?]… and to them [?]… it will be shown that the angle [?]…

Below the chart, the construction continues (badly abraded and cramped; read in fragments):

[?] we divide the angle [?] from it [?] by the line [?]… and they divide [?]… and afterward [?] from [?]… and we bound upon [?]… We say that triangle א-ב-נ [?] is equal to [?]… for the angle ח-ל-מ [?] equals the angle ז-נ-ד [?], and the right angle ה [?] equals the angle [?]… as [shown] in the first treatise [Euclid, Book I, ref. uncertain]… so this equals this and this equals this [?]… and this, by the third [proposition] of the [first?] treatise [?]… the point ף [?] is the center, and to them the angle ה-ל-ד [?] is [set] before you [?]… the line of the triangle [?].

Diagram. In the lower margin, an equilateral triangle with an inscribed circle and internal lines (radii drawn to the points of tangency), forming the incircle construction. Labels are largely under the chart edge; only one exposed label reads confidently.

- ה (left/apex region): reference letter
- [?] (remaining points): labels not resolved / run under chart

[Illegible: closing line at foot of page, compressed and abraded]

PDF p. 8 (verso)

At the top of the page a single prose line is exposed to the right of the diagrams before the chart:

And if we wish to inscribe [a figure] upon the triangle, the circle that surrounds it [?]… [Occluded by color chart]

Diagram. A circle with an inscribed five-pointed star (pentagram), i.e. the pentagon-in-circle construction. Two labels are exposed.

- ה (upper left, outside circle): reference letter
- ז (within the figure): reference letter
- [?] (remaining points of the star): labels not resolved

Diagram. A circle with an inscribed square set as a diamond (vertices at top, bottom, and the two sides), crossed by a horizontal and a vertical diameter dividing it into four quadrants. Marks in the quadrants are not legibly resolved.

- [?] (four vertices / quadrant marks): not resolved

Diagram. A square with an inscribed circle; a vertical and a horizontal line through the center quarter the figure. Corner labels present but not legibly resolved.

- [?] (four corners): not resolved

Diagram. A second square with an inscribed circle, similarly quartered by center lines, corner labels alongside.

- [?] (four corners): not resolved

Diagram. At the foot of the outer column, a circle with an inscribed square (diamond orientation), the vertices touching the circle. Labels alongside not legibly resolved.

- [?] (vertices): not resolved

The prose exposed below the chart (right side, foot of page) reads in fragments:

we wish to inscribe within it the circle that surrounds it [?]… and we divide each one of the four sides [?]… upon the point ח [?], and we make by the line ח-ז [?]… upon the line, the point ב [?] is the center of the circle that [?]… and thus [?]…

We say: if we wish to inscribe upon [?]… the circle that surrounds it [?], and we make [?] by the lines ב-ג ,[?] ב-ב ,[?] א-נ [?] they will be cut [?]… a side, and we make a center and inscribe at a distance ה-א [?] the circle [?]… and it is as we have drawn [?]… and it will be made clear from the extremities [?]… the [circle] inscribed upon the circle [?].

[Librarian note: pencil foliation "112" at lower right]

The leaf is blank cream-colored paper with no manuscript text, no shelfmark, and no ownership note. At the lower-left corner a printed conservation label is affixed:

[Librarian note: printed conservation label reading "ALLEGRI — LABORAT. RESTAURO LIBRI — PARMA" (Allegri Book-Restoration Laboratory, Parma), with a small open-book device.]

The leaf is blank cream-colored paper with no manuscript text, no shelfmark, and no ownership note. A photographic scale/color-reference frame (blue tick marks and the numerals "20 / 30" of a measuring rule) is visible along the outer and lower margins of the scan bed, outside the leaf itself.

Both pages in this opening are blank, unruled front flyleaves. No text, foliation, shelfmark, ownership note, table of contents, or ruling is present on either side. The binding edge (red leather turn-in) is visible at the right and foot margins, confirming these are paste-down-adjacent flyleaves preceding the body of the manuscript.

The verso carries no primary ink text on the face toward the camera. It shows heavy pink/red staining and foxing along the inner (gutter) margin, scattered light-brown foxing spots across the leaf, and — very faintly — the mirror-image bleed-through of a decorated panel (an interlace/knotwork medallion with a small ornamental heading) belonging to the following leaf's decorated page. Per the bleed-through rule, this show-through is not transcribed; it indicates that a decorated title/ownership page faces on the next leaf. A librarian's photographic scale bar (blue printed rule marked "20 / 30" in centimeters) lies in the outer margin beside the leaf.

[Librarian note: photographic scale bar (blue printed cm rule, "20"/"30") in the outer margin — modern archival photography aid, not part of the manuscript.]

No shelfmark, ownership inscription, foliation, contents note, incipit, or body text appears on either page.

[Librarian note: "V — 25" (pencil, upper center)]

This leaf carries no primary text. Faint bleed-through of a decorated panel — an interlace medallion with a rosette above a scrollwork/knot ornament — shows through from the following leaf; it belongs to the recto of the next folio (the decorated opening page) and is not transcribed here. Additional faint pencil traces appear at the upper left, illegible.

This leaf carries no primary text. The decorated opening panel of the following leaf shows through in reverse (mirror-image): the top displays the bleed-through of a large ornamental heading in outlined/decorated letters, and below it the interlace medallion (rosette within a circle) and knotwork ornament. Because this is show-through of the next leaf's recto, it is not transcribed here; the decorated title/incipit will be read on the leaf where it is inked directly.

[Librarian note: "Ms. Parm. 2769" (pencil, lower center) — shelfmark]

[Librarian note: "B I" (pencil, lower right)]

**Opening of the science half of *Midrash ha-Ḥokhmah* — natural-science section (leaf_001 recto, global **

[Damage: this leaf is heavily obscured by a large dark water/mold stain covering the greater part of the written area, with several parchment holes/losses along the top edge. Ruled lines of Sephardic semicursive are present across the page, but the iron-gall ink blends into the brown stain over most of the surface, so connected prose cannot be recovered with confidence at this resolution. The page at native resolution. Best-effort legible anchors are given below; the bulk of the text is flagged illegible rather than reconstructed, to avoid confabulation.]

[Illegible: top ~5 lines — obscured by staining and by parchment holes along the upper edge; scattered words discernible but no continuous sense recoverable.]

The middle portion of the page continues a discussion in the natural-science register [?], with recurring particles and connectives visible (…אמר… "he said" / "it is said" [?]; …כי… "for/that" [?]) but the substantive content is lost under the stain. [Illegible: ~8 lines of body prose, heavily stained.]

[Red ink header / rubric:] **בתואר** [*be-to'ar* — "On the form / description of …"; the continuation naming the topic of the section is obscured by the stain and cannot be read]. [?]

[Illegible: the lines following the rubric, which would state the subject introduced by the heading, are lost under the stain — ~4 lines.]

[Illegible: foot of page — ~3 lines, stained and abraded.]

[Foliation: a faint mark is present at the lower outer (right) corner but is not legible with confidence; by position this is leaf_001 recto. Marginal jottings (a few small words) appear along the outer right margin but are too faint/stained to read.]

Midrash ha-Ḥokhmah (Natural-Science section) — leaf 2

Recto (folio 2r)

[Damage: water/mold staining across the upper margin, ~3 lines lost, with blanched patches into the first lines of the text block.]

[The opening lines continue the preceding discussion of the internal exhalation and the vital heat.] … [?] and it is found in the arteries [העורקין] … [?] much [הרבה] … [?]. And [this concerns] the disposition of the organs [תכונת האברים]

beside the heart [אצל הלב], and … [?]. And they hold [ומאמינים] that a vapor [עשן] rises [עולה] from here, and … [?] from here, for a time [עד שעה]; … [?] white [ולבן] … [?], and this is called [ונקרא] … [?], and it alone [והיא…בלבד] … [?] like a reed [כ… קנה [?]] … [?].

אברים הפנימיים — The Internal Organs [enlarged-script rubric]

הלב — The Heart [enlarged-script rubric]

… [?] are not [לא ימשו [?]] … [?]. [It concerns] the heart, for it is the beginning [כי הוא התחלה], and … [?] the liver [הכבד] and the crown/top [וראש] … [?]. [As for] the vital [חיוני [?]] heart, [Aristotle] brought proofs [ראיות] … [?]; and they said [ואמרו] that a vapor [עשן] … [?] with all [עם כל] … [?]. [Whoever] would take issue with your words [על דבריך [?]] — and even [ואפילו] one who says [מי שיאמר] that an [external] act [מעשה] … [?] — [answer him] like a wise man [כמו חכם], or [as] the physician [הרופא [?]] would answer against him [יאמר כנגדו] and dig deep to investigate [ויחתור לחקור] what … [?]. [What] the heart says [שהלב [?]] … [?]; there is a scent/vapor [ריח / עשן [?]] … [?] to conceal ourselves [להסתיר עצמנו] … [?] a vapor [עשן] … [?] from within [מן קרב] … [?] near [קרוב] … [?] from the heart [מן לב]; and this is … [?] the natural heat [החום הטבעי].

[Lower margin: stained blank parchment below the text block.]

Verso (folio 2v)

[The heart discussion continues.] … [?] the lung alone [ריאה בלבד] … [?]. [As for] one that has no lung [מי שאין לו ריאה] — it has a liver [יש לו כבד] … [?] this heart [זה הלב] … [?] for the sake of [בעבור] … [?].

… [?] the liver [הכבד] … [?] more [יותר] … [?]. It is difficult [קשה] … [?] the heart [לב] … [?] more [יותר] … [?], because the heat [בעבור שהחום] … [?] in it; and … [?] more [יותר] … [?]. It is [הוא] … [?] the heart before the heat consumes [שהחום יכלה] … [?].

The heart is at the center [הלב באמצע] … [?] the space of the cavity [מקום החלל]; … [?] it is found [נמצא [?]] inclining downward to the left side [נוטה מטה לצד שמאל], up to [עד] … [?] more [יותר] … [?] from the right side [מצד ימין], and the heart [והלב] … [?] the organs [כאברים [?]] do not cease [לא יבטל] at all [כלל]; and so it is fitting before you [וכן ראוי לפניך] … [?] the heart [לב] … [?], for it is not seen [כי לא נראה] … [?] which appears in the liver and in the lung [שנראה בכבד ובריאה].

בריאה — On the Lung [enlarged-script rubric]

… [?] the [?] receives [מקבל [?]] … [?] the lung [ריאה], and there is no small cavity [ואין לעמק קטן] … [?] a lung [ריאה]; and there is a small cavity [ויש לעמק קטן], something [מה ש…] that fills the space of the cavity [דבר שממלא מקום החלל] … [?]. Like [כמו] … [?] in blood [בדם [?]] … [?], and the lung [והריאה] … [?].

[The physicians] of old [קדמו [?]] … [?] and to the cavity [ולעמק] … [?]. And so the living being [וכן החי] … [?] … [?], like the physicians [כמו הרופאים] … [?] from within them [מן…] … [?]. In the cavity [בעמק] … [?] … [?].

[Librarian note: pencil foliation "2", lower right.]

[Script: Sephardic (Oriental) semicursive, single hand (scribe Sasson ben Menashe). Iron-gall ink, well-spaced and largely legible under magnification; the lower thirds of both pages, and the dense Arabic-derived physiological clauses, are lighter and resolve less cleanly. Two display rubrics in heavier ink mark the organ sections.]

This leaf continues the anatomy-physiology of the internal organs. It carries the tail of the discussion of the lung, then the liver, the spleen, and the kidneys and bladder.

[On the Lung — continued]

it is hollow, and sensation [reaches] as far as the heart by means of what is joined to it. And everyone who has a lung has a voice.

The benefit of the lung is to fan the heart and cool it by admitting the cold air from outside, and to expel what has been heated within it; and for this reason it was formed soft and spongy [מחולחלת]. It fills with air and empties of it, conveying the air to the heart; then it contracts and expels the breath that has been heated. Whatever is finer and hotter requires more fanning, whereas what is cold [requires] only a little [?]; such a creature has no need to be fanned and cooled, and therefore its lung is small. For this reason there are many [creatures whose] [?] … [Illegible: ~1 short clause] … only slightly in substance [?].

The lung has yet another benefit: to serve as a bed for the heart. And why does the lung have many lobes [אונות]? So that, if one of them should sicken, the other may stand in its place. Fish have no lung, because they do not breathe; instead of it they have [gills] [?], and [they draw in] the water itself [?]. And since they have no [warm] blood [?] … [Illegible: ~1 clause] … on account of [their] coldness.

בכבד [On the Liver]

The liver is the seat of the blood [מושב … הדם]. Its function is to concoct the digested matter [העיכול] that comes to it from the stomach [אסטומכא — Greek: στόμαχος, stomachos, "stomach"], until it becomes blood. In its concoction there is a fine residue [מותר דק], which goes to the gall bladder [כיס המרה], while the coarse [residue] [העבה/העכור] goes to the spleen [טחול], and [thence] to the kidneys [כליות]. And by [this] concoction the [?] … of the liver is made whole [?].

For this reason, among living creatures there is one whose liver is bad — such as the tortoise [סלחפא — Arabic: sulaḥfā, "tortoise"] — and [such blood] is [mostly] bad in its nature [?]. And there is a portion of the living creatures that has a spleen [that is] thick and dry [?] … [Illegible: ~2 lines of dense clauses on the digestion, the residues, and the coarse blood — individual words legible (מותר, החי, טחול, לרחף), but the syntax does not resolve securely] …

the fine [?] blood is bad in its nature [?]; and therefore some of the living creatures have no spleen [מחול], and some have a small spleen. [Illegible: ~2 lines — a dense continuation on drawing off the residue and the flesh/members, not securely readable] …

[On the Spleen — continued, verso]

and to the spleen is assigned one benefit. And there are there [?] … muscles [?] that bind the sides [?] of the bird [העוף]. And the spleen [?], because it is [?] hard [קשה], for this reason [labors] [?] to draw off that residue [היתרון]; and when the blood grows abundant [?] … [Illegible: ~1 line] … and its odour [?] and its heat [?].

בכליות וכיס השתן [On the Kidneys and the Bladder]

[Left-margin notes beside the rubric, verbatim but not securely readable: "מהכבד" ("from the liver"), "מייב[?]", "מ[?]אלו".]

Their benefit is to draw off [למשוך] the residue that is not fit for nourishment [לזון]. The kidneys draw off, from the outset, the [watery] moisture [?] from the liver [מהכבד]. And when [these] are joined [?] … [Illegible: ~2 lines of dense clauses on the moisture drawn from the liver and expelled through the members of the bird; individual words legible, syntax not secure] …

and therefore [those creatures] whose kidneys are weak [חלשים] are watery [מיימי] [?]. And the kidneys are found [only] in an animal that has a lung [ריאה] and is watery [?]; and therefore there comes forth [from it] [?] … And its nature

desires the watery residue [היתרון המיי]; for this reason [the residue] is directed to the kidneys and to the [bladder] [?]. And therefore an animal whose lung is not watery has no need [of them] [?].

And why [?] … the kidneys [?] … [Illegible: ~1 clause] … because of the weakness [?] of their lung [ריאתן]. And a creature of [porous] [?] structure has no kidneys, because it is porous [מחולחל], and the whole [?] [Illegible: ~1 word].

The right [kidney] is set apart from the left, because it is more serviceable and more esteemed [חשובה]; since the right is more esteemed than the left, it is therefore placed higher above it [the left]. And on the same principle the liver is set higher than the spleen [מהטחול].

And why is there more fat [חלב] in the kidneys than in the other organs [האברים]? Because their seat is [?] hotter [יותר חם], and this comes [to them] [?] from a residue [מיתרון], as was explained [כמו שנתבאר] concerning fat. Moreover, because their [nature] [?] is red [אדמי], they are nourished by the red fat [חלב האדמי], and so they take on fat. And [this is so] because [the fat] has another benefit: it warms the kidneys and makes [a defence] [?] against the cold, since they are in a place toward the back [מהאחור] where there is no flesh, and they are at the extremity [בסוף] of the members [אברי] of the bird [העוף]; therefore they need to be warmed [לחממן] by the fat [שומן].

And there is less fat on the left side [מהשמאלית], because the members on the right side are warmer [חמין] [?] … And the pain [ומכאוב] of the kidneys is hard to heal [להתקן] [?], because [it reaches] [?] the [?] bone [עצם] [?].

[Script: Sephardic/Oriental semicursive, single hand (scribe Sasson ben Menashe). This is the lighter iron-gall natural-science front of the codex; the ink is genuinely fainter than the astronomy leaves and the dense Arabic-derived anatomical vocabulary resolves less cleanly than elsewhere in this witness — so this spread carries a real (not caution-driven) minority of unresolved connective clauses, even under magnification. The heavy-ink display rubrics (ב- + organ) and one major treatise heading are legible; the anatomical backbone (the dividing membrane, the stomach, the organs, digestion, the dove's missing gall bladder) is secure.]

[This opening continues the anatomy–physiology exposition of the internal organs, treating the dividing membrane (midriff) between the thorax and abdomen, then the belly and stomach and the workings of the digestive organs, and opens a new major division — "The Fourteenth Treatise" — which

enumerates the internal organs common to living creatures and takes up the classic claim that the dove has no gall bladder.]

On the Midriff [rubric — heavy display ink, top of recto, partly abraded; reading בטרפש "the midriff / diaphragm" fits the body, which describes the membrane that divides the thorax from the abdomen] [?]

It is that which divides [המבדיל] between the [?] and the lung [הריאה] — that is to say [כלומר] … [Illegible: ~3 words] the organs [האברים] … [?] and others [ואחרים?]. And so, for the living creature [לחיה] it is set apart [מובדל], a work [מעשה] … [Illegible: ~2 words]; and the organs [ולאברים] have … [?] in it. And [?] … its chest [החזה] is on its left [בשמאלו], and the middle of the side [ואמצע הצד] … [Illegible: ~2 words]. It is a great work [מעשה] … [?] the frame [העצם/the bone] which … [Illegible: ~1 line — dense clauses on the framing bone and cavity; individual words (העצם, האברים) are legible but the syntax does not resolve securely] … it is joined [?] to the [?] of the organs [האברים], and it is … [Illegible: ~2 words].

On the Belly / Abdomen [בבטן]

[A short marginal/interlinear note at the right edge, verbatim but not securely readable.] [?]

[Illegible: ~1 word] the stomach [אצטומכא — Greek: στόμαχος, stomachos]. And as for the rest of the animal [ומאשר בשאר החי] … [?] its excellence [מעלתו] and its place [מקומו] … [?]. And it has no feet [אין לו רגלים]. And there is [ויש] … [Illegible: ~2 words] one belly [בטן אחד], as [in] the [other] living creatures [כמו החיות] … [?] length [אורך]; and that which has no … [Illegible: ~2 words] is [not] found [נמצא]. And [?] … [Illegible: ~2 words] as … [?] it is fourfold [מרובעת] … [Illegible: ~2 words] the three [השלושה] … [?]. And [?] … [Illegible: ~1 line — dense]. And because of [ומפני] the distancing [ריחוק] of the … [?] from the … [?], as … [?] points [נקודות] … [?]. And because [ומפני] there is no [?] … [Illegible: ~2 words], it has no cause [יש/אין לו סבה] … [?]; and the living creature [והחיה] … [Illegible: ~1 line]; this work [מעשה זה] differs [חלף] … [Illegible: ~2 words], and some of them [ומקצת] … [?].

On the Workings [rubric — heavy display ink, lower-middle of recto; reads במעשים "on the workings/functions," though the anatomical sequence would also admit במעים "on the intestines" — display letters carry a clear shin] [?]

[Illegible: ~2 words] they have no [אין להם] … [?] on account of [בעבור] … [?] in [its] place [במקום]; and it is … [?] in actuality [מפעל/בפועל?]. And [?] … the belly [הבטן] … [Illegible: ~2 words]. And [it is] set [ותאמצין?] for it, and there [ושם] … [Illegible: ~1 word].

The organs of digestion [אברי העיכול] … [?]: just as at first it is … [?] cooked/concocted [מתבשל], and afterward [ואחר] … [?] — so [כן] flesh [בשר] stands [יעמד], which the organs [האברים] draw [שימשכוהו], one after another [… אחד ואחר] … [Illegible: ~2 words]. Therefore [לכך] it is fitting [ראוי] that the organs [האברים] be … [Illegible: ~2 words], one … [?] of … [?]. [Illegible: ~1 line — on the disposition of the digestive matter; individual words (האברים, המבושל, "cooked") legible but the clause does not resolve securely]. And [?] … [Illegible: ~2 words] to the place [למקום] … [?] the gizzard [קרקבן] … [?]. And [?] … [Illegible: ~1 line]; it takes [ליקח] from it [מעתנו/ממנו] … [Illegible: ~2 words], … [?] it takes [ייקח] … [Illegible: ~2 words] from the liver [מהכבד]. … [Illegible: ~1 line] the residue [that] goes out, the coarse [matter] [היוצא … העב] … [Illegible: ~2 words]. [Illegible: ~1 line — the final line of the recto text block, very faint] … what … [?] the works [המעשים] … [?].

The Fourteenth Treatise [המאמר הארבעה עשר]

[Major display heading in heavy ink, upper-middle of the verso.]

[Illegible: ~1 line — the closing sentence of the preceding matter runs into the top of the verso] … in order to preserve [כי לשמור] … [?] in them, and … [?]. And so [וכן] … [?] the work [שהמעשה] … [?] was always in need of [היה תמיד צריך] … [Illegible: ~2 words]. … [Illegible: ~1 line]; there is not [ואין] … [?]. And it is … [?] that has much blood [שיש לו הרבה דמים] … [Illegible: ~2 words]. And it is not found [ולא תמצא] that it has one belly [שיש לו בטן אחד] … [Illegible: ~2 words] the lung [הריאה] … [?]. And [?] … [Illegible: ~1 line] as [כמו] its blood [דמו] [and] fat [חלב] congeal [נקפא] … [?].

Every living thing has [יש לכל חי] … [?]: a heart [לב] and … [?]; the lung [הריאה] and the windpipe [וקנה]; and there is … [?] a further set [אלא] … [?]. And there is [a class] that … [?] its entrails [are] deep [עמוק] … [?], and there is [a class] that

has no … [?]. And it is fitting to mention once more [להזכיר עוד] one that has no gall bladder [מן אחד שאין לו מרה] — and that is the dove [והוא היונה] — as they mentioned [כמו שהזכירו], of blessed memory [ז״ל], in the Yerushalmi [בירושלמי?] [?]. And so I heard [וכך שמעתי] from the mouth of [מפי] my teacher, our master, who illumines all [מורי רבנו ומאיר הכל] — of blessed memory [ז״ל] [an honorific for the author's teacher; the name itself is not given here] [?]. And it is possible [ואפשר] that … [?] one [reads?] [קרא] or is charged/appointed [תפקד] in one matter [בענין אחד] of the living creature [מן החי], like the embryo [כמו העובר].

For the embryos [כי העוברים] — some of them [מקצתן] have a lung [יש להם ריאה], and some of them [ומקצתן] do not [לא]; and even one … [ואפילו אחד …?] … [?]. It will be [יהיה] large [גדולה] or small [וקטנה] … [Illegible: ~2 words], as … [?] the new [ומין החדש?] … [?]. And [?] … [Illegible: ~1 line — dense; not securely readable] on account of every kind of food [בעבור כל מזון] … [?]. As … [?] … [Illegible: ~1 line]. And a work [ומעשה] … [Illegible: ~1 line — dense; individual words legible but the clause does not resolve]. And so that in it may be discerned [?] the residue [… יוכר היתרון], and some of it [ומקצת] … [?] its bitterness [מרירתו?] [?]. … [Illegible: ~1 line]; it is for grinding/chewing [?לענשוק/ללעוס] [?] … [Illegible: ~2 words]. … [Illegible: ~1 line — on the working of the organs; not securely readable]. … [?] the organs [האברים] … [?]. And it lengthens [יאריך] … [?]. There is [a class] that … [?], according to the work [כמעשה] … [Illegible: ~1 line — the final continuous line of the text block, very faint].

On the [Gall?] [rubric — heavy display ink, foot of verso; reading not secure, possibly במיראאן / a form of the gall-bladder or bitter organ (cf. מרירתא / מרה)] [?]

and it is near [והוא קרוב] … [Illegible: ~2 words]; it has [יש לו] fat [חלב] … [?]. It has no fat [אין לו שומן] … [?].

[Margin: a short word (יהוא [?]) stands at both the right and left edges of the top line of the recto — apparently a catchword or header repetition, not certainly legible.]

by the action of the organs that cook the food and retain it. This [action] is greater in living creatures [that have] much flesh, and [thereby the food] is brought to completion so as to stand firm — [namely] the chyle (הקמיס [Greek: χυμός / Arabic: kaymūs, "chyle, humoral juice"]), which the organs that cook and retain [produce].

On the Organs of the Living Creature that Have No [Blood-Organs] (באברי החי שאין להם)

For such creatures have no blood-organs — such as the liver (כבד), the [spleen?] [?], the lung (ריאה), and the kidneys (כליות); these are the innards (הקרביים). Yet they do have a mouth and a belly, and an organ from which the residues (היתרונות, the excreta) are cast out. This creature is intermediate between the nature of the plant and the nature of the animal [חי החמור — trailing word uncertain]. And from this [it comes about that] some of them have a mouth and a belly in their front part, and [they act] by means of the organ that corresponds to [it] [?].

After the mouth there is something like a gullet (ושט), and after it a belly; and in the belly some of them — as does the crab (הסרטן) — [grind their food]. As we said [?], they complete the digestion of the rest of the food by grinding (בטחינה), since the teeth of the mouth (שיני הפה) do not suffice for them. After the belly there is a short, simple intestine (מעי פשוט), reaching to the place where the residue is expelled (יציאת היתרון).

In some kinds of the living creature one finds [a covering] thick like earthenware (עב כחרס), as there is in the snail (חלזון); and they have openings (שערים) which it opens to seek its food. And there are some that have, in place of the openings, perforations (פתוחים) with which they perform the function of the openings. And there is a kind of crab that has [?]: some have a claw (ענב) and some do not, and their heads are divided/segmented (נחתך), and it [moves] them by way of their [combats/movements] (מלחמותהן). At the sides of their heads are organs fit to receive the chyle and to expel it; and the crab is cold in temperament (קר במזג).

And the [creature] (הקולד [?]) has five teeth (חמשה שינים) and five legs (חמשה רגלים) [and...] [?], and it has five bellies (חמש בטנים) [like...] [?]. This creature can bear neither intense heat nor intense cold; [in a cave/hollow] [?] it is found, because on account of its warm [nature] it loves [warmth] [?].

On the Snail (בחלזון)

And some of its kinds remain fixed in their places, [differing thereby from the others?]; its head is in its lower part, since it receives its food from above, as from a tree, while its upper organs are above. This species is intermediate (בינוני) between the plant and the animal: it resembles the plant in standing in one place, and it resembles the animal in having a good faculty of sensation (מרגיש). And [this species is reckoned] between the two [natures]; or [it is] because their natures are shared [that] it is apportioned according to its own nature [?]. And

afterward it is provided for according to its need — for the Merciful One did not [wish] that any single [creature] should suffer loss, so that they should not endure want. And blessed is the Creator, forever and to all eternity [וברוך הבורא לעד ולנצח נצחים].

And from this [comes] the species that is unique [i.e. intermediate] between the plant and the animal, the [oyster / shellfish?] (האסטן [?]). Therefore there are many kinds of animal that continue to live after being cut into pieces, because of the closeness of their nature to the nature of the plant.

[In some] of the living creatures there is the organ called [?] [~1 word], which is an organ possessing the power of motion (כח התנועה) and [that of] the urine/excretion (השתן), and some of them perform their [own] functions. After this organ there is a simple intestine (מעי פשוט), and there is [in it] a place for the exit of [waste], and it [holds/casts] its seed [?] within the organs of the living creature.

Some of them have [?] (דלבש [?]), some have four legs (ארבע רגלים), and some six [legs]. All this is by [proportion]: [the parts] at the front are larger than those farther back, and those farther back are larger than those in the middle. Some have many [heads/parts] [?] and some few. And whichever has a shell (חומה) — in some it is within, and in some it is outside, like [the...] [?]; and in some it is on the outside. [According to the] view of [Aristotle?] (דעת ארסטו [?]) concerning what there is among living creatures: that which is [colder?] is nearer to the root, [close] to the earth [?], and therefore its [stature] is not erect [?].

And everything in which the innate heat (החמימות) is greater dwells [firmly] in its place. And the reverse [holds] with us: [that whose] stature is not erect is warmer than the rest of the [creatures] [?];...and therefore its front is higher than its rear, and the matter (החומר) is more [abundant] [?]. The upper [organs] are colder, and [those] over the belly (הבטן) are colder [still]; [these] are colder than the [nature/dominion] of the world, and this is fitting on account of their coldness. In a warm-statured being the heart [...] [?] — its temperament is cold; and indeed the [decay/loss] [?] that [occurs] in it is a benefit (חסד): it is like green water (מים ירוקים) in the stomach (אסטומכא [Greek: στόμαχος, "stomach"]) of water [?].

On the [Constitution] of Man (בדרי האנוש [?])

its completion is fixed [so as] to grasp [?]... [and] in order to attain the faculty (הקנין) — the small and the great [?] — on account of the many [openings?] [?] and their motions. And the length of the [hand] resembles [...] [?]. The middle [part], which is called אומץ ("the strong / the brace"), is like the beam (הקרן) in the

middle of the ship (הספינה); and but for [?] the variation of these extremities in length — [whereby] their ends are not equal when they grasp onto one thing... And the plants [grow] toward the depth beneath them: they stand [fixed] to their root; whereas in man [it is otherwise] — the uppermost parts are their standing-place, and their support rests in the [substance/bone] [?] of the organs... the fingers (האצבעות [?]).

[Pencil foliation "4" appears in the lower outer corner of the verso — see the foliation note below.]

[some kinds have] five digits in each of the forelimbs (בכל קדמין) and four in the hindlimbs (במאוחריו); and some have five in the hindlimbs as well.

On the Chest (בחזה)

Because of the [strength?] of the [head / breath?] [Illegible: ~2 words] of the living creature (החי), [Illegible: ~2 words] [set / placed?] in the head of the creature (בראש החיה), so as to [move / walk?] and to [Illegible: ~1 word]. And the creatures [as a whole?] have no [Illegible: ~1 word] breasts such as [?].

On the Breasts (בשדים)

That which [bears young?] [Illegible: ~2 words] has two breasts only (שני שדים בלבד). But that which bears its young [in front?] — like the pig and the dog (כחזיר וכלב) — has breasts [set near?] [the forelimbs?]; and the lionesses (הלביאות [?]) have two breasts only, and they are not among those that [bear many young?], since their way [inclines?] to combat (למלחמה) at their [sides?]; and [each such creature?] has [Illegible: ~2 words] its breasts [Illegible: ~1 word], as we find in it. And [a certain kind?] has two warm breasts (שני שדים חמות) [Illegible: ~2 words], but not beside its [Illegible: ~1 word], and there is no [Illegible: ~2 words]. And [as for] the [milk?] of the living creature [Illegible: ~1 word], [it is drawn?] [Illegible: ~2 words].

The [make] intermediate between man and the four-footed creature belongs to the ape: the hindquarters of the ape (אחורי הקוף) are composed such that its [bone?] does not stand fully erect (יושר) as in man, nor stand fully bent as in the four-footed creature (בעל ארבע), but rather [stoops?] a little [Illegible: ~1 word]; [and it is subject to?] injury in combat (במלחמה). [Illegible: ~2 words] its bones [are set?] straight [Illegible: ~1 word], [fitted?] to stand [erect?]. [Yet] it does not reach the erect stature (יושר קומת האדם) of man, nor its [full?] height; and its hands are not like the hands of man (אין ידיו כידי האדם) — rather it has hands [more suited to grasping?] than the rest of the living creatures.

And [as to] why the feet of man are [as they are?]: [Illegible: ~2 words] with digits, on account of his need to grasp (לקמוץ) — more than the rest of the kinds of living creature — since he stands erect (נצב קומה); and there is in [man's hand?] the power [Illegible: ~2 words] over things, and to grasp (ולתפוש) [Illegible: ~1 word].

On the External Organs of the Sanguineous Living Creature (באברים החיצונים של החי הדמי)

that which bears young among living creatures (המוליד מבע"ח). Every kind of this living creature [Illegible: ~2 words], since it has no [Illegible: ~1 word]. There are [some?] fitted to grasp [Illegible: ~2 words] with the jaws (בלחיין [?]) [Illegible: ~1 word], and [strong?] and spread out together. And that which [stirs / draws breath?] [Illegible: ~1 word] [in?] the breadth [Illegible: ~1 word] — there are some [Illegible: ~1 word] upward only [Illegible: ~1 word], such [a creature] as does nothing but [move?] the chest alone (החזה בלבד); and there are some that [stir / breathe?] upward, and [likewise?] the sides together (הצדדין יחד). And such a one bears living young like ourselves (המוליד חי כמונו), because it is [Illegible: ~1 word]. As for the [beasts] of the rest of the living creatures (משאר החי) — their heads were made toward the rear (נעשו ראשיהם לאחור); and the bird (והעוף) [Illegible: ~2 words] they were divided [Illegible: ~2 words], [arrayed?] according to [Illegible: ~2 words], as one who sees [their length?] [Illegible: ~2 words].

On the Bird (בעוף)

And [Illegible: ~1 word] the bird [Illegible: ~1 word] [more than?] the rest of the living creatures. And there is among them [one?] that [Illegible: ~1 word], or that goes from land to land (מארץ לארץ [?]); [Illegible: ~2 words]. So as to [draw in?] the air (האויר) and make [itself?] light to fly (לעוף) [Illegible: ~1 word]. And the bird has [something?] resembling the [Illegible: ~1 word] of man (האדם), but [Illegible: ~1 word] it is not [so?]; and every bird [Illegible: ~2 words], because [Illegible: ~1 word] [attaches?] to the living creature [already?]. And every bird that [soars?] in the air (עורם באויר [?]) — its [Illegible: ~2 words] [Illegible: ~1 word]; and every kind of it has [Illegible: ~2 words] here.

On the Dolphin (בדלפין)

And it dwells [amid?] the water (בין המים [?]) and the [Illegible: ~1 word]; and it has a [lung?] (ריאה [?]) [Illegible: ~2 words], and a place [Illegible: ~2 words], [Illegible: ~1 word] of death [Illegible: ~1 word], and it [Illegible: ~1 word] from their heads (מראשיהן) until [Illegible: ~2 words]. It has no [Illegible: ~1 word] and no feet (ולא רגלים), and likewise at the rear (מאחורין), so that it [could?] [rise?] to eat (לאכול), for it is [Illegible: ~1 word]; and had it been [Illegible: ~2 words]

[composed?] of [Illegible: ~1 word] food, it eats when it is [pressed?] toward the rear (לאחורין [?]). And [Illegible: ~2 words] has no [Illegible: ~2 words]; the rest [Illegible: ~2 words] [for / to fly?].

On the Egg (בביצה)

And its nature (וטבעה) is [intermediate?] between the bird (בין העוף) and the four-footed creature (ובעל ארבע רגלים) [Illegible: ~1 word]; because [Illegible: ~1 word] I have not written [it here?] (לא כתבתי).

and breadth for the quadruped. According to this, it is borne up above [?] at the time [?]. Although it has wings and plumage, it is not fit for flight, because [its plumage] is somewhat thin; and it has hair on the rest of its body, and it has bones like those of a quadruped.

The Fifteenth Treatise: On Generation [המאמר החמשה עשר בתולדת]

[Opening words above the first line of body text, small hand: "כל בעל דם הוא נולד" — "Every blood-possessing creature is born" [?].]

from male and female. Among living creatures there are some that are born from putrefaction, except that only a single kind is born from any one source of putrefaction. That which is born from putrefaction is not born from male and female, and that which is born from male and female is never born from putrefaction — not at any time [?]. The difference between the one born from putrefaction and the one born from male and female is this: in the one born from putrefaction, the matter is not [ordered?] in the generation, so that whatever is generated on its account is a known kind, and it is thin [?] according to the way of its kind; and it generates on account of one kind, but on account of another it does not [preserve itself?]. The one born from male and female, by contrast, has no cessation; rather, it can produce a continuing line of offspring from itself.

The living thing born from putrefaction is like a plant, since its nature resembles the nature of a tree that grows from putrefaction. And there are some [creatures] that have, in place of [?], [the sheep? הכבשים], in whose nature semen flows [?], as with the beasts; and there are some of them that incline toward [another?] nature — such as the [הקוסד'?], the weasel [חולדה], the [הסנאיר?], the [סלחטאה?], and the [לשוף?]. Generation occurs in these on account of the coldness of their temperament; and by their nature they are [enclosed?] within, at the end of the

belly. [Several clauses here are dense with technical and foreign zoological vocabulary and cannot be resolved with confidence: ונמלה מי שבצו מבחוץ טאנוס ובבעל ארבע הוא חש בטבעו והבצים הם הנצמא הראשון בתולדת והבטן קטרים ישרטה ממנו למין נ..שיס ואינו מולד אלא מה... בעבור עור כי הוא נקק לגבתה בכף שסרסוהו והדקה ממנו לפי שאורחן — [Illegible: ~3 lines, faded technical passage on the organs of generation].]

The view of Aristotle [ארסטו] is that the existence of the testicles [Hebrew: הבצים] is not required for the coming-to-be of semen insofar as it is semen: there are many living creatures that have semen without testicles. Rather, they serve for [strengthening / stabilizing?], and their function [?] is that the living creature should not discharge [its semen] too quickly, on account of the [?] — like the usefulness of [?]. And therefore the [?] has testicles [יש לו בצים] and does not copulate much,

and it prolongs the copulation a longer time. And the difference [?] is in one that has no moisture [?], as with the dogs [הכלבים?] and the beasts: these grow excited quickly and copulate quickly. The view of Galen [נאלינוס = Galen] is that they [the testicles] are required for the coming-to-be of semen, by the necessity of [?] — [בבא הקרינם והקדושה והלב בכח החי — the coming of the [?], the [?], and the heart, by the power of the living creature [?]] — and therefore there is [?] one [?]. And why do the animals and the bird not have [?] — this is on account of the length [?]; and since the living creature draws near, in its emission, to the gathering of nature [?], nature made [?] the length of the bird [?], and its [?] a fixed measure by nature [?]. Therefore, one whose [?] is long has a stronger offspring than one whose [?] [is short?]. And the kind of animal that has no sinew, cartilage, or [סוקיס?] has no [testicle?] [in it].

On the Womb [ברחם]

The number of its chambers in the animal corresponds to the number of its offspring, and to the number of the teats. The wombs of the bear [הדב] and the [שוף?] appear [?]. And so [?] its [?] persists [?]. The womb of the [קשיש?] is in the lower part of the belly, and the womb of the [שוף?] is higher up, near the [?]. The womb of some animals is [set?] in several places, or such as bear their offspring [in several?] places; and there are those whose offspring [are born] incomplete and are completed outside, like the [dogs?]; and there are those whose offspring are formed [within? בגוף] and it gives birth outside to a living young, like the beasts. And why is every womb enclosed within, and not outside? On account of the safeguarding of the fetus [השבר / העובר?] that is born in it, and the creature's need to copulate — which would not be possible for it if [the womb] were outside.

On the Nature of Semen, and from Which of the Organs [It Issues] [במהות שכבת זרע ומאי זה מהאברים]

[Small marginal / catch-word at the rubric: "יבא" (?).]

The ancients [held] that it [the semen] issues from every one of the organs of the body. But Aristotle [ארסטו] argued against them and nullified their opinion by [?]. Since it became clear that the offspring [comes] from the semen, and it became evident to him that there is no evidence that the semen issues from all the organs, he therefore now considers in how many senses one may say [that a thing issues from a thing]: for one who would speak of a thing according to what he intends by it — in one sense one says that the offspring issues from the semen. And he said that this is said in four senses [ד' פנים]. First: [it issues] from the kind — that is, "one," as when it is said, "from the whole [class] shall come [?]," meaning one out of the whole. Second: as the contrary to it, as when you say, "the priority of the white comes from the black." Third: from that which is [potential / conceived?] there comes to be a form [צלם, tzelem] — that is, that which is in actuality [comes] from that which is in potentiality [שבכח … שבפעל]...

[Pencil foliation "6" in the lower outer margin of the verso.]

) sits in the lower gutter of the verso, and the scanner's blue ruler ("20 / 50") frames the verso — neither is part of the manuscript.]

[Recto — p. 31]

Since he has just given the analogy of [בצבור קטן — "in a small aggregate/mass" [?]], [it follows that] the generation of the offspring comes from the semen. The semen is like one of the things that are made out of other things — or like [כאנקסי [?] — a transliterated term or name]. That is to say: at the moment it is absorbed and becomes active, the semen is a residue [יתרון], a [קדם/קרש [?]] residue that is, in potentiality [בכח], all [the parts]. And we say, regarding the matter, that [its power?] is not found in [another individual] of its own kind, but only in [מאיטמעי טריטו [?]]; yet in [קדם לבן שוטמס [?]] this residue is found [Illegible: ~2 technical tokens]. Therefore, from that which is a residue, [the offspring comes] to resemble [לדמות] the [form / face — הפנים [?]] [Illegible: ~1 word].

[This residue] is fashioned [Illegible: ~2 words] according to the sun's [heat] [כפי השמש], the temperament [המזג], and the [bodily] health [ובריאות]; and it is weakened when [the parts] are moistened, [just] as [Illegible]. When [the residue] comes [Illegible: ~1 word] according to the sun, up to the point of [קמריס [?]] and

grows strong [וחזק], [Illegible: ~1 word] a deed [מעשה] of a white [substance? — לבן] in which there is no [בקס [?]] [Illegible]; and the [sick? — החולים] [Illegible: ~1 word] this [deed] performs. [Right margin, small hand: הדס [?].] [Illegible: ~1 word] is renewed [חדשה [?]] and [Illegible: ~2 tokens], and accordingly the offspring — its cause is this [Illegible: ~1 word]: [Illegible: ~1 clause]. And the fatness [השמן] has an operation [of its own], and much [belongs] to these organs [Illegible]. This residue is in the heart [בלב [?]], and [Illegible: ~2 transliterated tokens] the many [Illegible], their operations and their births; and the matter [והדבר] [Illegible: ~1 word] as [Illegible], because [שרכבס [?]] — if it does not stand [as] an operation [Illegible: ~1 word], the residue [Illegible: ~2 tokens] to increase [Illegible]. And accordingly there are cases [יש מקומות [?]] in which there is none [שאין [?]].

[Enlarged display rubric — p. 31] במהות זרע האשה — On the Nature of the Woman's Semen

[Directly beneath the rubric, in large faded strokes: "וברס טדה … ודס" [?]. Almost certainly bleed-through of the rubric from the reverse leaf (or a decorative repetition), not a separate sub-heading; not resolvable. Further identification requires further verification.]

The [woman's contribution — the menstrual] flux [נדה] is a residue of a residue [יתרון מיתרון], one that is not [fully concocted] [Illegible: ~1 word]. For, on account of their ducts [קירותן [?]] and the moisture of [Illegible: ~1 word], a residue remains in [Illegible: ~1 word] that cannot be concocted [לעכל — "digested / concocted"]; and the embryo [העובר] [Illegible: ~2 words] in it, as one calls the residue of [Illegible: ~1 word] [that is] "in the sand" [בחול [?]] — which is called a natural flux [זוב טבעי [?]] — it can be concocted, and it produces [Illegible: ~1 word]. And accordingly [Illegible: ~1 word] they fill up with it [Illegible], full [מלאים [?]], and it does not [Illegible: ~2 words] [Illegible: ~1 word] of the [Illegible]. And the natural [heat] [Illegible: ~2 tokens] goes forth [Illegible] for the matters [that] fill the [Illegible], and you see [Illegible: ~2 words] that [Illegible: ~2 words] concerning the man, that one sees the [Illegible] and the deed [ומעשה] [Illegible]; [Illegible: ~2 words] to be from a single [Illegible], as they say [Illegible], and in the end [ולבסוף [?]] [Illegible: ~1 word] and the beginning [Illegible: ~1 word], the residue [Illegible: ~2 tokens].

[Verso — p. 32]

[Upper right margin, small hand: a marginal word, "אשריים" [?] or similar — a marginal note or catchword; not resolvable.]

For it happens to them from [Illegible: ~1 word], since the earlier ones [המוקדמים? [?]] [Illegible: ~1 clause]. And the tip of the nose [ראש החוטם] spreads out and is divided off from the [Illegible: מהמקורים / מהמקרים [?]], as [קדרים [?]] upon [their joints — פרקין [?]]. And the semen, [when? — ומשי] there is in it [something] that can be separated out [יתפרק] into a fleshy [part] [לתולדה בשרית] — just as [Illegible: ~1 word] can be separated out [Illegible: ~1 token] — [Illegible: ~1 word] that [the part] separates and is set right [וירפא / וירתפא [?]]. And there are [Illegible: ~1 word], [Illegible: ~2 transliterated tokens], up to the point that [the embryo] is generated [שיולד [?]]. In sum, regarding the matter: because the [Illegible: התדריון [?]] does not take [Illegible: ~1 word] as [Illegible: ~1 word] [Illegible: ~2 words] [Illegible: ~1 word].

Now [Illegible: ~1 word]: the view of Aristotle [ודעת ארסטו] is that there is in [the semen — Illegible] a power [Illegible: ~1 word] set in it [Illegible: ~2 words] to the generated ones [להוליד / הפולדות [?]], not the woman's semen. But the view of Galen [ודעת גאלינוס] is that in the woman's semen too there is a power fit to generate [כח ראוי להוליד]. And the view of [שי־סטו — Aristotle, again? [?]] is that he holds the man's semen [זרע האיש] to be required [יתחייב / needed] for this — like the rennet [כמו האנפחה — Arabic *infaḥa* [?]] to the milk [לחלב], which curdles [it and turns] the milk [white] [Illegible: ~1 token]. And consider [והבן / וכלבך [?]] what he said: that the offspring comes from the semen [מן הזרע], [and] it is the strongest [הקשין / הקשה [?]] of the [Illegible: ~1 word] — as our Rabbis, of blessed memory [רבנן ז"ל? [?]], said [Illegible: ~1 token], and it is called, as it were, "from [Illegible: מקושב [?]]."

And what Ibn Ishaq [בן ישאה [?] — an uncertain named authority, possibly Ibn Ishaq] said: the man's part [contributes] known [determinate] organs [אברים ידועים], and likewise [ומדבר [?]] the woman's part [contributes] known organs, and [Illegible: ~1 word] known organs — for [the semen? — Illegible] performs [Illegible: ~1 token] and [Illegible: ~1 token]; thus not every organ [כל אברי] of the embryo [העובר] is carried [Illegible: ~1 word], but [Illegible: ~2 words] alone; and from it [ומ] [Illegible: ~2 words] [Illegible: ~1 token].

[The semen? — Illegible] is brief [קצרה [?]] in the heart [בלב [?]]; and there is in it a power [כח] to distinguish one organ from another [להסיר / להבדיל אבר מאבר]. And it divides [ותחלק] whatever [Illegible: ~1 word] is mentioned in it [that] comes [Illegible: ~1 word] fleshy [חלבי / בשרי [?]], and in [Illegible: ~1 word] like the bones [כעצמות]; but [Illegible: ~1 token] has no [Illegible: ~1 word] found in generation [בתולדה]. For the [Illegible: לבד / נחש [?]] is [Illegible], and how does nature make [Illegible: ~1 word]? And further, because the male equalizes [הזכר

משוה [?]] — from it [comes / and against it is] the female [הנקבה]; and if [Illegible: ~1 word], the male is the active principle [הזכר הוא הפועל] toward this — this is why there come to be [Illegible: ~1 word] sometimes males and sometimes females [פעמים זכרים ופעמים נקבות].

The resolution [פירוק] of this objection [is] in the eighteenth treatise [במאמר שמונה עשר] [Illegible: ~1 word]. And there is [a case] in which [Illegible: ~1 word] — a doubt [ספק], another one, in the operation of [Illegible: ~1 transliterated token, "דורקטי" [?]] — [creatures] that have no menstrual flux [שאין להם רס נדה [?]] and no [Illegible: ~1 word], yet they generate [ויולדו]. One may say [יש לומר] that [Illegible: ~1 word], though it does not generate, and if [Illegible: ~1 word], its coming [Illegible] is by their [Illegible: ~1 word], as [it were] by witchcraft [כמו כשף].

And the view of Aristotle [ודעת ארסטו], as [was stated] earlier [כמו שקדם], is that it is [Illegible: ~1 word] [Illegible: ~1 word] toward [Illegible] the organs [האברים]; so too it [Illegible: ~2 words] toward [Illegible] the [Illegible]. For it is fit that the embryo be [Illegible: ~1 word] — the last [ridge? — Illegible] of the organs is the nature of the generated one [Illegible]. [Illegible: ~1 word] from it, and [Illegible: ~1 word]. And Aristotle held that the woman's semen [זרע האשה] has no power [אין לה כח] for generation [להתולדה] — it is only [שהוא] a residue [יתרון], and [Illegible: ~1 word] do not go forth [יצאו] from it, and the [claims / objections — הטענות [?]] are not found.

[The Fifteenth Treatise, "On Generation," continues from the foot of the previous folio.]

[Some?] hold [?] that offspring conceived at [the proper] time [?] are born male, provided that [people] cohabit with their wives at the time when the women are ritually pure (טהורות). And Ibn Rushd [אבן רשד; Averroes] said that it is difficult to obtain reliable testimony (בעלות אמונה) from women; and they reported to him [several things]. [The next line or two, badly faded, tell of a case related on the authority of Aristotle concerning the hen: how the hen lays a white "wind-egg" (ביצת רוח) [?] — an egg in which there is no chick — because it is only the [matter], while the form is lacking [?]; only some words are recoverable.]

When such an egg is produced, its likeness and appearance come to resemble the latter male [?]. There is a kind of [bird?] in which no male is needed [for every egg]: when the male casts its semen (זרע) upon the eggs, whatever the semen reaches among them it makes [fertile] — and it reaches the greater part of them — but the little that it does not reach it does not [fertilize].

And how does the menstrual blood (דם נדה) serve [as the underlying matter]? When the two mingle in the womb (רחם), the male's semen — because it was a concocted surplus (יתרון מבושל) — contributes to the embryo (העובר) its portion, which is the natural spirit (הרוח הטבעי); whereas the menstrual blood is an unconcocted surplus. Therefore the male's semen separates out [?] the menstrual blood, casts away the part that is not fit for generation and expels it, and acts upon it as rennet [אנפחה [?]] acts on milk to complete the setting (הקפאה). Thus the menstrual blood is the [matter], and the male's semen is the form (הצורה); and for this reason the male's semen contributes to generation in quality alone (באיכות בלבד).

The Sixteenth Treatise

On why [?] — [subtitle: מפני מה כ[?]; only the opening words are legible.]

The male and the female exist by nature in many of the living kinds. As [Aristotle] said, such a creature generates only by the union of the male with the female, on account of the excellence of that living kind — so that the nobler is [brought forth] by nature. A species that has both male and female is nobler than one that has a female alone, just as the animal that has [blood] is nobler than one that has no blood (דם).

The generating animal (החי המזריע) is of five kinds:

Some bear a live young resembling themselves in form within them, and [bring it forth alive] — such as man, cattle, dogs, and the viper (אפעה).

Some produce eggs (ביצים) within them, and the egg splits open within them, and a live young resembling them emerges — [these are] among the kinds of living creatures.

Some produce complete eggs [?] — such as [certain birds], the scaly creature (בעל קשקשים), the [tortoise?], and the lizard (חרדון).

Some produce eggs that are not complete — such as the fish (הדגים), and likewise the [?].

And some produce grubs (תולעים): this is the living creature that [reproduces so], and there is [also one that produces] a live young [?]. As for the small grub — the embryo (אפרוח) issues from one portion of the [fixed] portions [of the parent] and is nourished from one portion of it; but in the case of the grub, the living creature that emerges from it consumes [the whole of] it, and takes on the form of the

grub. And the living creature that does not reproduce [sexually] is the one generated from putrefaction (הרקבון), and all this [comes about through] heat and moisture (החום והרטיבות).

For the living creature that has semen — of one [sex] or more — is higher in the rank of generation. Therefore that which bears a live young resembling it within and without, and which is like it in form, is more noble than they, and is not among the inferior in the rank of generation; whereas that which bears incomplete eggs resembles it [only] deficiently [?], and is lower [in rank]. But that which bears a grub is the living creature that has no [blood?] in it, and it belongs to the [kinds] of birds [?]... [and what he said... is the form to the male... some words here resist.]

just as [the young] takes [its nourishment?] from the wood — [rennet?] [?] — so is the semen in the male. The male, by his semen, makes from the menstrual blood [a mixture] [?]. In the semen is the first principle of the animal's life-power (ראשית הכח החי), and [it is present] from the first in whatever is made from it — and that is the heart (הלב). For the heart is [the seat of] the soul (הנפש); from it nature begins to build the organs, and no organ is left without a soul acting in it by [its] power. This power ministers [to the organs] by nearness and by distance, and therefore it subsists in the heart more fully than in all the [other] organs, because the heart is, in potency, all the organs.

The substance of the living creature is [airy and watery] [?]. From the bird there issues a white [substance], the embryo's [navel?] [?]: the airy part [is warm], and when it is taken outside the body [of the bird], that warm spirit and its airy part [depart], and the watery part remains; and it becomes a black moisture [?], so that nothing remains in it but water and a little of the reddish part. Therefore the embryo receives its nature from the water and the spirit (air), and it appears that this is as was said before — that it is [airy?] and moist. And [as for] why all semen is white...

[The discussion breaks off here at the foot of the folio.] ...[because of its heat] [?]; and butter is white, and the same happens with oil [olive] [superscript gloss: זית, "olive"]. And because of its motion and its prior [warming] [?], the semen [is whitened] [?] before it becomes airy, like olive-oil [?].

[Display rubric, in enlarged letters across the line:] Is there a soul in the semen, or not? [היש בזרע נפש אם לא] [Interlinear/marginal addition above the end of the phrase: "and whether there is in it" (ואם יש בו נפש)]

[Whether the soul] is doubled from without, or whether [it is generated] [?] — there is in it, from without, something hard [?]; for [the substance] separates from the semen, that is to say, [it does its work] [?] afterward, and there remains [?]... And it is not separated from it. These are its powers [הכחות], which complete their action [?], for how [?]... it acts like the [nutritive faculty] [?] and the [?] of the living creature, and their [strength] [?]; and it is set to work in [the organs] [?] — as in digestion (העיכול) and [?] — and each organ [אבר] has its own function [?]. Therefore, by the power of the [nutritive faculty] (כח הזנה) [?] and [its composition] [?], it is concocted especially in the belly [בטן]; by the power of the psychic faculty (כח נפשית), which is set within the semen mingled together (בערבוב), it produces [?] the powers (הכחות) by which the living creature (החי) is made — its head, and likewise its organs (כאברים) and their forming [?]; and [it is that which] produces a soul [?]; and by this power [?]... for it is set higher [?]... and it makes for [the creature] a distinct form [?], because that which rules the whole [?]; and this is called the heart [הלב].

This is the opinion of Aristotle (ארסטו): that the heart, separated off first [?] from the heat (החום), is the part which they called [?]; it gives to the offspring (הולד) the power of the spirit (הרוח) alone. And this spirit [enters] into the menstrual blood (דם נדה) and mixes with it (ותתערב), until [it settles] [?] in the heart (הלב); and by this spirit the organs (האברים) are completed [?] — to form them (לצורם) and [to joint them] (ופרקים) [?], and to add to each organ [its form] [?]... just as [?] the heart, and it is like a governor [?] governing the inner [members] [?], [by means of] [?] a form that is known [?] and received [?].

And if [it is completed] [?], this pneumatic part (החלק הרוחי) is separated; it dissolves and divides into the air (האויר) taken into the cavity (חלל) of the organs, and [that within it] [?] divides and [forms] [?]... For it is not possible [?]... and at the end [it is] found [?] from the [decay] [?], and it necessarily follows [?] — and this, from its being within it, [because it is set to excrete] [?] or in the mingling (בערבוב); and [the heart] ought to have within it three things (שלשה דברים): the first, that no part of its action (מפעולותיו) should go out, and that it not be separated, and not [?], and not [be] a separated part.

And [it happens] [?] to the living creature to be distinguished [?] from [the matter] after [the parts] were created [?]; the corporeal (הגשמיים) organs are distinguished, and the living body (החי גופיי) [?]; and it is not possible for the semen to remain alive [?] — to preserve [it] in this way — except by a prior [?] part; and it is separated from it. For if there were moisture (רטיבות) [suspended] [?] in the menstrual blood (דם נדה), a part of it would be the heart (הלב). What is

said about this — that the swelling [?] belongs to the heart (לחלב) — is not true; that is to say, because the swelling [?] does not settle in the heart (בחלב) in [a known manner] [?], and the [?] settles [?] in the menstrual blood (דם נדה), and it is [?] to the swelling [?] at one instant [בשעה אחד] [?], and it is the [ventricle?] [נתבקטוריא [?] — a transliterated anatomical term, uncertain].

Inasmuch as the swelling [?] settles in the heart (לחלב) at [a known] instant [?]... one who speaks of the airy part (החלק האוירי), and one who speaks of the spirit that is in the heart (הרוח שבלב) at [its passing] [?]. For if it were generated by nature [?], the semen would be a part of the [matrix] (הקן) [?] and would not be separated from it; and were it so, chambers of spirit (בתי רוח) would be made in the heart (בלב), or a mixture of the organs (האברים); and were it so, a simple [i.e. undifferentiated] living creature (חי פשוט) would be made upon the composition (הרכבה) — which is not so at all. And the heart, which was [set] for its forming (לצורתה), is the one [?]... the sensing [organs] being distinct (משונים), the one [?] and the heart (ולב); and the rest, from the moisture (הרטיבות) [?] in which is the airy part (חלק האויר) — how can one say [it]?

For [one holds] that this part of the air mixes in (יתערב), like the moisture (הרטיבות), inasmuch as it is [made] from it [?]; and it is separated from it, in the way that the airy parts (חלקי האויר) separate from the [coarse] organs (האברים) [?]. And it is separated like [?] the menstrual blood (דם נדה), and there it separates from the mingled moisture (מעורבת רטיבות), and settles within it (וישקע בו) until the mixture (התבוסה) is completed [?] and its form [?] is found. And afterward it is separated from [?], for it makes a living creature [?] that is not mingled, unlike that which is mingled from it. And this is as Galen (גאלינוס) [held] [?], as was fitting... [not] with pains [?], for the pains (המכאובים) do not act so; but rather from the organs (האברים), [?] from the coarse part (מהעובי). And this airy part (חלק האויר) is itself [?], like the action (כמעשה)...

[generated] from the decay (הרקבון) [?]; and why is it called [?]... it does not divide (יחלק), and one holds (ויסבור) that in the flesh (בבשר) [?] this airy part (חלק האוירי) has sunk away from it (שנשתקע ממנו). And what appears is not [as] at the time that Galen (גאלינוס) spoke [?] — that the [?] say [such] accidents (מקרים) occur [?]; and were it so, [it would follow that] the one would be preserved (וישָׁמר) [?] in the flesh, and would be divided into a second [?], and would not be divided into another [?]. So they said, the masters of medicine (בעלי הרפואה) [?].

[The embryology discussion of the semen carries over directly from the foot of the previous folio.]

just as, even when it hardens, [the parts] return [to it]; and there was no difference on account of youth [הבחרות] nor on account of old age [הזקנה]. It has therefore already been shown that the semen of the male does not whiten from [?], but is wholly [uniform] to itself. And Galen's [גאלינוס] view is as follows [?]. He brings a proof from the words of **Hippocrates (אבקרט)** [Abuqrāṭ]: that [the semen doubled? — superscript gloss שכפל [?]]; after a few days [?], and the semen ceased [ובטל הזרע] from her, and [?]. But as for the membranes [מקרומי] of the [?], this is no decisive proof — for the point is that the semen does not separate from its uniformity [מהשווי] until it is complete [שיגמר], just as all the flour does not separate from what has been kneaded into it [?].

[Display rubric in enlarged script, three lines:] On the existence of the two residues [השתי יתרונות] — which are [?] [?] דסערה — reading uncertain] — and the semen being like the body of the living creature [והזרע כגוף החי]. [faint interlinear glosses at the rubric, too light to read with confidence]

These residues [יתרונות] are [either? (?)]; and the womb's reception [קבלת הרחם] of them is by the power of the attractive faculty [בכח המושך]. And why are they delivered [ימסרו] at the time of [?]? Because the residue of the semen [יתרון הזרע] serves [משתמש] first in [forming (?)] the organs [האברים], and it remains hidden until [the embryo (?)] is complete [נשלם]. And since there was nothing with which [it] could serve — or its service is diminished — because the organs are near to being complete [מלהיות גמורים], this residue issues [from the body (?) מהגוף]. And why is [it] finer [דק] in women, since they are colder [קרות] in their season [בזמנן] than men [מהאנשים]? Because the residue of the [menstrual] matter [יתרון הכבס [?] — the menstrual residue], which is not fine [שאינו יפה], gathers in them [יתקבץ] more than it gathers in men [באנשים]. And this residue serves in women in a fixed measure [בשיעור תקן], and the remainder [?]. Therefore it more often befalls them [women] that periodic blood [דם עתי [?]] comes at the end of the [lunar] month [בסוף חדש הלבנה — "at the end of the moon"], since that time is nearer to the new ferment [השאור החדש] on account of the gathering [קבוץ] of the superfluities [המותרות] — just as happens at the time when [?], since the light of the moon [אור הירח] is full [שלם] [?]. And if this residue issues from them as is fitting [כראוי], they are filled with many ailments [תלאים [?]]; and if it is too little or too much, it produces ailments [חלאים] for them; and [at the time (?)] of concoction [הבשול]: therefore, if the residue is thick [עב], it is well concocted [יתבשל], and if it is thin [דק], it [flows (?)]. And why is this residue in the womb [ברחם] more than in the rest of the organs [משאר אברים]? Because of the [?] in it. And how is the formation [היווי] of the [?] of its semen [זרעו], when it is received [נקבלה] into the womb [הרחם] [?] — [the final line of the written block before blank parchment].

[The lower half of folio 10r is blank parchment below the text-block; a Hebrew-numeral folio mark stands at the lower outer corner.]

in drawing from its region [מעונה] the tempered part [החלק הממוזג], until [it is drawn] there by itself — either by the power of the attractive faculty [בכח המושך], or [?] of the organs, just as [the heart] draws the [moisture (?)] that is outside [מבחוץ], or by [?] of the organs [?]. And according to the formation [היווי] of the embryo's organs [אברי], **the heart is [formed] first [הוא הלב תחלה], and it is the root of the body [עקר הגוף]**; and last are the inner organs [האברים הפנימיים], and after them the [intestines (?)], and after them the brain of the head [מוח הראש] and the liver [הכבד]. The organs that lie above the diaphragm [שמעל לצרתא (?)] — the midriff] are made before their completion [קודם משלמותה]. So too in the plant [בצמח]: the first thing that appears in it is short [קצר] [?]; and in some seeds [הזרעים] the last organs [האברים האחרונים] are not seen in it until after their birth [לאחר לידתם] [?].

[at] the time of their birth [זמן מולדתן]. And the organs that the embryo [העובר] uses outside the womb [חוץ לרחם] are weak [חלשין] and low [in function], since no work is [done] with them in the womb [ברחם]; and therefore [?]. And it is fitting that [it] be diminished [שיתמעט], since they do not carry the split [wounded] organs [האברים הפצועים] alone, separated [מובדלין] at the outset from the mixed ones [מהמעורבבין]; rather they carry the small ones [הקטונים] together with the mixed ones [עם המעורבבים], since they are a part of them [חלק מהן], and they are not torn away [ולא ימרטו] separated from them except in death [במות]. And the important organs [האברים החשובים] carry from the important part [מן החלק החשוב] in the [?] [בגלגלא — the "revolution/sphere" (?)], like [?]. It is said [?] that [?] in the [?] [שבגלגלא]; and there is carried first, from its region [מעונה תחלה], the important one among the organs [שכאברים] — and it is the heart [והוא הלב]. And after that, by degrees [במעלות], until at the end [נסוף] they carry [nourishment] to sustain [לפרנס] [?].

the hair [השיער] and the rest of the [?] from the [?] bone [מהעצם], and the shins [והשוקין] and the sinew [והעצב] and the bones [והעצמות] and the nails [והצפרנים] and the membranes [והקרומות] and the hair [והשער] return [יתובו] [?], and it is gathered [ויקבץ] from the cold [מן הקור]. And the first organ [ותחלה אבר] made from the simple parts [מהפשוטין] is the [hard part (?) קשוי], and the bones [והעצמות] and the nails [והצפרנים]; these are always smaller [קטין לעולם] than the rest of the bones [משאר העצמות], and likewise the flesh [הבשר]. And why are the bones [העצמים] always moist [טרין תמיד]? Because they are worn down [שיסחקו] in [?]. And we ask, what is the reason [?]? Because the residue of the bone [יתרון

העצם] does not [?] the hollow [הנבוב [?]]. And we say that the bones are always moist; therefore [?], since it is impossible [שאי אפשר] to repair [לתקן] them so that they return [שיחזרו] [?]; [rather] the choicest [המובחר] is gathered [יקבץ] from the residue of the ferment [יתרון השאור] [?], moist [?]. [?] And the bone draws [יחון (?)] from the hollow [מהנבוב], since the [?] heat [החום (?)] [?] from [?] of the [?] matter, until [?] — [the final line of the written block before blank parchment].

[The lower half of folio 10v is blank parchment below the text-block; a modern pencil "10" stands at the lower outer corner, confirming this leaf as folio 10.]

[The opening continues the Sixteenth Treatise (on generation), carried over from the preceding folio: the discussion of what the offspring draws from the female and inherits from the male semen versus the menstrual matter runs straight into the top of this page.]

the females [הנשים] … just as [the plant] sends its roots outward to draw nourishment from it [כמו שישלח שרשיו לחוץ שיקח ממנו], [so it draws] from her [ממנה]. And there is [ויש], between the womb [בין הרחם] and that which breaks it down [והשובר] [?], the premises that encompass [it] [והקדימות הסובבות].

Concerning what is essential — [enlarged display word:] **בעקר** ("at root / in essence") — it has [ויש לו] a part by nature [טבע] and a part by accident [ומקרי], corresponding to nature [כטבע] [?]. The male semen [זרע הזכר] or the menstrual blood [דם נדה] is imparted [נתן] either in their quantity [בכמותם] or in their quality [באיכותן]; and the sign of the male semen [וסימן זרע הזכר] in the offspring [המולד] [is this]: if it drips upward [אם יטף למעלה] it does not beget one [אינו מוליד] that is not of its own nature [שאינו מטבעו]; but if it sinks [ואם ישקע],

it does beget [הוא מוליד]. And the [?] [Illegible: ~1 word — "the elder / the old one" (?) הישיש] craves it [יתאוה בה] [?], in the kind of its color [במין הצבע] [?]. [?] [Illegible: ~1 clause] if it acts until it reaches [its] end [עד קץ] [?] and drinks of them [וישתה מהן] [?] — it is white [הן לבן], and this indicates [שזה יורה] that the semen is white [שזרע לבן], and that this belongs to the [proper] place [למקום]. It [?] pours toward those [that are] white [לאותן הלבן] [?], for a change is seen in it [כי יראה בו שינוי] at the time of its formation [בעת התהוותו] [?]. And therefore, most of the well-concocted, fine [portion] [רב הבשולה הדק] [goes] to the brain of the head [למוח הראש], so that the warm air is separated out from it [שיתפרד ממנו האויר החם].

And what is [produced] by nature [הנברא] and what by accident [המקרי] — whether they are its qualities [איכולו] [?] or [something else] — [is] on account of disease [בעבור חולי] [?]; and there is not, in any one of them, [a fixed] sign [ואין

באחד מהם … סימן] [?]. [It is] from this [?] that the semen of the donkey [שזרע החמור] is cold and dry [קר ויבש], and the proof [וראיה] of this is that it does not couple [כי אינו בועל] [?] except in heat [כי אם בחום] [?]. And there is yet another proof [ועוד יש ראיה אחרת] [?] that the horse [הסוס] [?] is warm: that if a donkey [חמור] couples with her [ויזדקק לה], the [horse-]pregnancy is spoiled [נפסד ההריון]; but it is not spoiled [ואינו נפסד] if

another horse [סוס אחר] couples with her [יזדקק לה]. And the generation of the mule [והתולדת הפרד] is on account of the mingling [בעבור עירוב] of the two opposed semens [השני זרעים הנגדיים] — in heat and in cold [בחום ובקירות] — which did not mix a complete mixing [ולא נתערבו עירוב גמור]; that is to say [כלומר], either they are of one species [או הם ממין אחד] and this [product] was an intermediate [היה זה מיצוע] and not essential [ולא היה עקר], but only because [רק מפני כי] the donkey itself [החמור עצמו] differs greatly in nature [מובדל הרבה מטבע], and not [merely] [?] [Illegible: ~1 word — "in accident / in temperament" (?)] — [and] not in their being opposites [לא בהפכם] [?]. And [regarding] the dog [והכלב] [?], by its nature [כטבעו], it was all the more necessary [יותר נתחייב] that what issues from them [היוצא מהם] [?] be a [distinct] species [מין]; and if not [ואם לאו], their species would be found void [היו נמצאין מינן בטל] [?]. And it is possible [ואפשר] that the [?] would be an intermediate [שתהי … במיצוע] [?] if they were not mixed [אם לא תגבלו] [?]. It is possible [אפשר] that it begets a white one [שיולד לבן], because the male [לפי שהזכר] is warmer than the female [יותר חם מהנקבה].

The Seventeenth Treatise, on the generation of [המאמר השבעה עשר בתולדת] the living creature that reproduces by eggs [החי המוליד בעצים]. [The word בעצים/ביצים carries supralinear diacritical points.]

[The heading stands about two-thirds down folio 11r in thicker display ink; below it the lower part of the leaf is blank parchment.]

[Interlinear addition above the first line, outer edge: "and the albumen" (והחלבון).]

[?] [Illegible: ~1 word], and the animal [והחי], by [its] nature, [is of] four [kinds?] [בטבע ארבע] [?]: there are found in them the albumen and the yolk [ימצא בהן חלבון וחלמון]. From the outside [the white] surrounds the yolk [מבחוץ סובב כחלמון]. And there is [ויש] a species [מין] whose [?] is like a single nature [כטבע אחד] alone [לבד]. And the white [והחלבון] [?] is made, by nature, fine [יעשה בטבע דק] [?] … toward it [לתקבה] [?]; and they are called [ונקראין]

the green egg [ביצה הירוק]. And it descends [ויורד] [?], more than what [it] made [מה שעשאה], in a manner [?] [Illegible: ~1 clause] not [?] [Illegible: ~1 word] much [הרבה]. [It is] like a little white [כמו עלבן] [?] and [?]. But the [?] [Illegible: ~1 word

— "the maker / the compound" (?) המעשתף] does it [only] a little, by nature [עשה מעט בטבע]; and in all that has [ובכל מה שיש] [?], a small [amount of] white [עלבן קטון] [is present] in its time [בעתו] [?]. It begets [הוא מוליד], descending by nature [יורד בטבע]; and they gather [ויקבצו] [?] from the residue [מיתרון] of the menstrual blood [דם נדה] [?]. And it is not [ואינה] separated from it [נבדלת ממנו], but rather [אלא] it takes [יקח] from them [מהם] [?] — the menstrual blood [דם נדה], just as [it] issues [כמו שיצא]

[?] [Illegible: ~1 clause, faded] … and they have not [ואין להם] [?] menstrual blood [נדה] [?], nor [ולא] their semen [זרעם] [?]. And the animal that makes it [והחי שעושהו] [makes it] fine [דק], and [?] [Illegible: ~1 word]; in it [שי בו] [?] it begets [יולד] a sharp one [חד] [?], because it does not contain them [לפי ש… לא יכלוהו] [?], [and] the hidden [portion] [הנעלם] [?] — its semen is made [נעשה זרעו] [?]. And the [?] [Illegible: ~1 word — "matter / natural [heat]" (?) הנרמא], when it is gathered [בהתקבצן] [?] or when it is used [או בהשתמשן], is [where] the heat is great [הוא כבה החם] and the moisture [והלחות], and it uses it [ומשתמש בו] [?]. And [when] it draws off [ומשך] [?] much [הרבה] and makes much [ועשה הרבה] [?], there is [הוא] a living creature [חי] beneath it [תחתיו] [?]. And likewise the liver [וכן הכבד], by its nature [בטבעו]; and in the organ that [ובאיבר ש…] does [something] [שעושה] [?] [Illegible: ~1 word] —

in its depths [בעמקיה] [?] [Illegible: ~1 word], and it is found [ונמצא] that it is part of the growth [שהיא מקצת צמח] that does not move [שאינו נע] [?], for [it has] but a single quality [כי אם טעם אחד בלבד] [?], just as the [?] [Illegible: ~1 word — "the beast / Eve" (?) החוה] is like the son [כמו הבן] [?] and [?] [Illegible: ~1 word], the whole [of it] being consumed [יכלה] at first [בראשונה]. And [as for] the variety of the members [וחילוף הקברים / האברים] [?] which is not [שאינו] much by nature [כטבע הרבה] [?] — and [when] one [?] examines it [וכואיא בו] [?] and it is drawn out [והוא מאויך] [?] [Illegible: ~1 word] days [ימים], so that it does not become fresh [שלא יעשה טרי] [?], but only [אלא] what was [already] mentioned [מה שנזכר]; its trace [remains] [כמעמון עטו] [?]. And there is to be reckoned [ויש לחקונו / לחקור] [?] a matter peculiar to them [דבר מיוחד להן], and it is [והוא] [?]: when they [?] [Illegible: ~1 word — "smell / gain" (?) כשיריחו], and the belly [והכריס] [?] toward the extremities [לתקצוות / לקצוות] is filled [מלאו], their innards [קרבן] [?] [Illegible: ~1 word]; for if [שאם] they crave much [מתאוין הרבה] [?], they have a smell in the navel [ויש להם ריח בטבור] [?]. And [?] [Illegible: ~1 word — "the eggs (?) וקנטלט"] gives birth to [יולין / תוליד] [?] warm ones [שיחם] [?], just as, when a small one is born [כמו שיולד קטן],

it takes the nourishment [יקח המזון] from the womb [מהרחם], just as it takes [כמו שיקח] the surplus [השובר / השארית] [?]. And it is not separated from it [ואינה נבדלת ממנו], but rather [אלא] takes from outside itself [יקח מחוצה ממנו] [?] [Illegible: ~1 word — "drawn off / saved" (?) נצולין], [namely] the heat [החם] from within it [מקרבה]. And all that grows [וכל מה שנגדל] [being] small [קטן] — this one digests [זה יעכל] those first [portions] [אותן הראשן] [?]; and it withholds [וטמסקב] [?] [?] [Illegible: ~1 word — "for the young (?) לבנועי"] until they [?] [Illegible: ~1 word — "come / suckle" (?)] and until they are ripened/formed [עד שיבשלו], and they do not ask of them [ולא ישאל מהם] anything [כלוס]; and there is not [ואין] the flock [הצאן] [?] and the [?] upon it [עליו] [?]. Thus [כך] it is set [נצוד / שקוע] [?] in heat [בחום], and when it is [fully] concocted [וכאשר יתבשל] it thickens [יתעבה] and hardens [ויקשה] [?] and putrefies [ומעפש] [?] — [such is] what is in the egg [מה יש בביצה].

[Final line, faint:] there are forms [שם דמויות] white and green [לבן וירוק]. [A faint word or two precede it, too abraded to read: [Illegible: ~2 words].]

[Below the text-block the lower part of folio 11v is blank parchment; a modern pencil "11" stands at the lower outer corner, confirming this leaf as folio 11. A modern pencil "20" with a ruler/scale mark appears in the outer margin (imaging apparatus, not scribal).]

because the heat, as it acts[?], separates out from it the reddish part, [drawn] from the red sediment. Know, then, that the reddish part is the yolk (חלמון), while the less-reddish part is the albumen (חלבון). The chick (אפרוח) is generated from the albumen, since it is the warmer, whereas the yolk is the fine substance from which the chick is nourished. And because the chick is not formed in a womb, nature makes for it, within the egg, a place suited to it.

It will be evident to you that the white from which the chick is formed is not the white surrounding the yolk, but rather the white lying in the middle of the yolk — which is very small, and is not found in an egg that has congealed, but only in [a fresh] egg[?]. And if this is so, then we must say [the following] concerning the surrounding white, which is the albumen: it is hot by its own nature. How, then, can we say of the yolk that it is hotter in itself than the surrounding albumen? [The answer is that the body of the chick] is formed from the yolk, as was said, while from the albumen are made the down (נוצה) and the beak (חרטום).

Just as, in the menstrual blood from which the fetus (עובר) is made, one part of it is set apart for the heart and part spreads to the remaining limbs, so it is in the coming-to-be of the chick. And just as the last things formed [in the fetus] for its

sake are the bones and the hair, so too the last thing formed [in the chick] is the down and the beak, [made] from the albumen, because it lies farther from that inner white. The first thing formed in the egg is the heart, and from it rises the great [vessel]; and from it extend two [vessels]: the one runs to the membrane (קרום) that surrounds the chick, the other to the membrane that surrounds the yolk. By means of the latter the chick draws its nourishment from the yolk, and it serves it as a navel (טבור); and the yolk is consumed[?] in great measure. Such is the rule, since [the yolk] is fit for nourishment.

[Right margin (strips r1–r2): faint interlinear and marginal jottings, largely illegible; a few detached forms are visible ("האנוש"[?]). Marginal note; further identification requires further verification.]

On the Eggs of Fish (בביצי הדגים)

Among the fish there is species by species. [In some,] the eggs are produced incomplete within the belly and issue out through the walls of the belly[?]; therefore they are not brought to completion in a womb. The second species forms within the belly a complete egg and gives birth outside to a living [young], since... it was not made outside, nor separated from the flesh, and it is an egg. The chick's being formed within the egg is like [the manner of coming-to-be already described], except that the egg is made pointed at the one end and likewise at the other end. And there is, among the kinds of fish,

[f. 12r]

[a kind] whose membrane bursts[?] when it is in the water, on account of the [great] weight, as in the previous kind. There are among the fish males and females, as in the rest of living things, except that among them their species [proceeds] from itself[?]. The difference between the males and the females among them — as regards the species — is like the difference found in another kind among the trees, part of which bears [fruit] and part does not: like the wild [tree][?], the vine, and the wild fig.

On the Generation of the Animal that [comes to be spontaneously][?] (בתולדת החי אל מ[?])

[Rubric qualifier in display script, abraded — reading uncertain.]...and it is the name of a [whole] class. There is [a species] born of itself, like a tree; and there is [a species] born from male and female. This [latter] generates the worms (תולעים), which do not remain [constant][?]... in the nature of the worms; and it grows from without, as the egg grows[?]..., which are not complete; and when it is

completed it takes on the form of the worm, as... And thereafter the creature has three stages: first the worm, then a pupa (גולם), and afterward the [emerged insect][?] — such is the nature of this animal.

And the Knowledge of the Generation of the Bees (וידיעת תולדת הדבורים)

Whether the bee is [generated] from male and female, or from its own kind like the plants — this has not been clarified. The bees are of three kinds: the kings [leaders], the [drones?][?], and those that make the honey.

[Strips r3–r4 are at the fade floor over several lines; the skeleton — three kinds of bees, honey-making, and the connection to the plants — is legible, but much of the intervening argument cannot be read with confidence.]...[a kind] generates many bees by reason of its great number[?]; and in years of [much] motion[?] there is much honey; and the honey... comes from the plants, from which a kind [of honey] is generated — much of it, like the honey of the [?][?]....[uncertain]... And on account of this...[?].

On the Generation of the Testaceous [Shelled] Animal (בתולדת החי החרסי)

This kind has no [parent of its own]; it comes to be only from... that gather, or from the moistures[?] of...; and there issues from it... [in] its place[?]. And from the water, the air, and the earth — which are filled with the psychic [vital] power (הכח הנפשיית), or with its remnant[?]... — at times[?]... And therefore a kind of animal is made that is generated in these places, of itself[?]...

[Foot of f. 12r: blank below the last line; pencil foliation "12" in the lower margin.]

[Folio: pencil foliation "13" in the lower margin of page 2 (f. 13r); page 1 is the preceding side (f. 12v), continuing directly from the prior discussion of coming-to-be. Both sides are continuous prose in a clean 14th-c. Sephardic semicursive. The hand is legible under magnification; the readings below are committed, with [?] reserved for the genuinely uncertain minority — chiefly the dense generation-theory vocabulary in the lower half of page 1 and the small, faded closing lines of page 2.]

Page 1 (f. 12v) — conclusion of the discussion of generation, then the opening of a new treatise.

for one of them is that in which the generative power resides, and the second is that which receives the generated form. The universal kinds [of generated things]

vary at times according to the variation of the generative powers and the recipient forms, and according to the variation of the forms [?]; and the variation of the forms follows the variation of the places; and the variation of the places follows the variation of the position [of the heavens?] and the variation of [?]. One of these [factors] is like the conditions of the places — the heat, the air, and the [?] — [Illegible: two dense technical lines on the mixture and the kinds of place; individual words legible ("the heat," "from every," "will be born") but the argument does not resolve continuously]... For in the sphere (הגלגל) no element (יסוד) is mingled; and the testaceous animal (החי החרסי) [comes to be from?] [?]... [Illegible: several lines of dense generation-theory at small scale — scattered legible words ("we learn from," "to the universal form," "a part of the [air?]") but not a continuous reading]... and every [?].

[Right margin, beside the upper text and the heading: several small notes in a lighter brown ink, a later hand, partly abraded. Detached legible fragments include "שינוי" ("variation"), "קסורות" ,"עבודות"[?], [?], and a longer note lower down. Marginal notes containing the foregoing verbatim fragments; further identification requires further verification.]

The Eighteenth Treatise: On the Cause of Male and Female [המאמר השמונה עשר בסבת הזכרות והנקבות]

[The opening lines of the treatise, in small script immediately below the display heading, are faded and dense; a few anchor words are legible ("are born," "the seed," "the matter") but the first sentences do not resolve continuously — Illegible: ~4 lines.]....

Page 2 (f. 13r) — the cause of male and female, continued.

according to the proper measure [of the seed] [?]; when the [male principle?] prevails over it in measure, [the offspring] is male — for if it is so, [the heat?] will [dominate?] and the offspring will be male. And if [the seed comes] from less than the proper measure [?], it produces a female. And just as the man's seed [stands] toward the woman's [?], and [as] the working [of nature shows], it appears that one and the same man may, with one woman, beget females, and with another woman beget males (ובאשה אחת יזרע נקבות ובאחרת זכרים). This is because [of the mixture (המזג)?] of the seed [?] — [namely,] its heat and [?], the mixture, the drawing-off of the wind (ריחוק הרוח), and the [thickness?] of the [?].

[On the environmental factors:] the place (המקום), the [?], and the air (האויר); and the sun (השמש), on the side of [warmth?], produces males more than [?]; and one

whose seed [?] produces females. As for the drawing-off of the wind: toward the left side, when a south wind blows, at the time [of intercourse], the offspring will be female; and one who couples toward a north wind — [the offspring] will be male [?]. And as for the place: if [things are] brought toward the south, it will be female, and if brought toward the north, it will be male.

And this accords with the words of our Rabbis, may their memory be a blessing, in their saying that whoever places his bed [between north and] south will have male children, etc. (הנותן מטתו… לדרום… בנים זכרים וכו') [Bavli Berakhot 5b: " כל הנותן מטתו בין צפון לדרום הויין לו בנים זכרים"].

And if the place is [moist?], it will be female; and if [hot?] and dry, it will be male. [And likewise as to climate:] How so? — the cold peoples (העמים הקרים), and those of cold climes, [beget?] [?]... cold [makes?] the offspring female, whereas its opposite begets a male. And some say (יש אומרין) that the cold peoples abound in [?] — and this is what he says regarding the nature of male and female.

Now, this is how it ought to be: [in cold climes?] and in the cold season, the begetting of females [would prevail], [and so likewise for] the rest [of the factors], such that it would follow a fortiori (קל וחומר) that from such a woman females would be born by nature. Yet we observe the opposite of the matter: in some men who beget females [at one time?] and males with one woman [at another], though by rights it ought to have been the reverse. And further, since women are cold [?]... [Illegible: the final ~5 lines are in a smaller, fainter hand and, though the glyphs are visible, the closing argument on coldness and the mixture does not resolve continuously — scattered legible words include "the mixture"[?], "to be," "known"[?] (ידוע), "the male," and a closing clause "at the time that one immerses[?]... [?]"].

[Foot of page 2: blank below the last line; pencil foliation "13" in the lower margin. A blue scan registration mark ("20" with crosshair) appears in the left margin — a modern imaging artifact, not text.]

[Continuation — On the Cause of Males and Females]

And the action of the [formative] understanding [operates] in [?בקדרוס], so that even where such-and-such is not done, it is not prevented from acting. [Margin: [?בקדרוס]] The [?heavy grows heavy] and is [?fixed], the setting-down [being] like a [?base]; [in this] it is not prevented at all. [Margin: אלא ("but/rather")] [The opening line and the following clause carry several hard, possibly corrupt technical tokens and are read only in their sentence-frame.]

As for the will (*ratzon*) in the seed — what will is there in the seed? It has a volitional will: when it wishes to make a male, it makes a male; and when it wishes to make a female, it makes a female. Therefore it seems to me that the power that makes and forms the male is the man's seed, and that which forms the female is the woman's seed. The woman's seed, too, has action and effect, and its existence is not in vain, as he said in the fifteenth treatise [במאמר חמשה עשר].

And what comes about — since it [the seed] is set there for the opening [?לפתחות] of things — everything is found [so ordered], in order that its existence not be in vain [?קלותמי] for the woman's seed. Nor are we obliged to deny that the woman's seed gives the form, just as the man's seed does. [Margin: ואין אנחנו ("and we are not")] For those objections attributed to Galen [גאלינוס], which are found in the fifteenth treatise, amount only to nullifying [the notion of] a mixing of the male's seed and menstrual blood with the female's seed; [they require] only that the woman's seed act just as it acts together with the menstrual blood, since in one [seed] alone there is enough, as he held.

But now, since its [the woman's seed's] existence is not in order to be matter (*hyle*) [קיולב, Greek ὕλη, "prime matter"], nor in order to form some of the organs — as Galen held — nor in order to give form to the heart, there is no reason there that would prevent it [from being formative]. And so the existence of the woman's seed has a purpose, and is not in vain.

And if you wish to know it precisely: why should the acting power be [the seed of] the man, and part [of the forming] the woman's seed? We say it is the [?power] of which they spoke — the one [?] upon the belly and above it — and the one that gives form is [the seed] that [makes] the son. [The clause naming the two agents carries two uncertain tokens and is rendered for sense.] And if the woman's seed does not come at all, the offspring will be male, as [normally] happens — a [?key / opening] — just as he recounted in the fifteenth treatise.

And as for what he said, "when a woman emits seed she bears a male" [אשה כי תזריע ילדה זכר; cf. Vayikra 12:2; Niddah 31a] — its meaning is that she emits seed first, before the man. And if you say that one of the two [?coagulates] and congeals in its heat, we say it is not in vain at all, but rather [?], and one of them congeals [?] like a seminal emission (*keri*). [Margin: כן ("thus / yes")] And if you say that the woman's seed is [designated] for [producing] the female — why does the female not come to be from herself [alone], [?the second]? [Margin: [?שתמצא] ("that it be found")] — just like the seminal emission (*keri*) that befalls men, when menstrual blood is present with it. What prevents this? One may say —

[Continuation — page 2 / verso; modern pencil foliation "14"]

— that, since these powers are not present in the male and the female separately, this matter could be completed only by their joining one with the other. One may say that the [joint] action serves so that from it what remains of the menstrual blood is strengthened and purified. [Margin: בעבור ("in order that")]

[Red-ink header:] בדמות — **On Resemblance**

Sometimes the son resembles his father, and sometimes he does not resemble him. Sometimes he resembles one of the father's kin — such as the father's father, or the brother, or the father's brother; and sometimes he resembles the mother, or one of her kin; and sometimes he resembles some one person who is not among his relatives at all. And all the kinds of resemblance can occur — either in the whole [body], or in one member, or in more.

The matter of resemblance appears confused, because the agent imparts to the patient a likeness of what is in its own form. Now the male, who acts within the seed, [carries] three forms. The first is the species-form (*ha-tzurah ha-minit*), which operates upon it at the time of the forming of the male, and it is impressed [?נטבע] in that species. [Margin: המין ("the species")] The second, the particular form (*ha-tzurah ha-peratit*), must be present in the act, when [the agent] works upon the matter (*gelem*) of the patient to form it in its own image. [Margin: הצורה ("the form")] Or [it may act] with the three forms together. Accordingly, if the male is fully human-forming, the offspring comes to be human and male and resembles that man.

But if, through its weakness, it is deficient in producing one of these forms, the offspring turns out opposite to it. How so? If it is deficient in the species-form, the offspring will not be a complete human, but a marvel among marvels [i.e., a monstrous birth]. And if it lacks nothing of the [species] form, but lacks the male-form, [the offspring] was female. And if it lacks from it only the particular form, the offspring shifts to the opposing form. [Margin: הנוכחת ("the opposing/facing")]

[This is] the pattern of opposition or of exchange: it is the form of the mother, the [?קטעית], and it is the likeness proper to her. And it is possible that the agent clothe itself in a [?recognition] and grow strong over the particular form, so that the offspring comes to be female resembling the father; and it is possible that this be reversed — that is, that the offspring be a male resembling the mother.

And if you wish to refer the form of the resemblance back to father or to mother: if [the offspring] was male and resembles the father, it is because of the strength

of the man's seed, an extra strength in forming it; and likewise if it was female and resembles the mother. [Margin: יתירה ("extra")] But if it was a male resembling the mother, or a female resembling the father — [this is] only because the nature did not proceed as [it should for] that which is the man's seed; rather the female's seed prevailed [over it] in one of its accidents, and that accident is the resemblance. And its formation will not be in vain, but proceeds in accordance with nature.

[Continuation — the discussion of resemblance and heredity (בדמות), within the natural-science section; the argument follows Aristotle, *On the Generation of Animals* IV. Page 1 = right half of the opening; page 2 = left half, bearing the modern pencil foliation "15" at its foot. The text runs continuously across the two pages.]

And so too the seed of the man is likened [to a resemblance] only, within the female, and there comes to be in it [?]. [The following clause resists a confident continuous reading — legible tokens include "a resemblance only" and "from a seminal emission (*keri*)"; the intervening words appear to be contracted or corrupt: [צלמח קורל בב קאישויה קועטלכהו?].]

And the offspring is likened to his father's father, or to his father's brother — and this because of the weakness of the generative power; that is to say, that the power of the seed does not [prevail?] [?]. So it passes over from the resemblance of the father to the resemblance of his grandfather or his father's brother; and likewise it shifts from that resemblance to the resemblance of his mother or her brother. And some are likened to their forefathers more than to the near kin [?]. And because of the lover's desire for the object of his desire, on that account the seed prevails — in species, in the particular, and in the resemblance.

And [?] [a stretch here — recto, mid-page — is written in heavily contracted forms that do not resolve into confident prose; the legible anchors are given, the connective tissue flagged]: … it is the wondrous act, and most of it [?]. And there are cases in which [twins are] born in a single belly, and there is only one heart, and it is the largest [organ] [?], like [?]; and the patient [that which is acted upon] [?], approximately. And the cause of the matter is that when [the formative power orders] the organs, before [each] reaches its place [?] — but the small [organ] [?] — that there is no surplus in what [?]; and not because of [?] the heat and most of

the [good?] things [?] [several words here unresolved]. [?] it generates in the mean, between much and little.

And [as to] why a man is born at nine months or at seven months, while one born at the eighth [month] does not live: [it is] because one born at seven [months] is alive [?], and likewise [?]; and one born in the ninth is [healthier?] [?] than one born in the eighth [month]. And therefore you say [it is] healthy, in that it is [?] [longer in?] time [?]. But the one born [prematurely / out of its time] [?] — this is not its time to come forth [?], for [?] its time [?]; [?] and therefore it does not live, because it is not according to [?] its nature. And there is likeness in it, in its organs and its nature, [such] that it is possible for it to live; and [?] against the stars [?] [reading of this clause uncertain]. And there is the wondrous [i.e., the monstrous], more than what is fitting, in [?].

[into?] one [?], and its formation is drawn out into two [?]; it comes forth as an offspring that came about by way of [?]. And in all this it falls out, in the nature of its formation, [that another form comes to be] like the first resemblance [?], to form it otherwise [?]. For there is in the world one who inclines more toward the head [?], and there is one who inclines to this [?] and takes on [?] in the world, [and so] resembles [?]. And it is possible [that this occur] in the small organs [?]; they said that they saw a man that [?] on the right side [?], and this [was?] in the mixture [?]. And what there is of it among the organs that are not reckoned in the count — it is possible for it to be so. But among the organs that are fixed, such as the head, it is impossible. And the cause [?]

— that [?] [some are formed as] androgynes [ἀνδρόγυνος, hermaphrodite] [?] and [?], and this is on the side of [?]. And the deficiency of the organs is due to the lack of [?], or because [the matter] does not receive [its] form [?]; or because of the weakness of the agent's power to [impress?] the [form?] [?], to form it into another [likeness]. And this is what they see [as] the monstrous cases in the offspring of the living animal — [creatures born with] [?] and roosters [?]; and it is possible that the nature be drawn [?] like [egg-yolks?] [?]. And already [?]; and the surplus [and the deficiency?] will be in the small organs [?]. But [when] this change [is present], it brings that same living being forth — in the likeness of [?] the sons of men, who say [?].

And it is possible that a man be born having four legs [?], or that [creatures] be born from a [different] species of animal. No — [it is not so], [?] in this [?]; for it is not in the power of the agent, within a single species, to give [the matter] another form in place of its own form of that same species. And likewise it is impossible for that [matter] of that same species to receive the form of another species.

And [concerning] its first generation [*ibbur*], and [as to] what [?] — no: [the female] does not conceive over again after its first pregnancy, for two reasons. The first: [because the matter was consumed] in the first generation, and there did not remain of it, nor of what it would nourish from it, [enough] except [for] the first alone. [?] and it cannot [?] generate [again] from another [?]. [?] and all the [?] its generation upon [another] generation [?]. Toward the near [kin] [the resemblance holds]; all the more so [*kal va-ḥomer*] [is it so] with the distant: and there remain [cases at] a long remove [in time], because [?] [the resemblance reaches back] as a son to the one who conceived it, over [and beyond] its [own] generation — and he will live.

Midrash ha-Ḥokhmah — Natural-Science Section (continued)

(The discussion of generation and heredity carries over from the preceding folio.)

and one that does not conceive again at all. The animal that inseminates abundantly and gives birth abundantly conceives again after its first conception within [two months?], and the smallness [of the new embryo] is added to it in the month following the coming-to-be of the first embryo. Its nourishment is whatever is available, and from it there forms a second embryo with its own nourishment. Abundant hair is a sign of much heat, and this is why hairy men [couple/beget?] abundantly; and one [female] that conceives over an earlier embryo — such that the first embryo is born while the [second] is still in the belly. [Superfetation.]

There is a class of animal, of much heat, that gives birth to young [that are not?] [?] [?], completed [?] because of the abundance of heat and moisture in it — as they say, on account of the majority[?]. [When?] [?] multiply [?] to be nullified on account of [?], the surplus[?] [is] in them. And the male is completed [in the womb] before the female, on account of the heat [of temperament]; whereas the female is received from outside, and she hastens to come to [?] the man's [?], deficient in [its] reception. Something similar occurs with deep-set[?] fruits, which are late to ripen [be concocted] before they are sound[?]. And there also occurs to people, in the liver, another circumstance: namely, that their menstrual blood ceases after intercourse, and it is cut off[?] in its season. For this cessation persists longer than the span of a pregnancy, and it is possible that she dies of it — for they may remain so for many years and die of it; and it is possible that the liver falls very [ill?], so that recovery is scarcely possible except with difficulty.

And now [as for?] the liver[?], [in?] the conceptions[?] and the corruption of the concoction by nature[?] [?], [it is?] the consensus[?] of the [natural philosophers?]; they know it in quality and in quantity, and the surplus is to be explained to them on account of the incidental[?] heat, not on account of the essential heat proper[?] — [as when one wishes?] to give form to the embryo[?] — because the path of the [incidental?] heat is toward the nearby cavity and to receive the reddish [matter]. And it is better, regarding this matter, before we set down [an account of] the rest of the animals, [to treat?] the blood of their menstruation. And the majority[?] [?] to the contrary [?] the concoction[?]; and therefore sensation appears to them to be of this kind, provided only that [the blood?] be preserved [as?] blood, as is customary.

On Milk [בחלב]

Because it serves to nourish the newborn outside the womb, at the breasts there forms — in the [proper?] month — milk that is [gathered?] sweet, well-concocted, and pleasant. And the milk is [joined?] [?] [?] together[?], and [?] the blood of *niddah* [menstruation]. [?] the natural [heat/moisture?] is upon its head[?] [?] — heavier than [that of the other?] animal.

(Page 2 / verso — on the variation of animals' lifespans and gestation periods.)

What accounts for the variation and the gestation of the animal species is the variation of their lives as to size — large and small — the variation of the faculties apportioned to the limbs, and the variation in the span of their lives: that is, the time of childhood, the time of youth, the time of old age, and the time of advanced old age. For the time of gestation is the time in which its formation is completed, since the matter returns to its place and to [?]. And likewise the four seasons of the year that exist outside the womb correspond to the time within the womb; and therefore the one long-lived [outside] is likewise long-lived within the womb.

So too the large-bodied animal: just as the time of its existence is longer than the time of existence of the small-bodied animal, so too the length of its days is longer than the days of the latter. The cause of this is the heat and the humors[?] that pass over[/act upon] the temperament — except that not everyone longer-lived is the larger of body. For man [?] lives longer than the rest of the living creatures, [though] the [creature] living within him[?] is [something?] outside [ordinary] nature, and his body is smaller than many bodies of animals [longer-lived?] than he. After this he spoke about the cause of[?] the gestation period of man and his manner of birth, [as differing] from the rest of the living creatures; and he connected the matter to the cycles of the stars, as he had begun.

The Author Said [אמר המחבר]

It is fitting to write here a little of what I have found from our Rabbis, may they rest in peace, concerning [this matter?] [?] — as is found written regarding [their] generations.

[Aramaic: *Tanu Rabbanan* — "Our Rabbis taught":]

Everything that bears live young nurses, and everything that lays eggs gathers [food], except the bat [עטלף], which, although it lays eggs, nonetheless nurses. Whatever [couples/has its seed] outside bears live young; [whatever couples] within lays eggs. Whatever couples by day gives birth by day; [whatever couples] by night gives birth by night; and whatever couples both by day and by night gives birth both by day and by night — [whatever couples] by day gives birth by day, and [whatever couples] by night gives birth by night; both by day and by night[?]. Everything whose copulation and gestation are alike beget and rear one from another; and [that] whose copulation and gestation are not alike do not beget and rear one from another. All [creatures] couple face against the nape, except three that couple face to face: man, fish, and serpent. What is the reason for these three? Because the Divine Presence [Shekhinah] spoke with them. *(Cf. Bavli Bekhorot 8a.)*

the camel couples back to back.

The Sages taught [baraita, Bekhorot 8a, in Aramaic]: The hen [hatches] at twenty-one days, and corresponding to it among the trees is the almond [לוז]. The dog, at fifty-two days [numeral: ושנים legible on the dog-line — see QA], and corresponding to it among the trees is the fig [תאנה]. The cat, at fifty days, and corresponding to it among the trees is grain [תבואה]. A small kosher animal, at five months, and corresponding to it among the trees is the vine [גפן]. A large kosher animal, at nine months, and corresponding to it among the trees is the olive [זית]. A large non-kosher animal, at twelve months, and corresponding to it among the trees is the date-palm [דקל]. The wolf, the bear, the lion, the leopard, the hyena [ברדלס], the elephant, and the monkey, at three years, and corresponding to them among the trees are the white figs [בנות שוח]. The viper [אפעה], at seventy years, and corresponding to it among the trees is the carob [חרוב]. This carob — from the time of its planting until its fruit is fully ripe is seventy[?] years, and the days of its gestation are three years. The snake, at seven years — and for that wicked one we have found no mate.

[One short clause here, reading uncertain: "חמור מחתול לצבע"[?] — three words, not confidently parsed.]

The Emperor said to Rabbi Yehoshua ben Ḥananya: The snake — how long does it carry its young before it gives birth? He answered: Seven years. The Emperor objected: But the elders of the academy of Athens [סבי דבי אתונא] mated a pair, and it bred within three years! He replied: Those had already been pregnant for four years beforehand. But they were seen to copulate openly! They too copulate like a human being — just as a human being couples with its mate, so do they couple with their mates. But those [elders of Athens] are wise! — meaning the elders of the academy of Athens, who do nothing but know a matter truly. He answered: We are wiser than they. The Emperor said: If you are so wise, go, defeat them, and bring them to me. He asked: How many men are they? The Emperor said: Make me a ship. And he set out, and he saw in it… and so forth [וכו'].

המאמר התשעה עשר — The Nineteenth Treatise

[Margin: flanking the display heading in a smaller hand, reading uncertain — to the right "השבר במעל"[?]; to the left "אמו לא יאמר"[?]. Apparently a topic rubric; not confidently legible.]

In it [we treat the following]: it is not a matter of excess but of a deficiency of sensation [חסר ההרגש], like the boundary [הקו] fixed between the plant and the [sentient] living being.

On old age and youth [על הזקנה והבחרות]. Youth has abundant moisture [רב הרטובה], whereas old age is the diminution of moisture; in youth the moisture is abundant, and in old age it dwindles. Therefore the child, when its moisture is rising… [and the aged, when it is low — the connective clauses here are partly faded [?]].

Why does one see at night more than [by day / than a grown man[?]]?

[The answer runs onto the verso; the opening clauses are faded:] Because the moisture is displaced and withdrawn on account of the light [בעבור האור], so that more of it is dispelled from the eye [several words faded [?]].

One whose eyes are deep-set [שוקעות] sees at a great distance [מרחוק], whereas one whose eyes protrude [בולטות], set forward in the flesh, sees near and does not see far. One whose eyes are clear [זכות] but protruding sees near but does not see at a distance; one whose eyes are deep-set but not clear sees things at a distance

but does not see the fine details [הדקים]; and one whose eyes are both clear and deep-set sees the fine details and sees them at a distance as well.

And just as we have said concerning sight, so we say concerning hearing [שמע] and concerning smell [ריח].

[The remaining discussion — that sound and scent reach their senses from a distance through the air, "for the cause of them all is one" [עלת הכל אחד] — is carried in a much lighter, washed ink and is only partly legible. The recoverable technical vocabulary supports this skeleton: "מריחוק" (from a distance), "האויר" (the air), "תנועתן" (their motion), "שמריחין" (which give off scent), "קול" (sound), "הריח" (the scent). Clause-level reading of roughly ten lines (page 2, strips r3–r4) is not reliable and the interior is left [?].]

so that [the scent / the sound] not be dispersed within it [?] … [several words illegible [?]] … The scent[?] rests upon the place from which it issued [הוא על המקום שבא ממנו]… [and] the air adjoining them [is at rest], the motion subsides [התנועה שוקטת], and the whole comes to rest [ונח הכל שוקט].

At rest [שוקט]. ⟨end of the page; catchword below: שוקט⟩

[These two folio sides (f. 18r–v) continue the natural-science Problemata on the body — questions in the manner of Aristotle's *Parva Naturalia* / *Problemata*, on hair, voice, and teeth. No new treatise (המאמר) heading appears; the sub-sections are set off by enlarged display-script topic rubrics of the form "ב + topic" or "עלת + topic," each often accompanied by a smaller flanking topic-gloss in the same hand.]

On the Thickness of Hair and Its Fineness [בעבי השער ודקותו]

[Flanking the display rubric in a smaller hand: to the right, "זה יורה ל…צבע…"[?]; below it, "אם היה דק או עב" — "whether it be thin or thick."]

Why does hair have length? Because it is the residue [יתרון] of the sanguine humor [האדמי], these being the residues of the moist and the dry. From the moist and the dry, hair is generated. Hair grows from the skin [מהעור[?]], not from the flesh; and if [the hair] is cut back from the skin[?], no hair will grow in that place. If this residue is scant, the hair is short; but if it is abundant and rich [ודשן], it will be long.

The Hair and Its Softness [השער וריכוכו]

[Smaller-hand rubric: "עלת קושי השער" — "the cause of the stiffness of hair."]

It is the residue of the [earthy[?]] part and the sanguine part. One of them abounds toward one side and the other toward another side, and accordingly the hair takes its form. If it is on account of this residue and its heating, [the hair is stiff]; and the reverse of the matter [produces the opposite]. Those who dwell in the [north[?]], their hair is soft, because of the coldness of those lands, so that [its texture] is soft-set. By contrast, those who dwell in the south have stiff hair, on account of the heat of those places: the pores are [heated/contracted[?]], and the hair emerges fine and [curled[?]]. Those of the middle regions, between the one and the other, have hair intermediate in stiffness and softness. And likewise [its curliness[?]] varies … [several words effaced [?]] … and the animal that [has moist, rich matter[?]] has hair fine and soft, like the [?] … and the hare [והארנבת].

The Cause of the Beard [עלת הזקן — the heading glyphs render ambiguously (≈ "הנבח"); "beard" is secure from the body that follows]

[Smaller-hand rubric beside the display heading: "הרטיבות והחום" — "the moisture and the heat"; and "ומפני מ…"[?].]

Hair does not grow in the place of the beard[?] because in the [organs[?]] the [heat[?]] returns … which cause growth; whereas the beard[?] does not restore what has passed off from the heat, and [only a little[?]] is dissolved. [This occurs] in men and not in women, for there is no organ in the human body that grows hair like this organ, and it is called [?] — in men alone, because its matter is finer than all the parts of the brain [חלקי המוח] and hotter; therefore an exhalation [קלחה[?]] separates from it swiftly. It does not occur to women in [the same] measure of moisture, and therefore it does not befall women … [several words illegible [?]].

On the Cause of the Colors of Hair [בעלת דמויות השער]

[Smaller flanking rubrics, only partly legible: "… / "יש אשר[?]" / "אפשר[?] בעוד"[?]".]

It is caused by the variation of the heat and the moisture. The cause of the variation in the forms of hair among the species of living creatures is the variation of [heat and moisture[?]] in them. The air, the wind, the water, the place [המקום], and the food [המזון] each act upon the forms of hair.

Aristotle [ארסטו] related that in the borders of [Rome — רומיים[?]] there are streams such that when the flock drinks from one of them, the color of the sheep [הכבשים] is white; and if they drink from the other, they turn black. The animal that has many colors has many kinds of food, because it draws its nourishment in

[varied[?]] places, and so its residues are varied. For this reason the color of bees is uniform [אחד, "one"], since their food is one; whereas the colors of cattle are varied, because their food is varied.

On the Variation of the Voice [בשנוי הקול]

[Smaller-hand rubric beside the display heading: "קול הנער[?]".]

[the voice of the young is sharper[?]] than the voice of the grown man, except that their voice is thicker and heavier than the voice of [?]. The voices of women are sharper [חדין] than the voices of men; and the voices of the young children [הקטנים[?]] are sharper than the voices of the young men [הבחורים]. The sharpness of the voice and its thickness accord with the formation of the organs; for whatever passage [הנתח] is narrower and longer produces a sharper voice, because the passage of the air through it is swifter [במהירות].

And why is the voice of the old man sharp? Because they draw only a little from the air, so that their voice is feeble [עלוב[?]]; and likewise in the sick. As for the eunuch [והסריס], their voice resembles the voice of women.

On the Growth of the Teeth [בצמיחת השינים]

Why do the teeth grow before the molars [הטוחנות]? Because the teeth are for cutting [לחתוך] and the molars for grinding [לטחון], and cutting precedes grinding; so it is fitting that all cutting precede all grinding. Moreover, because a bone that forms as a small bone is finer than the bone of the molars.

For this reason the [wisdom-]tooth [שן[?]] is delayed in some people until thirty [שלשים] or forty [ארבעים] years (interlinear: שנה, "years"), on account of the difficulty of this bone's forming and completing. And therefore the [front] teeth are replaced before the molars, whose [roots] are more firmly fixed [קיימין] than the roots of the [front] teeth. Rightly, then, the growth of the teeth comes first, and afterward their replacement a second time. It resembles all the tools [הכלים[?]] that are replaced when they wear out [כשיפסדו] or out of necessity. And therefore what is replaced [is the front teeth], while the molars themselves are the more permanent, being not replaced. And this is [the reason[?]] ... the [enduring[?]] teeth, which last long [אשר יאריכו ימים].

The end of the chapter [תם הפרק].

⟨end of the folio⟩

The Book of the Soul — First Treatise

THE BOOK OF THE SOUL [ספר הנפש]

THE FIRST TREATISE — On the Ranks of the Sciences [מעלות החכמות]

[f.18r. Legible but dense: this recto paraphrases Aristotle's De Anima *I.1 (402a–403a) in technical, partly Arabic-derived philosophical vocabulary. The clearly legible throughline is committed; a minority of technical connective tokens remain genuinely uncertain and are flagged.]*

The rank of each science is measured in two ways: the first by the importance of its subject [חשיבות הנושא], and the second by the certainty [of its attainment] [?], just as [the worth of] a craft [is measured by its product]. And the science of the soul is exalted above all [others] [וחכמת הנפש נעלה בכל], both for the dignity of its subject and for what is achieved through it [?].

[We must inquire] whether the soul has parts [ואם יש חלקים]: one part joined to the body [נסמך לגוף] — [the seat of] anger and desire [והכעס והתאווה] — and a part bound to the intellect [קשור בשכל]. And we further investigate [ועוד נחפש] under which "root" [i.e. which of the ten categories] the soul falls [תחת אי זה שרש הוא] — whether it is one of the ten [categories] [מן העשרה]: whether it enters under [the category of substance] [תחת עצם?] or under one of the [other] categories [המאמרות]; and whether it admits of division [יכולה להחלק] or not; and, if it is divided, in what manner it is divided [על אי זה דרך היא נחלקת].

[We ask] whether the thing is divided item by item into distinct [aspects] [למשונים] — as [it is distinguished] in respect of color, of taste by way of the tongue [לטעם], and of smell [וריח] — or whether it is [rather] divided into [these] parts [לחלקים] as distinct in substance [במועצב?]; and whether they are distinct in quantity — that is, in number [בכמות כלומר במספר] — or in quality — that is, in relation [באיכות כלומר בערך]; and whether it [the soul] is one in [all these], or whether there is some further affected [subject] [?]. *[The naming of the several categories and their objects of sense in this stretch is only partly resolvable at the glyph level; the framework — substance, quantity/number, quality/relation, and the objects of the senses — is legible, several connective tokens are not.]*

[We ask further] whether the soul differs by species [משונה כמין], and whether it is one in essence [אחת בעצם] or differs both by species and in essence [כמין ובעצם] — that is, whether there is one and the same [soul] in every living thing that is affected [בכל מתפעל], such that it is one in every living being [אחד בכל חי]; or whether the definition of each soul differs [גבול כל נפש משונה], so that there is a

difference between the definition of the human soul [גבול נפש האדם] and the definition of the horse's soul [נפש הסוס] — the definition of man being one thing and the definition of the horse another.

He said: and it is fitting [ואמר וראוי] [not] to overlook [?] [the question of the definition — whether it applies] to the living thing [as such] [כענין החי] [?], or [whether] it does not [?]... [whether one can know] a thing outside [its] flesh [חוץ לבשר] [?], or whether [the soul is] something posterior [מאוחר] [?]... For when we know the essence of a thing [כשנדע מהות הדבר], [we thereby] have knowledge of it from itself [דעת ממנו].

[The final line at the foot of f.18r is faded and only partly legible; it appears to continue "…ומקריו טעם [?]" — "…its [ground?] and its accidents."]

[Foliation: modern pencil "18" at the foot of the recto; a small ink mark in the upper margin may be the Hebrew foliation but is not confidently legible.]

[f.18v. Markedly more legible than the recto; the throughline reads clearly.]

Thus, when we know a thing's complete essence [מהותו המשולם] in its particulars [פרטים] — [when its parts] are equal [שוים] [to it] — [we know it fully]. And likewise we are able to know its essence [לדעת מהותו] from its accidents [ממקריו]; but only [ובלבד] when the accidents are essential and proximate [המקרים עצמיים וקרובים]. Only then [ובלבד] do we rise [נעלה] to knowledge of the existence of all the essential accidents of the thing [מציאות כל מקרי הדבר העצמיים], or of many [of them]; and [we ask] whether it is possible to know the complete essence of the thing [לדעת מהות הדבר השלם], and which is the complete definition [ואי זה הוא הגבול השלם].

It is [that definition] whose knowledge [enables us] to know from it the accidents [of the thing] readily [לדעת ממנו המקרים במהירות]; and therefore any definition that does not lead us [שלא ידריכנו] to know from it the accidents of the thing readily is not [truly] a definition [אינו גבול].

Now because the soul [ולפי שהנפש] [is defined in a certain way] with respect to the body [מהגוף] [?], this shows [יורה זה] that it has a distinctive character [דבר מיוחד] apart from the body [זולת הגוף], and that distinctive character is the form in the intellect [הצורה בשכל]; yet [אלא] this form is proper to it [in such a way] that, apart from the body, it would be predicated only as [being] in body [כי אם בגוף]. And the matter resembles [ודומה הענין] those things whose operation exists only in their matter [שיש להם מפעלתם בגלמם] [?] — for it is impossible to find the complete [account] [אורך] of their operation apart from [their matter] [בלי גבולם?]. It is as we say [that the geometer] describes [a circle] [?] about a single point

alone [על נקודה אחת בלבד], as was explained in the first [book] of *[?]osios* [בראשון מהאו⟨?⟩דוסיוס — a garbled title, most plausibly Euclid's *Elements* Book I, but the letters do not confidently spell it; [?]]. Yet [the geometer] cannot [realize it] in act [למעשה] except by way of its being in body [שהוא בגוף]; and if it is not in body it does not [subsist] [ואם אינו בגוף לא יתקיים?], because it is not an act [כי הוא אינו מעשה]. And likewise [וכן] the [form] in the intellect that is proper to the soul [המיוחד לנפש] cannot have this account [זה הטעם] except from the body [רק מהגוף].

But as for the affections of the soul [אבל מפעלות הנפש], through which the soul is affected [שהנפש מתפעלת בעבורם] — such as anger [הכעס], and will [והרצון], and aversion [והירחק = withdrawal/recoil], and violence [וההחמס] — and, in general, everything whose bond appears in the body [שנראה קישורו בגוף], inasmuch as it is affected [לפי שהוא מתפעל]: [take] the definition of anger in its matter [גבול הכעס בגלמו], and its meaning [וטעמו] — namely, that it is the boiling of the blood about the heart [רתיחת הדם שבלב] on account of the desire for revenge [מפני תאות הנקמה]. This shows that the [material] definition [is] other [than the formal one] [הגבול היא זולת...].

And whatever [is defined] together with [the body] belongs to one science, which is Nature [מחכמה אחת והוא הטבע]; and whatever [treats] the affection as separated [מובדל] from the soul — a definition only [גבול בלבד], not in reality [לא באמת] — this [too concerns] natural science [מחכמת הטבע]; whereas whatever resembles the soul [as pure] definition [ובדומה לנפש גבול] and [treats it] in its operations [ובמעשאות] belongs to First Philosophy [מהפילוסופיה הראשונה] [i.e. metaphysics]. *[The source assigns the two "definition-only" cases in a way that reads tightly; the natural-science / metaphysics contrast is the settled* De Anima *I.1 doctrine and is committed as such.]*

That which is affected [המתפעל] is distinguished from the [state of] that which is affected by sensation and motion [בהרגש והתנועה].

And after this [the author] abridged [the views of] the ancients [קצר... הקדמונים] concerning the essence of the soul [במהות הנפש], and refuted them [והשיב עליהן], to the end of the treatise [עד סוף המאמרין]. And there is no need to elaborate [ואין להאריך]... in this our book of ours [ספרנו זה], in the complete manner [באופן השלם].

[Foliation: modern pencil "19" at the foot of the verso.]

The Second Treatise

Substance is predicated in three ways: of matter, of form, and of the composite of the two. [Matter] exists in potentiality, whereas form is the actuality [שלמות, entelechy] of what exists in potentiality. Form is predicated as a kind of form — of the first form, like the wise man whose intellect (interlinear: חכמתו, "his wisdom") is in act. And since it is said in this way, [the terms] are predicated first of the soul: "the one" and "the existent," which are predicated of matter and of form alike. And [truth] resides most properly in the form, which is the actuality; and because the soul is more truly existent than the thing in which the soul resides, it therefore acquires [the name] "form."

Thus it has been explained that the soul is substance in that it is form; for the soul is [the answer to] "what the body is" — that is, to the question asked about it, "what is it?" [מהו], by way of essence. And since the subject of "what is it" is substance, the soul too acquires [the name] "substance." He further distinguished between substance and the accidents: the difference between substance and the accidents is that the substance, [when it is removed, removes the accident with it], whereas the accident may be removed without the substance being removed [? — the polarity of this clause is faded and uncertain]. Therefore it has been explained from all these matters that the body is the substratum [נשוא], and the soul is borne upon it by way of "what is it"; and just as the [visible appearance / mirror] [המראה] is a form to [?], so the soul is the form of the body.

And since form is actuality, and actuality is of two kinds — first and last, as we said in the example of the wise man — then, among natural [bodies], some receive life: these are the organic ones [אורגני, Greek: ὀργανικόν, "equipped with organs"], [so termed] in Hebrew [?]; and there are some that do not receive life, which are not organic. The soul, therefore, is the first actuality of a natural organic body belonging to it, and this is its definition [גבול]. This soul, the actuality of this body, is not found in [just any] body whatever, but only in the body in which it resides; for since it became the form of the body and its actuality, [the body cleaves to it] and it is not separable from it — just as form is not separable from the matter that is its subsistence. And it is impossible that it be found except in a body, or in potentiality [as a power residing in it].

And likewise it is impossible that the soul be found in any body whatever, but only in specific bodies (interlinear: uncertain) — those in which there is a soul, [directed] also toward [an end] [?] — all the more so that it is not found without a body at all. Therefore let the complete definition [הגבול הגמור] of the soul, according to the [proper] method — the definition that comprises the cause and

the existence together in every soul — be this: that it is the actuality of a body possessed of life, which is an organic thing — the first actuality. This definition is common to both animal and plant, for [both] have [?] change, increase, and reproduction, and [each] generates; and they are not fixed [and inert] like the elements. For among the elements, one of them does not move except in a single direction alone, whereas the plant grows upward and downward (interlinear: together) and in breadth; its roots correspond to the mouth [drawing nourishment], and it grows; and its leaves are a covering for it and a protection for the fruit.

All the more, then, is the name "life" [החיים] predicated of everyone in whom there is, beyond the [maintenance] [?] of nutrition, also motion; for this is said of the animal [חיואן, Arabic: ḥayawān, "animal"], not merely of the "living." And on its account we cannot say "animal" except where there is life. And similarly Scripture uses the term: "of all the living, of all flesh" [מכל החי מכל בשר] (Bereishis 6:19) and the like; and "and you shall say thus: To life!" [ואמרתם כה לחי] (Shmuel I 25:6) — for Nabal was alive in the form of a man. And all these active faculties of the living being — such as sensation [הרגש], motion, sight [הראיה], intellect [השכל], their offspring [reproduction], and their nutrition [הכלכלה] — are the soul which that body received; it is the body's form, its [design] [?], and its image. And since the soul is the form of the body, it is therefore not separable from it.

This may be seen in many things [that differ] by their faculty [?] — as in the power of the plant, for when the plant is found, in every part of it [its powers are present] [?]; and likewise sensation and motion are found in part [of the living being] [?]... in every disposition that may be conceived [?]... [something] of it is in itself living. And he has already mentioned, concerning what preceded in my words, in the Fourth Treatise, which recounts [?]... And there is no doubt that everyone who possesses sensation desires, and suckles [וינק], and craves; the matter, therefore, is evident from this — that nutrition [המזון], increase [הפריה], generation [התולדה], sensation, and motion, and [invigoration] [?], and strengthening [החוזק], and sight are not separable from the body. And if these are not separable, neither are the rest of the soul's faculties that are actualized in its body — [proceeding] from the living being — such as sensation, anger [הכעס], courage [הגבורה], and fear [ומורא]: in them, [too,] they are not separable from the soul.

Because the soul is one — yet in potency many, [and passing] into act — while as for the intellect [השכל] and the faculty of apprehension [המשיג], [Aristotle] left it in doubt whether they are separable or not. Thus Aristotle [ארסטו] said: it may be

that this [intellect] is a further principle of the soul, and that this one alone is capable of being separated, just as the eternal [הנצחי] can be separated from the corruptible [הנפסד]. And he further said:

As for what we said in defining [בגבול] the soul — that it is an actuality [שלמות, entelechy] — this actuality is not predicated of all the faculties [כחי] of the soul equally, in the way that the definition of "living being" [החי] is predicated of all its species equally; rather, it is predicated by priority and posteriority [בהקדם ואיחור]. This definition of the soul resembles the definition of "figure" [תבנית]: just as the definition of figure comprises all the geometric figures [הצורות החקוקות], and not one is lacking that does not fall under it — except that it does not designate any one of the figures in particular — since the triangle [המשולש] is prior to the quadrilateral [המרובע], so too with the definition of the soul. The actuality predicated of the soul is not [uniformly] prior; [rather] the actuality is predicated by gradation [למדריגה] and belongs to the ensouled [ולבעלי הנפש?]. The actuality predicated of the intellect — [as] soul — does not fall under this actuality that belongs to the possessors of [the lower] faculties [שבעלי כחות].

Among the species of living beings there is that which has a certain superiority over another in the faculties of the soul: as there is one that has the faculty of touch [כח המישוש] alone — such as the sponge [כאספוג?] and a kind of shellfish [מין מהחלזון?] — and there is one that also has the other senses [שאר הרגשים], and there is one that has [hearing?], sight [והראוה], and imagination [והדמיון]. [...] [? — a short clause here, roughly "...is found...," is uncertain.] The faculty prior by nature to all these faculties is this one [the nutritive], for it is found in the plant [בצמח]; after it [comes] touch [המישוש], and after touch, motion [התנועה]. Therefore whatever possesses motion must possess the faculty of sensation [כח ההרגש] and the nutritive faculty [כח הזן]; but it does not follow that everything which senses and is nourished [מרגיש ונזון] also moves.

And since [the living body] is compounded of the four qualities [מהארבעה איכיות], its food too must be compounded of these four. The instrument by which it recognizes its food must be touch [המישוש], for this sense is specially suited to apprehend the moist and the hot and the cold [הלחים והחמים והקרים], the sweet and the bitter [המתוקים והמרים], the white [הלבן?] [...]. Touch and taste [המישוש והטעם] are of necessity required for life [בהכרח לחי] more than the other faculties of sensation, [whereas] sight [reaches] to a distance [למרחוק?] [...] [? — the close of this line is faded and its wording uncertain]. And hunger [והרעב] is the desire [תאוה] for the hot and the dry [החם והיבש].

and thirst [והצמא] is the desire for the cold and the moist [הקר והלח]. Everything that has touch [מישוש] has appetite [תאוה]; and everything that has the faculty of imagination [כח הדמיון] has local motion [התנועה במקום].

On the Nutritive Faculty [בכח הזנה]

Nutrition and reproduction [הזנה והמולדה], which are one in [their subject] [במוצע?]. That by virtue of which a thing is called "substance" [עצם] is predicated of two kinds [שני מיני]: the one, as matter [היולי], which is [the underlying nature] of the form [הצורה]; and [the other] as the sensible qualities [?]; while the recipient is the composite of the two, and it is that which is described by them [?]. The nutritive faculty exists for the use of food [שימוש המזון] and reproduction [וההולדה].

Accordingly, what we find in the things that come to be [בדברים ההווים], and in [...] [?], is a thing resembling a mold [טופס] [?], so that thereby the species may endure [ישאר המין]. Reproduction is for the sake of that which is to come [העתיד?]. And [the first principle] has been called a "mold" [טופס] in three respects: [...] [? — the three are enumerated but the terms are faded]; and form [וצורה] [...] to it — [these] are on the side of the recipient [המקבל]. The first principle for the growing things [הצומחים?] is the soul [הנפש]; the plant grows and is nourished [ונזון] by it, just as the animal [החי] senses by nature through the sensitive faculty [המרגשת?]; and that which has no soul [...] [?].

On the Essence of Food [במהות המזון]

Food [המזון] [is spoken of] in two ways [?]: the one is [food] by resemblance [דומה], and the other is [food] in itself [עצמו]. For everything that changes from potency to act [מהכח אל הפעל] is spoken of in reference to it — that it is [food] itself; and when its combination [חיבורו] with it is completed and it is dissolved [ויתבטל], it is said to be [food] by resemblance. And food, if it is of a contrary kind [מחלף], over against that with which it is altered [?], becomes separated [נבדל]; and it is said that it nourishes [זן] and yields a surplus [ויעדיף] upon the body [הגוף]; and its residue [?] is called its "end" [מטרה — maṭarah]. Moreover, there is in it a power to generate [כח להולד], like the food, and it is generative [מולד]. Therefore, of the three [functions], the one prior by nature is nutrition [הזנה]; after it, [growth / the maṭarah] [?]; and after it, reproduction [המולדה].

There are here three things: the nourisher [הזן] — which is the soul [הנפש] — and the food [המזון] (interlinear: and the nourished — והנזון). And the end achieved by this faculty is to generate [להולד]; and it acts through the natural heat [בחום

הטבעי]. Therefore there are here three things: the nourisher [הזן], which is an agent and does not change [לא ישתנה]; the natural heat [והחם הטבעי], which is an agent and changes [?]; and the food [והמזון], which changes and is not an agent.

On the Sensitive Faculty [בכח המרגשת]

The existence of sensation [ההרגש] in us is in potency [בכח], not in act [לא בפעל]. [The exposition of the sensitive faculty begins here; the text breaks off at the foot of the leaf.]

[Margin, top of the right-hand page: שב[?]וה — a marginal word or correction; further identification requires further verification.]

that is, [the sense is] in potentiality so long as the sensible object is not present, and in actuality at the time when it is being sensed. Consider a body in relation to fire: the bodies that are in potentiality [to become hot] are such before the fire [acts on them], and perhaps, when the fire [acts], they come to be [hot] in actuality. The agent acts upon the patient because the patient is contrary to it, and it makes the patient like itself in the respect in which the patient resembles it. In the same way, the sense is acted upon by the sensible in the respect in which it resembles it, and it comes to be like the sensible inasmuch as it is made like it.

And when we said that "it comes to be like the sensible," we mean that the sense-perceptions are, in potentiality, [receptive of] the forms of the sensibles, not of the sensibles themselves; for the sense does not come to be in the [material] likeness of the sensible. Rather, that same faculty of sense is what receives the sensibles when it is acted upon by them. And that which is acted upon [in this way] does not [truly] undergo [motion] and alteration; rather, it is like the knower when he is acted upon by [the object of] his own essence — that is, when he exercises his knowledge so as to put it to use — passing, in other words, from potentiality to actuality.

And what he said — that [the sense] perceives in potentiality at the time when it is not [actually] perceiving — is like what we say of the intellect: that it is wise at a time when it is not [actively] wise, just as we say of a wise man, even when he is not exercising his wisdom, that he is [still] wise; for that potentiality of his is a potentiality that is able [to act], a proximate potentiality.

The relation of the sensibles to the sense is like the relation of the intelligibles to the potential intellect, except that there is a difference between intellect and sense in two respects. First, that the sense apprehends particulars, whereas the intellect apprehends universals. Second, that the intellect apprehends what

reaches the soul from within ourselves, whereas the sense apprehends what is outside. Therefore, when the wise man wishes [to think], he enriches himself [from his own resources]; but the sense-perceptions are acted upon by the [nature of the] sensibles [only] when the sensibles are present — it being known that it lies in the nature of the sense to receive the sensible.

Some sensibles are per se (essential), and some are per accidens (accidental). Of those that are per se, some are proper to a single sense, and some are common to more than one sense — such as motion, rest, figure, number, and magnitude. Thus motion and number are apprehended by [all] five senses, while figure and magnitude are apprehended by sight alone. And the error of the senses falls, for the most part, upon the common sensibles, as [in a case] that resembles… [clause faint; uncertain].

But as for the proper sensibles, the sense does not err about them: the sense of sight does not err as to which color it sees, nor does hearing err about a sound, as to which sound it is. The accidental sensibles, however, are as when [we say] "this white thing is Reuben"; for when sight perceives "this is Reuben," it is not on account of his being white, but because it happens that Reuben is white. And [the sense] may indeed err in perceiving this accidental sensible.

And the reception in the sensitive faculty is such that [the faculty] comes to resemble the form [of its object], and there comes to be in it a likeness[?] of that form — [the faculty] itself [taking on], in itself, the form that acts upon it in matter[?]. The sensitive faculty receives the material form, receiving it without the sensible object being divided [from its matter] in the sense — as [the eye receives] the material form of the visible. Therefore it is possible for the transparent [part] that is in the eye to receive it, like a sphere[?]; and this sensitive faculty perceives two things at once, like the mirror that holds black and white within it together.

On Sight [Rubric: בְּמַרְאֶה]

its explanation being that [sight] receives the simple forms [separated] from matter; therefore it bears a particular relation to matter — [and were it not so, it would be intellect]. Now the reception is through a medium: the air or the water. These two elements are set as intermediaries between the seer and the seen, and for this reason what passes over to the organ of sight is the water and the air.

And one might ask: is not fire swifter to serve as the intermediary — [being more] transparent and spiritual[?]? Yet the faculty of sight was distinguished from the

other three [elements] in that it receives by its light[?]… And now he says that the medium is not seen in itself, but is seen by reason of a nature that is in it. This medium is like the water and the air, and some of the hard bodies — such as glass and crystal; and likewise the heavens are a transparent body. Light is to the transparent body as color is [to a colored body]; light has existence, whereas darkness has no existence. Therefore light is a thing that brings [the transparent] into being: it is [the actualizing of] this transparent body, [rendering it] actual. Light is not a body, nor a thing that is transferred from place to place[?]. And that which receives the color is the transparent [medium], [now] in actuality after it has received; and everything that has color is seen only in light.

[Margin (top outer, right page): ועגן[?] — a brief marginal word/gloss; identification uncertain, requires further verification.]

But the luminous things — [certain glowing bodies: …[?], …[?], and the scales of a fish[?]] — some of them are seen the better in the dark; yet the color proper to them is seen only in light. For every color is seen only in light, and its manifestation comes about in light. This is a matter of nature, since it is the nature [of light] that brings [color] into actuality[?]. And so the visible form conveys[?] color through the medium of the air and the water. Nature acts upon vision itself, yet vision does not of itself alter [the color]; and [the medium] is a thing shared[?] [in common].

This is what he set down concerning the sense of sight in this book, having completed the inquiry into what necessarily follows regarding the order of the sensed and the sensing; and it is fitting to begin here.

The author of the book said: the receptive [medium][?] that remains [in the organ] is such that the forms of their sensibles are impressed upon it, just as a form is impressed in a mirror; and for this reason there is the lasting persistence [of the image][?], [as with the many and the white and the like][?].

The nerve of this faculty, so long as it holds to the balanced temperament of its nature — with nothing added to it, and with nothing impeding it from without or from within, such as anger — [functions rightly]. For anger produces in it, on account of the rising of heat to the head, the seeing of a single thing as two; and this is because of the motion that befalls the seer at the moment of anger. For just as the part that receives the form from the sense, in its being displaced, shifts one portion onto the second portion while the impression of the first portion has not yet been effaced — so the one form appears as two forms, as double vision appears to the eyes. In like manner vision is sharpened[?] by a strong ray[?], as if

its source were white and its color were changed on its account; and for this reason the trees are seen [as though] moving[?] amid the light[?], and likewise [certain] places[?].

The activity of vision resides in a part [of the eye] shaped like a sphere; and of this, this part is the perfect substance[?]. Therefore protective coverings[?] were set over it, to guard it from the things outside — and these are to the eyes as scabbards are to swords. Accordingly, one whose [optic] nerve is the thicker[?] is the stronger to see things from afar; for the nerve[?] draws[?] the [eye's] waters and [shields them] from the heat that is outside and from freezing[?], and [protects] them from the cold that is outside. And for this reason many of the other animals see things from farther off—

—than [a person][?] sees, on account of the thickness of their nerve[?]. And the act of vision is completed[?] many times over by means of the air or the water, and in light. The air does not shine of itself[?]; rather it enters [into the process], and not from outside — for were [the eye] luminous of itself, it would see things in the dark. Therefore it comes about — as has been confirmed among us — that afterward, when we open [the eye] but a little, one does not see the thing as it truly is until after [things] have been illuminated before his eye. And so it happens to vision when it would see a distant thing … from outside[?]; and this befalls it all the more because he is seeing in the dark, and at the time when [the light] sinks[?]. In such a case [the object] is not like a thing plainly seen: [it is perceived] in intermediate light, and the sight is neither strong nor does it perceive [it clearly].

[Page 2, lower half (r2–r4): the ink here is oxidized to a faint grey and the semicursive largely resists confident reading. The legible anchor-words — הסבבה "the (transparent) medium," האויר "the air," המים "the water," צורות הדברים "the forms of things," and כמו מראה "like a mirror" — show the passage continuing on the transmitting medium: the medium must be [suitably disposed / transparent] [?] … as the air is when it is illuminated …; vision receives the forms of things because the air, in itself, when it passes on, receives the form of the things and it changes[?]; and then [it conveys them] to the outer medium, which passes[?] them along to the rest of the media until [the form] reaches the near [medium] … the eye receiving the forms … like a mirror … [followed by faded clauses concerning the eye's moisture / tear[?] becoming more refined / spiritual[?]]. The intervening clauses cannot be recovered at this resolution and are left unread rather than reconstructed.]

Therefore the form here has three grades. The first grade is [?]; and after it, the grade that is in sense-perception (הרגש) — and this one is spiritual; and after it, a third, which is the grade in the faculty of imagination (כח הדמיון). The imaginative faculty then examines the form so as to refine it, and takes from it [?]; and there is yet a further grade [?], so that the form ascends through the grades in the remaining faculties, growing finer from grade to grade, each finer than the one below it.

Therefore [?] — this is what the impressing of the form is: sense-perception effects it within the [medium?] of the eye [MS: והשן, so written; the context (the eye receiving the form through the air) requires "the eye"], by way of the motion of the air; and it appears through the imprinting [?] that is within it [several words in this clause are cramped and only partly legible].

Now the master of the science of optics (בעל חכמת המראות) — as to what he maintains concerning [the visual rays; the terms here are corrupt transliterations: קיוטאיס, הנטוטייס, מהקוקיס, הזטוטרב, נאינוס, [?]] — [holds] that every ray goes out from the eye and reaches the objects. But this impressing, or this "acquiring," is not true; rather it is only a supposition [?]. For as to the rays that go out from the eye, it is certain that vision and what is imprinted in it are not completed [?] — the objects are apprehended only through the mind's grasp of them, or through the acquiring [of their form]; and the form that returns [to the eye] is the true one. [Therefore vision is by reception, not by emission.]

Or [take] the distances: their medium is the intermediate transparent body (הגוף הבינוני השקוף) — whatever it may be — for it is by means of it that the [transparent] body comes to receive the air and the color. For light comes from the mixture of the luminous body, which is fire, together with the transparent body — whatever it be, namely water or air. And accordingly color belongs to them in proportion to fire's strength or weakness, and to [its] abundance or diffusion [?]. This is the cause of the colors' being varied: when the light of the sun takes hold of a body [several clauses here are faint]… and color is a faint light [?] within shadow, for it comes to be through the mixing of the [transparent] body with what is in the luminous [medium?].

The white color is produced through the strong blend of fire together with the element that is very transparent, which is air. The black color is produced through the turbid, dimmed fire together with the element that is not transparent, which is earth. And the intermediate colors between them are produced through the variation of the luminous constituents in their quantity and in their quality. The difference between color and light is that color

is seated in a determinate body, whereas light is a general thing, superadded, not confined [to a determinate body]; and according to its element the appearance [of it] varies [?]. By nature the air receives it first, and only afterward does it convey it onward to the sight, inasmuch as [the air] is transparent and luminous. And it appears that the air receives what belongs to [the object] by its nature, like the other thing itself — as when [light] passes over the green plant and tints the walls and the ground with colors [?]. Therefore the air is the cause of the color's appearing, and the air is the cause of its conveyance to the sight.

The elements of the colors are the white and the black, and it is from the mixture of these that [all the rest arise], namely in the intermediate colors themselves. And therefore they stand according to their mixture in quantity, and their variations [?] in this have no [countable] limit from the standpoint of their generality; and so the colors have no [countable] limit — for everything one may reckon and comprehend, behold, the hues are of one kind [?] as regards color [several words in this stretch are cramped and only partly legible]. And it is nature [?] [that produces them]; and although the sensible hues [?]… For this reason nature is more to be esteemed than craft (המלאכה), since the craftsman can make only what the sensory [faculty] is able [to conceive], whereas nature brings forth all that the natural [faculty] is able to conceive, and produces its like. This comes about because craft is an act proceeding from the posterior, whereas nature [proceeds] from the prior; and therefore [craft] cannot [attain?] the grades that nature [attains], but only borrowed grades [?]. And what has been set forth here is correct, [drawn] from sense-perception [?]; Aristotle (ארסטו) [treats?] this in the Book of the Soul (ספר הנפש = *De Anima*), in the [?] discourse.

On Hearing (בשמע). Sound is produced through the rending of hard bodies (העצמים הקשים); and the swifter the rending, the stronger the sound comes forth. What contributes to the production of sound in general is, in the manner of its reception, the shape of the place — for instance, that [the places] be hollow or wide; and [sound] is realized in the medium of air or of water. And just as the air moves [the form?] onward to the sight, so do they convey the sound to the hearing, it being a reception of motion and a being-imprinted with it. The motion remains in [the medium] after the mover has departed, and there remains that short form [of motion] [?] for a time by means of it, until that motion is set in motion — the [motion] that is called the echo (הד) — because every motion is in time.

just as the object is grasped in vision, so too it is with hearing; however differently the two may present themselves, the cause of both of them is one, and

each thing is done for its own sake[?]. And accordingly a man hears the sound itself, and the forms of the sound are received into the material medium (*al-hayulani*) [Arabic: al-hayūlānī, "the hylic / material"][?]. For this reason we cannot assign a soul to it, nor produce a sound within it except for the sake of an image; and accordingly what is not completed is not called [a sound?][?].

It is because of this that all that is heard is the air taken into the ear; and the more this air is fine (דק) and transparent (שקוף), the more perfect is its action (מפעלו). And so—

On Smell (בריח). All smell is the air taken in through the nose (חוטם), and it is that which receives the kinds of odors through the air's being acted upon; and this sense operates in the nearness[?] of some animals more strongly than what is found in human beings — as with flies (זבובים) and bees[?]. The matter is close: the odors are like flavors (מטעמים)[?]. [Here the argument that the sense is, as it were, exchanged within us is only partly legible][?] — for smell is of the nature of touch (משוש). And touch is stronger in man than in the rest of the living, as are the other senses[?] which in man fall short in [several?] respects[?] of what they are in the [other?] animals[?]; and smell is found to [complement?] this faculty[?].

And the operation is composed of quality (איכות) and air[?] […][?] to smell is [assigned?] whatever is [refined?] from the odors, according to the nature of the air[?]; […][?] toward the [warm?] powers[?], so that they are prepared[?] for the perceiving of smell through the action of the air upon the fire[?]. And how the sense comes to be[?] — it is possible[?] that there is no [gross?] sound[?], as with […][?] and its like[?]; and the sense becomes proper to man beyond the rest of the living[?], for [it apprehends?] only […][?]. But how does the odor come to be? — [it comes to be?] in the air by a preparedness set within it to receive the [power?] of the [odor?]; and there is[?] in the odor something [drawn?] from the [powers?] of fire and[?] earth[?], so that it comes to be[?] […][?]. For it is the way of the elements (יסודות) to move, or to set in motion[?], some of them toward others — […] from substance[?].

[Interlinear, above the first line: תנועה ("motion")]

the recipients that are acted upon by them, because they are […][?]; and accordingly the air receives the dry [element] toward the water[?], and the water receives […] toward the earth by cold[?]. And the water[?] — it is transferred by moistening (לחלוח) to the air, and the air receives it because it is [made?] moist and strong[?] for it; and the air acts, and they become like fire[?] […][?]. And so

hearing [corresponds] to air, and smell to the portion of fire (חלק האש); and each [is fitted?] […][?].

And accordingly the [physicians / teachers?][?] held[?] […][?], because [the head?][?] is cold, and the smell [is cold?][?]; and its cause is the portion[?] that belongs to the […][?], and they are called[?] […] so that it is called [thus?][?].

On Flavors (במטעמים). [So called] because [flavor] has no smell of its own, nor operation, except in [its] operations; and there is a body (גוף) touching the sense (נוגע לחוש), and the qualities are stirred[?]. Likewise its [own?] qualities (איכיות) [arise?], and the operation carries[?] […] for the sake of […][?]. And it comes to be that flavors vary, in a way that is not [determinate?][?]. How? — the sweet is hot and moist; the bitter is hot and dry; and the [salty / sour?] is cold[?]. These are the elements of the flavors (יסודי המטעמים), just as the white and the black are the elements of the colors (יסודי הצבעים).

But the odors, because they are not […][?] [that rest in a determinate body?][?] — in what way does the air come to be their carrier (נושא)? […] between [wetness?] and dryness (היובש). And a proof that the nature of the odors[?] is such[?]: there are many things that have no smell at all until they are [burnt?] by the fire, as with [wood?][?] and the like. And in a way, man has a measure (מדה) in the forms of the odors (תמונת ריחות) as he does in the flavors, also because of the sense of the hand [= touch] (חוש היד) and its dryness. And accordingly man is likely to be better at distinguishing the tangibles (משושין) than the rest of the living; yet there are many of the rest of the living that are stronger than we are at [perceiving?] the odors from a distance.

On Taste (בטעם) [reading of the rubric uncertain — possibly *On Touch* (במשוש)]**.** This sense needs [contact?] from outside[?] […][?]; for it requires that the [tastable?][?] be [brought near?][?], because it is […][?] — it is a touching (משוש) of the thing; and it is known by the little[?] moisture (הלחה) that is within it. And accordingly [the tongue?] was set[?] to draw out[?] the moisture (הלחה); and one whose moisture is corrupted (שנפסדה הלחה)[?] — as with the sick[?] — [tastes?] the flavors (המטעמים) upon the [tongue?] […][?]. And as he already said (וכבר שאמר), that the elements of the flavors (יסודי המטעמים) [are…]

are the bitter and the sweet. As for the intermediate flavors that lie between them: the one nearest to sweet is the fatty (הדשן), and the one nearest to bitter is the salty (המלח); and between these fall the pungent (החריף), the astringent (הקובץ), and the sour (החמוץ). The tongue itself, however, has no flavor fixed in it by nature; and when a little of some flavor settles upon it, [by that excess?][?] its

own taste is spoiled. And in this same way the rest of the senses too are constituted.

On Touch (במישוש). The power of this sense is to perceive the hot and the cold, the hard[?] and the soft; and also the softness (הריכוך) and the hardness[?], [the rough and the smooth?][?], the heavy and the light. These differ, in the object grasped, from what is grasped by the power of sight and by the power of hearing; for the ears perceive only what lies directly opposite them, and nothing else. And there is that which lies between the two extremes — as the intermediate colors lie between white and black, and as the kinds of sound (הקולות) that are intermediate between the heavy [pitch] and the light. Now the organ proper to this sense — the reason the sense is sound[?] — is, as [Aristotle] wrote in the Book [of the Soul?][?]: it perceives by the natural sense that is within it, and its medium is the flesh (הבשר). And the more the flesh is well-tempered as a mean, the more it perceives — as at the extremity of the palm, and as at the fingertips (ראשי אצבעות) that are more finely tempered than it. This sense does not require, in order to perceive, a medium from outside — namely the air; therefore this [internal] medium perceives by contact[?], like the senses that are touch and taste. And the difference between the intermediate objects within this sense…

for the perceptibles act first through a medium and successively; but in touch they act together (יחד). And the excellence of this sense is a sign of intelligence (לבב), and its weakness a sign of dullness of soul. Therefore one whose flesh is hard is not intelligent, and likewise one whose flesh is coarse; and the reverse holds [for soft flesh]. This sense stands together with the sense of sight in grasping the shape (התבנית) and the magnitude (השיעור). And the reason they are interchanged is that their perceptibles act by their primary operations; whereas the sense of hearing and the sense of smell — because their perceptibles do not alter except toward a single term, and are separated from their operations — are therefore not interchanged. For to every patient there belongs an agent; and since the agent acts by an operation like itself in actuality, the agent must necessarily be like itself in actuality in that very respect in which it is like it [in potency?], not in actuality; and therefore…

the organ that perceives heat does not perceive it until [there is something] hotter, [something] made warm[?], equal to it in its warmth[?]; nor does the cold organ [perceive] until [something is] equal to it in coldness. Rather, the organs perceive only that which is hotter or colder than they themselves are.

And therefore this sense, as touch, must be a mean set between the intermediate extremes. And just as sight must be void of color — [neither] white [nor black] —

so that it may receive both white and black, so too this sense must be a mean in all the qualities, since it is impossible for it to be [wholly] void of them. And this holds in the unity of all the senses, for there is in them nothing in actuality of what they perceive, but rather all in potency. And [the medium of] touch is the flesh; for it is composed of the qualities that are in [the perceptibles]. And therefore it perceives of them only the extremes[?], by reason of its being a mean. And therefore, the more the flesh is tempered as a mean, the more it perceives the qualities proper to it[?] — that is, the hot and the cold, the moist and the dry. And therefore man perceives more by this sense than the rest of the living beings, and above all in the finger called אמה (the middle finger). And the excellence[?] of touch is a sign of intelligence (הלבב) and of the refinement of the soul (זכות הנפש).

The Third Treatise (המאמר השלישי). In it, he will first explain — in this treatise, by propositions (מותבות) — that the number of the senses is five, and that there is no sixth sense [found?][?] at all. He demonstrates this by three propositions. And the third proposition is thus: it is fitting [to argue] that if there were here another sense besides the five, it would be for the sake of perceiving some perceptible other than the [existing] perceptibles. And if the matter were so, we would necessarily find one of two things: either there would be found [in us] this quality, additional to [the others] and besides it[?]; or the organ present with us [would have] a quality besides it, or [there would be found in] the organs present with us a quality besides the [existing] qualities[?] — and [both of] these are false. And moreover, it is impossible for there to be a sixth sense proper to the common perceptibles (המורגשין המשותפין), which are motion (התנועה), number (המספר), and the magnitudes / lines (הקווין) that are shared; because these perceptibles are grasped by [several of] the five senses, and not one of them is proper to a single sense — neither to one of the five, nor to any beside them. This is as will be shown: that not one of them is proper to any one of the five senses.

For if you take one of them, for instance motion, we perceive it by sight, by hearing, and by touch; and likewise number, which is grasped by all five together; and each [of these] is not proper to any single sense.

[Book of the Soul (De Anima), Third Treatise — continuing: the common sensibles and the discriminating power of sense]

because in each of them the sense perceives, on its own account, what is proper to it: here sight perceives on account of motion, and so too hearing and touch. The perception of motion by sight is not incidental, in the way we say "this is Reuben, who is moving," perceiving him from the aspect that he is white. For sight is not affected on account of Reuben insofar as he is Reuben, but only insofar as he is

white; whereas sight is affected on account of motion in its own right, and therefore motion is perceived by it essentially.

And if there were here a second sense specifically dedicated to motion, it would follow that sight would perceive motion incidentally, in the way it perceives [Reuben] — just as [when one says] "this color is sweet," which it perceives because the sense of taste was affected on its account, not because the sense of sight was affected on its account. But we find that hearing too perceives motion in its own right, and so with everything of this kind. Therefore there is no distinct second sense belonging to motion alone. The same argument holds for the rest of the senses, each according to its nature [?].

He said: each of the senses perceives the sensible (interlinear: המורגש) proper to it, and also perceives that it perceives. How do we perceive this color and know that we see it? This is not done by two powers, but by a single power. That is, by this one power it perceives the color, and by that very same power it perceives that it perceives it. And this is possible because the sense does not [merely] apprehend the sensible proper to it alone — such that all that sight perceives is that a thing is colored, and thus it perceives the color, which is proper to it.

And if there is a further point: the sense and the sensible in actuality — it is necessary that they exist together and be brought to completion together. But in potentiality they need not exist together, for the sensible may exist without a perceiver [actually present]; just as hearing hears sound only when there is something moving in actuality. It follows that whenever one of them is found, the other is found; and when one of them is absent, the other is absent too. Therefore sound and hearing are, in themselves, one and the same thing in essence; and likewise color with sight, taste with the tasted, smell with the smelled, and [touch] (interlinear: והמישוש) with the tangible quality.

And since sound and hearing are, in actuality, one and the same thing, and concord is a known ratio between them, it follows that the sounding, on the side of the agent, is likewise a known ratio; and so it is with the perception of the sense. For this reason each of them is destroyed when this ratio grows excessive — just as hearing is destroyed by a sound that is too sharp, or too deep [and] excessive.

And likewise [touch is affected] by a strong [tangible], as by a violent impress [?]; and likewise sight, on account of strong light or darkness; and likewise smell, on account of a strong smell. On this principle, the best perception is the one found to be a mean in these matters. This matter is intermediate, as he said: it is fitting

that [the perceiving power] be a mean, and not [inclined] toward either of the two extremes. That is, the power by which it operates lies between the sweet and the bitter, or between the white and the black.

It must therefore be one power from one aspect, and two powers from another aspect. For from the aspect that it is one, by combining it perceives the color [and judges] "this is bitter and this sweet," or "this is white and that black." And how is it two? In that by it it perceives the white, and by it it perceives the sweet (interlinear: המתוק). Thus the thing is found to be one, yet two powers in itself, in the way it perceives.

This power divides [?] what each single sense perceives; or rather, this power is one with respect to the forms, like a single point. For from the aspect that it is one, it is impossible for one and the same thing to be divided — like a point that receives the two [opposites] together in the intellect, and is, as we said, one in itself, the very same point receiving heat and cold together in actuality by nature. Therefore this power is, as it were, one, an intermediate among the sensibles.

It must be so, then, for all the senses: this power must be one and yet many — like the center of a circle, when lines go out from it to the surrounding circumference. Just as the point is many insofar as it is the endpoints of the lines going out from it, yet is one and indivisible insofar as it is the terminus of them all — so too this power, which binds together all the senses, is one insofar as it operates in all the perceivers, and is many in respect of number, that is, in respect of the senses. Therefore, since it resembles a point, it judges the things as a point does, and, as it were, stands over them all like a point.

On Imagination

[Enlarged display rubric: **בדמיון** ("On imagination"), followed by a second bold word read **תב׳יל** [?] — uncertain.]

And he will explain that imagination is neither sense-perception, nor thought [?], nor intellect, nor compounded of these; and he will make clear that it is a motion arising from perception that has been actualized, and from the very existence of this [perception].

[this power], in some respect, is a power that is prior [?], because it is like the power of sense-perception. And this power and the perceiving power [are related] as [in] perception, when [the sense] apprehends [?] the sensible… [The final two lines of the verso are faint; the reading is uncertain and flagged.] But once [the sensed object] has passed away, [the sense] no longer apprehends it,

whereas the imaginative faculty [remains at work] [?] within [the perceivers]; for it does not apprehend the object until after that object has passed from the eye. And this faculty is [most active] when the senses are at rest, as in those who are asleep [i.e., in dreams]. Again, the perceiving faculty judges only from a prior [impression] and out of that prior [impression] [?]. And again, we are able to imagine things that were never sensed at all — such as [the substance of a stag joined to [?], a composite never perceived].

There is thus a difference between this imaginative faculty and the faculty of thought. For thought seeks out the precise limits [of its object], pursuing them to the utmost, whereas imagination possesses no such exactness or certainty. Now everyone who thinks is a "speaker" [מדבר, i.e., possesses discursive reason] — [and one who holds an opinion affirms it as settled [?]] — and if imagination were the same as thought, then every creature that imagines would likewise be rational. But this is not so; therefore imagination is not thought. Nor is it thought bound together with sensation [?], since we imagine a thing without being affected by it at the moment of imagining.

And it is evident that [imagination] is neither intellect nor certain knowledge; for we are not always made certain by this faculty in the way [that knowledge makes us certain] — that is to say, [imagination] is not always correct. The form belonging to imagination is changeable, [a material form], whereas the form of the intellect abstracts the object somewhat from matter [the hylic substrate]. As for the imaginative faculty: it exists both in potentiality and in actuality, and the intelligible passes from potency to act just as the sensibles [give rise to sensation]. For the sensibles produce sensation, and the impressions that are made [?] — by reason of the sensibles being sensed — bring the imaginative faculty into being [?]; that faculty is [in potency] at first and afterwards in actuality [?]. And the sensitive faculty is prior to it by nature.

[The lines that follow, at the foot of the recto around the rubric, are compressed and written in lighter ink; the recoverable sense:] ...the intelligible in this faculty is as [it was] at first [?]... and, in their conjunction with motion in place [?], there is a fleeing from the contrary and a seeking of stability [?]. And why is this faculty — the [imaginative] power that has no intellect — so ordered? So that it may have this [disposition] in exchange for what it receives [?], and be placed within [the domain of] the intelligible, so as to be preserved by it when it draws near to the intellect: [there occurs] a change, like an exchange [?] or an alteration [?], and the like.

On the Rational Faculty [בכח הדברנית]

This faculty is distinct from the senses, for each one [of the senses]...

the intellect, when it receives the sensible [and makes it intelligible] [?], [is the receiver of] all this. And he said that one should not wonder that this intelligible is apprehended [as though it were] material; for from the rational faculty itself nothing whatever is rendered intelligible except by virtue of the intelligible it has received — apart from this, [it produces] no other intelligible. This reception is called "intelligible," just as the perception of sight is named on account of light, or hearing on account of sound — except that [the intellect] draws [the object] very near [to itself] so that it becomes intelligible.

And the intellect sustains the intelligible, [receiving] it with a stronger power than [the sense receives] what is in the senses. For when we [encounter] a powerful sensible, [the sense] cannot perceive, because that sensible reaches [an excess] [?] and cuts off [perception], so that [after it] we cannot at once look at another light — the [organ] having been affected by that sensible. But the intellect is not so; rather, [it endures], for after grasping a strong intelligible it will the more easily [grasp] a lesser intelligible, readily and near at hand. And the cause of this is that the power of sense is mixed with the hylic matter throughout the whole of its operation, whereas the power of intellect is not mixed at all with the matter in which it is [made intelligible] — and this [unmixed intellect] is the human [intellect]. And this soul is potentially [an intellect]: the point being that the intellect does not apprehend itself [?].

Among the later [thinkers] there is, on this question, [a view that it is] but knowledge [opinion]. But since there is a dispute among them over the interpretation of the words of Aristotle [ארסטו] — and this is the text of his statement — that the material intellect [השכל ההיולאני, the hylic intellect] is the potential power alone, [receptive] to receive the intelligibles from all that [?] the hylic [substrate] in which it resides: some interpreted it [in one way], while others interpreted it to mean that it is a power existing in a separate substance — that is, [that this disposition] is a thing existing in a separate substance, [the Separate Intellect], as Alexander [of Aphrodisias, אלסכנדר] said. And Ibn Rushd [Averroes, אבן רשד] adjudicated between these interpretations, saying that this disposition, as it exists in man, is a small thing; and that this separate substance, from the side of its conjunction with man, [is likewise small].

Therefore they did not render it entirely empty of matter, as Alexander held, nor mixed [with matter], as others held. And whoever comes [to examine the

question] will see that it is not [wholly] [?]... nor is it mixed with matter, because this rational power [is a small thing] and does not [alter] [?]. This disposition is empty of [all] forms, and [it is what] presents the forms. And because this [intellect] apprehends itself as empty of forms, it was able to apprehend them all. Therefore this power — the hylic [material] intellect — is, in Ibn Rushd's [Averroes'] view, a composite thing: composed of the disposition that resides in our body and of the intellect joined to it.

The Master [Averroes] said [?]: "Intellect in potency" is said in two senses. The first, as we said, is "by nature," in that there is in it a power to receive. The second is as we say "in actuality," in that it is potentially [intellect] [?] — just as we say of a pupil that he is "learned in potency," meaning that he can come to know a thing, its essence being in the intellect alone. And we also apprehend this: that from this form there arises a form belonging to the soul, and this soul is a substrate (*gelem*) for the form, and through them we apprehend that which is produced anew. Now our apprehension by the intellect of this form is [what makes it] upright [?]; and by it we apprehend the disposition, so that [the disposition] comes to rest [?]. We apprehend the disposition, and it is the object apprehended — that which is produced anew — in natural things only. But in the mathematical sciences (*ḥokhmat ha-limmudim*) we apprehend, as a completed premise [?], things that are the form and the soul; and we apprehend that form for the sake of the soul [?], by intellect alone, since the intelligibles [?] in the mathematical sciences are intelligibles that have been rendered sensible. And this [work of] abstraction [?] is [as] in natural science.

That this intellect operates upon the intelligibles is reception only. And what this reception is, is the disposition; and this disposition resembles the disposition in the writing-tablet before it is written upon. That is: just as the disposition present in the tablet before the tablet receives the writing is not mixed with the tablet, so the disposition present in us to receive the intelligibles is not mixed with the man. This is the intellect: it thinks itself and it thinks all the intelligibles. Hence no further [distinct] thing is needed, for there is in it, from the side on which it is intellect and [on which] the intelligible it receives [stand], one thing — that is to say, that they are one from the side of the knowledge that unites the apprehender and the apprehended; and there is [another that is] other than it from the side on which the intellect is other than the intelligible.

Ibn Rushd [Averroes] said: it is proper to inquire into this. For what he said — that the knower and the known are one thing in every respect — is found in the eternal things and in the necessitated [?] things; but in the intellect that derives

from it [the human intellect], it is as though it acquires [that oneness] only in part. That is to say: since its essence is not a single thing, but is the intellect of what exists — the things that are sensed [?] from itself — it is prior for it to think itself, just as it thinks all the sensible things from itself.

For its essence is not a thing that [merely] points [?]: it apprehends the sensible things from itself, in contrast to the composite [?] things, since these do not think sensible things from themselves. Now since in all artifactual and natural things there is an agent and a patient, it necessarily follows that so too in the intellect. It is therefore divided into parts: an agent and a patient. The patient is a receiver, [acted upon] according to the power [of what is] written upon it, and is acted upon by them in reception only, as we said. And the agent is what brings the intelligibles to light, from potency into actuality — since it is like the light of the sun with respect to the potency [of the visible]. For the eye sees nothing without light, and the light is what brings the visible from potency into actuality. In just this way, this agent intellect brings the intelligibles from potency into actuality by itself. And for the hylic intellect, the substrate [?] in which it receives the intelligibles, [the agent intellect actualizes] them, so that the intelligibles come to be actual after having been potential intelligibles.

Therefore this agent intellect is an agent [operating] like the [act of] writing [upon a tablet], because it is what brings them out from potency into actuality, like light [to the eye]. And it is a form for us, so that the intellect becomes for us a known thing that we have thought; and that intellect is nothing other than the form of the intelligible itself. And afterward it divides again into a thinker and a thought [?] and a great reception [?]. The thing attributed to the intellect is like the color that arrives [in the eye] through [the medium of] light: these are the two things that are distinguished [?] within its likeness [i.e., the transparent medium]. That is to say, this intellect sets in the soul intelligibles by nature after they had been [there only] in potency.

As for the agent intellect [itself]: it exists by itself in nature, always, whether we have thought it or have not thought it. Its existence is not an agent intellect for us [in the manner of] our own act [operating only] within the intelligibles that come to be; and therefore it is [at once] the intellect and the intelligible. It is also called the acquired intellect (*ha-sekhel ha-nikneh*), as though [Arabic] *al-mustafād* [المستفاد, "that which is gained"], from the term meaning "benefit" (*fāʾida* / *toʿelet*). Its conjunction with us is possible, and it is the final perfection that man possesses. Thus far the words of Ibn Rushd.

And this intellect, which is a form for us on one side and an intelligible [?] on the other side — the matter is known: that it is not separate [?polarity] [from us], and that it neither comes to be nor passes away.

since the agent must always be more excellent than what it acts upon, and the form more excellent than matter (hyle). As for what the intellect is: the intellect and the intelligible derived from it are one and the same thing in itself, since it intelligizes nothing outside its own self. And it is found that [?] the intellect is an agent; for what acts upon the intellect must itself be an intellect, since the agent [?] is only, as it were, a kind of likeness of what is in itself.

He said: The intellect-in-potentiality is prior in time, in a single respect; but on the whole it is not so [?] — the intellect-in-actuality is prior both in time and in nature to that which is in potentiality. This is the agent intellect, which is the last form for us. It does not intelligize at one moment and fail to at another, nor does it exist at one time and not at another; rather, it has not ceased and will not cease. And when it is separated from the body it is not [something that comes to be and perishes?] [?], and in itself it intelligizes just as it is. Therefore, once the composite has passed away, we no longer recognize what we knew while it was joined with the body. Hence, when it conjoins with us, it intelligizes the intelligibles that are in potentiality; and when it separates from us, it intelligizes its own self. But whether, while it is joined with us, it also intelligizes its whole self — that we shall inquire into after this.

We have seen that the sages and most of the commentators [hold] [?] that the intellect within us is composed of the intellect-in-potentiality and that which is intellect-in-actuality, and that it is the ultimate perfection. And this, insofar as it is composite, does not intelligize its own self but intelligizes what is in potentiality, when these imagined concepts join with it. And insofar as it is separated — or [the matter?] [?] — there befalls whatever it had intelligized that these things perish, and forgetting and error befall it.

In this way, as Aristotle put it ∴ He said ∴ And the intellect is true in its apprehension of the simple things, one in relation to another; and it is that which endures [?]. And with the composite it is true and false. He said: And the intellect is that which combines the intelligibles, one with another, just as [?] the composite [is combined?]; and it is wholly distinct [?], combining the whole together with the distinction. And he says that it is separate in its own self; and thus it intelligizes the time in which a thing is done — past and to come. And falsehood exists only in composite judgments, not in simple ones.

When one says "white" of the white, this is not false; and likewise [?], if it says "white" of what is not white, that is the falsehood; but if it intelligizes of it that it is not white, that is the truth. And the relation of the simples to the intellect is like the relation of the proper sensibles to the sense; and just as those sensibles are not false, so too the simples are not false. :·:

In the intellect there is that which is separable and divisible in potentiality, like the divided [?] — with respect to that which has no [division?] in potentiality. And it applies too to that [?] in the form [?] that is undivided, and in a time that is undivided. And it apprehends [?] what is undivided in potentiality only, not in actuality, like the point [?] and the moving thing [?], in a time that is undivided; and it is divided by the soul that is undivided. Just as the faculty that apprehends white and black is a single power in itself, so the power that apprehends the intelligibles [?] is a single power in itself.

And what will it be when it is the intellect-in-potentiality? But insofar as it is that which is pure [?], free of potentiality, it does not intelligize except its own self [?]; and it does not intelligize [its own vesture?] [?] — all the more, then, does it not intelligize the [act of intellection?] [?]. :·: And the intellect operates upon the images just as the sense operates upon the sensibles; and it is impossible for that which is intellect to be [?] without an image, and it will never think anything without an image. And the affirmation and the [negation?] [?] belong to the intellect, just as the corresponding judgment of the sense bears upon its objects. And the intellect examines things and acquires [?] [what it draws] from matter, together with those that are in matter; and there is that whose thing cannot be [separated?] without matter — like that which cannot [subsist?] [?] without matter [...] [?] — while for another it is impossible to separate it without the [matter?] [?]. But the [mathematical objects?] [?] it is possible to separate [?] [...] [?] :·: And the master of the mathematical science [?], [treating] of magnitudes [?], is not concerned with the [enmattered form?] [?], for he did not ask [about it?] [?] [...] [?]. And the intelligible derived from it is one and the same thing in itself. :·:

They said: And the intellect cannot intelligize what is here except while it is clothed in us; and there is no need that the power of the separables be clothed in us, but only that it be possible for the separables to be intelligized [?] in it. And this is Aristotle's view, while it is within us [...] [?] on its account, and they did not find it.

He said: The soul, in one manner, is all the beings that exist — the sensible and the intelligible.

[Pencil foliation "30" at foot of page 2]

their apprehensions that are in the soul are [such] that they are outside the soul; yet [in another respect] they are outside the soul, and [they subsist] in the soul as forms [drawn] from what is concealed[?], for had they been in the soul [in actuality] … [?] There was one who, were he left [composed] of stone, his soul would be stone; and one who, were he [composed] of fire, his soul [would be fire]. For this reason the relation of the soul to the knowables is like the relation of the human hand to the tools: just as it is possible to use the hand for all the tools, so the soul is receptive to all the forms.

That is, it is disposed to receive the sensible forms (ha-murgashot), and it distinguishes among the forms — [both those] within the soul and outside the soul; for their being in the soul is a mode of the existence of the things that endure[?], which are called, as it were, qualities, whereas the existence [of the thing] outside the soul is [what] abides[?]. The first of the apprehensions is sense (ha-hergesh), and after it the intellect (ha-sekhel); for the intellect draws[?] from the imagination the things …[?], while the imagination takes the impression (ha-roshem) from sense. And what … [?] from the sensibles cannot be learned except through that impression … [?]

From the multitude of [sense-impressions] we obtain the first universals, and this comes about through three things: sense first, then imagination, then memory (ha-zekher) and the retained image. For every living thing senses. We observed one living thing sensing [an object]; then, after the object was hidden from it, we imagined it; and after this we remembered it. Likewise we observed a second living thing sensing in the same way, and we remembered what we had seen at first; and then we observed a third living thing likewise, and remembered the two that had gone before — and this many times over. In this way we came to [conclude][?] … [?] and we obtained what is called a universal: that every living thing senses. Therefore it has already been made clear that the first intelligibles are [derived from] sense, imagination, and memory — except that, since we find them within ourselves as though we had been created with them, we do not remember when they came to us; and in this there is no cause for wonder. It follows that whoever lacks one sense lacks the intelligible of that sense; and therefore one who [lacks a sense] from birth lacks [the perception of] every … color.

And so it likewise follows in one who lacks a [given] sense: he lacks another kind of that which … [?] — [for that is] its nature[?]. Now had the intelligibles been [attainable] through the senses[?], then every single intelligible would be hard [to

grasp][?], since what is not sensed is not recognized … [?] all that we have sensed. And were we [able] to attain the intelligibles without sense and imagination, wisdom would be lacking to us. Know, then, that we conceive the universal by reason of the existents outside the soul, just as we conceive the external [universal] because we have sensed many individuals of the living thing. The relation of the universal that is in the soul to the particular found outside the soul is like the relation of the father to the son: for the universal does not become a universal except through the particular outside the soul, just as the father becomes a father through the son. ::

בכח התנועעית — On the Motive Faculty

[Margin (left of heading): "נעלם" / [?]"נעלב"[?] — brief marginal note; content not confidently legible]

This faculty does not arise[?] except after the priority of sense and imagination; therefore it is not found in one who lacks those [faculties] … [?] like a plant[?] … [?] And this faculty is the faculty of the [natural][?] sense. It is the motive faculty: when it is directed toward a pleasant thing it is called desire (ha-ta'avah); when it is for revenge it is called anger (ka'as); and if it is for the good it is called desire and will (ḥemed va-ratzon). The heart, at its center, is the moving sense. Therefore it produces … [?] the images[?] … and the fears[?] … which give rise to motion; for it is on account of the root of these faculties — the images and the motions — that the imaginative faculty sets the motive faculties in motion, until the sensed imaginative form is raised up [to it]. … [?] [When a faculty is moved] to move on account of the imaginative form it is called …[?]; and, correspondingly, [its opposite] … [?] is called joy (simḥah). ::

ספר המורגש והמרגיש — The Book of the Sensed and the Sensing

[Marginal mark to the left of the heading: "ז" with abbreviation stroke — probable quire/section signature (= 7?) [?]]

And it is also called the Book of Sense and the Sense-Object (Sefer ha-Ḥush ve-ha-Muḥash).

[This is the *De Sensu et Sensibilibus* (On Sense and Sensible Objects), the first treatise of the *Parva Naturalia*; its body text begins in the following folios.]

[Pencil foliation "31a" at foot of p. 80.]

המאמר הראשון — The First Treatise [On Sense and the Sensible Objects — *De Sensu et Sensibilibus*]

The senses necessary[?] to a living creature are touch and taste, for it is through them that its nourishment and its life are secured, since by them are discerned the things fit to be eaten, whether from within or from without. Sight, hearing, and smell, by contrast, serve its well-being, for their function is not to distinguish what is fit [to eat] from what is unfit.

Each of these five faculties requires the organ proper to it: the eye for seeing, the ear for hearing, the nose for smelling, and the palate for tasting (interlinear: והבשר למשש — "and the flesh for touching"). Three of them — sight, hearing, and smell — require a medium: air, water, or fire, as was stated in the Book of the Soul (*De Anima*). But the two senses of taste and touch have their medium within themselves and need no medium from without. What is distinctive to the sense of sight is that, beyond air, it requires a bearer of light — that is, light itself. He has already explained all of this in the Book of the Soul, and there too he explained the remainder of this treatise.

As for what is distinctive about these five senses in man: man attains through them the [ways?][?] of things and grasps their particulars; and the other animals too grasp through them some of the things that are outside, which are like an impression[?] of the particular. For man rejoices when he hears a sweet, pleasant [sound], which does not please the beasts so; and man is moved when he sees [beautiful] colors and lovely forms, whereas the beasts are not moved by this. Man too has something distinctive in his sense of touch that the beasts do not have.

Man is likewise superior in the indication given by smell, which points to what is beneficial and what is harmful, whereas the beasts are not so. For those beasts that do recognize [such things] recognize only by nature — as Solomon said of it, "…in all your ways"[?]. But to recognize a particular plant by its scent — whether its scent is beneficial for some known purpose or not — the beasts have no capacity for this, whereas man does have the capacity for it with respect to many kinds of plants. In man, hearing and sight are the pathway to the first intelligibles and to learning, together with their acquisition in the intellect. Therefore one who is not deprived of these two senses is the more intelligent and the better able to acquire [knowledge].

[The lower portion of the folio side is blank; faint bleed-through from the following leaf shows below the last line.]

המאמר השני בזכר והזכרון והשימור — The Second Treatise: On Memory, Recollection, and Retention [*De Memoria et Reminiscentia*]

Remembering concerns things apprehended in past time. Recollection is the [act] whose starting point is the intellect operating by will (deliberately), when a person retains [something] and his grasp of it comes to him only afterward — after it has [first] been made an object of thought. Retention (*ha-shimmur*), by contrast, is from the outset a continuous memory. And this is the distinction between it and remembering: memory is a retention that is not continuous, though it belongs [to the person] by nature, whereas retention is continuous at every moment. Therefore retention is superior to memory, just as continuous motion is superior to the motion that rests upon it by nature.

This recollective faculty apprehends other things insofar as they are a bounded quantity that it has already sensed and represented in the imagination. It is not the universal nature of the quantity that the intellect apprehends [through it]; rather, [what is grasped] is renewed upon the faculty that joins sensation and imagination — for a man remembers only a thing that he has already sensed and imagined in his imagination.

The distinction between this [combining] faculty and imagination is that this act of judgment (estimation) is nothing other than the bringing of the content of the imagined thing to the [receiving faculty?][?] after it has been registered; and it now judges concerning it that it is the very same [object] that was sensed and imagined. Hence there are here four things: the imagination; the retaining of that imagined [form]; the judgment concerning it that it is the same imagined [form] that belonged to the earlier percept; and the [re-]reception of the imagination afterward, made fit for the faculty proper to it — the faculty that apprehends the intelligible. But the judgment concerning this intelligible — that it is this represented thing — belongs, in man, to the intellect, which is what emanates within him, whether by [thought?][?] or by nature.

By this faculty, which in man operates through thought and reflection, a person recollects [something] after he has forgotten it; whereas in the other animals it is natural, and so the animal remembers but recollects nothing of what it once

retained, since it does not possess the [deliberate] faculty within it. Avicenna (Ibn Sina) calls it *al-wahmiyya* [Arabic: al-wahm — "the estimative faculty"]. By this faculty the animal flees by nature from what is harmful, even before it has ever sensed it — as many [creatures] flee from […?] and from other kinds of […?], though they have never seen them at all.

Further, the matter is completed by enumerating [these] faculties.

[Pencil foliation "32" at the foot of the folio side.]

[On Memory and Recollection — continued from the preceding folio.]

which is the notion of the likeness of the thing, and it is called *zekher* (a memory-trace). Its completion is the gathering — that is to say, the gathering of the image (*dimyon*) of the thing together with its impression [?] in the soul; and this is the faculty of cogitation (*ha-machashavah*). It therefore stands as an intermediary and a judge between the pure intellect and that which is the imaginings (*ha-dimyonot*) and the sensed (*ha-murgash*). Recollection is completed through [?] the pure [faculty]; and the error proper to each of these faculties is the one specific to it.

For we sometimes apprehend the notion of the form without apprehending the imaginative form itself, and sometimes we apprehend it without that form at all — that is, without grasping from it the notion of the form. Therefore we are able to retain many things at once, even though we cannot depict them all together. [Scribal collation note: וסלי אלבן דב[..]לי [א]נוסח [?] — a variant reading recorded by the scribe; further identification requires further verification.]

Accordingly, what the imaginative faculty apprehends is more than the particular sensed thing [?]; and what the inscribing faculty inscribes from it serves as a retainer; and what the faculty of recollection [receives is] the notion of that inscription. For this reason the impression of a thing in the faculty of recollection is more spiritual than what it is in the imaginative faculty. And since the operation of the faculties [?] upon the sensed form is a single act repeated many times — whether composition or division — in the manner in which [?] it works upon the forms it has already sensed, it is an act performed many times over. This comes about, as we have said, in that each faculty conveys to the next what it holds; and each of the faculties of the simple intellect [?] receives that which is proper to it.

But reception and separation occur in the very taking-up of the thing as sensed, while it is still being sensed. When the sensed thing is sensed, the common sense

[?] first takes it in [?]; afterward the imaginative faculty (*ha-metzayyer*) depicts it; afterward the recognizing faculty (*ha-makkeret*) recognizes that form as it is impressed; and afterward the retentive faculty (*ha-shomer*) receives what the recognizing faculty has recognized. Hence, if the thing must be recalled, it returns by way of combination.

Because these faculties are distinct — for the sensed content is first sensed, then the imaginative faculty depicts it, then the recognizing faculty recognizes it, then the retentive faculty receives it — it necessarily follows that their organs are arranged in a corresponding order: the receiver of the sensed at the front [?] of the brain; next to it the cogitative faculty (*ha-machashev*), in the middle ventricle; and next to it the inscribing and retentive faculty (*ha-shomer*), at the rear of the brain. This becomes evident [?] when these faculties are impaired — through injury, or through some corruption [?] or pressure — in the region of the head.

[Interlinear, above the first line: המורגש — "the sensed."]

Therefore there are here five grades (*ma'alot*). Their beginning is substance (*etzem*), which is the form outside the soul. The second grade is the existence of this form within the soul, coming to be as the soul makes contact [with it]; and this is the beginning of the grade of spirituality. The third grade is its existence in the imaginative faculty (*koach ha-dimyonot*), which is more spiritual than the first. The fourth grade is its existence in the recognizing faculty (*ha-makkeret*) — that is, cogitation. The fifth grade is its existence in the faculty of recollection (*ha-zikaron*), which is more spiritual than all of them, since it is the reposited faculty (*ha-koach ha-munach*) — what the perfect man has refined and selected out of what is received (*ha-kelitah*).

Retention (*ha-shimmur*) is the joining and preserving of the existence of the sensed content in the faculty of memory without cessation. Forgetting (*ha-shikhchah*) is its loss. Recall (*ha-zekher*) is its return after forgetting. Recollection (*ha-zikaron*) is to reflect upon its selection, and it is proper to man alone. The nature of this faculty of memory is brought to completion only through the forms of the imaginings and the cogitations: the imaginative faculty (*ha-metzayyer*) belongs to the imaginings, and the recognizing faculty (*ha-makkeret*) is cogitation.

Recollection comes about when we come [?] to the notion of that thing: when we bring it forth, the faculty of memory brings to the imaginative faculty the form of that thing; and cogitation composes [?] them — the recognizing faculty performs its recognition, or its separation. Thus, by [?] the form, memory brings it and its inscription [?] to the imaginative faculty, and the composition of the notion is set

toward the [rule / cogitation (?)] — which is the recognizing faculty. [...] [?]; and we gather, or the faculties combine, and the thing comes forth [?]. Its bringing-forth is the act of one of them.

One must know that this bears upon the spiritual [faculty (?)]: the site of pain. When there is pain in [the common sense (?)], and in the more spiritual [faculty (?)] [...] [?] — there is the pain of the imaginings; and when there is pain of the imaginings, it becomes pain of cogitation; and when there is pain of cogitation, it becomes pain of recollection. And if the thing does not return, [that is] an illness (*chalah* [?]).

He said: In the depths of a man's nature [?], things gather in the brain or in the common sense [?], and things are depicted that were never sensed at all — rather, their depiction was left unspoken [?] for them; just as Aristotle (*Aristo*) related concerning one of the ancients, who used to depict the forms of things he had only heard about [...] [?], and afterward [...] [?] — as one depicts the form of an elephant though he has never seen it.

[Text continues on the following folio.]

[Parva Naturalia — the close of the treatise *On Memory and Recollection*, then the opening of the treatise *On Sleep and Waking*. Continued from the preceding folio.]

[Margin, upper outer edge: a short word, reading uncertain — possibly הרביעה.]

and the gathering — the drawing-together of the faculties and their unification — serves [the intellectual operation [?]], just as their dispersal serves the bestial functions. This gathering is difficult for people, because it withdraws [?] the corporeal being, whereas the motion of the animal soul lies in their dispersal. And so this gathering occurs only in those whose thoughts rest in their proper places at [set] times, and who withdraw the heart from busying itself with the affairs of the senses. In them the form returns, to hold fast the faculties; and thus the faculties are unified in sleep, and the soul grows quiet over the wonders of the world, in acts resembling a dream — like the drowsiness ascribed to those who are said to have released [?] their souls.

One whose brain-temperament (*mezeg*) inclines toward dryness is slow to learn and slow to forget: slow to learn, because through its dryness it receives a thing only with difficulty; and slow to forget, because the dryness retains the thing. One whose temperament is moist is quick to learn — for the moisture receives a thing swiftly — and quick to forget, since it does not retain it. And one whose brain-temperament is balanced between the two learns quickly and forgets slowly.

Therefore memory is good in the days of youth (*ha-bacharut*), and forgetfulness comes with old age: in childhood [good] because of the natural moisture, and in old age [forgetful] because of the incidental moisture (*ha-lechah ha-mikrit*, phlegm). Whoever is not overtaken by the nature of this incidental phlegm has the firmer [memory], since the old man's temperament is dry; and so some old men are found who remember and do not forget. In the young, retention (*ha-shimmur*) is found more than recall (*ha-zekher*), whereas in grown youths there is both retention and recall.

And why does a man remember far more [than the animals [?]]? Because he perceives much [?] and directs [his sensation] well; [...] he senses much, and the intellect grasps [?] much of it; and therefore he prolongs the taking-in and the grasping of things within his knowledge, so that it is hard for him to lose them.

[Section rubric, display script:] בשינה ובקיצה במהותם ומוצעם — On Sleep and Waking: on their quiddity and their disposition.

[Sub-rubric:] מהות השינה — The Quiddity of Sleep.

It is the sinking (*shekiʿah*) of the sense and the inward motion of the sense into the body; and waking is the going-out of the sense and its motion to the parts outside the body. Therefore the rule (*chok*) of sleep is that the motion comes to rest, and [the rule] of waking is that the motion returns; and it happens that a man secludes himself in order to think about some matter or other —

[Foliation: pencil "34" in the lower outer margin. Librarian marks: a blue archival stamp along the upper margin and a blue register mark ("20 / 20") in the outer margin.]

— so that this sense likewise sinks its form into the body and effects nothing [outward]. The cause of its sinking at the time of thought is to aid the thinking faculty, which grows strong through the quieting of the other senses; it then brings about and completes [the grasp [?]] of what it has taken in, for its binding holds that thing fast. And we required the imagination (*ha-dimyon*), because the object grasped — whether in imagination or in thought — is spiritual; therefore the faculties must be confined at the [time] proper to it. And so a man sleeps away the corporeal things and does not sleep them in waking; in sleep the senses become bound, tightened, and firm, because they are sinking and are not in use, whereas in waking there befalls them the dulling of their functioning, on account of their weariness in use.

Sleep and waking are not a single separate [faculty [?]]; for every living thing that possesses sensation — in it are found sleep and waking, and joy and grief and [perception [?]]. And whoever has the [five] faculties acts with each one of these things [...]; but whoever is deprived of one sense by accident and not by nature — like a blind man or a deaf man — does not [thereby lose sleep and waking [?]]; in sleep and in waking his [other] senses [remain [?]], since [...]. Yet this is necessitated because the sense is withheld from him by nature, as in some animals.

Together with this, sleep comes about through the weakness of the sense-faculties, which grow weary from the length of thought and from the vapor (*ha-ʿishun*) [rising to the brain]; for the vapor rose in them to sink the sensation of the form [...]. And it is reasonable to say that the sense-faculties gather at the time of sleep, as living beings do; for when these gather, sleep [comes], and it seems to a man that sleep has befallen him. It is possible, too, that the [vapor of] sleep be so stirred in some people that it becomes for them like death — that is to say, like the faint [?] loss of the motions, on account of the [ceasing of the] functioning of the faculties: the first operations and the second, the great and weighty matters. And there gather upon the [...] things, as a whole [?], like the angels and the heavens and the rest — just as it befalls those who forget their souls. And the disposition (*mutzaʿ*) of sleep and waking belongs to the common sense (*ha-chush ha-meshutaf*), because the cause of the sense-form's sleep [...]; for the aspect of sleep is its sinking.

[A faint, abraded marginal line below the last line of text; not legible.]

[Text continues on the following folio.]

[Parva Naturalia — On Sleep and Waking (De Somno et Vigilia), continued: the physiology of sleep; then the opening of the treatise On Dreams (De Insomniis). Continued from the preceding folio.]

[the descent (?)] of this sensation. The origin of this sinking is in the heart, and the head is one of the instruments that bring this action to completion, by virtue of the aptness [?] found in it. The matter, then, is clear: just as the descent of this sensation in waking proceeds from the heart and sets the brain of the head in motion, so too the descent of sleep proceeds from the head and reaches down to the heart. Sleep, accordingly, is the return of the natural sense (*ha-chush ha-tivʿi*) and its gathering to the place of its origin, which is the heart. And since the gathering of the natural sense comes about through its opposite — namely cold and moisture — then just as its outward flow passes to the outside [of the body],

so likewise the sinking into the depth of the body comes about through the passage of the cold and moisture over the brain of the head; and waking comes about through the passage of the heat [?] and its issuing forth upon the heart.

The nature of the matter is this: the moisture restrains [?] the natural sense with cold and thickens it, and it prevents the *ruaḥ* (the vital vapor) from moving the organ proper to it — just as clouds screen the sun. But the coldness, because it overpowers [?] the natural sense, beats it down [?] and congeals the body, so that the sense contracts to an ever-smaller quantity; and this is why the cold element is smaller in quantity than the hot element. As for what befalls the *ruaḥ* from the agitation of the food and its digestion in the brain of the head and the heart, and from the labor that reaches [?] the sense-faculties and the natural sense: when the food is broken down [?] and distributed to each limb as is proper to it, the cold portion of it rises somewhat to the brain, so that the brain necessarily becomes mingled [?] with it and grows colder than it was. Moreover, on account of the food, the organs [?] become thick; and therefore, because of them, the coldness of the [body's] nature is retained [?], and the *ruaḥ* grows heavy and is drawn to gather at the place which is the heart — and this is natural sleep. And because of the weakness of the brain and the heart, when the food has been depleted, the sleep of the living being occurs while the food is still being concocted (*ʾikkul*). When digestion is completed, the power of the natural sense is freed [?] from those organs and from the moisture; the sensation gives off its vapor amid the thick [vapors] and [?], and waking is produced.

So sleep is produced by two operations, by reason of the [aroused (?)] nature of the body. The first is that the natural sense, when it is withdrawn, finds a resting place [?] and settles; the [second] is that the motion of the sensation works down into the depth of the body, to occupy it with what it must —

[Marginal note (small hand, reddish-brown, in the outer margin, three lines): "וימצא / מוצב / [מ]התנועה" — best read as "and it finds a settled place [free] from the motion." Constructive helper aligned with the adjacent clause; further identification requires further verification.]

[Last line of the page, centered: "...from the remnant of the last [meal's] food."]

[Foliation: pencil "35" in the lower outer margin. Faint bleed-through shows in the lower blank portion of the page.]

— so that there may remain in it, at the last, that which was renewed [?] by the motion. Sleep is, as it were, the motion that cuts off [?] the natural sense: the sense is cooled and moistened by reason of the cold, and therefore it returns to its

source to rest, so that its soul may be freed from the chill [?] that comes upon it. Thus sleep occurs by reason of a change in the natural sense, in both its quantity and its quality. The sleep that comes on account of food is by reason of the moisture of the food and its coldness; the sleep that comes on account of motion is by reason of a deficiency in the natural sense and its coldness; and the sleep that comes on account of distress [?] — which we have mentioned to you — is so that the sense may rest from the agitation of motion.

On Dreams. [Section rubric in enlarged display script, set within the running line.] Dreams are attributed to the faculty of imagination (*koaḥ ha-dimyonot*), and it operates in sleep just as it operates in waking. For in waking the sensibles (*ha-murgashot*) begin [to move] from outside toward the common sense (*ha-hergesh ha-shutaf*), and afterward the common sense conveys them to the faculty of imagination. But in sleep the process is reversed; that is to say, the starting-point comes from the faculty of imagination, from what has risen up within it of the form of the impression [?] it had received — whether from outside or from the deciding faculty (*ha-koaḥ ha-machria*ʿ) — and it returns, and the common sense apprehends it. And when the common sense apprehends the particulars, it happens that the person perceives the sensibles; and so, while he sleeps, it is as if he sees and hears and feels and touches and acts [?], and imagines that the sensibles are present, though they are not present from outside — because their vapors have already borne away the sense-impressions. And there is no difference whether the vapors be from outside or from within. The like of this happens in waking to a sick person; and this is by reason of the strength of the faculty of imagination in its operations, or because, strengthened [?] by some action, it grows strong and reverts and produces that for which it was set in motion — namely, the common sense.

And because the faculty of imagination grows strong in sleep — since it is freed from the rule of the faculty of thought (*koaḥ ha-machshavah*) and departs from its dominion — and because of the weakness of the faculty of thought in a sick person, there happens to them the like of what happens [to dreamers]. He said: the cause of veridical dreams (*ha-chalomot ha-nitzdakot*) is like that of all analogy [?]; and it, in itself, apprehends the first intelligibles (*ha-muskalot ha-rishonot*) and gives the universal starting-point in natural matters.

[Text continues on the following folio.]

just as their existence was explained in the Book of the Soul (*De Anima*): namely, that they derive their motion from a single substance. And now there arises in them the higher knowledge [?], drawn from the received [principles] — the first

intelligibles. So it is that in dreams there comes the foreknowledge of future things, at the coming of their proper time.

Yet here a doubt arises. Since the cause of true dreams is the recipient intellect [?], a difficulty presents itself, for it is that which receives them [?]. Now it has already been explained, in the divine science (metaphysics), that the Separate Intellect is what bestows the universals, inasmuch as it is itself universal — whereas that which belongs to the world [is another matter]. The nature of a part of the intellect is not in the world of nature, and it does not bestow a natural, particular thing; for the particular is apprehended only through the sensible. How, then, [could the Intellect bestow] the form that is individuated in time and place?

We answer that nothing prevents [the Intellect] from producing anew, in a dream, that which is present here — whether in a person himself, or in someone close to him, or among the people of his city [?]. And, returning to resolve this doubt, we said, in conclusion: since this existent bestows [its effect] in a known manner and a known order — received from the upper movers down to the elements, and whatever proceeds from them, as was explained in the Book of Generation and Corruption (*De Generatione et Corruptione*) — so too the things that derive from the plant and from the animal are known in their existence, and their causes are bounded, [proceeding] from them by way of the prior [cause] and the recipient intellect. And in the renewal [?] of the elements, the upper movers, and the recipient intellect, or in the knowledge of what lies present before you, [these forms] are of necessity bounded in relation to the Separate Form — that is to say, in the recipient intellect. And they relate this Separate Form [to them?] as the instrument [relates] to the form of the work. These are fine and subtle degrees, such that they cannot be fathomed.

[The lower portion of page 1 (f. 35v) is left blank; the argument resumes at the top of the following page.]

And therefore no one of those who observe [the heavens] [?] is equal to another, whether by reason of the subtlety [of these degrees] or through prior knowledge; for every master of a craft grasps [only] the measure of the knowledge proper to a master of that craft. As for the matters of the will — such as [what is permitted?], the customary usages, and human affairs — these are bounded in the Separate Intellect, and they belong among the first intelligibles.

He said: And as for the craft of judging the stars [judicial astrology], what it purports to reckon concerning the hidden [future] things, relying on those who

put their faith in it — this is what the astrologers (*ha-ḥozim*) supposed. Ibn Rushd [Averroes], of blessed memory, said: it is for this reason that the early masters of that art [?] held that there must be renewed anew now, in themselves, either the hidden things or the [sensible ones]; for they supposed that whatever exists now is, in itself, the recurring thing.

All these things are set forth as true. Therefore there is not found a [particular] form which the Separate Intellect bestows upon the imaginative soul except inasmuch as it is in the world. And just as [the Intellect] gives the universal and gathers the particulars from the world, so too here it gives the last of the particulars to the imaginative soul as an instrument, and the soul receives the particular.

And why does a person grasp, of these particular things, that which is distinguished in our time, or at its [proper] time, or in its place? Because a person perceives only those other things that he already knew, and over which a prior providence [attention] had rested; for a knowledge is renewed within him, for the sake of the human being, so that it may be verified in every respect — seeing that a prior knowledge has [already] advanced, so as to be verified [?].

And why does a person not see that very distinguished thing itself, but rather sees another thing resembling it? Because these are spiritual, simple forms, and the spiritual [faculty] is nearer to the intellect than to the sensible; and this spirituality is the imaginative faculty (*ha-medammeh*). Therefore, for the most part, it sees the imagined form; yet it also sees the form itself, and not [merely] the one resembling it.

Why is the imaginative faculty strengthened more in sleep than in waking? Because when a person is asleep and the activity of one of the faculties ceases, the faculty that remains is reinforced. When the action of one power falls still, the power that remains grows stronger and takes over the work—on account of the sense that is engaged [in waking] but that comes to rest [in sleep]. At the time of waking the soul turns toward sense-perception; it therefore necessarily follows that the imaginative faculty is strengthened at the time [of sleep]. For this reason he raised the point that those born blind [?] and deaf have stronger sensory faculties [and a stronger inner representation than others [?]]. And so divination becomes fitting, as it were resembling [the truth]—that is, it resembles [what is to come]. For when these sensory faculties are engaged, the strong motion gathers up the external senses, until the person becomes as one in a swoon.

He said: it is not far-fetched to find a person who is asleep while awake, just as the sleeper sleeps at the time of sleep; and it is possible that he also sees a thing that has not [yet] happened. And what benefit is there in what arises in dreams? It is on account of complete providence—[warning a man] by punishment [?] to guard his heart toward good or toward evil—so that he may understand the reason for which it was fitting [?]... the cogitative faculty; for future things are not before you, and it is deficient in this [?]... the last [faculty], the excellent one, and the spiritual apprehension. And because divination is produced in this way, from [an exalted] rank, they ascribe it to God and to Ptolemy [?]. Accordingly he said [?]..., and he argues against the [masters?] of nature; there is one who says that this was their wisdom—but we say that it is we who grow wise in wisdom [?].

One who would interpret dreams [?] must have his soul rightly disposed by nature to grasp the images and the likenesses fixed in dreams. It belongs to his conditions that he comprehend the images—encompassing all the nations, and what is proper to a single nation—and that he be reliable [?] in every craft, and in the counsels and the practices that are born of them. He must be such that he improves what is in his soul through thought, reflection, and depth of speculation, and that he be holy in spirit. It is possible that a dream be seen within a dream; and the recollection of a dream after waking follows the same way in which one recalls what passed while awake. And whoever is [?] near—his dreams turn out the truer, because in him the imaginative faculty is the more firmly established.

As for the little that comes before you, in it the earlier [/nearer] ones are strengthened the more; because this one is the first, and the later one rises a little from the whole, the more; and by this the dreams are made clear concerning the past, concerning what is now, and concerning what is to come. Dreams may also be of service to some craft among the crafts, just as the ancients knew many matters of medicine that were made known to them in a dream.

He said: yet the reasoned sciences are not grasped through dreams—only [in this way]: nature has already given us the means to attain the sciences and the first premises. Therefore we have no need of dreams for these, since we acquire them openly, and [dreaming does its] work for nothing [?]. The dreams that come true are those that persist by nature as is fitting, when [the dreamers] dream according to nature; and in this there is light and [?]... and darkness [?]... good [?]; and likewise the mixed dreams, mingled with the great power of nature and with its opposite. Hence there are true dreams and false: the false is false [?] because the true ones are found rooted in nature, and much is heard in them, though one

is confounded by them on account of the nearness [?] of the spiritual apprehension that is fitting in them.

The Third Treatise

On the Length of Days

[Margin, beside the opening line: "as a premise" (בהעצה) [?]]

He says: the length of days and their shortness pertain to a root, and, as regards time, to a species; and [the individuating matter] is reckoned to the prime matter [ההיולי, Greek: ὕλη, hyle] [?]. This is on account of some of the natural powers—namely heat and cold and coagulation [?]—and it is because of some of them that the [outward] spreading [?] comes about; and likewise moisture and dryness. And because coldness and its increase come about through heat and through moisture, one whose temperament is hot and moist is therefore the longer-lived—provided that the consuming heat masters the moisture gently [?], for in this way it prevails over the [prime moisture?] [?] and does not diminish [?]. But if the moisture flares up and overpowers, it produces [?] a coarse [?] heat that scatters it.

And between the active powers and the passive there is a limit [?]: when [the heat] warms [?]... and the more enduring [?] the heat is, and the more that substance does not depart far from [the mean?] [?]...; the heat is far from coagulation. And in the dissolving [?] of this, if the heat is small, [?]... Here I have said that the limit [?] lies in the ratio of heat to moisture [?]... the [limit / whole] [?]. [Text continues.]

[Foliation: the second page (verso) bears a pencil "37" at its foot.] ...that is, that the heat be double the moisture — and this is the lesser limit. Whatever falls short of this limit will have less durability, and this holds to a greater or lesser degree. For example: one in whom the heat is one and a half times the moisture is stronger and more excellent in himself than one in whom the heat is one and a quarter times the moisture.

Likewise, in each of the paired extremes of these powers there is a known ratio: there is a known ratio between the heat and the cold, and likewise between the moisture and the dryness. Therefore, when the heat in a given individual stands to the cold in its proper natural ratio — whether that ratio be greater or smaller — and likewise the moisture to the dryness; and when the individual is so duly set in order that the active quality in him stands in the proper natural proportion between itself and its opposite, and the passive quality likewise stands in the

proper natural proportion between itself and the active quality in him — then such an individual endures and prolongs his life greatly, for as long as he is able to live from a single portion [?] of his natural heat. Shortness of life, by contrast, follows what nature decrees for him.

Natural death is that the natural heat consumes the radical moisture [rṭivut ʿaṣmit]; and once it is consumed [?], the cold overtakes [the body], so that it dries out and perishes. Accidental death is an excess [of increase?] [?], such that nature cannot bring [its work] to completion.

Those who indulge much in intercourse have shorter lives than those who do so sparingly, and eunuchs live longer than other men. Those of abundant flesh live longer than the lean. The mule lives longer than the horse, because it does not mate. Females live longer than males, on account of their inactivity. Those who dwell in warm and moist lands live longer than those who dwell in cold and dry lands; and for the same reason island-dwellers live longer than others. The sea creature lives longer than the creature of the desert, and the sea creature is fatter than the creature of the desert.

The End [תם].

The Book of Divine Wisdom

and it is called the Book of *mah she-aḥar ha-teva*, "what comes after nature" (Metaphysics)

[Margin: a single letter ח, marked with a stroke above, in the margin beside the book title — apparently a scribal section- or quire-mark; further identification requires further verification]

The First Treatise

The investigation of the truth is in one respect difficult and in another respect easy. It is difficult in that one who begins to investigate, in order to reach [the truth of] the matter, still requires that another after him refine it further. And it is easy in that no [human intellect] is wholly barred from it; for one of the sons of man grasps what another does not grasp, and when all that each one grasps is gathered together, a great measure is collected from it.

The difficulty of attaining the truth is owing to two things. The one is the difficulty [inherent] in the very nature of the thing — and this [portion] comes from the thing itself; but the greater [portion] is what comes from us. For our intellect,

faced with things that are [most manifest], is like the eyes of the bat before the eye of the sun: for although the sun is exceedingly bright and plainly visible, the eye of the bat cannot look upon it; so too is the intellect within us with respect to the things that are in themselves most intelligible.

Just as we would give credit to one for whom it was hard to hold his ground in the smoke, so it is fitting that we give credit to one who [labored thus]; for even a small premise will serve him as a foundation to establish [his point], since had the earlier [inquirer] not laid the groundwork, the later one would not [complete it].

And in another respect, that which is called the knowledge of the truth belongs to philosophy — for the end and benefit of theoretical knowledge is the truth, whereas the end and benefit of practical knowledge is action. We cannot know the truth [of a thing] unless we know its cause. Now each of these things is a distinct cause for that of which it is the cause among the rest of the things — among the things agreed to be within it as well. And just as fire, in kindling heat, is thereby the cause of every heat that exists, so, for this reason, it is fitting that what is most rightly to be called "true" among things is that thing which is the cause of the truth of the things that come after it. Therefore the first principles of the things that exist must always be reckoned among the truest, since they are not true at one time and untrue at another; nor is there any cause of their being true, for there is no cause of their existence — rather, they are the cause of the truth and of the existence of all the other things.

Each of these has four causes, which are: the form, the matter, the efficient [cause], and the final [cause].

[The First Treatise continues on the following folio; the foot of fol. 38 is blank parchment below the enumeration of the four causes.]

The Book of Divine Wisdom (Metaphysics) — First Treatise, conclusion

[The chain of causes] does not proceed to infinity; and therefore one arrives at the first cause.

For a thing may be called a cause in two respects. In the one respect it is posterior, as when you say "from the seed a man comes to be" — that is, the man

comes after the seed; and in the other it is prior, as when you say "from water, air" [and the like — the tail of the example is uncertain: כח … וכמאמר … [?]].

"Cause" is predicated of four [kinds]. One of the remaining kinds is prime matter (*ha-yuli*, היולי), according to its disposition [מעמדו כ… [?]]; and one is the patient, as when you say that the agent [stands] to the patient (*ka-poʿel … ke-paʿul*).

Among these [causes] there are some the one extreme of which reverts upon the other extreme, and some that do not revert. The one that does not revert is like what is said [of the posterior]: the man does not revert [into the seed] again, and likewise the agent does not [become] on account of the patient. And as for the remaining [material causes], a thing can revert cyclically, this coming to be from that [and that from this]. Therefore [הלכך … [?]] prime matter has a limit above it and below it, and [generation proceeds] from the composite to the simple.

Some of the ancients [קצת… [?]] asked: is it possible that [the series] should proceed with no limit — since [there is] but one [ordering] alone [?] — [Illegible: ~4 words: לפי שאין ל… אלא יורה אחת בלבד כי ה…], such that it [runs] as against three lines in three [respects (?)], with no bound at all [ואין לו קצבה].

as [air comes] from water, and from fire, [and so on] to infinity; and likewise the efficient [cause (?)], as the agent that comes to be [from another agent] — [but this is] for the sake of [a first end], and not in order to proceed to infinity. [The reciprocal-generation illustration in these two lines — כמו שיקח … קברייות … ותקבל … — is partly abraded and rendered here only for sense; several tokens are uncertain [?].]

Therefore, whoever affirms [the series] must grant [מי מ…שר שלא [?]] that the caused reaches a last caused thing that has none after it; that the moved reaches a first mover that has nothing to move it; and that the patient reaches a first patient. Nor does the [final cause (?)] proceed to infinity, because its cause, from the side of its nature and by reason of what is [proximate (?)], does not come to be from [other] existents — that is, [unless] prime matter be something separate, or a separate part, that is, a substance or an accident.

Among the parts of the existents there is the prior-by-nature and the posterior, for the prior is prior by nature to the posterior. And if we should say that the parts of the existents have no determinate limit (*ḥeqer*, חקר), then no first [term] would be found; and if the first-by-nature is not found, [there is no cause at all].

Moreover, the ascent [הירוקקף (?)] toward the first does not reach [an actual infinite]; and the general point in this matter is that the intellect grasps only a

thing that has a determinate limit (*ḥeqer*). And just as the sensibles have an end, so too the intelligibles have an end.

The Second Treatise

In this treatise he sets out the deep questions (*aporiai*) that are investigated in this science. And Ibn Rushd [Averroes] counted them as twenty-two [שנים ועשרים]; yet it appears that they were thirty [שלשים — the two counts are legible but worth further confirmation].

First question: whether the theoretical inquiry [into being] belongs to a single science or to many sciences.

Second: whether this science is to examine the primary things only, or whether it also has to examine, together with that inquiry, the first principles of knowledge — the primary premises from which every demonstration proceeds.

Third: the science whose task is to examine substance — whether it is one science for all substances, or many sciences; and if they are many sciences, whether they are distinguished [by their objects]; or, if they are not distinguished, that some of them be called "a science" and some [be called] something else.

Fourth: concerning substances — whether they are the sensible substances only, or whether there are here other substances besides them, or besides the sensible ones.

Fifth: whether substances have a single root [principle], or whether they have many roots — as he said that substances have three roots: the [natural], the sensible, and the mathematical.

Sixth: whether the inquiry is into substances only, or also into the accidents apart from the substances.

Seventh: to inquire concerning that which exists in itself, and concerning that which is other than it, and concerning priority and non-being, and the rest of the attributes that he ascribes to them in the fourth treatise.

Eighth: whether it is proper to inquire into the permanent accidents belonging to each one of the things, and concerning what belongs to each single one of them — and not concerning the whole substance, but rather that their attributes be considered in them — or not.

Ninth: whether the first principles and the elements are the genera, or the particular things called [the individuals]; and whether some of them are principles [to others]; whether the proximate principles, nearer to the manifest, are the more real, or rather the remote principles — which are also the universal ones.

[The list of questions continues.]

[The numbered questions (*aporiai*) of the Second Treatise continue from the preceding folio.]

[tail of the preceding question:] whether it is more fitting that they be among the principles [derived] from others [than] the remaining ones[?].

Eleven (אחת עשרה): whether there is here another cause besides these ten; and whether, if there are separate [causes], it derives from it.

[Twelve (ordinal at line-gutter, uncertain — see anomalies)]: whether the cause is one in number or in proximity.

[Thirteen (ordinal uncertain)]: whether there is a cause besides the one they call the *ha-yuli* [the *hyle*, matter] — that is, the form; whether there is no cause besides it, or whether in the depth of things there is a cause besides it, [too] deep [for us to grasp]; and what they are, and whether the things [derive] from among the existents[?].

[Fourteen–Fifteen (ordinals uncertain)]: whether the principles are distinct in number, or in form, or in nature — or [whether they simply] exist.

[Sixteen–Seventeen (ordinals uncertain)]: whether the principles of the perishable things are the [same] principles as [those of] the things that are not perishable, or whether their beginnings and their principles are different; and whether they are all [alike, so that] they do not perish — [that is,] whether the principles of the perishable things do not perish, and [likewise] the principles of the [imperishable] things do not perish.

Eighteen (שמונה עשרה): whether the One is itself the substance of existing things, [being] something else, or whether it is something else [entirely].

Nineteen (תשע עשרה): whether the principles are universal things or particular ones, like the individual units.

Twenty (עשרים): whether [existing things] are substantial or natural, like the units; whether they are eternal or [exist] by nature.

Twenty-one (עשרים ואחת): whether the principles are self-subsistent or not self-subsistent.

[Twenty-two (עשרים ושתים[?])]: whether the length, the figure, and the point are substances or not; and whether they [derive] from the objects of sense-perception, or are within them.

The Third Treatise

On the One and the Existent [Being], together.

Every single thing and every single substance — according to [this science] — is such that the One is entailed by the Existent, and the Existent by the One; and each of the two entails its fellow. That is: everything that exists within some species of the species of existence is one in the form [of its existence], and everything that is one within some species of the species of unity is existent in the form [of unity] by which it is, in itself, one. For just as everything prior to a thing is a cause of it, so everything that is a cause of a thing is a principle of it. It therefore belongs to the master of this science to treat things under [the aspect of] the One and the Existent and the like.

This science, too, treats them under [their] forms and in the way they are apprehended[?] — such as the like, the contrary, and the opposite, and the identical; the prior, and being; and the principles of the substances[?], which are the beginnings of the truth[?]. And it is fitting, before [all else], [to recognize] that this is the first, which is known [in itself] and not from anything else besides it; for this One has no prior known before it. Therefore, when we come to know [the truth], it is fitting [to grasp] that here there is no first starting-point for demonstration that could instruct whoever has grasped[?] … the starting-point — for it is known in itself, not from another, and not by way of any prefatory [proof] [?]. Were it otherwise, it would not be the first starting-point.

And in this respect[?] the science is [itself] a substance, [standing] between the whole[?] and non-being: for [affirmation(?)] establishes the thing in everything, whereas non-being is a privation[?], not [belonging to] any particular thing[?]. And "the first" is predicated of many substances: a thing is called "first" inasmuch as it is one of the genera, or inasmuch as it acts first, or inasmuch as it has something of the first.

The comings-to-be and the substances are composed of contrary principles; and the heads of the contraries are the One. Likewise, it is impossible for one thing to

be [both of] two things together in every respect; [and so] it is impossible to combine the two substances together — and, [as regards] persistence, it is impossible for one thing to be [and not be] in [the same respect]. It is impossible for there to be [an intermediate] between the two in [the same] respect. Therefore no thing among things is [both] such [and not such]; nor are all things [true(?)], nor are they all false; and not all things are at rest, nor are they all in motion.

The First Philosophy, moreover, is distinct [from the other sciences]. They all share in universal matters that belong to the master of the crafts — except that this philosophy, its aim is the knowledge of the truth, whereas a craft['s aim] is distinct[?] … so that people may think of it as deficient, because the excellence[?] … And what matters in them is the form and the end; for the form is the essence[?] of the thing in itself, and by it the thing is what it is; and the end is the [reason / the good(?)].

Here its words are completed.

[Librarian note: modern pencil foliation "40" at the foot of the left (verso) page; a blue-inked stamped figure — "19 + 79" (uncertain, partly mirror-reading) — in the upper margin of the same page. A small dark-ink marginal mark (a letter-form with two supralinear dots) at the lower-left of the right (recto) page — possibly a quire/foliation mark; no content claimed.]

[The recto opens with the closing lines of the **Third Treatise** (Book Γ), in markedly fainter ink than the rest of the leaf — the first two lines are attenuated and only partly recoverable:] … for he said that its rank [is the highest] … [Illegible: ~1 faded line] … and this is the discipline that is rightly called **wisdom** (חכמה), and the one who knows it is called **wise** (חכם).

The Fourth Treatise

"Principle" (הראש) [Greek: ἀρχή, *archē*] is said in several senses.

[1] Of the extremity of a line (קצה הקו) — for a line has a beginning at each of its ends.

[2] Of that from which each thing may best begin — as in learning (הלמוד), where one begins not from the very first point but from what is easier (יותר נקל) to grasp.

[3] Of that from which, as something present within the thing itself (הדבר והוא בו), a thing first comes to be.

[4] Of that from which motion begins from without (מבחוץ) — [the example that follows is too faint to read with confidence: Illegible: ~1 faded line].

[Further senses follow on a cramped, faded stretch; the securely legible anchor is:] … and of the premises [of a demonstration] (ההקדמות), for these too are called a "principle."

[The entry on **"cause"** (הסבה) [Greek: αἴτιον, *aition*] follows here on the most attenuated part of the recto. The four-cause framing and the material example are legible; the intervening connective clauses are not securely recoverable at this resolution and are honestly flagged.] "Cause" is said of the matter — as the silver (הכסף) [is the cause] of [a vessel] — and of the form (הצורה [?]), [and of the agent and of the end]. [Illegible: ~3 faded/cramped lines listing the subdivisions of cause — near and far, essential and accidental, potential and actual — of which only scattered anchor-words (בטבע "by nature", נמצא "is found", ידוע "known") are legible; a proper-name example of the accidental cause may stand here (ראובן [?] "Reuben"; לבן [?] "pale"), but the reading is not secure. **This stretch of the recto for higher-resolution recovery.**]

[The text continues legibly on the facing page, still on **"cause"**, distinguishing the proximate from the remote cause:] … And [causes are also distinguished as] near (הקרובים) and far (הרחוקים): the near, as the physician (הרופא); and the remote, as the art of medicine (מלאכת הרפואה), which heals him — and the like, as when it happens at the time that one is building and at the time that he is a builder. As for the particular privations (הנעדמות הפרטיים), it is possible that [they be reckoned among the causes] together with their [corresponding] forms — provided only that they be such that by nature they can never be found together at once (לא ימצאו לעולם יחד); for contraries (ההפכות) by their very nature cannot stand together (לא יעמדו יחד) nor be found together.

"Element" (היסוד — in Greek *asṭqmi* [Greek: στοιχεῖον, *stoicheion*, "element"]) is said of that from which a thing is first compounded as a constituent present within it (והוא בו), and which is simple, not divisible in respect of its form (בל נחלק בצורה). For example, the elements of speech (יסודות הקול) are those from which speech is composed and into which it is finally divided (יתחלק בסוף), while they themselves are not divided further into other sounds differing from them in kind (בצורה). But if speech is divided merely in quantity (בכמות בלבד), then the resulting parts are alike in form (דומין צורתם) — like water: if you divide water, [each part is still] water. In the same way the primary [propositions] are called the elements of the [geometrical] premises (הקדמות); these are the elements of the composite demonstrations (המופתים המורכבים).

"Element" is also said, by way of transference (על דרך ההעתקה — that is, metaphorically), of the One (האחד): since it is indivisible and is found present in many things. Some therefore supposed that it is simple and yet is [present] divided in them, because it is an element; and for this reason certain of the ancients (מקצת הראשונים) held that the One (האחד) and the Point (הנקודה) are the principles of the world (ראשי העולם). The sense intended in the definition of "element" is that it be found in many distinct things (מצוי בדברים נבדלים הרבה) — found in each thing more [widely] than each of the elements [themselves is] — that is, more universal (יותר כללות). And to the degree that the roots of things (שרשי הדברים) are universal and simple, [the term "element" applies to them the more truly]. For this reason some people said that the units [or: the "twos"] are the element; and the more elemental a thing is, the more universal it is — since whatever is more universal is more simple (יותר פשוט).

[Beginning the entry on **"nature"** (הטבע) [Greek: φύσις, *physis*]:] "Nature" is said of many substances (עצמים הרבה); but the truest of these [senses in this respect] is [the substance that possesses] the form (הצורה) — and, [in the heavens,] the sphere (הגלגל) — for a thing is not called "nature" except in virtue of its having received the form. And [nature is said] next of the thing which is the source (ראשית) of the coming-to-be (ההויה) and of the motion (התנועה) proper to [natural things], among the sensible existents (הנמצאין המורגשין), and which is present in them essentially, not by accident (בעצם לא במקרה).. Foot of the verso (page 2): pencil foliation "41".] ...and so, if the [form(?)] is the more truly entitled to the name "nature," then likewise the forms of the four elements are more truly entitled to the name "nature" than are the things that are composed of them.

The needed and the necessary (הצורך וההכרח) are said in many senses. In one sense the necessary is that without which a thing cannot exist or subsist — a joint cause, one of the constituent parts of [a thing's] cause, and not [that which acts] through the essence itself. Of this same kind are the necessary things that have never ceased and never will: these are simple things, meaning that they undergo no alteration in their essence — and this is the perpetual necessary. For among necessary things there are those that do undergo alteration, whose necessity is derived in them from their cause, and in all of these there are intermediates; that is, for them to be necessary, there must [first] exist [something] necessary [prior to them][?]. And if these alterable things are [each] necessary [only through another], it follows that the matter proceeds to infinity — unless there be found something that is necessary through itself. And if that is so, then the necessary in truth is the simple, since it is necessary by its own nature, while all other things are necessary through it. And since the necessary cannot exist in many states, [we

conclude that] if there are here simple, [perpetual(?)] things that do not change, then it is clear that the necessary does not change in what it is, nor is it a thing that is [merely] contingent in itself; for [such] things do not change — or [are so] if they are [things that admit of privation?][?].

The one (האחד) is said in many senses. Some things are said [to be one] by accident, being those that are composite here [only]; and some are one in essence [?]. Of the one per se there is a particular and a general. The particular is the continuous (הרצוף), like a line — whether it be straight, or curved like an arc — or a natural [continuum]...; rather, that whose conjunction is intrinsic (עצמי) is all the more to be called one. [And that whose nature makes it continuous — the straight [line] and the [bent?] — as [in?][?]...] So too, as when it is said that "the human" and "the writer" are one in essence, and that [the one there] is the living being. And the true one is that whose essence is divided neither in substance, nor in time, nor in place.

For our intellect apprehends, all the more, that if [the one] be a substance [in the primary sense(?)] it is more truly [one] than [if its unity came] through otherness. Whatever is not divided at all by its nature [is one]; and if it has a limit (קצה) it is called [one(?)], while if it has no limit it is otherness and part. And that which is divided in one respect, in quantity, is called "a line."

The things said to be one in genus are those that receive one thing, or are acted upon on account of one thing, or in which there is one known differentia, or that are related to one known thing [— a relation of association, al-ishtirāk(?) in Arabic]. And more truly one among these is that which is one [in itself] and admits neither addition nor diminution. Therefore substance is said to be "one" more than is the rest of existence (הקיום). And [the account of] the essence of the one is that it has no division — which is the beginning of number; and it is the quantitative part by which number itself is measured. The measure in each of the things is the one; yet the essence of the one is not, in all particulars, a substance — one, for the one is [predicated] in [more than one way?]; and it is [grasped] by the intellect... [one clause here resists confident reading: [?]].

And the one in motion is the daily motion (התנועה היומית). And the one in all things is that which is divided neither in quantity nor in form: what is undivided in quantity, like the point and the unit; and what is undivided in form, like the circumference of a circle (קו העגולה).

Therefore some things are one in number, some are one in form (species), some are one in genus, and some are one by analogy (בשווי). The one in number are

those whose matter is one; the one in form are those whose definition (גבול) is one; the one in genus are those whose predication (מאמר) is one — as "living being" is predicated of the human and of the horse; and the one by analogy are those whose relation is one, like the relation of one thing to another thing. And the prior by nature among these is the one in number; after it, the one in form; after it, the one in genus; and after it, the one by analogy. And these posterior ones always [refer back] to the prior ones: as when you say that everything one in number is also one in form, but this does not convert; and everything that is one in form is one in genus, but this does not convert.

[The opening continues the philosophical lexicon of Aristotle's *Metaphysics* (Book Δ), begun in the preceding folios; it picks up in the middle of the entry on **the one**.]

Everything that is one in number is also one in species. Reuben, for instance, who is one in number, is one in species. But Reuben and Shimon are likewise one in species, though they are not one in essence [i.e. not numerically one]. And Reuben, Shimon, and a horse are one in genus (בשרש, "root"), though they are not one in species.

The many. "The many" (הרבה) is predicated as the opposite of "the one." Some things are called many because they are not continuous (רצופין), and some because their underlying foundation (יסודן) is divided in species; and the correlative "manys" are so called because the separables (הנבדלים) that indicate [multiplicity][?] are many.

Being. Being (ההויה) is predicated both per se and per accidens, in every way [?], and it is that which is said of the ten categories (עשרה מאמרות). It is predicated of the existent thing (הדבר המצוי), for the existent "has being" (יש לו הויה), while its opposite "does not have being" (אין לו הויה) because it does not obtain; and likewise whatever remains of a pair of contraries [?] "has being," while the false (המשקר) "does not have being." Some beings are in potency (בכח) and some in act (בפועל). Being is found in all ten categories: of the qualities, for instance, some things are perceived by touch (במשוש) and some are perceived [otherwise][?].

Substance. Substance (העצם) is predicated of the four elements (הארבע יסודות); of that which is composed of them; of the [parts][?] of the living being (החי); of the three [dimensions][?]; of the numbers (המספרים); and of the definition (הגבול) of a thing, which is its form.

The same. "The same" (הוא הוא) is said both per se and per accidens; but we shall now speak only of what is said per se. It is predicated of everything of which one

of these is asserted — that which is one in number or in species — and of such things one says "yes, it is so." And likewise of things that are one in species. "The same" is also said of that which has two names, as when one says "Jacob is Israel." And it is said of the subject (הנושא) [?] together with its definition, as when one says "man is the rational animal" (החי המדבר). All of this is essentially "the same" — the same in number, in species, in genus (בשרש), and in relation (ביחוס). The contraries too are called "other," in that one says of them that they are so differentiated (משונין).

The like. "The like" (הדומים) is predicated of things whose quality (מעלתן) is the same in itself, except that they differ in more and less — as with two things, the one more red (אדמומית) than the other. It is said of things whose qualities are one, as one speaks in geometry (בגמטריא [Greek: γεωμετρία, "geometry" — not *gematria*]) of "similar figures" (הצורות הדומות). And it is said of things that share, or that may possibly share, in most of the properties in which they share — for instance, the kinds of honey (מין הדבש) are alike because they all share in the [same] humor (הליחה); [and honey … does not share …][?] sweetness (מתיקה).

The opposites. The opposites (המקבילות) are predicated of contradictories (הסתריות), of contraries (הנגדיים), of relatives (המצטרפין), and of privation and possession (האין ויש, "non-being and being"); and of both extremes together — and these are the [termini][?] of change. Each is an extreme, such that opposites cannot be found together in the subject that receives them. "Opposite" is also predicated of the intermediates along with the extremes, since by nature there is [a passage] from one extreme toward the other, as one says that red is opposed to black, inasmuch as there is in red a departure from white (מן הלבן).

The contraries. The contraries (הנגדיים) are those at the extreme [of difference], which differ most from one another — that is, those most differentiated in essence, like [possession and privation][?]; or those that fall under a single genus (שרש אחד), like white and black; or those that stand at the extreme of difference, also in species (בצורה). The one and the many are found in each of the [ten][?] categories. And a difficulty arises concerning what is said in the science of language (חכמת הלשון, grammar) — namely, that substance (העצם) has no contrary.

Prior and posterior. "Prior" and "posterior" (קודם ואחר) are predicated in many senses. First: the knowledge of universals (הכללות) in itself is prior [to the knowledge of the particulars]; the knowledge of particulars (הפרטיות) [is posterior], while the knowledge of universals is prior. The [simple][?] are prior to the composite (המורכב), and the perfections proper to them are prior to the

perfectibles. For the line (הקו) is prior to [what][?] is found in the straight line (בקו הישר); and the plane (השטח) is prior to the [parts][?] found in it. "Prior" is also predicated of what is prior by nature (בטבע). Substance (העצם) is prior [to that whose] predicates (מאמרות) are predicated of it; and the thing in which there is [apprehension][?] deserves to be more prior than it. And potency (הכח) is in one respect prior to act, inasmuch as the composite is potentially a known element (יסוד ידוע).

Potency. Potency (הכח) is predicated of the principle by which the agent produces its effect in another (בזולתו); of the principle by which the patient (הפעול) receives the effect from the agent (הפועל); of the principle by which a thing does not receive the effect at all; and of things that are not readily destroyed by another. It is also predicated of that in which lies the beginning of change (התחלת תנועה) toward another — as one says of black [?] that it is white in potency (בכח), or of wine (יין) that it is vinegar (חומץ) in potency. And apart from these, potency in the true sense (הכח האמתי) is a principle of change in another, or in [the thing itself] insofar as it is other.

And "incapacity" — that is, the absence of power — is predicated of that whose agent is weak, and of that from which has been removed what would naturally belong to it at a later time, as when one says that a certain one[?] does not beget. This may be said at a time when the capacity would still naturally be present in it, as when you say "this one likewise, in the case of a man," or with respect to that in which the capacity can never be present at all, as when you say "this, in the case of mules." And just as the term "potency" is applied to the possible, so it is applied also to the necessary — as the sun, which by its nature shines in potency; and likewise "incapacity" is applied to the impossible, as one says of the diagonal, which has no power to be made commensurate with the side of the square.

Quantity is predicated of number, of the line, of the surface, and of the body; and these are named together with whatever pertains to them. It is also predicated per accidens, as when the white is called a quantity, since quantity applies to it by virtue of the surface it occupies. Among the notions of quantity are the great and the small, the long and the short, the broad and the narrow — for these make known the essence of quantity. It is predicated as well of time and of motion, which are called a quantity because they belong to [magnitude][?]; thus, according to Ptolemy[?], the extent of a motion is grasped by reference to magnitude and to time.

Quality is predicated of the differentia by which one species is distinguished from another in its essence. It is predicated of the forms of quantity — the

mathematical figures, such as the triangle and the square — and also of the disposition of their origin[?]. It is predicated of the things perceived by the five senses: colors, sounds, smells, tastes, and tangibles. It is predicated as well of the things in which the sciences, the arts, and knowledge reside. Quality, as it is divided, is of two kinds: either it is affective or it is not. In these are found the good and the bad; that is, there are qualities that are permanent in their subjects and do not change, since these are substances that do not change, and there are qualities that do change in them — some of them being deficiencies and some excesses.

The relative is predicated of such things as the double and the half, the active and the passive, the father and the son, the measured in relation to the measure, the known in relation to knowledge, and the perceived in relation to perception. The relative is also predicated of another class, such as the equal, the like, and the same: for the equal is one with its fellow in essence and like it, and [the like is one with it] in quality. Among relatives there is one that is relative in itself, such as those of number; that is, each of "the double" and "the half" is relative in itself.

But the intellect and the intelligible — neither of them is relative in itself; rather, the intellect alone is relative in itself, whereas relation merely happens to the intelligible [accidentally]. That is, it appears from this that if you say "knowledge," a known object is thereby seen [to be its correlate], just as "the half" appears in your saying "the double"; but from your saying "the known" it does not likewise appear that there is necessarily a relative — namely, knowledge. This is the wording of Aristotle. Therefore all the relatives spoken of in the class of number are relative because each is said in relation to another thing; whereas the measure, the intelligible, and the known are relative because something else is said in relation to them. [The point about the intellect and the intelligible is then restated: whoever knows a thing has intellect, yet the intellect does not of itself show that it is intellect, since it is [so] called in that it is said [in relation to its object]…][?] — the remainder of the clause is faded and its sense uncertain.

The complete: a "complete time" is spoken of — a span so long that there is no other time outside it that is [merely] a part of it — and likewise a "complete magnitude." It is also predicated, in the strict sense, of the thing that is at the utmost of completeness with respect to [any] deficiency, such as a "complete physician," in whom there is no lack of any of the excellences[?] proper to his kind, nor any merit wanting that could be added to him. For this reason it is predicated, by way of metaphor, even of bad things, such as a "complete thief."

And it is predicated of whatever has attained its end in a given matter, as you say "a complete acquisition" or "a complete attainment[?]," since these are their ends.

The limit is like the point in relation to the line, the line in relation to the surface, and the surface in relation to the body. It is predicated also of the end, and of the essence of a thing and its form. And "limit" is more general than "beginning": for every beginning is a limit, but not every limit is a beginning.

That in virtue of which [a thing is what it is] is predicated of what is present in a thing in its own self, in its essence, and in its form — as when you say "this is good in itself," that is, in respect of its form; and likewise that Reuben is a rational animal [lit. "a living being that speaks"] in himself. It is predicated of that in which a thing first comes to be by nature, without any intermediary other than itself — as color, which is in the surface first and in the body only through the mediation of the surface. And it is said that the cause producing a thing in itself is the proximate cause, in the case of a thing that has no other cause besides it; whereas that which has, besides it, another cause—

[Librarian note: a faint Latin annotation (later hand, pencil/ink) in the lower margin of the verso, illegible.] …just as the essence of a man that belongs to him in his own right is his humanity — that is to say, that he is a man; and this is his essence [מהותו]. A man has many essences [עצמות], such as life, (interlinear: speech,) and the sensitive faculty, one of them standing above another or below it. And the parts of this essence are themselves parts: some of them lie in their substances and some in their forms.

— **Disposition** [ההרכבה, ἕξις, "having / state"]: it is like an activity proceeding from an agent and a patient. So too the garment, which stands between the one who wears it and the one who clothes him. And it is also called an acquired condition[?], [predicated] of the [good or bad] disposition[?]. It is likewise predicated in a combined sense: thus a good disposition is spoken of as a "good state," or [correspondingly] as a "bad state."

— **Affection** [quality, πάθος]: it is said of the perceptible alteration — that in respect of which a thing is altered — and, in general, of the qualities [האיכויות].

— **Privation** [στέρησις]: it is said of the quality of a thing — of what it is not in a thing's nature to possess; of what is in its nature to possess but which it does not in fact possess; of that which has its form at the time the form is present in it, or at the time it is natural for it to be present but is not present. And it is said of that which is taken away from a thing by force — whether some part of it or the whole of it — [so that it is deprived of it?]. [The further qualifying clauses here

are compressed and several tokens resist a confident reading: …that it may not[?] be predicated[?] truly of a man[?]…; …of one who does not affirm[?] a thing that cannot be denied[?] of one of two contradictories[?] — the affirmation[?] and its opposite[?]; and likewise of one who has [only] one [of a pair] and no longer [both], and does not see[?].]

— **Having** [הקנין, ἔχειν, "to have"]: it is said of what is found to belong to a thing in its own right, as when we say that a man "has" a hand; and it is said of what receives something into itself, as the bronze[?] receives the form of the statue [צורת הצלם], and [as the tongue holds speech?]. And it is said of one kind [of containment], as a province [מדינה] "has" people [and its several parts]; and this is the sense in which a man "has" a province, and beyond it more.

— **"From something"** [אשר, ἐκ τινος, "that which is from a thing"]: it is said of a thing [as reckoned] from its foundation [matter] — the remoteness or the nearness from the whole foundation, or from the depth of[?] [the thing]. And it is also said in another sense.

— **The part** [החלק, μέρος]: it is said of that within which there is [something measured?] and which is added to it, as the [unit] belongs to number; and of that which measures[?] [the whole], as [a part] of the five. And it is said of everything that is a part [of a composite]…, for each of these is a part of the thing composed of the two of them. It is also said of one kind, as [the genus] is a part [of the species], and likewise the [differentia?]; and the genus is called a part of the form, because it is more universal than the species.

— **The whole** [הכל, ὅλον]: it is said of the things from which no part of the parts is lacking. A thing is called "whole" insofar as the whole is not whole except by [reference to] its parts.

[f. 45v]

And it is said of universals — that which comprises many particulars, as "man" does. (interlinear: And "the all.") Yet totals [הסכומים] are not called [wholes] in this sense; for "the all / whole" [הכל] is said of that to whose parts, in at least some cases, a natural position belongs, whereas "the sum" [הסכום] is said of that whose parts have no natural position — as one says "this sum of water," or "this plant." In the same way one speaks of "a sum" of numbers [המספרים], whose [units] stand apart from one another. And it is [also] said of things whose parts sometimes have a natural position and sometimes do not — like wax and tallow [דונג וחלב]; for of these one says "whole," yet when they are treated [merely] as matters, one says of them "a sum."

— **The mutilated** [הקצוץ, κολοβόν]: it is said of the [uppermost end?] of the [surface?]; it is said of the one [limb] and of the other; and it is said in another sense[?]. [...that which is[?] a root of the fixed forms; and the [matter?] is a root of the forms that come to be; and the form is a root of change, or of the whole of a thing — every whole that is one by nature and in its totality — that is to say, of what is more universal than its part.]

— **The genus** [שרש, "the root," γένος]: ... and it is the root of the things whose first foundations [serve] them[?], such that no part of them changes over into another part; for quantity does not [reduce to] quality, nor quality to quantity — and likewise the rest [of the categories].

— **The false** [הכזב, ψεῦδος]: it is [said] as when one says of a thing that it [is so] at the time when it [is not so][?]; and [likewise ...]. It is said, too, of things one apprehends by another route[?] ...; and of one who supposes, concerning what does not exist, that it does exist — like the vivid imaginings produced in a dream. And it is said, further, of a thing represented as being such-and-such when in fact it is not — as one who [does away with] the question in the definition of the act[?]. In sum: the false is said of the things that have no existence outside the mind (interlinear: the soul)...

[The entry is left unfinished at the foot of f. 45v; it continues onto the following folio (f. 46r), where the lexicon proceeds to the accident (המקרה, συμβεβηκός) and the close of the Book of Divine Wisdom's philosophical glossary. The lower third of f. 45v is blank parchment.]

[Librarian note: modern pencil foliation "45" in the lower margin of f. 45v.]

Midrash ha-Ḥokhmah — The Book of Divine Wisdom (Metaphysics)

The Fifth Treatise

For all the sciences there must be a single universal science in which the premises of each and every particular science are demonstrated. For within a given science itself it is impossible to demonstrate the existence of the subject that that science posits, or to bring that subject to its full perfection; rather, the foundation for this belongs to another science — namely First Philosophy. For this science examines the first principles [ראשי] of the substances [העצמים] and

their premises [?], not insofar as they are existent and known in some particular respect, but insofar as they are existent in their own right.

The particular sciences, by contrast, each pursue a special inquiry rather than a universal one. Thus the mathematical science [חכמת הלמודים] inquires into existents that are not in motion, while the science of nature [חכמת הטבע] inquires into those existents that are in motion. Therefore, if there is some known existent [דבר ידוע נמצא] that neither moves nor is bounded [מוגבל], the knowledge of it — difficult though it is — properly belongs to the universal, theoretical science, and not to the science of nature (since the science of nature deals with things in motion), nor to the mathematical science (since it too deals with what is bound up with motion); rather it belongs to a science prior to both of these. For being the prior science, it must be the science of the prior things — the things that do not move, the separate things [הנבדלין].

This is the difference [ההפרש] between it and the mathematical science. Although the mathematical science does investigate separate things, it treats them as separate only because they are abstracted [?]; their being "in motion" and their being "separate" belong to them not in reality [בעצמות] but as a separation in thought [במחשבה נבדל]. It is for this reason that Solomon called them "words of understanding" [אמרי בינה] (Mishlei 1:2), since such abstraction does not empty them [יריקנו] of matter [הגלם]. This science [First Philosophy], however, investigates things that do not move and are separate in reality; and "the separate" means pure of matter [נקיים מהגלם], with a universal purity. These are the eternal things [הדברים הנצחיים], which are the causes [עלות] of all the remaining existents. Philosophy is therefore divided into three parts — the natural [טבעי], the mathematical [למודי], and the divine [אלקי] — as he stated at the opening of this book.

The Sixth Treatise

After we have already established that "being" is said [in many ways, according to] the categories [המאמרות] [?], it is all the more fitting that the name be applied to the category [המאמר] that makes known the essence [נפש] of a thing — namely, substance [העצם] — since what is primary in being is substance. For substance is primary [?] in predication [בנשאו], whereas the accidents [המקרים], since they subsist [קמים] only within it, cannot have the name "the existent" [שם המצוי] predicated of them. Substance is the cause [עלת] of the accidents, and it is prior to them in definition [גבול], in knowledge [ידיעה], and in time [זמן].

Substance is predicated first of the sensible bodies [הגופות המורגשין] and their parts [חלקיהן] — the four elements [הארבע יסודות], the heavens [השמים], and the stars [הכוכבים]. It is predicated also of the limit [הגבול], the surface [השטח], and the substratum [המוצב], which is that which is not itself predicated of anything else at all. This substratum signifies three things: matter [הגלם], form [הצורה], and the composite [המורכב]. [Interlinear mark above "the composite"; content not securely legible.]

The category that makes known the essence [נפש] of a thing — that is, the definition [הגבול] — is applied to substance alone. But the definition of an accident, even if it makes known the essence of the thing, does not make known what the thing is [מהו] except through a posterior and composite kind [מין מתאחר ומורכב]. That which makes known the essence of a thing together with its apprehension [השגתה] is the definition [הגדר]. And so, since each of the composite substances [העצמים המורכבין] is [a composite], and the things that make them known are predicables [נשואים], [the definition] is a single thing — because the separate [הנבדל] and the composite [המורכב] are one thing by nature. In all the parts of the separate, they are present in the composite not by nature but only potentially [בכח], as [example unclear ?]; and the rational faculty [המדבר] that accompanies them exists in man [באנוש] by nature, whereas the living [element] [החי] alone is not present in the composite in actuality [בפועל], nor by nature as part of the substance, but only potentially.

The existence of the parts of the definition within the composite resembles the existence of the form [הצורה] and the soul [הנפש] within the composite, since their existence together in it is in actuality [בפועל]; whereas the existence of only one of them alone is potential, and not actual. For the form and the soul that accompany the thing — neither of them is found in actuality in isolation, nor at any time whatsoever. And since neither of them is found alone in actuality, it follows that our statement about each of them is not the same: to say of the parts of the thing that they are in the thing potentially is not the same as to say of the forms that they are potentially in the composite. For in the latter case it is possible that one be found in actuality while the other is not found — yet there is no matter without form and no form without matter [גלם].

Therefore it is difficult to establish the survival [חיות] of the natural soul [הנפש הטבעית] after it has been separated from the body, for the soul is reckoned [תחשב] to the body as the form is reckoned to matter [הגלם]. And this is a difficulty [aporia — קושיא].

[The composition of soul and body together is] not like the composition of matter (הגלם) and form. For in all composite things matter and form are seen together within them: matter is never found empty of form, nor separated from the substance (העצם), nor is form ever found empty of matter. But soul and body — each of the two is itself composed of matter and form, and the two were joined in a determinate union (חבור ידוע).

As for the essence (מהות) of matter, before anything other than itself has been made from it — what is its essence? It is [only] a part of it. The universal form is neither generated nor destroyed as a whole, but only in respect of a part, whether in the category (מאמר) of substance or in the remaining nine categories. For just as the generation-in-substance already mentioned belongs to the composite, so likewise the coming-to-be belongs to the individual bronze sphere that is a composite — not to the sphere insofar as it is a sphere, nor to the bronze insofar as it is bronze. So it is with forms, with matters, and with the rest of the categories. That is to say, the coming-to-be in them belongs neither to the forms nor to the universal quality, but to the quality that is in this particular wood — corresponding to the quantity that is in this or that composite living thing. And just as the composite sphere here is [made] of bronze, so too the sphere conceived in the mind comes to be.

He said: The universal form has no coming-to-be of its own, for coming-to-be belongs to the things that are generated, whether by nature or by craft; and these are the separate sensible particulars (הנפרדים המורגשים). For the form that comes to be — which is other than [the universal] — lies concealed [?] within this sensible matter, being a part of the universal matter. The generated things, then, are the separate sensibles. Some of them have names, such as Reuben and Simeon; and some of them have no names to designate them individually, but are pointed to in time, such as this sphere and this circle (העגולה). The universal forms, by contrast, do have names — such as "man," "animal," "sphere," and "circle." And what is made is one in form but many in number. Form is form insofar as it is in matter, not insofar as it is separate and universal. There are, then, some things that come to be by craft (המלאכה),

[Margin (right, p. 111), verbatim best-effort: "כלומר זה התשובה הנה פירוש ידיעה" — an explanatory gloss ("that is: this is the answer; here is an explanation of 'knowing'"); further identification requires further verification.]

and some that come to be of themselves — such as health (הבריאות), which comes to be either by craft or of itself. [Interlinear gloss: "הרפואה," medicine.] The reason for this is that the thing coming from outside is not present by chance. So

too with health: health comes to be because there is in it a craft [Interlinear gloss: "הרפואה," medicine] that acts essentially upon the heat (החמימות) that is the cause of health. And there are things made by craft alone, such as the house — for it is made from the stones and the timber by way of the form that is in the builder's soul. And there are things made by substance alone, such as man from man; and there is found in man the form of man in potency. Likewise there is found in the plants (הצמחים) the form of the plants in potency. Therefore nothing is made except through something in potency that already possesses the form.

Man, who is made through the seed of man, [comes to be] either [directly] or in another way, through the form; what is made through the seed of man is such because the seed is not itself like the form. What is like it in form comes to be through what resembles it. For the term "seed" is applied to the thing shared (interlinear: "המשותף," the shared/common) between the horse and the donkey — since these are not close in root [i.e., in species, so that their offspring is the mule].

[Left margin, p. 112: "אחר" — a variant-reading marker.] [Scribal collation note: "אחר" ("another [reading]").]

The priority of form and of the substratum (היסוד), in actuality and in time, over the composite of the two, is already necessary in the category of substance; but in the remaining categories it is not necessary. For just as man in actuality is prior in time to man in potency, so it is not necessary that this quality now being brought into being have another quality, in actuality, prior to it in time. Rather, what is prior in these [categories] is that which is in the thing potentially — namely the substratum. The substratum is a part prior (interlinear: "למקובץ," to the aggregate), prior to the form; yet the substratum is not prior to the form itself. Rather, the part that is prior to the form is one of the parts of the form, which combine so that the one part joins [with the other]. For just as the wood is prior to the semicircle (חצי העגולה) — though not qua wood — so the part prior to the universal circle consists of the parts of the universal circle, namely the line (הקו) and the point (הנקודה). Likewise flesh is prior to this snub nose (האף השחום); but the part prior to its snubness (שחימות) is the [?]. And things whose division is in their matter alone do not have their form destroyed — like the division of the line into two halves. But things whose division is in their form are destroyed — like the division of man into bones and sinews (עצמות ועצבים).

[Script: Sephardic/Oriental semicursive, single primary hand (Sasson ben Menashe). Clean, well-spaced iron-gall ink of moderate intensity, fully legible

under magnification. Continuous philosophical prose — no display heading in this opening. A few interlinear/marginal corrections by the same hand.]

The thing whose existence is in the soul, and which is manifested in its definition, perishes together with them. That perishable thing is as this, and [likewise] the definition-formula [הַשְׁעָלָה(?) — the recurring term throughout this opening for the definition/account (λόγος); rendered "definition" hereafter, distinct from the גבול of the same sense] of substance; and this perishable thing which does not [remain — clause resists a confident continuous reading] [?]. In sum, as for the separate things: when the foundational element [היסוד] is prior to them and a cause to them, and according to [their order — reading uncertain] [?] in their alternation; and anything that does not appear (interlinear: in its definition) is either form alone, or else does not perish as a whole, or does not perish in them. These are the species and the roots [המינים והשרשים], since for these there is no foundational element as a part, and no cause.

Therefore, since the parts of the particular definition are called essences [מהותות]: the parts of the particular definition are prior to the particular definition and posterior to the generic definition [הַשְׁעָלָה הַמִּינִית]; the parts of the universal definition are prior to the universal definition; and the parts of the particular definition — which is of substance — are prior to this particular one. Hence, although the parts of the particular definition are prior to this definition, they are posterior to the universal definition. And so the argument runs, so as not to grow too obscure regarding the things whose parts are taken up in their definitions. For the five marks of the discourse [חמשה סימני הדבור] are parts of the [word — התבות] — that is to say, parts of a form; but the fourth [kind] of definition is a part of the definition composed of substance and form [הַשְׁעָלָה הַמּוּרְכֶּבֶת מֵעֶצֶם וְצוּרָה].

One cannot [give] a bounding definition [גבול], for there is no bound to the individual thing — not by way of matter [clause partly resists a continuous reading] [?]. Matter that is only potentially a bound is not truly a bound; the bounding belongs to the form alone, and not to the body [/matter, הגלם]. And [the form] is not to no purpose [לבטלה]; rather it is for the form, for the soul, and for the end [לצורה ולנפש ולתכלית]. [The composite] does not bound the substance, as in bronze or in a stone in which the form is engraved [כאבן שהצורה חקוקה בו]: this is only the bounding by its form, which is prior to the matter, abstracted from the matter [נִקְיִים מהגלם]. Therefore "living" and "rational" [החי והמדבר] are the definition of the form of man, not of his matter [לצורת האדם לא לגלמו]. "Living" is a part of his form, and likewise "rational" is a part of the form of man. But the thing gathered together out of the form and the matter — such as this

[composite], or any other thing, whether sensed or imagined in the imagination — has no definition [גבול] and no abiding knowledge [ידיעה קיימת].

[Verso — the leaf foliated "48":]

— because there is no knowledge of them except when they are sensed or imagined; but when they are removed from sensation and from imagination, we do not know whether they exist or not. In sum, the single particular is not known by an abiding universal knowledge; rather, [what] is received in itself [is] the truth, and it is not known at all — neither by particular knowledge nor by universal knowledge — because its existence is in potency alone [מציאותו בכח בלבד]. Part of it is the sensed foundational element, and part of it is imagined. The sensed are the things whose existence is in the substratum [ביסוד], and from which motion is not separated — like wood and bronze [העץ והנחשת]. But the imagined — those of the mathematical [disciplines], such as numbers and magnitudes [כמספרים והגדלים] — are pure of motion, since they are taken in potency and not in actuality [בכח לא בפועל], and are not sensed.

And since the definition [הגבול] is for the form alone and not for the body [/matter] — for it is not found [except in another matter — the intervening clause resists a confident continuous reading] [?] from the matter — it does not follow at any time that the parts of the form are not found [apart] from the matter. And what is separated from the matter in the things produced by nature [בטבעיים] is an easy matter: that the [form] should be found wholly in nature and in the substance. Do not let it enter your mind that [the individual] and the substance [together] are the substance of the definition. So too the apprehension of forms that are found only in another matter — like the form of man that is found in the particular substances and in the particular flesh [ובבשר הפרטי]: therefore we conceive [נשכיל] its form apart from it, in potency; but to apprehend it as a form in actuality [בפועל] is impossible.

The parts of the definition are prior to the definition, and the definition is prior to the defined [הגבול קודם המוגבל]; therefore the parts of the definition are prior to the defined — for "living" and "rational" are prior to "man" [קודם האנוש]. [Man] is found in two ways: the one is the [substratum] indicated [המורמז], which is that of which [change] is predicated — as this "living" that is predicated of it; and the second is the [thing] found alone, which is in actuality — that is to say, the form [כלומר הצורה].

Substance [העצם] is said of three things: of the [substratum], of the definition [ועל הגבול], and of the universal [ועל הכללי]. The universal is not substance, and this is

manifest from each of the sensed things: for if the universal were substance — that which extends over many things and is found in all of them — then, according to this, it would be the substance of [many] of them. Take the case of "living", predicated of many species [מינין]: we would then have to say that the substance of this indicated Reuben [עצם ראובן זה המורמז] is "living" — [but] the substance of this indicated Reuben is not "living".

[Foliation: pencil "48" at the foot of the verso (second page); the recto side bears no visible foliation. Blank lower portion of the verso below the last written line is blank parchment, not a lacuna. An archival blue stamp appears in the upper black scanner border of the verso — outside the text block.]

[Script: Sephardic semicursive, single primary hand (Sasson ben Menashe). Brown iron-gall ink of light-to-moderate intensity; dense Arabic-derived philosophical vocabulary. Continuous argumentative prose; the display heading opening the Seventh Treatise (enlarged script) falls mid-verso.]

Therefore, by means of the universal [כללי] precisely insofar as it is universal, it is impossible to make known, of a known composite thing, its substance [עצם] and its essence [מהות]; rather, the universal is only a known quality [איכות] in the composite thing. We can speak this way only as when we say that the essential life [החיים העצמיים] which is in Reuben [ראובן] — what is it? That is to say: it merely *happens* to that life to be universal, whereas in itself it is a universality. And since the universal is a quality, and a quality is an accident [מקרה], the universal is therefore not a substance — for a substance cannot come to be from what is not a substance.

Likewise it is impossible for one substance in actuality [בפועל] to be [composed] of two substances each present in actuality — just as one line, though in actuality it possesses two parts in actuality, [is not composed of two lines]: its extremities and its midpoint [?] are not [things] distinct in actuality; rather, each is distinct in itself only in potency [בכח], while joined together they are found in it [Illegible: ~3 words]. And the universal expressed by a name — which is the definition [הגבול] — neither comes to be nor passes away [?].

The most universal of the universals is what makes known the substances of things; and they are: "being" [ההויה], "the one" [האחד], "the principle" [הראש], "the element" [היסוד], and "the cause" [העלה]. Yet none of these is a substance, since they are not [predicated] of many things [?]; and no one of these common terms [המשותפים [?]] is a substance — for qua substance a thing is never found in any other thing at all. Rather, a thing is a substance either for itself or for the other

thing to which it is a substance, just as substance is never found together in many things at once.

So every universal [is predicated] of many things together. And since the universals and their attributes [התכונות [?]] belong to the particulars and are found in them, it is clear that it is impossible for any universal to be separate from the particulars at all. In this way the question is fully [posed] concerning the composite thing, just as we said: why is "man" [האנוש] a "writer" [כותב]? — for "man" and "writer" are not one and the same thing. And likewise this question, "why is it [so]?", [arises] only in the composites, not in the simple things.

And the answer is by one of the four causes [ארבע עלות]: the thing by virtue of which a thing is what it is, and by virtue of which it comes to be and passes away — and this holds of necessity; therefore it is not a body, nor is it composed of body, and this is the substance proper to each single individual. But [what] made this flesh, and this substance, and this [?] — [is nothing] other than that it is the First Cause [העלה הראשונה]; [the cause] made the thing exist in actuality.

The composite [made] from the elements [היסודות] — the elements are not found in it in actuality, but only in potency. Likewise [a word] is not found in its [component] letters [אותיות] in actuality, but in potency. And so it is with every composite: the things from which it was compounded are not found in it in actuality but in potency; and so too with the composite composed of matter [חומר] and form [צורה]. As for composite things, it appears from them that they are composed of a substratum [יסוד] and accidents [מקרים]. And the specified [determinate] thing is a substance insofar as it is in actuality; it is not [a substance] in actuality on account of itself [?], nor on account of the accidents, which are posterior to it. But inasmuch as the accidents are found in it in actuality, it is therefore clear that it is a substance in actuality by virtue of the nature that is called "form"; and that it is a substance because it was the cause of the thing's being a substance in actuality; and that this substance is not [derived] from the substratum, nor is it itself the substratum. The substance of a thing is its form, and not the matter [גלם] from which it was composed — neither a substratum, nor an accident of accidents. And in the form lies the "what it is" [the essence].

The Seventh Treatise [המאמר השביעי]

Since it has been explained that neither the universals nor the roots [שרשים] are substances, one might raise a difficulty about what we said — that substance is the definition [הגבול], that is, the definition of the thing — [seeing that] the

definition of a thing is stated only by a name. The resolution [הפירוק] is this: the universals are not substances, nor are the roots; and yet what the universals — taken according to their definition — indicate, *these* are the substances.

Every composite substance has a substratum [יסוד]. The difference between the substance and the substratum is this: the substance is prior, for it makes the thing that is in potency come to exist in actuality, and it is prior; whereas the substratum is, in potency, this specified thing, and is not [it] in actuality. And the substance is distinguished from the substratum by definition and by essence [מהות], not by existence [מציאות]. The substratum is a substance shared [שותף] by all composite things, since all the various [components] [?] gathered together in the substratum [Illegible: ~2 words] are substances.

We shall come to know the essence [מהות] of the parts of the particular substratum [היסוד המיוחד] as it is found [?]. First let us know the two first parts of things; and these are as follows: some of them are taken from place [מקום], some from time [זמן], some from position [השיוב, reading uncertain], and some from quality [איכות] and from the sensibles [המורגשות]. And there are among things [some] whose essence is the quality of position [?].

[Script: Sephardic semicursive, single primary hand (Sasson ben Menashe). Clean, open, well-spaced ink of variable intensity; dense Arabic-derived philosophical vocabulary. Continuous prose on the recto; the Eighth Treatise opens with an enlarged display heading in the lower third of the verso.]

[Recto:]

There are things whose essence lies in their position [השיוב], and there are things whose essence lies in combination [מצירוף] — as, for instance, the extremities of a single place [קצוות המקום]. And when things are combined, their essence lies in the way they are ordered together: it is the arrangement [שיוב] of the low sound within the single sound [הקול כבד בקול האחד] [?]. But qualities [האיכיות] whose essence is not a shared arrangement of this kind — their essence is simply the quality of position [איכות השיוב].

For as regards the substances [העצמים], there is the matter [היסוד], the actuality [הפועל], and the composite formed of the two. How so? Take a part of it: its matter is the timber [העצים] and the stones, together with a form that serves as a shelter to take refuge in; and the composite of these is the house [הבית]. The definition [הגבול], therefore, must comprise the composite of matter and actuality [היסוד והפעל]. And if the thing is taken as a complete whole — consider one who takes the air: for it is a certain disposition of air [?], so that the disposition [שיכון] stands

to it as the actuality, and the air as the matter. Just so, the smooth [ordering] [?] is the actuality, and the substratum is the matter.

When you take some known [determinate] thing [דבר ידוע], you do not [immediately] grasp that it is composed of a subject [המשא] and [its form] [?]; rather you grasp that the composite is [a whole] taken as one [?], on the view that what is taken is itself [the thing]. So too when you take "man" [האנוש]: he is a living, rational being [חי מדבר], yet you do not thereby grasp what the receptacle [הקבול] is [as distinct from the composite], for man is composed of ["living"] and "rational" [ומדבר] — such that the "living" [החי] is one part of him and the "rational" [המדבר] another. And yet you do grasp that man is the living, rational being precisely through "rationality" [בדבור], on the view that these [the genus and the differentia] are his essence. The name "man" [שם האנוש] signifies something other than the matter alone, and other than the composite of form and matter [מהצורה והיסוד]; and it is not [?] [merely the matter]. For it is not right to say of the forms of made things [בצורות הדברים העשוים] that they are substances, except in a separate nature [בטבע נבדל].

It is said: the definition cannot be divided, since the definition is a statement [מאמר] that indicates the existence of one thing by means of another [מורה על מציאות דבר לדבר]. One of its parts is the universal [הכלל], and one is the particulars [קצוות]; and thus man is posited through "rationality" [בדבור], the "living" being his matter and "rationality" his form. How this is so requires investigation. For there is in the definition one perplexity: how can one say that a single thing has a single definition, when the definition has many parts [חלקים]? Why, then, was the composite formed out of the parts of the definition made into one thing — this composite [המחובר]? For man is one and definite [ונטול] [?], and he is a living, rational being — that is, more than one thing [יותר מאחד].

[Verso:]

It has already been made known — for we said, concerning the parts of the definition [בחלקי הגבול], that their aggregate is one [קבוצם אחד]. Yet it is not one in the way a single [simple] thing is one, nor one by an adhesion that is not visible, nor one by contact [במגע] and position [והשיוב]. Rather, the definition is a single word [מלה אחת], neither joined together nor counted up [לא נקשר ולא נמנה]. Why, then, is man one and not many, though he is many things [דברים רבה] — such as "living" [חי] and "footed" [ובעל רגלים] [?]? The resolution [והפירוק] is this: because some of the sensible substances [העצמים המורגשין] are matter [יסוד] and some of them are form [צורה]; the matter is body [גשם], and the form is what is actualized [נפעל]. The definition is composed of the form and the matter [מורכב

מהצורה והיסוד]. Hence there must necessarily be, in a body, two things: the one is a potency [כח], and the other actualizes that potency [פעל אותו כח] and completes it, so as to bring what is in potency [שבכח] into what is in actuality [שבפעל].

The "rational," therefore, is man; for the definition is a potency compounded of matter and form [כח מחובר מיסוד וצורה], since the "living" [החי] is the matter of man and "rationality" [והדבור] is his form. The existence of life [מציאות החיים], in every member of this species of animal [מין מן החי], is present in potency, not in actuality [בכח לא בפעל]; but its existence in actuality lies in the form, which is "rationality" [הדבור]. It is thus as though "rationality" does not [fully] complete the life that is its matter [יסודו], since [the whole] rests on the aggregate that dwells [together] [?] — because that aggregate [is what makes it] one thing [דבר אחד].

The Eighth Treatise [המאמר השמיני]

Two things that are entailed [שני דברים שיתחייב], on account of the existence of the first, the existence of the second [מציאות הראשון … מציאות השני].

We say: if the first is [taken/posited], the second is [taken] [?]; and if the first is [otherwise], the second is [otherwise] likewise [?]. The possibility [potency] of a thing [אפשרות הדבר] is not found together with the thing, but is prior to it in time [מוקדמת לו בזמן]. Among things there are some in which the potency precedes the actuality [שיתקדם בהם הכח על הפעל], and there are some in which [the actuality] precedes — [that is,] the actuality over the potency [הפעל על הכח]. Thus, [consider] the potencies that arise [in the soul] [?], the acquired dispositions [המתנהגות] [?] — such as the crafts and the reflections [המלאכות והמחשבות] that become known through study or through habit [הנודעות בתלמוד או במנהג]; for in these there precedes either the actuality that is found on their account or [else] the potencies. But the potencies that arise [otherwise] — the passive ones [הנפעלות] that do not come through study or through habit [שאינן באות בתלמוד ולא במנהג], such as the senses [הרגשים] — in these the potency is prior to the actuality by nature [בטבע]. The thing of which the actuality is said in truth [הפעל באמת] — its potency is […] [?].

[Foliation: pencil "50" at the foot of the verso; the prior opening bore "49." Lower portion of the verso below the last written line is blank parchment (not a lacuna).]

Everything in which there is a principle of change directed toward some other thing, insofar as it is other — as we said — is such as to receive the being-acted-

upon on account of that other. The cause of what is acted upon is the substratum, while the cause of the acting is the form.

Consider the non-rational potencies: by their very nature the active passes into the passive, and it is impossible for it not to act; hence the patient too necessarily undergoes the effect, so that whenever the two draw near one another it acts in every case. The rational potencies, by contrast, are not by their nature compelled to act merely by the fact that the agent exists; rather, along with this there must be desire. For one who possesses the potency for a given action — not everyone who possesses a potency is thereby bound to act.

This is the sense in which potency is spoken of concerning the things of which it can be said that they are able to act — as when you say "so-and-so is such-and-such potentially": the thing exists potentially on account of its substratum and of other conditions. Likewise it is said of the continuous that it is divisible without end potentially, and that in it prime matter [ha-yuli, ὕλη] exists potentially without end. For the potential stands to actuality as [image stands to represented] — but here we speak of another thing: that which is potentially something and in which there is a potency to pass out of potency. That is to say, of one thing it is said that it is potentially [such], in that it is not yet first... first precedes second in actuality; and just as there is a first, a second, and a third [in a series], the first is potentially the third, and the third is potentially the second. [?]

The example is potency itself: the seed and the man. For of the seed that already exists in actuality we say that it is potentially a man; but we do not say of bread that it is potentially a man, nor of that which exists potentially as nourishment [destined to] become a man [that it is a man] potentially.

Actuality is prior to potency in definition and in nature. In time, however, actuality is prior in the thing that confers that actuality upon the potency residing in the thing which receives that actuality; whereas the potency is prior in time within that same receiving thing, prior to its actuality. How so? Because a thing that is [such] only potentially is, in actuality, more deficient than that which is [such] potentially [in the fuller sense] [?]. Rather, in the thing that receives heat, the potency in it is prior in time to the actuality; and yet the actuality is prior to the potency in nature — in nature, in its differentia, and in its form. For nature is the actuality, its differentia, and its form; and this is why the end of wisdom is the deed. The one exception is that the actuality itself be something acted upon and that same actuality be an agent — on account of the endless [series].

Rather, we say of the first [mover] [?] that nothing else is mixed into it, nothing of potency, since it is eternal. Everything that changes with respect to place comes to be and perishes — except the cause of the heavens. These eternal things have no potency beyond the potency for being in place, and there is nothing that [...] them [?]. It is by this that the things which come to be and perish are set in continual motion forever. Therefore, if there is here some thing existing in complete potency — and it is a substratum, or the substance that comes to be — there must be that which brings it out from potency into actuality. Necessarily, then, the actuality is something more than the motion; and whatever is greater in actuality is fit to be a cause to that which is less in actuality than itself. The matter is plain: actuality is more excellent than potency. Actuality, therefore, is prior to potency in all respects — in definition, in nature, in rank (which follows the way of actuality, its differentia, and its form), in time, in coming-to-be, and in value.

The Ninth Treatise. The One.

The One is spoken of in four senses. First, that which is one by continuity, like the line. Second, that which is one because it is a whole. Third, that which is not divided in thought, neither in quantity nor in quality — like the unit and the point. Fourth, that which is one by the universal name applied equally to things that are one in a common, general sense shared among them, as "the living" is predicated of both man and horse.

The One is set against the Many in respect of division and in the manner of division; and it is the contrariety of privation and being [?]. It is set against the Many in yet another sense as well: of the One it is said that it is "the same," "equal," and "like," whereas otherness is predicated, for the most part, [of the Many as its contrary]. Thus the opposition of the One and the Many runs through all things, according to the number of the things of which they are predicated: of the One are said "the same," "equal," and "like," and of the Many are said their opposites — "other," "not equal," "not like."

He says in the thirteenth treatise that the One has no contrary, and that the Many is not, in truth, its contrary; rather, what is truly contrary to the Many is the Few. And the contrary of "few"... the few is [?] its other. The Equal is contrary neither to the great [? b/d: גדול] nor to the small. Greatness, smallness, and equality are not predicated of quantity, nor of color; but rather that [the equal] is without [interval] [?]...

[Text continues at the foot of the folio; the sentence runs on into the following folio.]

The prior of the two is privation — that is, negation. That which is opposed to the many, insofar as it is many, is the one, not the few; for the many is a plurality of ones, while the few, taken in the full, unqualified sense [בגמירא], is the small. And what is said of the one — that it is opposed to the many — holds insofar as the many is a plurality of ones, just as the few is. And likewise the measures are measured by the measure, and in this respect they are a many opposed to a one. Were it not that they differ in their very nature absolutely, then that which serves as a measure would not be undivided; but because it is such, it is not divided into anything less than itself.

Among relatives [המצטרפין — the correlatives, τὰ πρός τι], some are correlative in their own essence: this is when each of the two is predicated of its correlate — as with the double and the half, the greater and the less [excess and the exceeded], and the great and the small. And some are correlative in the manner of a measure: this is when the correlation does not run reciprocally between the two opposites, as with measure and the measured — for the measure is a cause to the measured, whereas the measured is not a cause to the measure. This is the reverse of the correlative that is such by its own nature. "Measure" is said in relation to the measured, and "measured" is said in relation to the measure.

He said: the one is opposed to the many in the way that accidental correlatives are opposed — as with measure and the measured — and not in the way that those correlatives are opposed which are essential, and which are the true contraries. Therefore no difficulty arises from what was stated in the [thirteenth?] treatise [?], namely that the one is not [truly] contrary to the many. For the one was said to be among the members of the pair of contraries in that they are not found named together as one thing; but the many is not so, except as being a repeated multiplication of the one — and accordingly it is not contrary to it. Rather, what we have said here, that the one is opposed to them, holds only insofar as it measures them, just as the measure measures the measured.

He said: the many is reckoned by number, and therefore number is a many measured by the one. He said: it follows necessarily that knowledge stands to the knowable as the one stands to the many, and as the measure to the measured. For knowledge is, in a way, a measure of the knowable; yet we rather say that the knowable is a measure of knowledge, because the knowable is prior within the essence of knowledge, just as the one is found within the essence of the measured, and the one within the essence of number.

Knowledge is not identical with the essence of the knowable, since it is derived from the sensibles [and the intelligibles] that are not yet known; yet knowledge is

not found without the knowable, just as number is not found without the one. Therefore knowledge is measured against the knowable, just as number is measured by the one. Hence the many, insofar as it is many, is not opposed to the few; rather, the many that is opposed to the few is the correlative many, which is greater than that to which it is compared. Likewise the one is not opposed to the many except from the side of its happening to be few and divisible; but insofar as it is one and undivided, the divided many is not opposed to it except by way of the opposition of measure and measured, and not by way of a complete opposition.

This holds in each of the categories [המאמרות — the praedicamenta], and knowledge falls under quality. The extreme terms are, in their essence, one together with the contraries; and as for the things that are compounded of the two and differ in form, these are essentially one [in genus]. Difference and variation in form are a contrariety of a certain sort, and not a complete contrariety. Everything that is not divided by contrariety at all is one in form. And the contraries are those that are divided — either separated as contraries at the extreme limit [בתכלית], or separated by way of intermediates [בבינוניים].

The Tenth Treatise — Divine Wisdom: the knowledge of the principles of existents

The inquiry into substances and into accidents belongs to a single science. Therefore one investigates the accidents in a derivative way [?], and the substances either in the way in which they are taken from sense-perception, or in the way in which they are taken, by way of completion [בהשלמה], from another science.

The Eleventh Treatise, which is Book Lamed [Aristotle, *Metaphysics* Book Λ]

Substance is the cause of all other existents, and it is prior to them in nature and in rank. Therefore substance is said to exist absolutely, whereas these others are said to exist only dependently — that is to say, that they are potencies belonging to substances, or qualities, or something other than these, since they do not exist except in substances. Substances are three [in kind]: one that abides forever and does not change; and also [the temporal ones]...

[Margin, outer edge of the verso, beside the Tenth-Treatise rubric: "ראשון" [?] ("first").] [Margin, outer edge of the verso, beside the line "they are potencies

belonging to substances": "כחות" ("potencies") — a keyword note echoing the body text; further identification requires further verification.]

[Continuation of the Eleventh Treatise — "Book Lamed" (Aristotle's *Metaphysics* Book Λ): the kinds of substance, change, and the principles of things. No rubricated heading appears on either folio side of this opening; the argument runs on as continuous prose, divided only by the scribe's mid-line "·" marks.]

Change, coming-to-be, and passing-away reach these [perishable, sensible substances] as well — just as they reach the plant and the animal — whereas that which is not [subject to them][?] stands forever, unto all eternity. For it must be that, underlying the changes, there is a substrate [מוצע] that exists in potentiality — the very substances out of which change proceeds; and everything that changes, changes from potentiality to actuality, the potentiality residing in each thing until that which is in it potentially emerges into actuality. Accordingly, the potentiality in respect of substance — to undergo coming-to-be and passing-away — lies in substance; the potentiality in respect of quantity — to undergo increase and decrease — lies in quantity; the potentiality in respect of quality — to undergo alteration — lies in quality; and the potentiality in respect of place [אנה, "where"] — to move up and down — lies in place. Therefore that which comes to be arises from what is in potentiality, not from what is in actuality.

Since body [גשם] is the bearer of potentiality, and potentiality is the cause of change, every changing thing has body and is necessarily corporeal. But the celestial bodies [גשמי השמים], since they change only in respect of place, must [likewise] be corporeal and require a substrate — one that admits none of the [other] kinds of change, but only translation from one place to another [מאנה לאנה, "from place to place"]. The substrate of the things that come to be and pass away, by contrast, is one in itself. [The celestial substrate] admits none of the changes save translation from place to place, and it does not admit coming-to-be and passing-away; their substrate is therefore in actuality, not in potentiality. It cannot be that every thing receives every power[?]; rather, each has its own distinct power as an actual power. [The question then arises] whether the substrate for those powers is one or more than one — but it must be one; for although in many matters some of them differ[?], that which is composed of them must be one. When the actuality is one and the potentiality is one, the actuality must be one, not many.

The differing causes [העילות המשונות] of the sensible bodies are three: the privation [האין], the form[?] [היש], and the substrate [המוצע]. These are the three principles [ראשיות] that he set out in the first treatise of the *Physics* [מספר השמע

הטבעי — *Sefer ha-Shema ha-Tiv'i*, Aristotle's *Physics* I] — the form and the privation [הנעדר], the privation being that which stands opposite the form. He then shows that this privation and this form are not, in themselves, self-subsistent things; for were they [such], they would have some further matter out of which they were made, and that in turn from another, and so the matter would proceed without end [לאין סוף]. Hence there must necessarily be a first[?] existent that neither comes to be nor passes away — and the same holds with respect to form.

Plato [אפלטון] used to say that there exist separate Forms [צורות נבדלות] — universals that bring into being the particulars of man, of animal, and of plant — that is, the forms that generate and the things generated. But Aristotle [ארסטו] answers him and says that it is impossible [for such a Form] to be [numerically] one[?]. For were there two [such forms] serving as a single generator for the particular, each would be a separate thing, distinct in number, like it. Aristotle's own view concerning these separate Forms is that they possess existence in so far as they are separate[?], and he means by them that they resemble the sphere [הגלגל] in one respect. Yet if they had any share in coming-to-be, [the same conclusion would extend] to all the natural forms — as appears from the words of Themistius [תמסטיוס]: that this applies to all the forms, even to the forms of the non-rational animal [החי שאינו מדבר], and to the ensouled things [that arise] from decay[?]. That is to say, everything that has a soul [נפש] has within it [the capacity] to become a generator; in them there is a determinate thing bounded by its nature [?]. Accordingly, the giver of form [נותן הצורה] is form; but that which shapes the bodily organs [המצייר את האברים] is not a separate form, since it works through them [the organs]. Rather this shaping agent — that is, that by which [the living thing] fashions itself — is, if it be a soul, a power of soul [כח נפשית].

He explained in the [numeral: ?] treatise of the *Book of Animals* [מספר החי — Aristotle's zoological corpus; the section on animal generation] that in the human seed there is a power[?]; and that the mover within it — the power residing in it — is the intellect [השכל], whereas that which shapes the limbs is not the separate intellect [השכל הנבדל].

After this he raised many difficulties. For the elements [יסודות] of the ten categories [העשרה מאמרות] are those same three: the matter, the form, and the privation. By way of illustration: heat, as fire, is the form, and cold is the privation of heat, while the matter that receives them [corresponds to the substrate]. And within the category of quality, whiteness [הלובן] is form [as against its contrary][?], while blackness [השחרות] answers to privation [as against

cold][?], and the matter that receives the color corresponds to the substrate. Likewise light [האור] corresponds to form and darkness [החשך] to privation. These three, then, are the elements of the ten categories. They are therefore predicated [of things] within genus and species in the very manner in which "the one" [האחד] and "the existent" [המצוי] are predicated of them. And why did we call these three "elements" rather than "principles"? Because the elements are more particular than the principles: the principles comprehend both what is found within a thing and what is outside it, whereas the elements are found only in what is within the thing. [Since substance,] having been the head of the three, [it] must be the head of all — for substance is the head of the remaining categories, inasmuch as these are established only in substance and out of substance, while [substance itself] stands by itself [קם בפני עצמו].

[Margin (verso, left, beside the lower lines, in darker/red-ink[?]): brief marginal note, "והכלל"[?] ("and the rule/sum") — reading uncertain.]

[Margin (verso, upper outer corner): small marginal mark of ~2–3 letters, illegible.]

Therefore, the principle of this substance — the one that moves it — is a necessary substance, and it is a principle in its own right. He now begins to inquire into the quiddity of this principle: whether it is the soul, or the intellect together with desire, according to its nature. Then he sets down the principles of the existent: potency and actuality. For actuality is the form and its realization, while potency is the substratum.

Of these principles, some are in potency directed toward actuality — and this is prime matter, the first of them; some are always in actuality — and this is the intellect; and some are at one time in potency and at another in actuality — these are the composite things, such as the animal and the plant. Potency and actuality are not one and the same in things that have no single substratum, no single form, and no single mover — that is to say, because actuality is the form and potency is the substratum. And of form, one kind is within the thing, and this is what exists in the thing; while another kind of it is outside the thing, and this is the mover. This mover is either near and corresponding to the form, as the lover is to the beloved, or else far and separate from the form, like [?]. For the universal is not a cause for man, nor for what is generated from him, in the sense of being form — and not privation, and not substratum — with respect to form. Hence nothing remains but that it be a cause, like the mover, and nothing more.

After this he begins to speak of the First Cause: in what sense we say that it is the cause of all, and living, and not a body. And this is the wording of Ibn Rushd's statement. He said: "It is fitting to explain that we should begin with [?], so as to know that the causes are spoken of in a universal manner and a particular manner, and in a particular temporal sense[?]. And that the true cause is the prior one, since the thing that exists in actuality outside the soul is the prior thing; and it is the mover of the particular — one of these — and brings it out from potency into actuality. But the universal cause does not move, nor does it bring anything out from potency into actuality; rather it is a universal intelligible cause for a universal intelligible thing. And [effects] come about in the particular for the sake of that intelligible principle, since [?]. For the intelligible father is the cause of the intelligible son — that is to say, the universal — whereas this designated father, who is Reuben, is the cause of his son, who is Enoch. And likewise the letters are the cause of speech. And this truth is truly the cause of this matter."

Now, of the causes that are stated in the universal manner, some are stated universally in truth — as when we say that the cause of color is [the nature of?] the white and the black; and likewise the cause of day is the air, the light, and the darkness. And some are stated by way of relation — as when we say that the causes of the categories are the form, the privation, [and the substratum].

But the causes that are truly causes are the separate ones, and therefore the cause of all is separate. Thus it has already been explained in how many senses it may be said that the principles of substance are principles of all things, and that the same term is predicated of them. In one sense, by way of relation, as we said — that the form, the privation, and the substratum are a principle for all the categories. And in a second sense, as we said — that the principles of substance are the principles of the remaining categories, since substance is the principle for those principles; they are the principles of them. And in a third sense: the separate principle, which is the principle of every designated substance — that is, the complete principle[?]. This principle is one that is not stated by way of relation, nor by way of the universal[?], nor by way of the privation and the substratum; rather it is truly a single thing, esteemed and higher than these other principles. And this is that for the sake of which the present inquiry is undertaken[?].

For inasmuch as there are here three substances — two of them moving substances, namely the body of the heavens and whatever comes to be from the substances that are generated and perish, and the third the substance that does

not move, as was explained from his words (we found it treated in natural science) — our intent here was to speak of the divine science[?].

It is seen that, of necessity, there must exist an eternal substance that does not move; and it does not change[?]. For if no eternal substance existed, all substances would be perishable. And it is seen that it is impossible for motion to perish, nor for it to come to rest, without there being something that moves; and there is no need to state this on account of the substance, since motion is the change bound up with it[?] — and this not in a single motion alone, but in the continuity[?] of motion. And it is eternal, because only that which comes to be and perishes is subject to "prior" and "after," which are among the divisions of time — that is to say, if no time exists, no "prior" and no "after" exist. Therefore whoever holds that time came to be holds that time both exists and does not exist together in a single act. And if time is not generated, then the continuity of motion too is neither generated nor perishing, but continuous — inasmuch as time is either motion itself, or is the change measured off from motion.

and how the thing must be so as to be [permanent?] and eternal. It has already been explained in natural science that no motion can be eternal except local motion, and specifically the circular motion; and if there exists an eternal motion, it is the circular one. The mover, therefore, must be [perpetual?] and itself unmoved. For just as, if there is a mover that is [itself] moved, the motion must be eternal — so too, were it to come to rest at any time from moving, potency would become mixed into its own essence. And once potency is mixed into its essence, it is no longer [purely itself] but is [otherwise?], so that at the very time of its being [a mover] it would not [truly] be one. Furthermore, as for this mover — for what reason would it move at one time and not move at another? Therefore, if the matter is so, it has a cause prior to itself.

And if we posit that it does not move at all — yet was [somehow the cause?] that the circular [motion] exists, and that in this way there exist eternal separate substances that are not moved, as the proponents of the Forms maintain — then there is no need for the existence of an eternal substance that does not move, just as there is no need for the existence of an eternal substance [at all]. For if it does not move at all, there is no motion together with it; and if it moves at one time and not at another, potency would become mixed into its essence, and once potency is mixed into its essence it is nullified, and no motion would be found.

For motion to be eternal, then, there must necessarily be found a mover in whose essence there is no potency at all; for whatever has potency in its essence may possibly not come [into actuality] — it may or may not come forth as moved. And

just as it is possible for it not to be found moved, so too it is possible that the motion not be [at all]. Yet they have already established that motion is perpetual. It follows, then, that a thing both perpetual and not-perpetual [would have to exist together], which is impossible. And what necessarily follows — since we have arrived [at the conclusion] that whatever is moved and has potency mixed into its essence [cannot sustain?] an eternal motion — is that there must be here eternal substances in whose activity no potency at all is mixed, and no motion. And if the matter is so, it is fitting that these substances be [?]... [a foundation?], that there be pure[?] forms [issuing] from the separate [intellect?], and that the actuality in them be prior to potency and to thought.

Yet there is here one difficulty [ספק], which troubles the mind: everything that is in actuality was already in potency before it came to be in actuality — and [yet] it is not fitting that everything which was in potency should come forth into actuality.

[Red ink: קודם] Therefore potency would [seem to] be prior [by nature?] to actuality; and thus, if potency were prior to actuality, nothing would come forth into actuality, nor would the existent be brought into being — so their words run. [But in truth] what is in potency does not, of itself, pass from potency into actuality; rather, the potency is brought into actuality by reason of some other thing that is [already] in actuality. Therefore actuality is, in the general [unqualified] sense, prior to potency.

And in what respect may it be shown that potency [is prior]? [Only] in that potency precedes actuality in particular things that come to be — that is to say, the existence of the designated thing in potency precedes its existence in actuality. But all things whatsoever have their being in potency and in actuality (interlinear: קודם); and since actuality is, in the general sense, prior to potency, it necessarily follows that motion is perpetual forever.

He said: And if there exists a motion that has no cessation — and it is the circular — then the moved thing, which is the heaven, is eternal, and the rest of its parts are eternal forever. And if the moved thing has no cessation in its motion, then the mover must have no cessation in its moving, and it is fitting that it not be moved at all. For if one thing is composed of two different[?] things, and [the one] exists in its own nature, then the other too would exist in its own nature; and if there be found one thing that both moves and is moved at once, and the moved is already found [in its own nature], [then there must also be] that which moves and is not moved — and it is the First. Therefore it is fitting to find a mover that is not moved at all, and it is the First. Hence it is clear that it moves in the way

that the desirable, intelligible thing moves; for the desirable and the object of longing move without themselves being moved. The origin of this desire and of the beloved is the form of the desirable thing within the intellect; for the desirable and the longed-for draw the desirer toward [themselves], because it is good and desirable[?] and exalted. And that which is [truly] beloved and desirable and pleasant is that which stands at the [utmost degree?] of worth and importance, without end. For we desire to love [a thing] the more, according as we judge it to be more worthy; and we do not judge it [worthy] because we desire it, but rather we desire it because of the [prior] thought [of it]. Therefore the origin of this desire — which is present in every [cause/motion of?] the heaven — is the form within the intellect, in the purity of the heart, such that the desirer['s]... its origin is the form, whether in [sense-perception?] or in the intellect or in nature; and the desirable, by reason of its being apprehended by [sense?] or by nature, is [the end?]...

It has already been shown that this beloved is not a body. It remains, then, that this desire too is directed toward an intelligible form. A form is reckoned, with respect to the substance, as that which is attained by whatever is moved toward it — that is, from among the existents. In other words, [each thing] desires it, and so an order is found for them by reason of its existing for the substance. For the intelligible order that belongs to the existents lying outside the substance belongs to them only by reason of the order that is within the substance itself; whereas the composite order — which is not grasped in itself and by its nature, but is grasped in its parts and in potentiality — that which is grasped within it is the intelligible order. And what is grasped in itself is the intelligible; but the composite substance is not one in truth, nor simple, nor is it intelligible in its own essence; rather it is intelligible in its parts. And the "simple" spoken of here is predicated not of them [the composites] but of the order that is in the substance — just as he said of the simples that they are simple, meaning that which has in it no multiplicity at all, and is therefore one from every side.

And when he had said this, [it follows] that what the body of the heavens thinks, it thinks from the one order that is taken from the matter, which is the cause of the permanence of the body of the heavens; and its standing firm is the cause, among the existents, of the intelligible order in all the parts of the world. It is just as with what the king thinks: the order that derives from the rulers is the cause of the existence of the intelligible order in all the parts of the city. Therefore this substance is not a cause to the sensible substance in the manner in which it would move it by nature, but rather in the manner in which it is a cause to it as an object of desire and as a form. For the beloved that the desirer desires is found

[to be intellect in one respect?]: it is intellect, because it is fit to be desired for its own perfection, the one; and this is nothing other than the intelligible order that belongs to it. Therefore every thing, since it desires that order according to the measure of what is in it to receive from it, [is moved] so that the order may be found for it in the depth [of its being] — and this is the good. Accordingly their rank is fixed by their nearness to it and their distance from it. Hence the uppermost sphere is in motion in order to attain that order and the universal good — the good that is the ultimate of what it seeks to attain from it.

(interlinear: brief scribal additions appear above the line at two points in the lower portion of this page; the added words are minor corrections and are only partly legible.)

And there is found, besides it, among the rest of the motions of the spheres, that which is done [?] above it. And so it is with the rest of the celestial bodies that are beneath the first sphere. And just as each of the [officials] of the city are occupied so as to secure for themselves the civic order — in the community, in the law, and in the form of a city — so it is with the first intelligible order, which [governs?] the substance of the whole, all the celestial bodies, and all the parts of the world. That is to say, all the existents are occupied for the sake of their completion and their worth, so as to attain the order that they are fit to receive from that first order.

He said: And whatever is newly produced in it from a known potentiality does not [share?] in it. Therefore, if it were changing in substance, there would be in it potentiality with respect to substance; and if it were changing in place, there would be in it potentiality with respect to place; and so with each and every one of the kinds of change. And if the matter is so, then the body of the heavens — since it has no change except motion in place — therefore has in it potentiality only with respect to motion in place. But the mover, since it does not change in the nature of the kinds of change, therefore has in it no potentiality at all. This, then, is the mover by necessity, and it is that which necessitates the motions. And the necessity meant here is not that it is impossible for it to exist in any manner other than the manner in which it is, but rather the necessity of the completion of the perfection that lies in its end. For "necessity" is spoken of in three [senses]: the first, by force — a thing that is compelled is necessitated by force; the second, that without which [a thing] cannot come to be, as [nourishment is necessary] for the life of the [living being] that walks; the third, that which cannot be found in any manner other than the manner in which it is. And it is by this kind of necessity alone that the first principle is said [to be necessary]: for it is necessitated neither

in the manner of force, nor in the manner of that which it is impossible for it to be otherwise.

And when the matter is so, then the heavens and the nature of the whole depend upon this principle — that is to say, that necessity belongs to it by reason of this principle, not by reason of itself. And this principle, inasmuch as it perpetuates its own being, is forever in contemplation and joy and praise and gladness. And the matter with it resembles what happens to us for a short time — that is to say, when we exercise its perceptions and its powers, the imaginations and the representations, and our own essence; and it is the intellect in actuality.

[Margin (p. 2): a dotted diagonal insertion line drawn from the outer margin into the text near "the heavens and the nature of the whole depend upon this principle"; no marginal text is clearly legible at the terminus — an insertion/guide mark; further identification requires further verification.]

(interlinear: brief scribal additions above the line at several points on this page (e.g. a corrected form of "the mover" and a "here"); minor and only partly legible.)

But this act is ours only for a brief while, whereas for Him it is perpetual. The superiority of this act of His over our acts is like the superiority of His worth over our worth — as far as the eternal stands apart from what is not eternal. And it will be shown that life and intellect are the seat of apprehension: for wakefulness, which is itself apprehension, together with sensation and understanding, is pleasant. The sum of the matter is that apprehension cleaves to its own nature — pleasant inasmuch as it exists by nature; and the pleasant is that apprehension which lies in potency, inasmuch as it is [in act?]. For this reason hope came to be pleasant, because its object comes to be for it; and for this same reason memory is pleasant, because what is remembered had already been attained in actuality. And since this is so, one whose possession is always good is grieved by nothing in it that comes from potency; rather he abides perpetually in [thought], which is the most excellent of activities, for it is a contemplation directed upon its own self, more precious than all [forms], since its own essence is more precious than every substance. And the form belonging to the more excellent and precious thing is itself the more precious in respect of substance; and this is the greatest of activities, and eternal. And the eternal activity can only be for its own sake, not for its offspring — it contemplates its own self, and can be directed to nothing but intellect alone.

Just so — and all the more so, since it thinks its own self, it and its object of thought being one and the same in essence, as was explained in the Book of the

Soul (*Sefer HaNefesh* — De Anima). Therefore intellect and its object of thought are, in Him, a single thing, unlike what obtains for sensation and the rest of the faculties, which are divided. The cause of this is the purity that belongs to [Him], apart from the matter of the sensibles. And since it has been shown, from the analogy that we drew, that He thinks His own self, and that His object of thought and His intellect are one thing in a certain known manner — therefore this divine intellect, which is the head of the heavens, is far more so in this respect, because no kind whatever of potency is mingled in its nature. And accordingly, what proceeds from this first principle is in the utmost perfection in its own right, in the utmost worth, and in the utmost excellence of all existents.

And if the matter is as Aristotle said — that there belongs to it always that perfection which we attain only at [certain] beginnings — then the matter is more wonderful and marvelous still. And if, further, this which exists always and eternally is greater and more exalted, then [the wonder] is doubled manifold beyond all inquiry — compared with what we find of it in a single moment. The matter adds wonder upon wonder, marvels without end.

All of this the prophet stated in a single verse: "To whom then will you liken Me, that I should be equal? says the Holy One" (*Yeshayahu* 40:25). And the sense of the word "holy" is that He is [set apart] beyond all likenesses to Him — that is to say, He has no likeness whatever to any of the created things.

Let us return to the words of Aristotle. He said: this first head is living, because life is above intellect, which is perfect apprehension. And why is it called "living"? Because there is no living thing except that in which the motion of its apprehension occurs — and this is sensation. Accordingly, one who possesses the life that is the most precious of extremes — which is the eternal apprehension — is the living one who possesses the life that is in the utmost worth. Therefore He possesses the precious life, and He is the eternal, gracious[?] living one — may His name be blessed forever and to all eternity.

He said: Now those who held that the good, the grace, and the perfection ought not to be posited in the first head — on the grounds that the good and the perfection are things acquired by way of causes, not exalted like the perfection and [?]; and that these are not present at the outset of the plant and the animal, but rather come forth from the animal, the animal being their cause — [their view] is not true. For the head which is in potency comes from what is in actuality, as the seed does; since the seed of a man comes from a man in actuality. Therefore the head is a complete thing, not a seed. Their opinion would have

been true had what is in potency been prior and antecedent to what is in actuality.

He said: As for the existence of a substance that does not come to be in time, that is separate from the kinds of motion and separate in its own substance — its own essence being [directed] toward the sensibles — such a substance is neither a body nor anything residing in a body. This is a matter made clear by natural science, for it was explained there that it is impossible for this substance to have magnitude at all; it has no part, and admits of no division, since it has already been shown that it endures for a time that has no end. And what is in this [reckoning?] has no limit; whereas every body has a bound and a limit, since every body has a limit. And likewise it has been shown that this substance is in no way acted upon, nor does it ever come to be — as was explained there.

And after this he began to speak of the separate substances. This is the text of his words: Since it has been shown in natural science that the first of the substances is the principle [*mabda*, Arabic: al-mabdaʾ — "origin / first principle"], the divine [source] of the sensibles, their first beginning comes to be neither in substance nor in accident.

[Margin: a small correction-word above line 1 of the recto, outer margin, reading "נעמוד"[?] — content uncertain.]

And this is the one fitted to be the mover of the first, eternal, single motion — that is, the diurnal motion. Therefore, if everything that is moved is moved only on account of [something else], and the first mover in every self-moved thing must itself be unmoved in itself; and if, further, we must posit for every moved thing a first mover [Margin: "כלומ"', i.e. "that is"]; then it follows that the number of the movers equals the number of the things moved. For every self-moved thing is moved in an ordered way — [the ordered one, and what is not ordered, and that other which orders it][?: the middle of this clause, "יתנועע כסדר … וזולתו הסדיר והתחלף … שיתנועע לו האחד", is only partly legible; the sense is that each moved sphere is moved in an ordered chain by its own single mover] — which the one [mover] moves for it.

Therefore, if the matter is so — and we do in fact perceive here many motions belonging to the bodies of the heavens, over and above the motion of the whole — and since it has already been shown in natural science that this body, in its totality and in all its parts, is neither generated nor corrupted, and that no cessation befalls its motion, lest [its substance] should ever come to a stop at all[?: "כלל לבל שא … שמא תעמוד … ואין על תנועתו…" — legible in outline, but several

words are uncertain] — which, as was shown in this science — it therefore necessarily follows that each of these motions is moved on account of a mover that is not moved in itself at all, and on account of a prior substance; for [the mover] must be prior to the [moved] substance. And since this is so, it necessarily follows that the eternal substances equal in number the motions of the bodies of the heavens — neither fewer nor more — and that they are without any excess whatever, on account of what was said first.

Likewise it appears that it is necessary either that all the substances are posterior to the first substance, the mover of the first motion — since it has already been shown that this motion takes precedence over the rest of the motions — and it likewise appears in this that some of them must be prior to others, just as the motion of the stars takes precedence, some over others.

And it is fitting that we should know that this statement, which Aristotle [ארסטו] makes concerning the number of the substances, is open to question[?: "הוא שיקוס עליו" — reading of the predicate-word uncertain] both in itself, in its demonstration, and in their ordering. For that he says that a given sphere lies beneath a given sphere[?: "כי גלגל פלוני … פלוני" — the two connecting words are uncertain] has not been established by demonstration. Had it been demonstrated to him that their order in speed and in their course, as they are, corresponds to their order in [their distances][?], their positions, and their reckonings, we would suppose that this order requires demonstration. But since this matter has not been made clear to us in their regard — and we too apprehend only part of what is written[?: the last, short line of the recto, "כותב לכב … מקצת…", is only partly legible; the clause runs on without break into the verso] [Margin: a small correction-word, "רוא'ן"[?]] —

for they are bodies distant from the sun, whose distance from it is not [determined][?: "שאינן … מרחקן ממנו" — the verb is uncertain] by us except up to the completion of their motions[?: "עד מ…לם תנועותם" — reading uncertain], and especially Venus and Mercury; and so he was led to say[?: "הלכך מען לו לומר" — the verb is uncertain] that the motion each of them has is on account of the motion of the star above it. This, however, was not established by demonstration, and for that reason Aristotle did not spell it out.

After this he replied to the one who held that the first [principle][?: the manuscript reads "הקבלה הראשונה" (lit. "the first reception"); the sense is the First Cause/Mover, reading uncertain] is not the mover of the first sphere, the one moved with the diurnal motion. Then he said that what ought to be gathered[?: "מה שראוי לחבר" — the verb is uncertain] from all these matters is that the

motions of the substance of the heavens are, all of them, eternal, and that each of these motions has its own particular mover, moving in this manner and being moved. These [movers] exist by way of [intellectual longing][?: "מדרך אנתעטיריו בשכל" — the middle token is corrupt/transliterated and could not be read] — that is, they desire the ordered intelligible, so that these [spheres] move; and there is a kind of wholly intelligible order, and it is the first. For it is on account of these that the heavens move in their totality, and their spheres[?: "כדורם" — reading uncertain] are particular intelligibles; and it is toward these that each and every sphere moves. All of them move with a motion because they long beneath the first motion.

Their action in this resembles the work of the architectonic [master] craft [המלאכה השירית], under which are set many particular crafts, each of which is [activated][?: "תתחמם" — reading uncertain] according to what the architectonic craft grants it, and performs its work[?: "ותעשה … עד שדעתה" — partly legible] — since it knows that it exists on account of the excellence of the general architectonic craft, like the craft of governing the states together with the rest of the particular crafts, by which the governance of the state is [conducted][?: "שירתקן בהן מנהג המדינה" — the verb is uncertain]. And there is no difference between the two cases, except that [just as][?: "אלא כי כתארים השכלים במלאכותם קמות במשרתיהן" — this clause is only partly legible; the sense is that the intelligible forms subsist in their craft through their operations] the intelligible forms subsist, in their craft, through their operations.

Here, however, there is an inversion. That is: the governance[?: "המושג/המנהג" — reading uncertain] lies in the forms, and the forms — on account of their operations — were served by the crafts[?: "היו ראטין נעבדין במלאכות" — the middle word is uncertain]; whereas here it is the reverse — that is, their operations exist for the sake of the forms. Therefore, what corresponds to the general craft of the states [i.e. statecraft] is the general order [that governs][?] all that the heavens do in their totality; and what corresponds to the rest of the particular crafts is the motion of the remaining spheres.

After this he began to speak of the number of the separate substances (the "holy ones," הקדושות) — how many they amount to — and he saw fit in this to rely upon the master of the mathematical science [i.e. the astronomer]. Then he said: the matter is clear, that if any man wishes to add to them whatever he observes in this motion …

[The text breaks off at the foot of the verso; it continues on the following pages.]

[Foliation: a modern pencil "58" appears at the lower outer corner of the verso.]

in its swiftness, in the intensity of its retardation, in its direct motion, and in its return [retrogradation], without there being any limit to it — as follows from the science of the sphere, where it was explained that all the motions are simple and uniform, with no distortion in them. For these motions require that there be other orbs that complete [their revolutions], or [that do so] by some means, not fewer than these, until the star itself returns to its first mean position.

Said the author: From this indication we may, upon careful reflection, form an estimate and direct our aim toward their order, as we shall mention with [God's] help in the second part of this book, in the mathematical [portion]. And by this same reasoning [we conclude that] there exists no eccentric sphere [גלגל יוצא מרכז] and no epicyclic sphere [גלגל הקפה], since such a sphere neither surrounds the center, nor lies at the center, nor proceeds from the center. It is therefore neither heaven nor an element. And given that it would be a bearer of forms [?] — if so, what is it? Moreover, if an eccentric sphere did exist, that is impossible, because on its account there would have to exist orbs that are not evenly [nested] and do not fit against one another, or else there would be a void place; and both of these cannot exist in the substance of the heavens, since it is simple and contains within it no void place and no empty part.

He said: And if the [celestial] motion were like the rolling of a sphere — that is, on account of the star set within the rolling sphere — then it would be possible for a separate substance [עצם מובדל] to exist without any activity; for [otherwise] the heavens would have to exist merely as an object of thought [?]. Therefore it is impossible for another heavenly body [גוף] to exist besides it, or [another] mover of the stars; nor is it possible for other moved bodies to exist besides these moved bodies. Hence the number of the mover and of the moved is this [same] number. For if movers were found besides it, it would follow that yet other moved bodies be found besides it — but it has already been shown that no others exist besides it. For were yet others found besides it, there would have to be still further moved bodies, [moved] not on account of the star, or else moving on account of themselves, which is false. And if [the mover] were on account of the motion, and the motion on account of the motion and not on account of the star, the matter would proceed to infinity, which is absurd; and it is likewise absurd that it move on account of itself. It must therefore, of necessity, be on account of the star. Thus the number of the movers of the moved [?] is the number that the nature of the motion of the stars requires; and the number of the moving spheres [?]

is the number of those moved bodies. The meaning of "the nature of the motion of the stars" is that it is composite — which leads us of necessity [to conclude], concerning each single [motion], that it is composite of two or of three. For the way of knowing the motion [?] is either by sense-perception, or by intellectual reflection, or by reflection upon all that is reasoned; and thereafter it becomes evident [?] that every one of those motions is either simple, or composite of two or of three, just as was explained regarding the varied motion of the star, which is composite. And when it now becomes evident by sense-perception — as has reached us and is with us in this our time — the composite [motion] is inferred with respect to which of them is simple and which of them is composite; and as for what is composite among them, [it is to be determined] of how many motions it is composite. This matter has not yet been brought to completion in our time; but when it is completed, then we shall know how many they are in number.

He said: And the heaven is one. For if there were many in number but one in definition — as [we count] the sons of man one by one — it would follow that the principles of the moved bodies [be many]; and the many moved bodies [would have] a swift motion, many in number. But since "many in number" is not so [in this case], except on account of [?] — and it has already been shown that the first mover, that is, the mover of the diurnal motion, is neither consumed nor deficient, since it is complete and exists through itself — therefore the moved is one in form and in number. And if the mover is one in number and in definition, it must follow that what is moved by it has one continuous motion alone. Therefore the first principles are one only.

He said: Since we have already said that the One [God] is intellect, in which there is a single intellect — and this is because this intellect must necessarily be at the ultimate degree of perfection — and if the matter is so, it has an activity [פעל]; for otherwise, that is, [it would be] a form in potency, or else it would have no activity and no form in the intellect. But it is impossible that it have no activity, for [then] it would be an intellect not in actuality but in potency, like the sleeping sage; and the thing that is free of deficiency ought to be at the ultimate degree of perfection. Therefore it must, of necessity, have an activity of intellect, and that is the form. And if we say that it has an activity of intellect which is the form, then what is the thing that it thinks? For the form is the intelligible [מושכל]; and as for the contemplator, its object of contemplation is found [?] — [namely] the intelligible — and it thinks it, just as sense-perception is a being-acted-upon, and the sensed is the terminus of the sense-perception.

And if it were to think something other than itself, and to think that other thing by means of it, then that thing would be its cause. It would not, therefore, stand at the ultimate degree of priority and excellence; rather, the thing it thinks would by nature, and of necessity, be more honored than it — more honored than both [the thinker] and the intelligible. Now this [object of its thought] is either one or many. Whether it thinks the things all at once, or thinks them one after another, it must follow — if it thinks them one after another — that [it passes] from one to the next, so that there would be change in it, and potency. And if it thinks for the sake of something other than itself — [this cannot be,] since there is nothing else more honored than it and nothing more sanctified than it, and it must be actual. It is fitting, therefore, that it think nothing but itself, and that this activity in it be continuous and perpetual.

For anything else would make it pass from potency to act; and were that so, it would have toil on its own account, thinking at one time and being prevented at another. And if nothing else causes [its thinking] but itself, [yet] it does not think that other thing, then on that account there would be a deficiency — for there are many things it does not attain [that are] with us [?], many things it is better not to see, as Aristotle said: there are many things that it is better not to see than to see them.

And there is in this a difficulty: whether the intellect [and] the intelligible... [the case] is likened to [that of] all perception, which is [directed] to something other than itself [?] — that is, whether its object belongs to it per se, and there is [also] a matter and a change [in it] per accidens [?]. Therefore, how is the One [to be understood]? We say that this [distinction between thinker and thought] holds only [?] for things that have matter; but as for things that have no matter, the intellect and [the intelligible] are one, and the intellect thinks itself. [And so it is with] the permanent [things (הכוכבים הקיימים [?] — possibly "the fixed stars")], of the hidden [order] that moves [?]. All of this [holds] provided that the whole [rests] per se upon the First, since there is nothing in it that it might attain [as other than itself]. It is entirely [simple]; for if there were multiplicity in it, its essence would depend on something else, and it would not be [free of] deficiency — [whereas in fact] its essence is at the ultimate of perfection. And since the matter is so, what it thinks it thinks always and forever, and at every time it is one simple thing, as they said. Therefore we do not say of it that it thinks all the intelligibles at once, nor that it thinks part by part [?] as a cause; for were that so, what it thinks would be composite and more honored than its own intellect. This is what Aristotle wrote when he wrote of the One [thinking] the existents [?].

And in this there is a great difficulty, over which [the commentators (?)] are divided. It is this: if it thinks nothing but itself alone, and does not think all the rest of the existents at all — why is that? And if [it does], then what it thinks of itself is one order, and thereby [it thinks] another besides itself — this [present] order. And if the matter is so, then its own essence is not the cause of the intelligible order; rather, there is here another order, and thereby yet another — and this is contrary to what has been explained. But if we say that what it thinks of itself is this very order, then it must follow that the existents [depend upon it (interlinear: ממנו)] and are centered [upon it] and prior by nature [to it (?)], in the way that the intelligible is prior to the intellect.

Perhaps the resolution of this difficulty is as follows. We answer that what it thinks of itself is this order in one way, and is not [this order] in another way. And what are these two ways, and how does the matter stand? We say: were what it thinks of itself to be this [very present] order, we would be saying that its essence exists for the sake of these existents — as though [they were] the work of its hands, which is what it thinks. But it has already been explained that they exist for its sake, and it does not exist for theirs. [The question then is] whether the order that exists in itself [is that same order (interlinear: הסדר)]; for were what it thinks of itself not [that order at all], there would be no order whatever, and it would not be a cause for the existents. Therefore nothing remains but that the order which is in itself is spoken of together with the order here [below] by way of correspondence, and of priority and posteriority — as heat is predicated of fire and [derivatively] of hot things. In sum, so it is to be said of the rest of the causes and existents within this whole.

And since the matter is so, the order here [below] depends by nature upon that [higher] order, of necessity, and is known [there] in one way that is more perfect than the way in which it exists for the rest of the existents. He, therefore, thinks all the existents in a way more perfect than the way in which they exist among the existents; and the existents desire and pursue [Him], striving to be made like Him — like that order — since it is impossible for existents to proceed from Him except in a known rightness. They stand within that order [ranked] by degrees, one above another, according to their nearness to and their distance from Him in existence. He, therefore — blessed and exalted be His Name — [knows them] in one way that is more perfect, while all the existents are, in another way, more deficient [?].

Therefore He [comprehends [?]] the evil existents as well, so that nothing of them comes to be from Him — from the least of the least to the greatest of the great. There is none besides Him.

We ought to inquire, on this account, into the good and the most excellent [?] among the existents — namely, the order and [its] nature: whether it is present among the existents as a thing separate, standing by itself, or is [present] in the existents [only as their order], or whether it stands in both ways at once. It is present in the existents by reason of [the First's] existence, as [in the case of] that one thing: like the order and the rank in an army. For the good is found in the order and in the leader of the army — but more in one of them, in fullness and perfection, and that is the general of the army, for whose sake the whole army [is what it is]; the army does not exist for the sake of the order [but the order for his sake].

There follows what this entails. The order and the rank in the whole cannot come from the essence of the thing itself, just as its existence cannot come from itself; therefore [the order] belongs to it necessarily by reason of something other than itself. And the thing whose order is [so] determined cannot derive its order from another [and that from yet another [?]] — for were it so, the matter would proceed to infinity. Therefore this [First] thing is that which possesses the order in itself; it is the determiner of the order for all; and it is that for whose sake the order comes, not it for the sake of the order. Between the one and the other, in every kind, [there is a gradation] of the good, [tending] toward the good that is [pure] intellect [?].

And so one ought to understand the good in the whole [of existence] as coming from the First: that is, the good — which is the order and the rank — is found in all things because of the First. He is like the one head, standing by Himself; except that the order [and arrangement] are not present in all parts of the world in a single [uniform] way. Indeed, in the celestial [world [?]] — generally — in the things in which matter is not mingled, [the order is present] in [full] completeness so far as is possible; there is no confusion of aspect in the perfect [beings], no disorder and no ill-ordering. But in the natural things, in which matter is mingled, there is found in them a confusion of the order, on account of the necessity of nature — since it is impossible, in [the realm of] nature, that [matter] should receive the order in [full] completeness. And that is like corruption, old age, and the other evils that nature [brings] upon the material world.

The matter resembles the custom of free men and slaves. For just as, in the household, the free men are scarcely to be found acting [at random, beyond their

bounds [?]], but [act] only according as the way is fitting — so is the operation in the existents in which matter is not mingled. And just as with the slaves, much of what they do is found to be [at random [?]] — so is the case with things in which matter is mingled.

It is not from [any] evil intent [?] that the evil [arises], nor because it was possible for the slaves to be so disposed that they would do no evil and fall short [?] as some [do] — but because, [given their nature [?]], it is impossible for [things] to be found otherwise than this. So too one ought to understand the evil that remains [in the world [?]]... together with the existence of the First Principle and the existence of the good and [His] bounty in itself. That is: just as, when the king speaks, not all the people of the city would accept it were [rule] made equal [among many] — so the good that exists from the First: not all [the existents] receive it in full [lit. "its parts"]. With this [the Eleventh Treatise] is completed.

The Twelfth Treatise

The line and the plane [?] — [the point [?] is] a boundary only; that is, the [point/line] is not itself taken [as a subject] in their definition, whereas they are taken in [its] definition; therefore it is prior to them [in definition]. Yet it does not follow that whatever is prior in definition is prior in essence. For [these things], when they are considered [?], [appear] more excellent [?] and more complete [?] — or [they are] not [prior] in one [and the same] way — because this is [the manner] of all completion together with the matter that is bounded by them. That is, [such a thing] is prior in existence only, since [these attributes] are not found [on their own] but are found [in a subject], like motion, the sensible [?], and whiteness. For the definition of motion is prior to the definition of the sensible [?], since the sensible is not taken in its [own] definition, whereas [motion] is taken in the definition of the sensible. Likewise the definition of whiteness is prior to the definition of the white [thing]; and yet whiteness is not prior to the white thing in essence. Nor is motion prior in the existence of the sensible [?], since [these] are found only [as dependent], never void of [their] substrate [?]. And that which is prior in definition is not [thereby] prior in essence — that is, [it is] like the definiendum [taken] from [?] the other, the one [substance]; and the one [substance] [?] is therefore [prior]...

[several words uncertain]... And so it is with the operation of the acquired [disposition [?]] and its apprehension [?]... Therefore one may already see, from this treatise, that the thing which has this [character] — namely, that which is prior in definition — [is not thereby prior in existence [?]], but rather the one [substance [?]] is taken as prior in existence; and not the thing which has this

character [is prior] in definition — that is, that which is [added [?]] in definition... [closing words uncertain]... like whiteness [?].

that which is added in the definition of the one — as whiteness [is added] in the definition of the white — would be posterior in its existence. This is not as those held who supposed that the surface and the line are prior in existence to the body, and that the body is composed of [that which] is prior to it.

He said: it has already been shown that none of these [mathematical entities] is a substance, and that they are not to be reckoned as having place, nor as prior in being to the sensibles, but [prior] in definition alone. And this being so, it is impossible that they should exist by themselves, in their own essence, in a place void of the sensibles.

He said: and so too we posit — for it has thus been shown — that it is impossible that they should be found in the sensibles on the view that they are substances other than the sensibles. Therefore, if they exist yet are not separate, and do not exist in the way the sensibles do, on the view that they are substances, it follows that in their existing in the sensibles they exist in one of the ways [of existing], not in all the ways; and this is their existing as substance [only] insofar as [the term] is found [to apply]. For "to exist" [ha-davar] is predicated in many senses.

The first [sense]: existing universally within it — as with numbers and the like among things — insofar as [each] is not found separate from the things to which it is universal. And again, they do not exist as those sensible things exist to which [something] is found to be universal, that is, [existing] in the world. Therefore the universal is not something separate; rather it is [found] in the world.

The matter is clear: the mathematicals [ha-limmudim, the objects of the mathematical demonstrations] are found in the world of the sensibles without their being sensible in that respect, but only from the aspect that they are in embodied and sensible things; for the [predicates] concerning a thing [?] do not signify a substance, nor a sensible accident, [taken] apart from the accidents [of the thing]—[but rather] by way of nearness [?]. And it does not follow, when one takes some one of the things [in the sensibles], that [it is] the substance[s] in the sensibles.

It has already been shown in the [preceding] treatise that their being [what they are] does not [make] their nature a separate substance, nor [make them] embodied by themselves. And just as the mathematical limits and figures [ha-gevulim ve-ha-mofetim] within the embodied things [exist] insofar as they are embodied — and it does not follow from this that there is here a nature wholly

embodied by itself, standing entirely apart from the sensibles [?] — so too the mathematical limits and figures that are embodied [exist] not insofar as they are embodied. For they are embodied in that there is in them the appearance of motion; but [they are studied] insofar as they are themselves alone, whether as lines or as surfaces.

Therefore, what he said — that the lines and the surfaces and the rest of the mathematicals exist in their own right — is erroneous. For [rather] they either exist and are divided per accidens, or they are not divided per se, like the units [ha-aḥadiyyot, the monads]; or else they are not divided per accidens, if they are divided per se, like the lines and the surfaces. And for this reason [?], the true statement concerning the limits and figures that the master of the mathematical science studies is this: they do not exist as things existing in themselves — that is, subsisting and in act — as the matter [of the case] would require, as though there existed [separate] limits and figures within the embodied things. And likewise they do not exist as any chance thing whatever; for they exist, and their demonstration [holds] [?], in each and every craft [of mathematics]. It is erroneous [to hold] that they should exist not per accidens [?].

[…already established] that the disposition [?] of [their] soundness [?] are prior [?] [several words uncertain] — not the accidental things, as it happens here for [a thing] to be white or black. Therefore the [essence/definition [?]] of the mathematicals and their figures exist per se in the world [ba-olam], while their privations [?] exist in the sensibles per accidens. And for this reason neither the [natural scientist [?]] nor the mathematician [investigates] the sensible things insofar as they are sensible — nor [do they investigate] their limits and figures qua [belonging] to the sensible things insofar as they are sensible; nor [qua belonging] to things subsisting by themselves. Rather, [the mathematicals] exist per se, and thus [they exist] in the world; and one says that they exist in the sensible things per accidens.

He said: it has already befallen many things that they be taken in thought as abstracted [mufshaṭim], and that one consider them only insofar as they are [what they are], without their being found [thus] by themselves — like maleness and femaleness. For the master of the science of geometry [ba'al ḥokhmat ha-geometria] regards the [magnitudes [?]] in them — and their essences and their magnitudes [?] [are what is] bound [?] to them — even though [?] maleness and femaleness are not found except in the living being. Therefore, from this, the master of the mathematical science abstracts the line and the surface and all the things that are prior in definition and simple within it — that is, [things] that are

themselves taken in the definition of others, whereas the others are not taken in their definition. [And there is a distinction between them [?].]

And although these things are not found apart from the corporeal [?] embodied sensibles — since the body [?] and the [propositions/predicates] [?], insofar as they are simple, [have] no motion seen in their definition — and the embodied things [several words uncertain] … [in this we say [?]] … [in the sphere [?]] … in a degree [?] so small … and the appearances [?] …

That is to say: those [sciences] in which the sounds [are treated], and by which the sights [are treated] — and [these] are made into sensible things — [the science] does not deal with them insofar as they are sensible, but deals with the sounds insofar as they are of the numbers, and with the sights insofar as they are of the lines and [multiplicity?] [?]. And since the craft of the mathematical sciences [distinguishes?] [?] [the form?] and sets down in them this [abstraction], apart from every object [of thought], the mathematician is not bound [to posit] a degree among the degrees of the void [?] on earth or in heaven; rather he speaks of it with the terms proper to it, so that no falsehood [arises] [?]. And likewise, if one [bends or breaks?] [?] [a line?] at one of its ends, nature does not thereby become false; nor, if one makes its length firm at a span [?], and its dimensions are not [truly realized] so, does [error] thereby arise. There is no falsehood in this, nor any change in its [position?] [?], and its premises will not, on this account, be falsified.

And this doing of the mathematician is a good doing — that is to say, that it is [sound] in statement, even with respect to what cannot [be realized] in act; for the nature of the things requires it. For the man, taken as an example, insofar as he is a man, is one thing, and is not divided except per accidens — that is, from the side on which he is a body; for the division that befalls the man insofar as he is a man is per accidens, and it belongs to him only from the side of the body, essentially. Therefore it is fitting that what must [be considered] be treated in the man insofar as he is [a body], and not insofar as he is universal and divisible; rather one treats him insofar as he is a body, and considers him insofar as he is divisible. For the quantitative [aspect] in the man is not divided [per se] — that belongs to him per accidens. And for this reason it is possible for the geometer to abstract it and to consider it, together with the rest of the essential attributes, alone, in [their] essence — [whether] of the man or of [all of them?] [?] — [set apart] from the things [taken] per accidens; for the kind of the essential things [subsists] in the one designated thing. Since these were its objects [of thought],

the science that considers them must treat them [as] its objects; and this is called a doing, for the quantitative is predicated of it.

[Red ink, outer margin, keyed to the lines below: המושלם [?] ("the complete" / "the perfected") — a marginal topic-word; further identification requires further verification.] the One [is predicated] of [nature?], and the other of potentiality [?]. Therefore the treatment [of these is] like the treatment of the sounds, and the treatment of the [others?] [?] — this [error] does not befall it. And the quantitative things always [pertain to?] [?] [the objects of inquiry?] and the existents [?]; the quantitative things among [?] […] [?] are the things [that have quantity]. And the rest of the things of which "complete" and "solid" are predicated are the things that have quantity in them [?].

And accordingly the good and the beautiful are predicated in many senses. He said: and for this reason, those who suppose that the master of the mathematical science does not investigate the good [erred?] [?] — for by their nature they [the objects of mathematics] are good, since, even if they are not called by this name, [the mathematicians] occupy themselves in their craft with things related to the good; and accordingly [it proceeds] from combination and order [symmetry], and this is a good kind. And among them are the things that the master of the mathematical science investigates. And these universal Forms, which the mathematician investigates — he speaks at the outset [as though] it were by way of the good, and its being on one side [?]; but as for those [aspects] of which he does not speak, [it is set aside as] void. Yet which [state?] [?] is the state of the doing that the mathematician considers in them —

that is to say, the line and the surface among the sensible things? We say that it is as [was mentioned?] [?]: they exist essentially, like a fixed measure of the things related [to them] and their combinations [?]. And [this holds] only of number; for at the [beginning of nature?] [?] there was no number and no time. And so the matter stands in the world. As for those [things] that are close to number, like number [itself], [they are close to?] the sensibles; and some of them are closer than others, from the side that some are more [?] close to being sensible: [the sensible] from the line, and the line from the point. And we said [it is] more fitting [?] […], since the sensible individual is not found from it [directly?], but [only insofar as?] [?] the existent takes it up.

But the existent takes it up in another way; and it is possible for it to be [?] […] just as [?] — as the geometers [?] put it — that the composite makes the simple surface upon a single point alone; and it is not so [?] among the [existent things?] [?] that no substance is found […] [?]; [and it is] impossible that the substance and

the quiddity be found separate from the thing whose quiddity it is [?], nor is [any such] separate [entity] found. And he did not there say that the Form [...] [?] the separate [Forms] and the [?] and the [?] [do not] correspond [?], nor [do they?] [...] [?].

And what the ancients said — that it is possible for the Forms to be separate from the sensible substances, they being those very substances — this is vain, and he [the Philosopher] gave a lengthy reply to them from many sides; there is no need to mention them in this book. ·:·

The composition of numbers from the units is by aggregation; and the composition of the sensible substances from their elements is either by contact or by mixture. ·:·

*Twelfth Treatise (Metaphysics epitome, Books M/N) — continuous prose. The critique of the Forms continues into the doctrine of number and the theory of universals. No section rubric occurs; the Euclid Elements geometry (definitions of point and line, labeled construction diagram) has **not** yet begun — the "right angle / acute angle" example below is Aristotle's priority-in-definition illustration, argued in words, with no drawn figure.*

PDF p. 145 (folio side 1)

[We say] [?] that the numerical units differ one from another. For it is impossible that units be combined [united into a number] except in quantity and not in quality; and if there be no [difference] in one of them or in their [character] [?], then there is no difference between them at all.

For if the units were distinguished from [other] units in quantity, one of them would be larger than its fellow; and if the difference were in quality, it would be fitting that the numbers be [distinct] [?], such that [their terms] [?] would differ [?] and each receive [its own character] [?] insofar as they are counted. For since numbers are either even or odd, it necessarily followed that the numerical [units] do not differ, as numbers, except in more and less.

And therefore every number is either equal or unequal, and every unequal is either greater or lesser. Therefore, if there is between the greater and the lesser any equality or [difference] [?], it would follow that the greater be more [?] and the lesser [less] [?] — [and it is] known that the [units qua units] [?] do not differ [in kind] [?].

But the units of sensible things do differ one from another, because the unit that is in [one thing] [?] [...] and the unit that is in [another] [?]; and therefore the count [?] of "man" was different [in kind] [?] from the count [?] of [another sensible kind] [?] [Lacuna: several words of this clause are legible as glyphs but do not resolve into confident readings]. Yet the sensible number [?] does not differ in this way [merely] by addition and subtraction; rather, [the units of sensible things differ] because they are not bare units but units of designated [particular] things.

And the One is the principle [head] of number, inasmuch as it is a part of it and a thing that plays the role of matter [*gelem*]; and number is the principle of the units out of which it is composed, in the way that the form is the principle of matter. The priority of number to the units resembles the priority of the right angle to the acute; for the acute angle arises upon [is generated out of] the right angle — in his [Aristotle's] view it is a part of it, and he says of it that it is smaller than a right angle — and the acute is not taken in the definition of the right. Therefore the right angle is [defined / described] [?] by [reference to] the acute [?], just as the thing is [described] [?] by its form, since the one of them is prior in time [?] [...] which is matter [*hyle*], and the [other] is prior in definition.

The units and the plurality [the many] are not [themselves] elements; rather, [things] are composed out of them — for it is impossible to be a composite out of the One and the many [...] [in the way] [?] that things are composed out of their elements. The intelligible forms — the universals — have no existence outside the soul [?]; for according to what [is judged of them] [?] [...] [several words unresolved].

PDF p. 146 (folio side 1, continued)

[Margin, head of page: המורגשות ("the sensibles") — an isolated topic-keyword in the scribe's hand at the top of the leaf, not a running header.]

[...] it is not something superfluous in its own nature, nor something added upon the [?], for it is a part of the designated [?] living thing. And since the universals and the substances are not superfluous in their own nature — and [there is] another [sense] in the way it is said of each of the existents that it is one, even though they are elements of the [sensible] [?] substances — it is impossible for numbers [?] [...] to be subsistent [?] in their own nature; rather they are reckoned as [belonging] to the [existing] [?] things in their own nature. And numbers are not prior to the sensible existents.

After this, [he replied] [?] against those who say that they [the numbers/forms] have sensible substances [?] [...] numbers and forms — and thus [assigned] to them principles and elements, and even posited [?] principles for the existents. For Aristotle did not lay down the principles except those three alone, namely: the form, the privation [lit. "the not"] [?], and the substratum; and he made the elements four, as was explained in natural science [*Sefer ha-Shema ha-Tiv'i*, the Physics].

[As for] the knowledge of what the universal is — what it is possible [...] for a universal to be, that is to say, [something] separate in its own nature: what is clear concerning the universals is that the composites [?] and the separate [things] [?] are combined out of them; as when you say [?] [...] that it is a [conclusion / piece of reasoning] [?] composed of primary premises. For it is impossible that the [reasoning] [?], which is the root of the demonstration, be found without the demonstration; and likewise it is impossible that the composite proposition — composed by a [complete] [?] composition — which is the root of the definition, be found without the [?] of the definition.

He said, as a general rule, that to treat the universals as existing [?] outside thought would make them subsistent [?] [...], because what is true is that the thing be found in thought itself, which for us is [what is] outside thought. Therefore, as for what thought does when we judge [?] that it exists outside the soul in one respect and does not exist in another respect — in respect of actuality it does not exist [?], but in potency it exists. For there is, in the nature of the existents insofar as they are universals in potency, [...] separate [?], such that the universal is acquired by means of the soul, which is in act; and from the side of [...] the universal and the particular: for both of them [?] there is a substance outside the soul, and therefore there was for each one a substance. [...] the universal thing is itself universal, and the particular thing is itself particular; inasmuch as the [appearing / representation] [?] [...] that is, in that it is an [appearance] [?] from its own side, [its apprehension] [?] [attaches to] the universal [?]; and this [appearance] [?] [...] its apprehension [...] the [?] nature [...] — [it is universal] only in that it is an [appearance] [?], but [only] incidentally.

[The written area ends here; the lower portion of the leaf is blank parchment. Pencil foliation "64" in the lower-right margin, modern hand.]

[Margin (topic keyword, top of leaf, scribe's hand): המורגשות — "the sensibles"]

in respect of what it is as the nature of a sensible thing; and likewise it is predicated fixedly [?] of the sensible representation. It too is predicated only

incidentally, for it is not predicated [of the thing] because it is the nature of that sensible thing; since, were the matter [otherwise], that representation would not be [distinct] from that nature — rather, it is predicated of it only because it is a nature. Therefore things are not acted upon insofar as they are sensible except incidentally; nor are they acted upon in respect of their being sensible except incidentally; and they are not brought into actuality except from the side of the sensible substance itself. That is to say: the color [?] [or: the nature] follows the representation, and [universals] are found in potency from the side of the universal thing. That is, the universal color [?] comes to be corresponding to the universal representation; and when the matter is thus, the nature is the nature of the universal thing [as present] in the particular things in potency, not in act. For if the universal were not found in all this, the sensible thing would be raised up [?] insofar as it is sensible; and likewise it would be raised up [?] — or the nature of the universal would be in act — from the side of [its being] in the sensible thing; and there would follow [?]…

the [first] principles [that lie] outside nature. Universals in act could exist in [particular things] because of their existence in the soul — universals in act, in the manner in which [they are] found in [?] the demonstration [?]. And if the universals have no existence in act except because they are parts of composites [?], and the composite [things] cannot exist separated [?] in their own selves, then [there is] no single [?] [universal] except [as] a [?]; [and] it does not follow [?], since [the universals] are not found separated except [when] they are found in act [—] as opinions in act [—] and [they exist] in potency when they are in potency.

And [Aristotle] has already spoken of the part [that is] in substance [?] which is universal in potency, and made known what it is: it is the [matter?] [הקטירה — term uncertain] that is found — [these being] universals in potency; and it belongs to it incidentally, on account of the matter [hyle] that unites with it. Therefore it is also said that it comes to be and perishes incidentally, for it is coming-to-be and passing-away incidentally.

The Thirteenth Treatise

[Display heading, large script, p. 147/f. 64v foot: המאמר השלשה עשר]

[Subtitle, smaller script beneath the heading:] Concerning the equal [?] and the unequal; and concerning the different [?], the correct [?] and the like.

and concerning [?] the thesis [?]. The one has no contrary, and the many is not its contrary; for the true contrary of the many is the few. The thing that [is measured] [?] [is what], [being] among the measured things, is in one respect [also] something else; and it is a thing that is not divided in that respect. [To explain] how: as to the essences of the measured things — [the one is present in them] sometimes [as one] [?] [נֹאסֹ / abbreviation uncertain]. And Plato [?] [ובן דלס — reading uncertain] [held] the truth; and in the categories, the letters [?] of the mineral [?]; and in heavy [bodies] the light [?]. And in this manner it is found many times in the treatise. That is to say: the [unit] measured out of them is a thing that is not divided in that respect.

[To explain] how: among qualities, there are primary measured qualities, namely whiteness and blackness; and in the [category of] quantity a measured [unit]. That is to say, [the measure is] that which is not divided; and it is the one that is not divided. And that which is not divided [in the case] of such things — there is [a case] in which the thing other than it is divided, as a one in number [?]; and there is [a case] in which the thing other than it is divided [צלעע / uncertain]. [Marginal corrections present alongside these lines: "כמו" ("as"), "כאחד" ("as one"), and a further inserted word — legible content uncertain.] [The one is] as a one [set] over against [?] the measured things; and by four [?] [means] [מאמנעס / uncertain] it is weighed [reckoned] by them. And if the way of the one is this — that is, that it is a measure, in that it is of a nature such that the thing other than it is divided —

then the one is not a species belonging to the objects [?] of number; for number is measured, whereas the one is a measure. Number is a multitude, and they are [reckoned] in number [?]; and the one is a measure [?], not [itself] a number [?]. And since the one is not a species belonging to the objects [?] of number, it is therefore not the contrary of the many — because [the one and the many] are witnesses [?], as has been explained: they are two species under a single nature, which is a universal. It is fitting that the contrary of the two species [?] [belong to] one of the beings [?], one [of them being] the contrary [?] of the other. For we count [?] the horses by [the unit] "horse," and one says "five horses"; and [we count] the men by [the unit] "man," and one says "five men." Therefore this one is…

a species of the many, but it is not a substratum for them, nor prior to them. And the combination came about [?] in the one that is a substratum — that is to say, [the one] in which it is impossible that it be [merely] among the species of the

many that [?]… them; rather it is a prior species [set] over them [?], and not [ranked] on one level with the measured things in that respect.

[Then Aristotle] said: neither the great and the small, nor the few and the many, are the whole substance of a thing [the "what-it-is"]; for not all the measured things are found in the universal [?]. As with substances: it is sometimes said of them that there is here no thing that is great in itself, nor first [greatest] [?], nor small — that is to say, no thing [מטיו / uncertain] belonging to it such that [במו שנא / uncertain] its very self would be the greatness and the smallness.

[Text ends here; the lower portion of the leaf is blank parchment. Pencil foliation "65" in the lower-right margin, modern hand.]

And he sees that the relative, as something predicated, is not a substance insofar as it is relative. This [category] falls short of many of the [other] categories: in its own right it has neither coming-to-be nor passing-away, as substance does; nor alteration, as quality does; nor increase, as quantity does; nor locomotion, as there is in the category of "where"; nor [does it admit] any of the kinds of change — [it changes] only incidentally. That is to say, [the relative] merely follows upon [another's] change [?], and in this there is something necessary. In other words, the relative attends upon [another's] motion only per accidens: a thing does not become greater, or smaller, or equal [by any change in itself], but only in relation to a change [in quantity? [?]]; and likewise a thing does not become "father" or "son" [by changing itself], but only in relation to [the other's] coming-to-be, [and] in name.

After this he begins to inquire whether it is possible — in the case of the eternal things — that they be compounded together with the elements, such that they would possess matter. He said: It is a clear matter that everything [deriving] from an element is composite. Therefore, if there is an eternal existent [רצו / ?] that is [composed] of the elements, it must be composite; and if it is composite, [it must be] a mixture [?], as [holds] of things that have the power to be mixed out of [others] — that is, things that have in them the power to receive composition. And anything whose cause is separate [from it] [?] may exist at one time and not exist at another [time / ?]. If, then, what is eternal has matter, or a substrate [ממסטר / ?], or [parts / ?], there is in it a potentiality not to exist — [a potentiality] to exist not at a fixed time [?], as happens with things that are not eternal but [endure only for] a time that has no end.

If this is so — and it has already been shown in natural science [the *Physics*] that it is impossible for there to be eternal things in which potentiality is found —

then no eternal substance is composed of elements; for the composite has potentiality in it, whereas the eternal thing has no potentiality whatsoever. And this being so, it is therefore impossible, [by composition] out of the elements, for [such things] to be eternal.

Yet a difficulty remains concerning this, namely: how can this be, on the true account? For as regards the substances: every body is composite of matter and form, so it must necessarily follow that all this [is] the body of the [eternal] substances [being] composite of matter and form. This is the position found in Ibn Sina, together with his distinction [?]. But a difficulty was raised against the words of Ibn Sina [second name uncertain [?]], because he holds [?] that with the presence of composition in a thing [comes] the presence of potentiality. Therefore what is said [is] that composite subjects [admit] two modes of existence: [one] in itself, and this is what is called *the Necessarily-Existent in itself* [Avicenna's wājib al-wujūd bi-dhātihi].

[The text block ends here in the upper portion of the leaf; the lower part of the folio is blank parchment. The line "the Necessarily-Existent in itself" stands as a short, centered final line. The argument continues without break onto the following leaf.]

And this is the First, according to him [Avicenna]. And [the other mode is] a kind that is necessary of existence through its cause [yet] possible in itself as regards its subject — and this is the body of the heavens.

Ibn Rushd said: As for what this man [Ibn Sina] says — that there is potentiality in it — the opposite of this has already been demonstrated at the end of the first treatise of the Book of the Heavens and the World [De Caelo], by means of strong theses [?]. So one of two [options] remains: either we suppose that there is a substance of matter that has in it no potentiality — nor any power at all; or we suppose that the first body is simple and not composite of matter and form. And whichever of these two [options], or more, we adopt — whether you affirm the existence of a matter that has no power at all [in it], or the existence of a simple body that is not composite — the body of the heavens must [fall] under one of these two; for the [celestial] body and the generated-and-corruptible body — it is impossible for them to be [brought] under a single name, as we said in this book. But if "body" is in every case predicated of both equally — well and good.

And we have found that Ibn Sina [name uncertain [?]] … [maintains] this — that it [the heavenly body] is composite of matter and form — but he [Ibn Rushd] does not hold so. [As for] the material premise, that "every body is composite of matter

and form" — it is not among the first premises. For, given what we suppose, we have judged that the simple bodies — namely, the four elements — are composite of matter [*gelem*] and form on account of the change found in them in [their] substance, that is, coming-to-be and passing-away. Hence what has been asked among us is: [why is it] that every generated-and-corruptible body is composite of matter and form? And [the answer is] on account of the change found in the generated-and-corruptible body in [its] substance; and we have established [?] that in the nature of matter [?] … and likewise its existence is in potency and not in act. Therefore what has become clear to us, on account of the change found in [its] substance, [is that] in every substance [there are] two things: first, that every generated-and-corruptible body is composite of matter and form — not [?] … composite of matter [*gelem*] and form; and second, that there is a substance [?] whose existence — being generated and corrupted — is in potency; that is, in a single potency by which [?] … this substance. And this substance is what is called *matter* [hyle].

And since this is so, and since it has already been shown, on account of the necessary [premises], that eternal things have no power at all in them, therefore the eternal substance must not be a possessor of matter [*gelem*]; and that a part of substance [is] … composite [?] of matter and form [the sense here requires "not composite"; the literal text reads "composite" — see report] — and these are *the eternal substances*.

Thirteenth Treatise (the Metaphysics epitome), continued: the composition of the celestial body — Ibn Rushd resolving the Avicennan difficulty over matter and potentiality in the eternally-moved thing. The treatise concludes on f. 67r with a completion formula, and a new authorial section opens.

f. 66v

And Aristotle stated this very thing explicitly, in the following words: We require of the body of the heavens no power except in respect of change of place. And accordingly we do not judge the heavens to be [corporeal [?]] except on account of the change of place found in them. The matter is clear: the change of place makes it necessary, on its own account, that the moved thing be a body only — and not a body composite of matter (*gelem*) and form. And although we [examined [?]] this at length, we did not arrive at it until after many investigations and a long time — when we turned our thought back to it, [and drew testimony [?]] from the treatises of this sage; and we [reached agreement [?]] ⟦(interlinear: נוספת ("added"))⟧ … and we completed the rest of [his [?]] treatises apart from it.

Here end the words of Ibn Rushd [Averroes]. And he [Ibn Rushd] said further: I was for a long time perplexed by this difficulty, and I could find no resolution for it. For it was explained in the third treatise of the Book of Natural Hearing [Physics III] that the body of the heavens receives a form [and a substance [?]] apart from anything prime-material [*hiyulani*] at all; and by this the difficulty is resolved, since it is in itself [possible / necessary [?]] of existence — as Ibn Sina [Avicenna] understood [?]. And by this the eternal [thing] is [set apart [?]] from its matter. Moreover it has already been explained in the first treatise of the Book of the Heavens and the World [De Caelo I] that there is no potentiality [*efsharut*] in it. Therefore [the two views [?]] are distinguished one from the other; and even so, how can one still be in doubt about [it [?]]? — and its resolution is written in the treatise of the [Natural] Hearing [Physics [?]].

For, [it follows [?]] from one of the premises made in it — namely, that every body has a limit (*ḥeqer*) — and it has already been determined that "limit" is predicated of the eternal and of the generated-and-corrupted [equally [?]]; and [from this [?]] it was explained to him that that [X [?]] did not avail him. And [it was established [?]] that there is a moved existent that is not in prime matter (*hyle*) at all; and that it is the [agent [?]] moving-cause … and the moved thing and its [soul / self [?]] is [possible [?]]. Rather, it was explained from it that there is a moved existent not in prime matter at all — since everything moved that is in prime matter has a limit; and that the moved thing, on its own account, [is eternal [?]], and that it is a body; and [that there is [?]] an existent, by nature, in which there is no power at all — [as [there is] in [?]] the [sensible [?]] living things. And [therefore [?]] every moved thing that moves of itself is composite of a mover and a moved — that is to say, of form and [substrate [?]] … it is impossible for this moved thing, in respect of its being [the matter [?]], in respect of its being moved, to be in prime matter. Therefore it remains that it be a form that has no prime matter; for if it had prime matter, its motion would have a limit. Therefore it is a form belonging to an existent, [which] by nature has in it no [subsistence [?]] — rather its subsistence [?] is in it; and it is the body of the heavens, the moved thing …

f. 67r

and it is what was explained here, that there is no potentiality in it at all. For were there here [coming-to-be [?]], and had it received an eternal form, there would not be found [X [?]], since the thing moved with the eternal motion is a possessor of prime matter … [for prime matter, its nature [?]] … is in potency. Therefore it is fitting, as was explained, that the thing moved with the motion of

the heavens is not a possessor of prime matter in any respect … [rather it is [?]] a form other than [that of [?]] a possessor of prime matter, and afterward [it is said [?]] that it is moved. And, it being so, the moved body of the heavens is composite of a body and a power added upon the body — not in the way in which the [corporeal [?]] natural [bodies] are composite, and not [as [?]] … and the souls; and the nature that is said of it —

that it is neither heavy nor light — is nothing other than the nature of the body: not that it is a part of the body, as heaviness and lightness are a part of the body of earth and of the body of fire. For if not, it would necessarily follow that the body of the heavens is composite of matter and form. And if we say that it is composite of matter and form, and that there is, among the material forms, one that is eternal, then there has not been clarified to us the demonstration from which it was explained that the thing moved with the motion of the heavens is not a possessor of prime matter at all — but rather it would follow from it that [there is no [X [?]]] possessor of prime matter in potency; [the possessor of prime matter belongs to [?]] the things that come to be and pass away. Therefore that which is [ascribed [?]] to the [body [?]] of the heavens — namely, the form of the moved thing — is [in the relation of [?]] the [prime matter [?]] to heaviness or lightness, as the [substratum [?]] is.

And it [the body of the heavens] is a simple body, not another [kind]; for it is known of itself, from what was explained concerning the substance of the sphere, that it cannot be [a void [?]] enclosed, and it cannot receive matter [and] form, [being eternal [?]] — from what was explained at the end of the eighth [?] treatise: that everything material has, in respect of its [operation [?]], a limit; and [that [?]] this eternal [thing] does not … There will not be clarified to us [any [?]] demonstration [pointing [?]] to the existence of the first moved thing apart from matter at all.

Therefore, how far is this [reasoning [?]] from the [view [?]] of Ibn Sina ⟦(interlinear: ארסטו ("Aristotle"))⟧ [which I knew [?]] — [namely] that there is here a way to demonstrate the existence of the first moved thing [?] — a way other than his ⟦(interlinear: ארסטו ("Aristotle"))⟧. And from what was explained — that the mover of the body of the heavens is a form added upon the body — it appears that … [Be strong · Finished · [תם · חזק · [?]]]

Said the author: You have already seen the opinion of Aristotle ⟦[Enlarged display line — new authorial section; its final word begins the new section:]⟧

Aristotle …

and you know the commentators on his [Aristotle's] words—such as the philosopher Ibn Rushd [אבן רשד = Averroes] and others—concerning [?] [obscure closing token: "בעשן המות" [?]]—regarding the existence of the Creator (may He be blessed), His unity, and His being no body: [proving these] from the premises [הקדמות], and so forth. And it is not possible [?]... to be good, and afterward [?]...; yet **"Not like these is the portion of Jacob, for He is the Fashioner of all things"** [Yirmiyahu 10:16]—He is the All. As I shall explain [?]... [obscure clause [?]].

And at the outset I composed this book in the Arabic language. And when circumstances brought it about [lit. "when the matter came round," נתגלגל הדבר] that I went down to the land of Tuscany [ארץ טושקאנה = Toscana], my companions urged me to render it into the Holy Tongue [Hebrew], and I did so as best I was able. [May it be blessed [?]... Amen [?]...] Let [the reader] judge me favorably [לכף זכות], and let him not blame me for the errors—whether in [meaning [?]] or in my own craftsmanship—nor for the shortcoming of its language [i.e., the deficiency of the translation]; for my heart fell short [?] in its expression, and I labored [?] over the rendering of the technical terms [העתקת השמות]. And I have said what comes closest to being understood, according to the capacity of the [Hebrew] language. [In truth [?]...] And know that our tongue is called the Holy Tongue [לשון הקדש]—for two reasons: the one [?]... and the second [?]...; all this will be explained [?], from beginning to end, as I shall explain [?].

So he explained the [several] languages: that in it [his own tongue] he calls the masters of the First Philosophy [i.e., metaphysics—בעלי סופיא הראשונה; סופיא = Greek σοφία, "wisdom"] by [one] name, "wisdom" [חכמה]; and natural science by [the term] "musari" [מוסרי [?]]; and the mathematical sciences [חכמת הלמודים] by [the term] "banah" [בנה [?]]—and there are many more words of this kind, each according to its meaning. [The reason] the Name [made] His tongue a single tongue was so that we should all be of one language; and through this [unity] there is expressed in it [?]... [obscure token: "פלוס" [?]] and love. But in the other tongues you will find, under a single expression, several distinct meanings; and it is called by one word [?] because a foreign tongue [?] is not sound at its foundation [?] [obscure clause [?]], and likewise in other places. Moreover, since His tongue is the primordial one [הקדמון], it is fitting that man—[being] from the earth [אדמה]—should speak it [i.e., there is an etymological bond of *adam* to *adamah*]. And you will see that the nations call their letters by a name close to the [name by which] we call them; yet they do not know the reason for this. For we call [a certain] letter [?], and Ishmael [i.e., the Arabs] calls it [?]; and the vernacular-speakers [ולועזין = speakers of Romance] say "el" [?], while we say

"samekh"; and Ishmael [says] "ṭīn" [?], and the vernacular-speakers "pa" [?]; yet neither of them knows the reason [for the names]. But one who understands our tongue will know that there is no [true] correspondence between their letters and ours, or [that they correspond] only in part—the likeness [being] as [that] of a stone to living man. And there is no need to be lengthy here.

[Pencil foliation: none clearly visible on p. 153.]

And now we begin, with the help of Shaddai (may He be exalted) [וְעַתָּה נַתְחִיל בְּעֶזְרַת שַׁדַּי יִתְעַלֶּה — enlarged vocalized display line]

to explain some of the verses—from Bereishis [Genesis], and the book of Tehillim [Psalms], and the book of Mishlei [Proverbs]. And [as for] every man whose heart moves him to draw near to the work, to undertake [it] [cf. Shemos 36:2, " כל איש אשר נשאו לבו… לקרבה אל המלאכה לעשות"]—namely, to copy this book—[let it be a caution [?]] that he not be permitted to copy from it any single [portion] and leave the rest, but that he copy the whole book as it stands, in order, from beginning to end, letter for letter and word for word; and that he not report a saying in the name of its author except as it is found written in the book. And in this he is as one adjured from **Mount Sinai** [מהר סיני]. And may the Holy One, blessed be He, help us, and grant us strength of tongues, valor, to be faithful [?]. May He be extolled and exalted, forever and to all eternity. Amen, Selah.

"Let the heavens rejoice and the earth be glad," etc. [יִשְׂמְחוּ הַשָּׁמַיִם וְתָגֵל הָאָרֶץ וגו' — Tehillim 96:11 — enlarged display line]

"In the beginning God created," etc. [בְּרֵאשִׁית בָּרָא אֱלֹהִים וגו' — Bereishis 1:1 — enlarged display line]

There is a benefit [?]… in the proper understanding of the verse, [namely] that [the heaven and the earth] are the host of "the beginning" [צבא בראשית [?]]… [obscure stretch [?]]. "In the beginning" [refers] to the [creative] acts and the working within them; and [in the beings [?]] after it, [Scripture] said "acted"; and [so on] until it stands apart in its own right. Therefore this [word] points to a great matter, and to [some [?]] of the secrets of the Torah [סודות התורה]. And this will be explained in the book of Mishlei [Proverbs], in the verse **"The LORD acquired me as the beginning of His way"** [קָנָנִי רֵאשִׁית דַּרְכּוֹ — Mishlei 8:22]. For inasmuch as [Scripture] did not recount [?]… the creation of the primordial world [בריאת העולם הקדמון], but mentioned only the beings that are in the midst of the worlds—and they are [the heaven [?]] and the earth—therefore it began and said, "In the beginning God created," etc. [Scripture] points by this, here, [to the fact] that when they are [expressed [?]] in the [proper [?]] tongue…, and it is by it [?]

that [Scripture] speaks [of] "heaven"… [obscure clause [?]]. And its meaning is: the issuing-forth [צאת] of the thing that is "the beginning," which is a power that [does] not [?]… "God created the heaven and the earth"—and this is its correct interpretation. For [the heaven] issued from the Holy One, blessed be He, first; or [it was] the first perfect Spirit [הרוח הראשון], [which] issued from [the substance of [?]] that world, or from some of the worlds. And this is the meaning of "the beginning of His way." Here [Scripture] set forth the order of all the existent beings, and began from the first world, which issued first from the power [מכחו] of the Holy One, blessed be He.

[Pencil foliation: "68" (reading "68a" [?]) at the lower-right margin of p. 154; a small pencil "V" mark at the upper-right of the leaf.]

they are called "the beginning of His way," and after it, "the first of His works of old, etc." [Mishlei 8:22–23], "…before He had made the earth and the open fields, etc." [עד לא עשה ארץ וחוצות — Mishlei 8:26]. And they are ten levels, and each and every level contains several[?] sub-levels. Concerning this it is said, "For one high one is watched by a higher, and there are yet higher ones over them" [כי גבוה מעל גבוה שומר וגבוהים עליהם — Kohelet 5:7]. They are arranged[?] within the [creative] work according to their rank, one above the other; and the intellects[?]—

In the first level there are [five or six [?]] kinds of lights: [a list of technical light-names follows, in a compressed abbreviated hand not securely legible at this resolution — [?]]. And they are six[?] lights, corresponding to the six days [of creation]. [Letter-label [?]] corresponds to the first day, on which was created the light [reserved for the [?]] righteous—and concerning it is said, "in all My house he is trusted" [בכל ביתי נאמן הוא — Bamidbar 12:7]. [Letter-label [?]] corresponds to the second day, on which the firmament was created […][?]. [Letter-label [?]] corresponds to the third day, on which the plants were created. [Letter-label [?]] corresponds to the fourth day, on which the luminaries were created. […] [Letter-label [?]] corresponds to the fifth day. [Letter-label [?]] corresponds to the sixth day, on which Adam was created, who is the completion of the whole [creation]. And such are the [six [?]] lights.

Therefore our Rabbis, may peace be upon them, said: "[the accusative *et*] the heavens"—to include all that is in the heavens; "and [*et*] the earth"—to include all that is in the earth. That is to say, all the existents […][?] came into being by a power that goes forth, according to [their] nature[?] […][?].

"And God saw the light, that it was good" [וירא אלהים את האור כי טוב — Bereishis 1:4]. You will observe that, of all the created things that were set in order,

[Scripture] did not say of any single one of them, in itself, "that it was good," except of the light alone. For it did not say "that it was good" [...][?]. It did not say, "And God saw the gathering of the waters, that it was good"; and so with all of them. Yet [...][?] on that same day; but of the light, which [...][?], [Scripture] said "that it was good," because it rules[?] over all the [world / existents [?]] that come after it. Therefore it said of it "that it was good."

And therefore it said of it, "And God divided between the light and the darkness" [ויבדל אלהים בין האור ובין החשך — Bereishis 1:4]. This is not the light of the sun; and if so, what reality is there in its being divided from the darkness? And likewise the darkness is another thing—for if the darkness were merely the privation of light, as [he] explained[?] [...][?]. In any case, that light is not this one that we see, but rather a luminous[?] [light]—it is in the heavens [שחקים].

it is the perfect [light], all of which is good and enduring[?], and it is perpetual, forever, without cease. Concerning it is said, "Light is sown for the righteous" [אור זרוע לצדיק — Tehillim 97:11]; "In Your light we see light" [באורך נראה אור — Tehillim 36:10]; "The sun shall no longer be your light by day, nor for brightness shall the moon give light to you, [but the LORD will be your everlasting light]" [לא יהיה לך עוד השמש לאור יומם ולנגה הירח לא יאיר לך... לאור עולם — Yeshayahu 60:19]. And concerning it is said, "And God divided between the light and the darkness" [Bereishis 1:4]. And it is said: how many separations there are between it and this perfect light—which is called "darkness" in relation to us! Yet that light has no darkness in it at all, but only continuous light. And therefore it is called the light of life, [...][?] "to give light with the light of life" [להאיר באור החיים — Iyov 33:30] [...][?].

And [Scripture] shows that this light mentioned in the verses is [...][?]. The One is God[?], who is the whole activity[?] upon [...][?] worlds; and for its sake it said, "And God saw the light, that it was good; and God divided between the light and the darkness" [Bereishis 1:4]. And the second[?] is this perceptible light of the sun; and for its sake it said, "And God called the light Day" [ויקרא אלהים לאור יום — Bereishis 1:5]. And because of this light emanated upon the existents, the prophet said, "the whole earth is full of His glory" [מלא כל הארץ כבודו — Yeshayahu 6:3]—for in each and every one of its parts [...][?] the light was made, and in it [each thing] lives. And now, therefore, they said, "Let there be light, and there was light" [יהי אור ויהי אור — Bereishis 1:3]—that is to say, let this light be emanated and rest upon the [...][?] whose essence[?] is in it.

And you will see that, [in] the verses of the six days of creation, [Scripture] says "Let there be such-and-such" only concerning the heavenly things, as they are [in

themselves][?]; and [concerning] the perfect one, the sphere—that is what says "Let there be a firmament" [יהי רקיע — Bereishis 1:6], "Let there be luminaries" [יהי מאורות — Bereishis 1:14]. But concerning things that come to be and perish—and they are [...][?] of the earth—it did not say of them "Let there be," but rather, "Let the waters be gathered" [יקוו המים — Bereishis 1:9], "Let the earth sprout" [תדשא הארץ — Bereishis 1:11], "Let the waters swarm" [ישרצו המים — Bereishis 1:20], "Let the earth bring forth" [תוצא הארץ — Bereishis 1:24]. And concerning those lower[?] things it did not say "Let there be," because there is here nothing emanated except [...][?] this lower perfect-one alone. But concerning the light, which is the higher[?] perfect-one—which was emanated by its power, and rests upon the sphere, and accompanies[?] the earth—of it was said "Let there be." There, twice it is said, "Let there be light, and there was light" [Bereishis 1:3]—that is to say, that light which was emanated from the power of the Holy One, blessed be He, [...][?] now, which is emanated and [seen[?]] by its power, or [some[?]] of the worlds. And because that light upon this lower perfect-one is not in a single measure nor in a single manner, therefore the prophets, peace be upon them, prayed on its behalf...

Judah ben Solomon HaKohen. Witness: Parma 2769 (NLI Ktiv), scribe Sasson ben Menashe. Continuous Genesis-creation commentary; Sephardic semicursive. Folios: f. 69v (p. 157) and f. 70r (p. 158) by the pencil foliation ("70" at the lower-right of p. 158).

[f. 69v]

for it to rest continually. This is the meaning of what is said: **"and let His glory fill the whole earth, Amen and Amen"** [וימלא כבודו את כל הארץ אמן ואמן — Tehillim 72:19]. For if it always rested upon them in a single measure—as it is emanated upon the [nitbal — the ecliptic sphere?][?], the existent, in a single measure, so that its motion would be uniform, without variation—then we would have no need to pray on its behalf. But because it is at one time less and at another time more, we therefore need to pray to the Creator, [may He be blessed,] that He increase the emanation upon us and upon all the existents likewise.

And therefore David, peace be upon him, said: **"and take not Your holy spirit from me"** [ורוח קדשך אל תקח ממני — Tehillim 51:13]; and there are many [verses] like it about this. For in it is all good, and from it perfect [good][?]; and therefore [Scripture] said: **"May the glory of the LORD endure forever; may the LORD rejoice in His works"** [יהי כבוד ה' לעולם ישמח ה' במעשיו — Tehillim 104:31]—that

is to say, when this light is emanated forever, then the LORD rejoices in His works.

And you should know from this[?] that [this light] is not upon all the existents in a single measure, nor in a single proportion, but rather it is upon each one according to the nature of its own light[?]—as we wrote at the end of the Eleventh Treatise, which is Treatise Lamed of the Book of Divine Wisdom, which is Aristotle's [= Metaphysics Book Λ (Lambda)].

And it is known[?] that [the case of][?] that which is generated from putrefactions, without male and female—up to the highest degree [arising] from it, namely man—resembles in its process the semen[?]. For just as the semen[?] is what [quickens][?] the [heart][?], and forms from the good portion the [noblest organ][?], and by it makes the heart; and from the remainder, which is not pure, it forms from it the rest of the limbs, each and every limb as befits it in due [order][?], until [the body] is completed from the binding—whence come the bones and the [tendons][?]—so likewise resembles the working of the light[?]. Here[?] it binds[?] its matter, which is form; and they are [imprinted][?] [...][?] from the good and choice portion—[which is] heaven—and from the motions of the light[?] [...][?] the heaven and the earth are one; and all the existents, each one according to [its portion][?]. Therefore [Scripture] called it "light," for it is the first [purity][?]; and when portion by portion of this [substrate][?] begins [to take shape] by this [purity][?], all the existents were made—which are the heaven with its offspring. And this [purity][?] is itself that which sets all the existents in motion; and their motions—whence do they have them?[?] And therefore [Scripture] said: **"and the earth was formless and void"** [והארץ היתה תהו ובהו — Bereishis 1:2]—that is to say, that the light of the existents[?] [...][?].

[f. 70r]

after they were [hewn out][?] and [...][?] were not gathered[?] thereby—[so that] just as this light came to be a substance[?] [...][?], and the light was [borne][?] within them and was gathered[?] into them and grew strong within them, from which[?] [each thing] is made and completed. And this is close[?]—that is to say, [the sense of] the completion and the [ripening][?]; and they change[?] [...][?] in our language. It is found that "[He made] good"[?] is a designation for the finished[?] and the completed[?] state of its light[?] [...][?] and its [ripening][?]. And after this light was gathered[?] in its entirety and in its whole[?]—[namely] the [totality][?], which are the heaven and the earth—and was worked[?] into their portions, and there was made thereby a [quality][?] in each one of them, the things fit[?] to be found in it [came to be]. And thus [it is said]: **"let the earth**

bring forth" [תוצא הארץ — Bereishis 1:24], **"and luminaries in the firmament of the heaven"** [ומאורות ברקיע השמים — cf. Bereishis 1:14], **"let the earth sprout"** [ותדשא הארץ — cf. Bereishis 1:11] [...][?].

[For] all of them arose[?] [...][?], and they will not be[?] at rest[?] [...][?] this light within them. And the action of this light in each part, in its works, is—as we said—not equal[?]. And therefore [...][?].

הקדמה — Premise. Every thing that has a quality, and stands in that quality at its utmost limit and determination[?], with nothing else surpassing it in that quality—one does not predicate [a superlative] of it in that quality, because [it is stated] only by relation[?] [...][?]. For those existents whose limit[?] [is such] that they have of that quality [only in degree], they are bounded[?] in that quality [...] [?]—not [absolutely] in [the thing's] own measure. [It is] toward the extreme[?].

For example, the heat of fire: it is itself its own utmost and determination[?], with nothing above it in heat[?]. Therefore one does not say of it that [the fire] is "burning-hot"[?] toward heat[?]; rather one says of it only "hot." And also we do not say of it "very hot," since there is nothing else hotter than it. But we do say of its part[?] that it is "very hot," because there is [something] hotter than it, above it in that quality[?].

Therefore, [consider] how—when He made His works complete[?] for all the existents—[Scripture] said: **"and behold, it was very good"** [והנה טוב מאד — Bereishis 1:31]. It did not say "good" alone, but "very good." It added the word "very" for [substantive] meaning, not for eloquence[?] [...][?] (interlinear: נאמ' ("it is said" [?))] [...][?] just as one adds further[?] [...][?].

[Continuation of the הקדמה (Premise) on "very good" — f. 70v]

For had [Scripture] said "and it acquired good" alone, it would have seemed that they possessed [only a partial] completion — [whereas "very good" means] the telos beyond which there is no [further] telos, which is the complete perfection [השלמות הגמורה]. It is for this reason that [Scripture] added "very," so it seems: that is to say, do not suppose that there is [in them] only the good [?] ... the complete perfection; rather, [Scripture] pronounces them "complete" [?] in themselves [?] — and this is the general rule [הכלל]. For the true good is not [called good] except [?] ... For it says "The LORD is good to all" [טוב יי לכל — Tehillim 145:9]; but what [Scripture] says [of the works], and what it means [?] by

"for [it was] good," is [?] … [it] appears that "[it was] good," [and even] "very good," [pertains] to its rank, in that it is complete [?].

For [God] knows [?] that He did good with us [?]; and for what reason did [Scripture] say, concerning the individual made-things, [only] "that [it was] good," but concerning their totality "very good"? [It said so] for two reasons. The first: because the whole is complete [?] … [and the lack] would be recognizable [?] the more from its parts [were any part missing]. And further: because it is impossible for any [single] existent [?] and [any single] made-thing [?] to stand [firm] by itself in every respect [?] — [each] made-thing [subsisting] upon that of which it is made [?]. For had [God] made [?] … but a single living species alone, it would not have been complete except as one species [?] — rather [He made] what is possible [in its fullness]. And likewise, [had there been] the heavens alone, it would be impossible for them to subsist [?], and [so too were there] the earth [alone]; for everything that is complete [?] … [is] a possible-effect [?], [and] it is impossible for it to subsist of itself [?] …

[it is] as [something] complete and appears so to every beholder [?] … [God?] … "very [good]" — [they are] all together [יחדו], and not [merely] for the sake of [?] … as it is stated in Tractate [כדאיתא במסכת — the tractate name is not legible][?]. Therefore every existent [?], since it was set forth [?] as [one of] His works, is [first] in potentiality [בכח]; and upon all these made-things He calls [?] His works "in actuality" [בפועל] … [He] indicated [?] in it [?] … "good," and at its head [?] … [reading of this clause not secure][?]. And in the end [ובסוף] I will explain that this "good" is "mixed" [מעורב] —

פרק [Chapter]

[Red ink header: פרק — the rubric-word alone, in enlarged red script mid-page; the words following it are in black]

this is a fixed name [שם קבוע][?] … [the opening clauses of this chapter are compressed cursive; the recoverable thread:] … one holds it [?] … [and it] endures [?] … [reading uncertain] … it will be explained [יתבאר][?]. But I say, in its [proper] place, that it is "mixed" [מעורב] [in the terms] "creation" [בריאה], "formation" [יצירה], [and] "making" [עשייה]; and the connection [?] between … the general principle … is that it is "mixed" [?]; for the term "[creation]" [?] — like [the term] "creation" [כבריאה] — points to [?] … a thing that has meaning [?] … [end-of-page phrase: "the existence of a thing has meaning" — reading not secure][?].

[f. 71r]

and it was not disclosed [נגלה] from the beginning, nor was it decreed [into being] at all. And this is the difference [ההפרש] between us and Aristotle: for [in his view] the matter [הענין] is one of the first principles [הראשיות], as he says in the first book of the *Sefer ha-Shema ha-Tiv'i* [ספר השמע הטבעי — Aristotle's *Physics*], by Aristotle — for he says that this matter [הענין] is the [subject] which, whenever [it takes on] form [?] … Rather [in his view] the first-disclosed [prime matter] [הנגלה הראשון] is that which stands prepared [מוכן], always, for [receiving] the forms [הצורות] — and it is like the ready wax [הדונג הנכון] [that is fit] to receive the form of the seal [צורת החותם]; and this disclosed [matter] is not [itself] a power [כח] but is acted upon [נפעל].

But we say that this matter [הענין] has no complete reality [אין ממש גמור], and that there was no existent [יש] that preceded [it] — no first-disclosed [prime matter]. Rather, HaKadosh Baruch Hu created the disclosed [matter] [הנגלה] and the form [הצורה], and the joining [המחבר][?] of the one with the other, as is fitting. Therefore He made all this by His will, as we have explained.

And [as for] this first-disclosed [thing] that was created — if we say that it is [something] prepared [מוכן] to receive the forms [?], and that it is [therefore] simple [?], putting off [יפשוט] [one] form and always clothing itself in another [וילבש אחרת], [such that] it does not cease [?] — [we may say so only] provided that the form [/the matter itself][?] was [also] created, as we have explained. And even if one should say that this disclosed [matter] has [some] likeness of a form [דמות צורה][?] … [that it is] a power [כח][?] in which [something] is written [?], and the piece [?] … as in the working [?] of nature [?][…][?] — [still,] there is in this no clear premise [אין בזה הקדמה ברורה]. And this [?] … is what is called [?] the "disclosed" [matter] … [several exemplary words here are not securely legible: "formation" [יצירה][?], "like a star / sphere" [ככוכב][?], "God" [אלהים][?], "ten" [עשר][?]] … the [matter of the] earth [האדמה]; and here I would disclose [?] the portion [that comes] from the first-disclosed [matter], according to the plain sense [כפשט] [when it takes on] the form "earth" [צורת אדמה] and clothes itself [afterward] in the form "man" [צורת אדם][?].

Behold, "the making" [?] — [that of] which we said [that] it is a "creation" [?], as we have explained — is not itself a "formation" [יצירה][?]; for [as] Aristotle would say [?] … [reading uncertain] … And we may [also] say that this "making" [?] is that of which [Scripture] said [?] … upon the creation [?], and it is a "formation" [יצירה]; [it is] said [?] of the heavens [?] and the earth [?] … "God said" [?] … and

there is [a term] that points to the artificial [made] things [?]; and "and He made" [?] [points] to the composition [?] … and [these are] disclosed [?] together [יחד].

פרק [Chapter]

[Red ink header: פרק — the rubric-word alone, in enlarged red script; the scriptural lemma and its commentary follow in black]

"…the heaven and the earth" [את השמים ואת הארץ — Bereishis 1:1]. The word **את** amplifies [מרבה] — [it signals] amplification [ריבוי], always, in every place [?], as is appropriate [?] … [when God made them][?], it was fitting [?] in each of them [?] … to set in order [לתקן][?] … [reading uncertain] … [the meaning is] "from the [prime] matter" [מן המקום][?] — that is to say, the disclosed [matter] of the heavens and the disclosed [matter] of the earth, which at first was disclosed without form; and afterward there came forth into the light [יצא לאור] that which is the form — [the form] to be kindled within them [להתלקח בהן], as we have explained. And since [the form] came into them [?], as [when] one calls [?] … there is a "making" [עשיה][?], "and there was … every [king / thing]" [?] — that is to say [כלומר] …

[The text breaks off here, mid-sentence, at the foot of the verso. The reading of the final line is not secure.]

[Pencil foliation, lower outer corner: "71"]

for it arose in His thought [?] that now, at the first [these should come to be], and only afterward "and it was so." These were [made] now [?]. He said, "the Creator [בורא] of the curtain [היריעה]" — that is, the heavens are the curtain and the earth is the curtain [?], for there are no other heavens and no other earth except these. And so Aristotle explained.

פרק

> וְהָיוּ לִמְאוֹרֹת [בִּרְקִיעַ] הַשָּׁמַיִם לְהָאִיר עַל הָאָרֶץ — "And let them be for lights in the firmament of the heaven, to give light upon the earth" (Bereishis 1:15).

["and fowl that fly above the earth," עוף השמים]: [the point is] that they illuminate with their light the places that were fixed there at the first. That is to say, [the stars] do not move [of themselves], and so too the sphere [הגלגל] [carries them] in its motion; rather, it is the sphere that moves, and they move within it and along with it, like a nail fixed in a ship. But if we were to say that they move in their own place — [Aramaic: כנגרא ד…, "like a carpenter …"] [?] — as they said [?], this

cannot be, since not one of the masters of astronomy, nor a single one of the philosophers, ever mentioned such a motion.

Third [point]: as to his saying "to give light upon the earth" — that is, that the soul [נפש] of the heavens is [active] [?], and it does not conceal the light of the sun and the stars. And it becomes evident from the eclipses [הלקוֹת] that the body of the moon is not translucent like the body of the sphere; and likewise we may say of the other planets that [each] is denser [עב] than the body of the sphere, and for that reason the lower one conceals the upper light when they are in conjunction.

Fourth [point]: as to his saying "and let them be for lights" [למאורֹת] — it is written defective, lacking the final *vav* — a hint that [?]. [At] the moment of the conjunction [המולד] it does not give light upon the earth, for [only] the light of the upper luminary [is present]; but the moon does not illuminate the earth at all at that time, because all its light is [directed] above — a hint that the light of the moon is drawn [from elsewhere and is not its own].

פרק

See how it says "made" [עשה]: "and God made" [ויעש אלהים], and [then] it says "and He created" [ויברא]. [Concerning] its creation [as one of] the six [days of] making, He said "made" [in one form], and [concerning] the term "creation" He spoke in the singular; and in "and He created" [ויברא] he noted the word *et* [את], which is all-inclusive [?], [joining the language of] formation [יצירה] with making [עשה].

And the action [lay] in the matter [הדבר], since in his account of the making he mentioned both prime matter [גלם] and forms [צורות] [?]. The form [is one thing], and the [substrate that receives] form is the matter [הגלם]; therefore he used "making" [עשייה] in the plural. But in mentioning [the making of] man [האדם], who is form alone [?], ... the matter — that is, the material intellect [השכל החמרי] — [he spoke] in the singular, because it is the portion of the rational soul [הנפש הדברנית] that endures. And that is what Scripture says of him, "and He created":

> בְּצֶלֶם אֱלֹהִים בָּרָא אֹתוֹ — "in the image of God He created him" (Bereishis 1:27).

For the Holy One, blessed be He, is the intellect [השכל], the one who apprehends [המשכיל], and the intelligible [המושכל]; therefore it says of him "*et* ha-adam" [את האדם] — that is, the form of man — and the word *et* here [signifies] form, as we said, that *et* everywhere [indicates] a plurality [ריבוי], just as [it does] form.

Therefore, in the composition of man out of [matter] and prime matter [גלם] and their joining [together] [?], He said of him "let us make" [נעשה], for the term "making" [עשייה] points to this. But regarding the creation of the form He said of it "and He created" [ויברא], since it is not [something quarried / drawn from a substrate] [?]; and moreover it is impossible that … [there be here] the term "formation" [יצירה], as we said at the first — that [the term is] a designation [?] for the forms [?] of the luminaries upon the first prime matter [הגלם הראשון]. For the form [?] of the luminaries here is not the same one that was spoken of in the first treatise of the *Book of the Physics* [ספר השמע הטבעי, Aristotle's *Physica*]. Therefore, for the composition of form together with matter [he used] [?] the terms "making" [עשייה] and "creation" [בריאה], and for the form alone [the term] "creation" [בריאה]. What we have said here — that he set down the form in the masculine and the matter in the feminine — Plato [אפלטון] did likewise; and so too they laid it down in the book of allegory [ספר משל] [?], which calls the form "father" and the matter "mother," just as … [?].

פרק

He used, concerning the firmament and the luminaries, the term "making" [עשייה]:

> וַיַּעַשׂ אֱלֹהִים אֶת הָרָקִיעַ — "and God made the firmament" (Bereishis 1:7);
>
> וַיַּעַשׂ אֱלֹהִים אֶת שְׁנֵי הַמְּאֹרֹת — "and God made the two great lights" (Bereishis 1:16),

for they are equal [שוין] with respect to the [prime] matter [הגלם]; and the [prime] matter was created first. And he said of both of them "and He created" [ויברא], because they are the beginning of … [?].

And [as for the fact] that the prime matter [הגלם] out of which they were made already existed [?] — [?] … it was created at the first, [and so] "and He created" is used in the term of "creation."

פרק [?]

[See] how it says "and He made" [ויעש] … because He made the … that illuminates [?], which He calls [?] …; because it is in the air, therefore there was compounded [נתרכבה] within it this … [?]. And therefore He said "made" [עשה], and did not say of it "created" [ברא], because that thing which is spoken of in the term "creation" [בריאה] is the intellect [השכל].

[Remainder of the leaf blank; pencil foliation "72" in the lower outer margin.]

is not to be likened [?]. He therefore said "made" [עשה] — meaning the composition of the form within the prime matter [gelem]. Yet it would have been better for [the form] to remain as its own form in its own place, and not be composed within this prime matter — as our Rabbis, of blessed memory, said: "It would have been better for a man not to have been created [than to have been created]" (Eruvin 13b). And Solomon, peace be upon him, said [?] ... "and better than both of them is he who has not yet come to be":

> וְטוֹב מִשְּׁנֵיהֶם אֵת אֲשֶׁר עֲדֶן לֹא הָיָה — "and better than both of them is he who has not yet been" (Kohelet 4:3).

For a form that has not yet been composed with the prime matter is better than one that was composed and afterward separated. And [Scripture] said "and I praised" [ושבח]: the separation [is praised] more than the time of the joining — that is what it means by "and I praised" (cf. Kohelet 4:2); and it also praised [?] ... more than [?], as it said "and better than both of them" (Kohelet 4:3).

For the soul, before its composition in a body, is like a king seated [upon his throne]; and in its composition within the body it is like a king bound in chains [אסור בזיקים]. ... [several clauses only partly legible] ... to imprison [?] ... he loosed [?] its dominion, and [?] [?].

There is a doubt [ספק] ... the king [?] ... [the soul] at first [is better] than in the intermediate [state] [?], for at first it does not [?] ... and [Scripture] said "and it is good" [?]. And it is fitting [?] ... [as] they said [?] ... that the first [state] is superior [to the second] [?]. And [Scripture] already said:

> וַיַּרְא אֱלֹהִים אֶת כָּל אֲשֶׁר עָשָׂה וְהִנֵּה טוֹב מְאֹד — "And God saw everything that He had made, and behold, it was very good" (Bereishis 1:31).

One may say [this refers to] the first soul, which is more elevated than the second; [Scripture] praised [it] [?] ... [saying] that the first is more elevated and other than its [later] station [?].

[it is called] "good" [?] ... for we know its measure, its beauty, and its worth only after [?] its removal from [the body] and its return to it. And accordingly the souls of the pious [?] are seen to return to their first place [?]. And accordingly [Scripture] said "also" [גם] [?] — a term of praise; that is, [only] after [the soul] has undergone the return [to the body?] and come to know its worth [?] ... for the youth does not know [its worth] except when he grows up [כי לא ידע הנער כי אם בגדלו]. And at first it used a term of "good" [?] — meaning that by its own nature it is good, [even] before I reckon it good [?] ...

We said in the previous chapter that, even though [X] is the form, "likeness" [דמות, demut] is the prime matter [gelem]. And if the phrase troubles you —

> בִּדְמוּת אֱלֹהִים עָשָׂה אֹתוֹ — "in the likeness of God He made him" (Bereishis 5:1) —

one may say that "likeness" [demut] here is like your saying "a servant of God" [עבד אלהים]; that is, [as if] the likeness were derived [?] on account of the first prime matter. That is to say, a man [is composed of] many prime-matters, particular to each [?], greater and lesser [?]; but [in essence] he is [of] the first prime matter, and he is the prime matter of the earth, as we explained regarding "these [are the generations] of the earth" [?] — that is, [something] small [?] within the earth: elements and sources [יסודות ומקורות] [?] and ... [?]. For they are compounded [נתרכבו] into one prime matter, like a man [composed] of bones, flesh [?], sinews, skin [?], hair, and [?], out of which the [body] is compounded as one prime matter — and it is the [?].

To join [?] ... what the verse raised [?] ... and it is [?] [saying] that each of the creatures of the earth [מכרואי האדמה] has a prime matter particular to it [?]. [Rather,] there is but one first prime matter; that is what it says:

> הַכֹּל הָיָה מִן הֶעָפָר וְהַכֹּל שָׁב אֶל הֶעָפָר — "all came from the dust, and all returns to the dust" (Kohelet 3:20).

that there are great ranks in the receptivity of the creatures for [receiving] action: [?] — there is one that receives from it a rank like the living thing that does not speak [i.e., the non-rational animal]; and [?] their [?] is not equal, and there are among them many ranks; and there are also among them one superiority [יתרון אחד], in potentiality and in actuality [בכח ובפעל].

And concerning what it said, "and one spirit [רוח] for all," it is written: the form is one for all — for the servant [?] and for [?], for the good and for the evil, for the impure and for the pure — except that it said "it will be seen according to [its] deed" [?] ... and it will not be seen but will make a world [?], and it goes to [?] for eternal abhorrence [דראון עולם] (cf. Daniel 12:2) [?]. [?] the great [?] is found [?] like the man [?]; and it [?] to them, and its form comes forth from potentiality into actuality [מן כח אל הפעל] [?].

עיין [Consideration]

Let us return to our subject. See how here it mentioned the prime matter [gelem] alone, without the form; and since this act [?] — as it said, "the generations"

[התולדות] [?] — pertains to the [?] of the prime matter, not to the [?] of the form, [Scripture] therefore mentioned [it] in this verse, whose opening is:

> זֶה סֵפֶר תּוֹלְדֹת אָדָם — "This is the book of the generations of man" (Bereishis 5:1).

But there is [?] [chaos?] [?] in respect of what man is in form alone [?]. And therefore it said:

> וַיִּקְרָא אֶת שְׁמָם אָדָם בְּיוֹם הִבָּרְאָם — "and He called their name Man [Adam] in the day when they were created" (Bereishis 5:2).

And of the prime matter it said "He made him" [עשה אותו]; and that is the composition [of form with matter], as we said at the first. And why did [Scripture] repeat [?]:

> בְּצֶלֶם אֱלֹהִים — "in the image of God" (cf. Bereishis 5:1)?

There is an argument [that] it is not fitting to [?], and the discerning will discern [?] (interlinear: האחד [?])] — except this "making" [עשה] that we mentioned; and it [?] …

[Recto — f. 74r. Continuation from the prior leaf — the "Consider" (עיין) note begun there, on why Scripture mentions the prime matter (gelem):]

this human form stands at the third level of the separate forms [הצורות הנבדלות] [?].

עיין [Consider]

Consider how [Scripture] said **"in our image, according to our likeness"** [בצלמנו כדמותנו — cf. Bereishis 1:26] and did not vary [the phrasing]: [it set] a bet [with "image"] and a kaf [with "likeness"] [?] … [the connective clauses that follow — turning on the distinction between "image" and "likeness" — are at the ductus floor and are read only in part] … [the image], which is of the spiritual world [העולם הרוחני], He joined [סמכה] to the world, which is the [holy / the form] [?]; and likewise the kaf, which is of the separate world [העולם הנפרד], He joined to [the likeness] [?], as we explained in the Gate of the Interpretation of the Letters [בשער פירוש האותיות] [?], concerning [the Name] Shaddai [שדי] [?], may He be exalted.

עיין [Consider]

Consider how [Scripture] used the expression **"since the day that God created man upon the earth"** [למן היום אשר ברא אלהים אדם על הארץ — Devarim 4:32]. It did not say "the man" [את האדם] [?], nor did it say "made" [עשה] — [it said "created"] — nor did it say "in the earth" [בארץ, with a bet]. This [wording] comprehends three matters. First, that this man is composed of matter and form [מורכב מגלם וצורה], and this is his totality [כללותו]; and for that reason it did not say "the [man]" [?] … For that by which He "made" it is the formation [היצירה], not the matter [הגלם]; and therefore they said [?] that the term "created" [ברא] indicates the form [הצורה], not the matter — [and third] [?]: for from that holy form [it is fit] to rule in rank [לשלוט במעלה] and to lay hold of spirituality [ולאחוז ברוחאניות]. And therefore it said "upon the earth."

And it said in the verse [?] … "for He created … man upon the earth" [?], for the men of that generation had let their desire sink [שקעה] into the earthly desires [בתאוות האדמיות] and would not consent to believe [להאמין] in the spirituality for whose sake they were created [שבעבורם נבראו]; and therefore [?]. And in this verse, "since the day that God created" [Devarim 4:32], [Scripture] concealed [סתר] the one [matter], [namely] that the [creative] intention was for its sake [שהיתה הכונה בעבורו]; and therefore it said "upon the earth."

[Scripture] said **"in our image, according to our likeness"** [בצלמנו כדמותנו] explicitly [בפירוש], and afterward [?] the form is one in its essence [אחת בעצמה]; and therefore it attached to it [סמך לו] [a bet, and not a kaf] [?]. But the general rule [is that] wherever resemblance [הדמיון] is possible — that this resembles that in [some] particular [בפרט], and is not literally one [אחד ממש] — [there Scripture uses a kaf]; and therefore it said "according to our likeness" with a kaf [כדמותנו בכ״ף]. And as for what we say [in the wedding blessing] [?] — **"who formed man in His image, in the image of the likeness of [His form]"** [אשר יצר את האדם בצלמו בצלם דמות … — birkat nisu'in] [?] — the point of "in His image, the first" is: that is to say, in the image of the Holy One, blessed be He [של הקב״ה]; that is, the form — which is the light that the Holy One emanated [האור שהאציל הקב״ה] upon all His creatures [על כל בריאיו]. And the interpretation [ופירוש] of "in the image of the likeness [of His form]" —

And [with this] the human likeness [דמות האנושי] is completed [ונשלם]. ·

[Verso — f. 74v]

— that is to say, this form of man is entangled [מסובכת] with matter [בגלם]; and therefore, in [respect of] matter, it is [only] a likeness [דמות] and not a separate form [צורה נבדלת]. And because of its entanglement [סיבוכה] with matter it became possible [for man] to beget [להוליד]. That is what they said: **"and He established for him, from him, an everlasting edifice"** [והתקין לו ממנו בנין עדי עד — birkat nisu'in] [?], and so forth.

This is the meaning of what it said, **"who gives breath to the people upon it"** [נותן נשמה לעם עליה — Yeshayahu 42:5]. The *neshamah* is the [rational / volitional] soul [הנפש הדברנית] [?] — the one of which it is said to "ascend," since such [souls rise] upward [למעלה]; and "spirit" [רוח] is a shared term [שם שותף]. But of the souls of the other living creatures [שאר החי] it is not fitting to say "upon it" [עליה]; and therefore it said **"and spirit to those who walk on it"** [ורוח להולכים בה — Yeshayahu 42:5]. And similar to it is [the sense of] "for He created … man upon the earth" [?]: for the souls of that generation were bestial [בהמיות], and therefore they went down to the earth [ירדו לארץ].

עיין [Consider]

Consider how [Scripture] said **"Surely as a mere image does man walk about"** [אך בצלם יתהלך איש — Tehillim 39:7]. It means, [by virtue of] the rational soul [הנפש הדברנית]; and consider how [Scripture] specified, in [describing] the motion of [?], that man, in the pursuit of the sciences [בדרישת החכמות], "walks about" [יתהלך]. That is what it said: **"and Enoch walked [with God]"** [ויתהלך חנוך — Bereishis 5:24]; **"when you walk about, it shall lead you"** [בהתהלכך תנחה אתך — Mishlei 6:22]; **"[Noah] walked [with God]"** [התהלך נח — Bereishis 6:9]; **"walk before Me"** [התהלך לפני — Bereishis 17:1]. But its [bodily] motion in other respects is [?], and so forth; and likewise the motion of the rest of the living creatures is not separate [אינה נבדלת]: "and spirit to those who walk on it" [Yeshayahu 42:5] … and [this] recurs often in Scripture [והרבה במקרא] [?].

And it emerges [ותראה] that the motion of the form [תנועת הצורה] is separate from the motion of matter [מתנועת הגלם]; and because of the [rational] essence [העצם] [?] … "walk about in the land" [התהלך בארץ — cf. Bereishis 13:17] — that is to say, [walking] in the pursuit of the deep [things] that are in the earth [?]. For we do not find that [Abraham] literally walked in the land [שהלך בארץ] to its length and to its breadth [לארכה ולרחבה — cf. Bereishis 13:17]; rather he sat [ישב] and did not walk. The whole [point] is what is said, **"and Abram moved his tent, and came and dwelt"** [ויאהל אברם ויבא וישב — Bereishis 13:18]. Therefore this "walking" [ההלוך] was its [the soul's] motion [?] — [seeking] the matter among existent things [בנמצאין] and through acts of understanding [ובתבונות] of the earth. And

this is impossible except through a settled dwelling [בישיבה], and [through] the stilling of the body [ופסקת הגוף] [?].

And it is that "he pitched his tent" [ויאהל] is like "one who dwells in tents" [יושב אהלים — cf. Bereishis 25:27], for the seeking-out [הדרישה] of the secrets of the things made [סודות הנעשין] — which is the matter of the soul [?]. Its [the soul's] need [?] is like the matter of seeking, relative to the body [בערך הגוף] [?]: for relative to the body [belongs] the motion of the body [תנועת הגוף] and the stilling [והפסקת] of the soul; and relative to the soul [ובערך הנפש] [?] ... And this is the drawing-out [?] of the sciences [החכמות]; [each] requires the motion of the soul [תנועת הנפש] and the stilling [וכשקט] of the body [הגוף] [?].

And as for what it said — **"for to you I will give it"** [כי לך אתננה — Bereishis 13:17] — it means: "I will give you knowledge and breadth of heart [דעת ורחב לב — cf. Melakhim I 5:9] to know the essence [/ the forms] of the things that are made [מהות הנעשין]."

[The lower half of the verso is blank parchment below this line.]

[Pencil foliation, lower outer corner: "74"]

and similar to it is "and he prepared" [?]; [it concerns] wisdom, not [mere] building [?]. And what is the reason [Scripture said] "he walks before" [Me]? Do not wonder at this: [those who] go to their [study] daily — if your desire does not go [after] the intention of his heart [?]. For by the nature of its diligence and intent it is a motion effected by nature, as it said [?] to plow the way [?]; and it did not turn aside [?]. Therefore [Scripture] did not use of it the expression *yehelekh* ["he walks"].

[?] the expression *yithalekh* ["walks about"] falls only upon one who [hopes/aspires], being discerning, to attain the [higher] degree [המעלה] — like **Enoch** [חנוך], and **Noah** [נח], and **Abraham** [אברהם], peace be upon them. And likewise for one occupied [האוסק?] with the ways [?] and their appearance [?], toward [the good?] by nature — of such a one too the expression *yehelekh* [?] is used.

But one who is found in his iniquity [?], doing evil [?] against [?] his Creator [הבורא?] — and [such men] are wise in their [own] eyes [?] — of them it says *yelekh* ["he goes"]. Therefore [Scripture] said, **"O house of Jacob, come and let us walk in the light of the LORD"** [בית יעקב לכו ונלכה באור ה' — Yeshayahu 2:5], and [continued], **"For You have forsaken Your people the house of Jacob, for they are filled from the east and are soothsayers like the Philistines, and**

they abound in the children of strangers" [כי נטשתה עמך בית יעקב כי מלאו מקדם ועננים כפלשתים ובילדי נכרים ישפיקו — Yeshayahu 2:6]. Therefore it did not use of them the expression *yithalekh*, for they are not yet upon the [right] way — until they walk and complete the path [?], [until] they ascend [שיתעלו?] from it, and afterward they will walk about [*yithalekhu*] upon an established way. And therefore it said, **"After the LORD your God you shall walk"** [אחרי ה' אלקיכם תלכו — Devarim 13:5], and did not use of it the expression *yithalekh*, because they are still [only approaching] the path of the [higher] degree [המעלה].

And [Scripture] said [that] the [Holy One?] was walking about [מתהלך] [?] — [where] "there was darkness" [?], and it was a holy darkness [מחשך קדוש]; and it was set among those who [?] before [?]. [?] a testimony [אזהרה?] upon [?]; **"and they heard the voice speaking"** [?] to us [cf. Bamidbar 7:89].

עיין ("Consider") — how it said [that man/Adam] walked about [מתהלך] in the Garden of Eden [בגן עדן]; rather, the Holy [One] [?] who [?]. It did not say "who created him," and mentioned him at another level [במעלה אחרת]; and [?] there is [?].

Its intent [?]: the portion of the place [מקום] where they walk about [המתהלכן] upon the way of the garden [?] is not the intellect [השכל] [?].

[Folio 75v. Top margin darkened by the mount; no running header visible. A small interlinear word appears above the first line: (interlinear: הרכבה ("composition / combination")). A brief marginal note stands in the upper outer corner; its text is not securely legible — [Margin: brief note, ~one word; further reading requires further verification].]

in the sense of what we do today. Therefore the law was fitting [?] for that [state of] long life [אורך ימים]. And [as for] one who eats [?] — [what] he ate [?] was upon them [?], and he was [?]. And [the law] gives to the eater that his occupation [עסקו] be more with the needs of the body [בצרכי הגוף], not with the needs of the soul [בצרכי הנפש] — such as we do today. Therefore it said, **"Of every tree of the garden you may surely eat"** [מכל עץ הגן אכל תאכל — Bereishis 2:16]: for the law does not require the eater [?] to be occupied more with bodily matters [בעסקי הגוף]; for they [the trees] were easy in their making [קלים בעשייתם] [and yielded] much [הרבה], and he did not need [?] to spend his days [?] in labor [?] upon those trees [אילנות], but only a very little [דבר מועט מאד] — just as the manna [המן] required nothing but its gathering [לקיטתו] alone. And perhaps those trees were even easier [?].

But the [tree] they called the **Tree of Knowledge** [עץ הדעת] — this is what our Rabbis, of blessed memory, said [?]: it was wheat [זרע חטה]. For it [would] require [?] labor [עסק] [?] and toil [ועמל], much [?], as it said, **"[By the sweat of your brow] you shall eat bread"** [תאכל לחם (בזעת אפיך) — Bereishis 3:19]. And now he must take pains [בהטרח] to have great labor [עסק רב] in it, while it [yields] the little [?] — bread. [This is] labor in the affairs of the soul [עסק בעסקי הנפש]. And the parable is like what they said, of blessed memory: **"The Torah was expounded only for those who ate the manna"** [לא נתנה תורה לדרוש אלא לאוכלי המן — cf. Mekhilta/Tanchuma, Beshalach]. And so it is pure [נקיה] for man, as it was pure [שקיה] for our fathers with the manna [במן]; and **"our soul loathes [this worthless bread]"** [ונפשנו קצה (בלחם הקלקל) — Bamidbar 21:5] — the corrupt [/ worthless] images [?]. Therefore they called it a tree mixed of good and evil [עץ מעורב מטוב ורע].

And as for what it said, **"these gods"** [אלה (אלהים)] — "these" here [comes] to encompass the soul [לרבות הנפש]: "you shall not eat" [לא תאכל], as we said. And had [Scripture] said "Adam," [?] it would indicate the soul, and would gather [?] together. And it said **"these Elohim,"** that is to say [?] that this place [המקום] was [?] planted before it was planted [?] alone [בלבד]. Therefore we explained "these" [אלה] as said in **"And God created man"** [ויברא אלקים את האדם — cf. Bereishis 1:27], to encompass the intellect [לרבות השכל]. And we explained it here, that is, "the plant [הנטע]": for man is composite [מורכב] of these three things — intellect and soul and body [שכל ונפש וגוף]. And it indicates [?] the body and the craft [?], which [?] man; rather [it is said] of the intellect [על השכל], and not of the soul [ולא על הנפש], [nor?] of the body [על הגוף].

From here [you understand] why they called its way — the tree — the "Tree of Knowledge": for the expression "knowledge" [דעת] is said with respect to good [and evil] [על טוב (ורע)], [namely] man's occupation in the affairs of [worldly] life alone [בעסקי חיים בלבד], as I said; and [as it is written,] **"and by knowledge the chambers are filled"** [ובדעת חדרים ימלאו — Mishlei 24:4].

And you should know [?] that the assembly [/ gathering] [?] for eating [לאכול] from it [ממנו] increases [יוסיף] [?] hunger [רעב]; and you shall see what they said, of blessed memory [?], [in?] [?] — a matter [?] of great things [דברים גדולים], as you see [כראיתה] in the tractate [?] [Bava] Metzia [?]: an act [מעשה] concerning [?] the [?], and concerning the [?], and concerning [?], and concerning the harmful [?] ones [המזיקין]; and [?] of wisdom [חכמה] [?] and [?] for purity [לטהור], and for study [ולתלמד], and many [ורבים] heard [שמעו] and learned [ותלמדו] [?] — and there is no [?] level above [?] [?].

[Lower portion of the leaf: pencil foliation, lower outer corner, "75". No further text on the leaf.]

[Marginal/interlinear keyword, upper area of p. 169, with supralinear dots: "מעים" / "שמעים" [?] — verbatim; function undetermined (probably a keyword tied to the "bowels/Shema" passage that follows), reported not as a running header.]

[the morning meal] endears him to his wife so that he does not desire [מתחזק [?]] another woman, and it kills the louse in the bowels [והורגת כנה שבבני מעים]. And some say [ויש אומרים]: it also brings in love and drives out jealousy [מכנסת אהבה ומוציאה קנאה].

And further they said, in the tractate [במסכת בבא קמא [?] — but the derashot are those of Bavli Bava Metzia 107b]: **"and you shall serve [the LORD] your God"** [ועבדתם אותו (את ה') אלקיכם — Shemos 23:25] — this is the recitation of the Shema and the Prayer; **"and He will bless your bread and your water"** [וברך את לחמך ואת מימיך — Shemos 23:25] — this is bread with salt and a jug of water; from here onward, **"and I will remove sickness from your midst"** [והסירותי מחלה מקרבך — Shemos 23:25]. "Sickness" [מחלה] — this is the gall [מרה]. And why is it called "sickness"? Because there is a total of eighty-three [שמונים ושלשה] kinds of illness, and all of them a morning [meal of] bread with salt and a jug of water nullifies.

At the end of the [creation] chapter [it is written]: **"And let them be for lights [in the firmament of the heaven to give light upon the earth]"** [והיו למאורות — Bereishis 1:15]. And why was this stated [שאל [?]] and [then] set aside [ובטלה [?]]? It is not on account of the [giving of] light, for it has already said "to give light" [להאיר]; rather, because there are stars that hold dominion by day, such as the Sun, Jupiter [צדק], and Saturn [שבתאי]; and there are those that rule by night, namely the Moon, Mars [מאדים], and Venus [נוגה]; and Mercury [כוכב חמה] is a partner [שותף] — if it is [with a diurnal planet] it rules by day, and [if with a nocturnal one] it rules by night; and some of them rule by day [ויש שלהם מושל ביום [?]].

"And the heavens and the earth were finished" [ויכלו השמים והארץ — Bereishis 2:1]. **"And all their host"** [וכל צבאם — Bereishis 2:1] — [Scripture] said "and all their host" in the singular, and not "all their hosts," yet it referred [it] in the language of a row [שורה [?]] to both the heavens and the earth. And what is the reason? Because everything that is in the earth has one thing in the heavens corresponding to it. How so? Just as there are seven mineral sources [מקורות] in

the earth, so correspondingly there are the seven planets: gold to the Sun, silver to the Moon, iron to Mars, tin to Jupiter, copper to Venus, lead to Saturn, and quicksilver [כסף חי] to Mercury. And the remaining sources, whose number we do not know, correspond to the fixed stars.

And there are [things] corresponding to the living creatures [החיים] and the plants [והצמחים] — [what is alluded to [?] in [?] one, in [?] Shaddai [?] — text uncertain]. And likewise there are [things] corresponding to our four elements, but [belonging to] other natures [בעלי תולדות אחרים]: the waters [and] fire, a little [מעט] toward the firmament, corresponding to [את [?]] the water; and likewise there is fire and air and [a thing [דבר?]] that corresponds to earth [אדמה]. But they do not [have?] the substance of those according to its [own?] nature [עצם אותן כטבעו [?]], and they are not of one kind, nor of [?] one [thing]; rather, [Scripture] applied to them the names [את השמות [?]] by way of [?] alloying [והתכות [?]] alone.

Consider [ועיין] how it said "and all their host" — from the four elements alone: it hinted that all of this — its host — is comprised [נכלל [?]] in four things: elements [יסודות], [mineral] sources [מקורות], plants [צמחים], and the kinds of living creatures [מיני החיים].

Consider [ועיין] what our Rabbis, of blessed memory, said: "The heavens [שמים] — fire and water [אש ומים]" [cf. Bavli Chagigah 12a] — this teaches that the Holy One, blessed be He, [brought them and] fused [ותרפן = וטרפן [?]] one with the other and made of them the firmament [רקיע].

If you understand this statement according to its plain sense, it is not [?] [שעות [?]] — and because the Torah [?] — for the nature of that fire and water is distinct [מובדל] in every nature [?]. Do you not see that, before Aristotle [ארסטו], there were some whose opinion was that the stars are of fire; and moreover, the light [אורה [?]] of the fire above is not a single nature, for the fire of which the Sun was made is not [the same as the fire] of the stars — which is the fire of which it is said [?] "from its midst" [מקרבו [?]], or [?] — as they said: "everything in the world, there is fire in them [אשות]" and so forth [וכו']. And if you interpret [תפרש] this concerning a single smoke [עשן [?]]…

But the truth is that this statement is a parable and a figure [משל ומליצה], and all of it was said because these two elements were still very [far apart [?]]: this one at the one extreme of coldness, and this one at the other extreme of heat; this one light and this one heavy; this one moist and this one dry. And when you mix two things that are contraries [נגדיים], an intermediate thing [דבר ממוצע] is produced

from them; and the more the two things are contraries, the more the mixture from them is intermediate and simple. Now fire was at the utmost extreme of heat and of lightness, and the water at the extreme of coldness, and they are heavy; therefore it is fitting that the [body [הגוף [?]]] made from the two of them be neither heavy nor light, neither hot nor cold, nor [?] [חקר [?]], neither moist nor dry at all — a thing that is intermediate among all the qualities [האיכויות], as Aristotle explained.

"These are the generations of the heavens and the earth when they were created" [אלה תולדות השמים והארץ בהבראם — Bereishis 2:4]. [Ptolemy [תלמי [?]] … the … [הנבט [?]] — the two words following the lemma are not securely legible.] … of them, and it is that which comes into being [הנברא [?]] — first from nothing [מאין], and afterward from it — **"in the day that the LORD God made earth and heaven"** [ביום עשות ה' אלקים ארץ ושמים — Bereishis 2:4], as we explained earlier; for **"He is God in heaven above [and on the earth beneath]"** [הוא האלקים בשמים ממעל — Devarim 4:39].

It is fitting that you know that [heaven?] cannot be [?] the meaning of "in the heavens" said thus [?]. One of the [senses [?]] that Aristotle mentioned is stated in the fourth [book] of the *Physics* [הרביעי מספר השמע הטבעי — Aristotle, *Physics* IV]: "in how many senses is [heaven [?]] said." For [it is] a matter [דבר] about which, God forbid [שחלילה], one should say [?], one; and [as for what] the Holy One, blessed be He, [is called "the Place"], it is because He is the place [מקום] and there is no place for Him [ואין … מקומו]. We have already explained, in the introduction to this book, the meaning [of it].

[The following lines toward the foot of p. 170 are in fainter ink and only partly legible; transcribed as far as the glyphs permit, with uncertain tokens flagged.]

they belong [הן/הם [?]] to the name "God" [אלקים] and to the name "the heavens [and] the earth," for it is on account of the three [things [?]] — completions [שלמות [?]]. And [Scripture] mentioned in this passage [בזו הפרשה] the language of growth [הצמיחה], the [?] [האויה [?]], for it is after [?]… first, and [?] Israel: what is your God [?] [מה אלהיך [?]]; and [?] it was [?] set in the mind [במחשבה] to say… And what more [is there] for their Creator [לבוראם [?]] in the labor of man [לעבודת האדם]; and therefore it is [?] plain that there is no [?]… in His deeds and works [במעשיו ומעשה [?]], that one should inquire [שיחקור [?]] on their account into the Creator [הבורא]… [יב [?] — a two-letter token at the line's end, not securely legible].

Judah ben Solomon HaKohen, Parma 2769 (NLI Ktiv), scribe Sasson ben Menashe. Sephardic semicursive. Continuing the exposition of the opening of Genesis; this opening turns to a homily on divine providence, reward, and the heavens' proclamation of God's glory (Psalms 8 and 19).

(The upper lines of this side are faded and hard to read; readings below are flagged where genuinely uncertain.)

Therefore he said: just as [His providence[?]] is in the heavens and in the heaven of heavens, so too [is it] in the earth and in all that is in it. That is to say [?], that His providence [השגחתו] does not extend only as far as the sphere of the moon [?]; and one who said [?] … that His providence reaches [even to the lowest[?]]. And what is [meant by] "[He rejoices / sports[?]] in the inhabited world of His earth" [בתבל ארצו…ותשע [?]] — [namely] over it alone, so that [?] … [?]; rather it is found [?] together with the plants that are in it [והצמחים שיש בה]. "And all that is in it" [וכל אשר בה] — you may [understand[?]] "and all that is in it" [to include[?]] every [creature[?]] … [several words faded and uncertain here].

"[that You[?]] repay [?] with kindness [חסד], **for You render to each man according to his deed**" [כי אתה תשלם לאיש כמעשהו] *(Tehillim 62:13)*. That is to say: out of His kindness, HaKadosh Baruch Hu's providence [requites each[?]] measure by measure [בשעורין[?]], until [He renders] to each man according to his deed. And accordingly he says [that He does[?]] kindness, justice [משפט], and righteousness [צדקה] — "justice" [meaning[?]] … that is to say, that out of the kindness which HaKadosh Baruch Hu [shows[?]] toward [?], [His providence[?]] is apportioned into justice and righteousness: since it was fitting to grant the righteous man his due [צדק לצדיק[?]], and since it was fitting [to impose] justice [where] justice [is due] [?].

A second interpretation [פירוש אחר]: [namely, that[?]] a man [is not compelled[?]] to commit a transgression … [if] he did it [?] … if he performed it, [there is[?]] good reward according to his deed [שכר טוב כמעשהו]. And let it not trouble you [to ask, regarding[?]] a deed [that seems slight[?]] … [why the punishment[?]] is severe [קשה]; for it means [that the effect[?]] falls upon the soul [הנפש] more than upon the deed [יותר ממעשה]. [If] he performed the act of a commandment [מעשה מצוה], they grant him reward according to the act of the commandment; and if he transgressed [?] … [and did not[?]] perform the deed [?], they [still[?]] grant him reward according to the act of the commandment; and if [he did[?]] transgress — [when[?]] his impulse [יצרו] overcame him [?] and he performed the deed — they grant him [?] … [the sense being[?]] that they do not [reckon[?]] it against him [merely[?]] according to his deed, [?] … for there is a further consideration [?],

that the stars are not [distinguished[?] נבחדים[?]] … [so that his impulse[?]] should not compel him — as we have explained further, in the [?] section [בחלק ה…] of this treatise [מזה המאמר], concerning **the luminaries and the ministers of the stars in their [planetary] hours** [במאורות ומשמשי הכוכבים בשעות של…].

[Red-ink / display heading] פרק — Chapter. It is written in the Book of Psalms [Psalm [?]]:

אֲדֹנֵינוּ מָה אַדִּיר שִׁמְךָ בְּכָל הָאָרֶץ אֲשֶׁר תְּנָה הוֹדְךָ עַל הַשָּׁמָיִם — "O LORD our Lord, how majestic is Your name in all the earth, You who have set Your glory above the heavens" *(Tehillim 8:2; the lemma-word* אדונינו *is written enlarged)*.

That is to say: because [His glory / providence[?]] rests first upon the heavens, and afterward [passes] from the heavens down upon the earth — therefore [Scripture says] "majestic is Your name in all the earth." And because that emanation [האצילות] is effected all the way down to the lowest [?], therefore there is in it a power over the [lower beings[?]] … so that [?] … it is fitting for the lowly ones [השפלים] and the nurslings [היונקים[?]] that [?] … their making be as [?].

And they thought in their mind [?] … [that this emanation descends[?]] to the seminal fluid [לשכבת זרע], and from the seminal fluid [?] … and afterward [comes] to be a possessor of a soul [בעל נפש], and to have intellect [שכל] … [several words uncertain] … until it [returns[?]] to the first nature [הטבע הראשונה]. And a sign [וסימן[?]] for [all[?]] this … [is[?]] "if there is [?] in the utterance of [?] …" [text uncertain] — [?] to destroy the enemy [לאבד האויב] and to take vengeance [ומתנקם]; "for there is no enemy" [כי אין אויב] and no [?] … as [we[?]] explained [?] … is it not [?] … "[?] Your name [?]" … [several words illegible].

הַשָּׁמַיִם מְסַפְּרִים כְּבוֹד אֵל וּמַעֲשֵׂה יָדָיו מַגִּיד הָרָקִיעַ — "The heavens declare the glory of God, and the firmament proclaims His handiwork" *(Tehillim 19:2; the lemma-word* השמים *is written enlarged)*.

The sense [ענין[?]] … [of] "declare" [מספרים] is not like the [sense[?]] mentioned [earlier[?]]; for [ordinary] "binding/connection" [הקשר[?]] is such that one does not [intend[?]] to make it known to another, whereas [here[?]] [it is[?]] that [the heavens[?]] proclaim [it[?]] so as to make it known to others. Therefore he said "the heavens declare the glory [of God]" — that is to say, [as with[?]] the world [?] that rests upon it first [rests[?]] "the glory of God," and this is [what is[?]] heard [as] "declaring." And afterward it is emanated [נאצל] from it upon the sphere [הגלגל], which is the firmament [הרקיע]; and the firmament tells [ויגד] us that same thing, as a matter accomplished in the [?] of the world. That is to say, that

all the [?] — or the things done in their midst, [their[?]] coming-to-be [and[?]] passing-away [?] and rest [והשקט[?]] — [are[?]] works [מלאכות] and changes [וחילופיהם[?]] that are nothing but an effect [מפעל] like the motion of the sphere [כתנועת הגלגל]; and the motion of the sphere is [?] because it [?] … the [being[?]] near [?] … [several words uncertain].

And he began to explain which [?] of these are [?], and said: **יוֹם לְיוֹם יַבִּיעַ אֹמֶר [וְלַיְלָה לְלַיְלָה יְחַוֶּה דָּעַת]** — "Day unto day pours forth speech, [and night unto night declares knowledge]" *(Tehillim 19:3)*. That is to say, the [daily[?]] motion [התנועה היומית] that encompasses [המקפת[?]] the uppermost sphere [הגלגל העליון]; and because [?] … the sphere [?] is not [?] … therefore [?], according to [the words of[?]] the ancients [קדמונים], who made the day [precede[?]] the night [?] … [and so] one day [?] is set in order [?] … and in writing [?], according to the ancients [כדברי קדמונים[?]].

(The remainder of the folio side is blank; a pencil folio number "77" appears in the lower outer margin.)

(Continuing the exposition of the Psalms "glory / emanation" verses from the prior folio. The commentary now runs through Tehillim 19:4–7 and then takes up Tehillim 36:6–12.)

[…and likewise[?]…] in this verse [he said]:

אֵין אֹמֶר וְאֵין דְּבָרִים בְּלִי נִשְׁמָע קוֹלָם — "There is no speech, there are no words, their voice is not heard" *(Tehillim 19:4)*.

That is to say: unlike the speech of human beings, whose voice is heard [by the ear]…

בְּכָל הָאָרֶץ יָצָא קַוָּם — "Their line goes out through all the earth" *(Tehillim 19:5)*. The word קַוָּם ("their line") is from the root קו ("measuring-cord/line"); that is, their bound[?] goes out through all the earth, for from [them][?] one comes to know the length of the regions and their breadth. The sun and the moon[?]… [?]… and from them is known the measurement of the earth and the variation of the days[?]… in all the dwellings[?]. Moreover, each and every region[?] that is illumined[?]… facing it, is known from the firmament, and [something rests?] over it continually, revolving over it and not over any other place. Therefore each and every place of the earth is distinguished [from another][?], such that no [one place?] is confused with another — as [Ptolemy said[?]] in the Book of Ptolemy, in the Book of the Four Treatises [Tetrabiblos].

לַשֶּׁמֶשׁ שָׂם אׇהֶל בָּהֶם — "In them He has set a tent for the sun" *(Tehillim 19:5)*. The word "tent" here means a dwelling, like a tent [to dwell in]; for the orb of the sun is fixed[?] within the [motion of[?]] the sphere, as we said.

לָרוּץ אׇרַח [יָשִׂישׂ כְּגִבּוֹר] — "[it rejoices like a hero] to run its course" *(Tehillim 19:6)*. That is to say, like the nature of the sun, which begins from its allotted portion, the point of the head of Aries — which is the house of [its rising / its light] [?] — and therefore he called it "its canopy" (chuppah) [as in "like a bridegroom coming forth from his canopy," Tehillim 19:6]. Thus the sage R. Avraham ibn Ezra, of blessed memory *(ז"ל)*, explained it... until [the sun] returns to it.

מִקְצֵה הַשָּׁמַיִם מוֹצָאוֹ וּתְקוּפָתוֹ עַל קְצוֹתָם — "Its going forth is from the end of the heavens, and its circuit unto the ends of them" *(Tehillim 19:7)*. That is to say: here [it means] a year[?]. The sun[?] is [reckoned] from the beginning of the sun's course and from the edge of the heavens; and this is a figure of speech, for [there is no fixed edge]. What he said, "from the end of the heavens," is not to be taken literally, for there is no [absolute] end by which to delimit a beginning and an end. Rather, it is a convention of the ancients to begin from the head of Aries and [to continue] until [the sun] returns to that very same point; and that is [what is meant by] "its circuit" (ותקופתו). The tekufah (circuit) is the end of [one revolution]... [and its return?]... the dwellings[?].

וְאֵין נִסְתָּר מֵחַמָּתוֹ — "and there is nothing hidden from its heat" *(Tehillim 19:7)*. That is to say: everything that exists in this lower world needs the sun[?], for it is the cause of coming-to-be and passing-away and [rest / removal][?], and it is the cause of all the heat that is in every existent [being], properly[?].

בַּשָּׁמַיִם חַסְדְּךָ אֱמוּנָתְךָ עַד שְׁחָקִים [ה'] — "O LORD, Your lovingkindness is in the heavens, Your faithfulness reaches to the skies" *(Tehillim 36:6; the lemma-word* בהשמים *is written enlarged)*. **צִדְקָתְךָ [כְּהַרְרֵי אֵל] מִשְׁפָּטֶיךָ תְּהוֹם רַבָּה [אָדָם וּבְהֵמָה תּוֹשִׁיעַ ה']** — "Your righteousness is like the mighty mountains, Your judgments are a great deep; man and beast You save, O LORD" *(Tehillim 36:7)*.

Here he stated four attributes: chesed (lovingkindness), emunah (faithfulness), tzedakah (righteousness), and mishpat (judgment). The meaning of chesed is like "surplus/superiority" and emanation — that is, divine emanation; and they are [set/directed][?] for the sake of the three worlds. [The first is] the upper world, which he called "heaven" absolutely, and therefore in it is the knowledge —

— that is, the true heavens; and that world is the source of life, which he called chesed and "the light of life." Afterward it is fitting that there emanate from it upon the sphere an emanation — and this is what is called "Your faithfulness

reaches to the skies," and likewise, "For Your mercy is great above the heavens, and Your truth reaches to the skies" *(Tehillim 108:5)*. And "unto" (עד) is inclusive. That is to say: since the source of life and of lovingkindness was in that spiritual world, and this sphere was subservient to it, it is therefore fitting that there emanate from that [world] to this [sphere] whatever is fitting for it. And therefore he said "amunatcha" (Your faithfulness) without a vav, because it is by way of necessity.

Afterward, it follows of necessity from it that there be — in this lower world, which is subservient to that sphere — tzedakah and mishpat; and that is what he said, "tzidkecha" (Your righteousness), and therefore it too is [written] without a vav. And it is comparable[?]... as it is said, "who performs chesed, mishpat, and tzedakah [in the earth]" *(Yirmiyahu 9:23)*. Therefore he set[?] the parallel[?]... [with] "and beast" (adam u-vehemah).

Afterward he began to tell some of the praises of that exalted source, which is the upper world, and said: **מַה יָּקָר חַסְדְּךָ אֱלֹהִים** — "How precious is Your lovingkindness, O God" *(Tehillim 36:8)*; and like it, "How abundant is Your goodness" *(Tehillim 31:20)*. The word "mah" ("how") is an expression of wonder. And [as for] "in the shadow of Your wings they take refuge" *(Tehillim 36:8)* — he is addressing the sons of[?] man, those who occupied themselves with[?]... human [nature][?]; and like it, **אֲלֵיכֶם אִישִׁים אֶקְרָא וְקוֹלִי אֶל בְּנֵי אָדָם** — "To you, O men, I call, and my voice is to the sons of man" *(Mishlei 8:4)*. And they are those who attained [something] of that [world] according to their capacity; therefore, "in the shadow of Your wings they take refuge," as he said of it, "He who dwells in the secret place of the Most High [abides in the shadow of the Almighty]" *(Tehillim 91:1)*... **כִּי עִמְּךָ מְקוֹר חַיִּים בְּאוֹרְךָ נִרְאֶה אוֹר** — "For with You is the fountain of life; in Your light we see light" *(Tehillim 36:10)*.

Afterward he began [to describe] that there emanate upon him, from that radiant light, and said: **מְשֹׁךְ חַסְדְּךָ לְיֹדְעֶיךָ** — "Draw out Your lovingkindness to those who know You" *(Tehillim 36:11)*. And also — that is, that there emanate from that exalted source the enlightenment within them, to know the supernal secrets — "to those who know You," that is, the enlightenment within them. **וְצִדְקָתְךָ לְיִשְׁרֵי לֵב** — "and Your righteousness to the upright of heart" *(Tehillim 36:11)*.

After this he indicated the way by which it is possible to attain that level, and said: **אַל תְּבוֹאֵנִי רֶגֶל גַּאֲוָה** — "Let not the foot of pride come upon me" *(Tehillim 36:12)*. Its explanation is in two senses. The first, according to its plain meaning: that is, "remove from me [the...][?]," which is the "foot of pride" — namely, the one who is arrogant, who[?]... [so as] to turn the heart to engage in the

contemplation of the secrets. The second is: that [pride] not [drive / cast] me [away][?], that I become arrogant; for arrogance deceives, so that [a person][?] does not attain that level.

(Pencil folio number "78" appears in the lower outer margin of the second folio side.)

And the interpretation of "foot" (*regel*) is found to correspond[?] to *le-regel ha-melakhah* — "according to the pace of the labor" (Bereishis 33:14). And this resembles the saying of our Rabbis, may they rest in peace: "Envy, desire, and [the pursuit of] honor drive a man out of the world" (Avot 4:21). This alludes to [this lower] world — that is to say, the lot[?] of the wicked is in this world; and most of their dominion[?] … [is] by way of reflection, to guard oneself against these [three], [and to note] how wickedness arises[?]; and it is well[?] for them, since this [brooding] preoccupation prevents [a man] from delving into[?] the secrets.

And afterward he said there, "There the workers of iniquity are fallen" etc. (Tehillim 36:13) — that is to say, this pride[?], and the end appointed for the wicked, is only in this lower world, [the world of] flesh and blood, and their dwelling in it. And afterward, "they are thrust down and are not able to rise" (ibid.) — [that is, they cannot] be lifted up to that upper world, in which the children of men take refuge.

And afterward he said …[?]; and the whole theme of this Psalm concerns cleaving to that which is above. It is, as it were, an explanation of what he compared — righteousness to the mountains and judgments to the deep, [namely] "Thy righteousness is like the mighty mountains, Thy judgments are a great deep" (Tehillim 36:7). That is to say: … "Thy judgments are a great deep"[?] … [so that] Thy righteousness may be[?] … [one thing][?].

כשמך — "As is Thy name, O God, so is Thy praise [unto the ends of the earth]" etc. (Tehillim 48:11) — that is to say: His name and His praise are one, and whoever knows His name knows His praise.

אמת — "Truth springs out of the earth, and righteousness looks down from heaven" (Tehillim 85:12). That is to say: when [truth] springs forth — at the time [that there is disclosed?][?] the truth of the [supernal things?][?] — righteousness looks down upon us from heaven. And similar to it: "let the earth open, that they may bring forth salvation, and let righteousness spring up together" (Yeshayahu 45:8).

מעון — "[LORD,] Thou hast been our dwelling-place [in all generations]" etc. (Tehillim 90:1). That is to say: He is the place of the world (*mekomo shel olam*), and the world is not His place. And similar to it:

לפנים — "Of old hast Thou laid the foundation of the earth, and the heavens are the work of Thy hands" (Tehillim 102:26). And similar to it: "in the day that the LORD God made earth and heaven" (Bereishis 2:4). As our Rabbis, may they rest in peace, said ...[?]: it stands to reason[?] that when He created them, He created the heavens first and afterward created the earth; and when He [stretched them out?][?], He made the earth first and afterward the heavens [cf. the dispute of Beit Shammai and Beit Hillel, Ḥagigah 12a][?]. That is to say: the heavens are prior in importance and in rank; and the creation of the earth was for its sake, so that there should be some enduring thing upon which [it rests?], and the [fashioning?] of the earth [serves] as a foundation ... [like a ceiling?][?]. And similar to it: "He that created the heavens and stretched them out, that spread forth the earth and its offspring" (Yeshayahu 42:5). And He spread out[?] ... [and] spread forth the earth from above[?] ... for the sake of[?] ... but the heavens[?] ... for the sake of[?] ... "and them that stretch them out"[?].

And the term "founded" (*yesod*), which he used, refers[?] to the earth: "He founded the earth upon its foundations, [that it should not be moved for ever]" (Tehillim 104:5).

כי — "For as the heaven is high above the earth, so great is His mercy toward them that fear Him" (Tehillim 103:11). "As far as the east is from the west, so far hath He removed our transgressions from us" (Tehillim 103:12). It is a known matter[?] that the distance of east from west is double the height of the heaven above the earth. Therefore, for the removal of transgression, he employed the greater distance; for so it must be that there remain no remnant of it in the world at all — not any residue whatsoever. But His mercy — and it is the lesser [distance][?] — because we[?] ... at the lesser distance it is impossible that [it be more?][?] ... goes forth beyond its place[?] ...

עשה — "He appointed the moon for seasons" (Tehillim 104:19) — [regarding] the diminishing[?] of the lesser[?] of the luminaries ... so that every [span of][?] an hour is called a *mo'ed* (an appointed season); and thus it is written, "and for seasons" (ibid.). And it is not [my purpose?][?] to expound here what our Rabbis, may they rest in peace, said in tractate Ḥullin, in the chapter ...[?]: "The moon said before the Holy One, blessed be He," etc., up to "it is impossible for two kings to make use of one crown," etc. (Ḥullin 60b). For the light of the moon is[?] ... [and] therefore Scripture styled it in the phrase "one crown," "one light"[?]. And

because[?] … at the time of that conjunction the moon is[?] … And it is a known matter that the three days adjacent to the conjunction — and it is [the interval of concealment?][?] — are not fit for the beginning of the [month / reckoning][?]. And already[?] … "you shall not return"[?] … before You His iniquity[?] is atoned[?] by the goat-offering on the New Moon [Rosh Ḥodesh; cf. Bemidbar 28:15 and Ḥullin 60b, the goat as atonement "for My having diminished the moon"][?] … And when you consider that whole statement — [it is] by way of "let the luminary not be diminished"[?] … [and] we have now found[?] that they brought [into it] by this manner much that is very good, of the ways of[?] parable and rhetorical figure.

And likewise I saw fit to explain here the story[?] of Rabbah bar bar Ḥana, in the chapter "One Who Sells the Ship" (Bava Basra, *ha-Mokher et ha-Sefinah*): [Aramaic: "A certain Arab said to me: Come, I will show you where the earth and the firmament kiss one another"] (Bava Basra 74a), etc. And this means to say the place of the equinoctial line (*kav ha-mishor*), which is the place where day and night are forever equal there, and it has no [inclination?][?] … the point where[?] the day [rests] upon the horizon[?] … to that place; and it is [aligned with?][?] the point of the pole (*nekudat ha-sedan*) … [Aramaic: "of the firmament"]. And it is like[?] a sign … since the sun is[?] near … that point; and it is from here[?] … [Aramaic: "and some say from here"][?] … "in the window of the firmament"[?] — that is to say, that he set[?] the sign beside the point of the pole; and it is a great matter, correct[?], according to the way of the sages.

[This opening continues the exposition of Rabbah bar bar Ḥana's tale (Bava Basra 74a) begun on the prior folio — the marker set in the "window of the firmament," read as a demonstration that the meeting-point of heaven and earth lies on the equinoctial line.]

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in order to know with certainty how wide that place is, and whether it has width or not. For [the marker] had already [been set?] [?], and he had taken that mark within the rotation of the sphere [so as to learn?] whether it had width; for had it had width, it would not have vanished from sight. And he was still in doubt whether it has any real width — [that is,] whether that marked spot would return [to its place] once in a rotation of twenty-four hours. [The man] said to him: [Aramaic: come the next day, for at this same hour you will find it — … כי האירתא ומשכחת לה]. And since it had vanished from him and did not return to that place until the next day — which is twenty-four hours — [it became clear] [?] with certainty that it has no width at all, nor [has] that place [any width]; and we

established it as lying on the line of the equator [המישור]. And a proof for the matter: that place was hot [חם], as we told you, for it says nearby — [Aramaic/quotation, uncertain: הא אחוי לך [?] ...] — a wilderness; and those places are exceedingly hot. And Scripture gave a sign [?] for this, as in **המוליכך במדבר הגדול והנורא** … **ועקרב** ("who led you through that great and terrible wilderness … and scorpion," Devarim 8:15).

לעולם ה׳ דברך נצב בשמים ("Forever, O LORD, Your word stands firm in the heavens," Tehillim 119:89). [Interlinear above the lemma: דברך] — **לדור ודור אמונתך** ("Your faithfulness endures to all generations," Tehillim 119:90). [Interlinear above: כולם] — and [it stands / it endures — ולעמוד? [?]]: that is to say, the heavens and the earth stand firm and endure forever. "And to all generations is Your faithfulness" — and similar to it: **דור הולך ודור בא והארץ לעולם עומדת** ("One generation passes and another comes, but the earth stands forever," Kohelet 1:4).

And he said: the term "stands firm" [נצב] with respect to the heavens, and the term "standing" [עמידה] — [thus] [?]: the term "standing" indicates rest and repose, which is the opposite of motion, [while the moving thing] [?] is in continual movement; but the term "stands firm" [נצב] indicates rest [?] … rather [the firmness] of uprightness/strength [תיקוף?]. And likewise the heavens are set upright over the earth.

כה אמר ה׳ השמים כסאי והארץ הדום רגלי ("Thus says the LORD: The heaven is My throne, and the earth is My footstool," Yeshayahu 66:1). "The heaven" — the spiritual world, and it is His throne; and "the earth [as] footstool" is the sphere [galgal]; and the footstool is the earth. Know that the footstool [הדום] is the first place for a body that revolves within/around it. And because the place of the sphere is the thing that bears upon it [?], therefore it is called [?] … the footstool, [and it is] called [?] … you know that it is a "foot" [רגל]; and he spoke of the "nearness" [הקרבה?] as a matter [?] … and what [?] …

הללו אל בקדשו ("Praise God in His sanctuary," Tehillim 150:1a) — and that is the supernal, holy world. And therefore [?] … in one [conception?] [?] … a hint that that world of [?] is [?] … in [its] simplicity/incorporeality [הפשיטות], inasmuch as it is remote [?] from composition. **הללוהו ברקיע עזו** ("Praise Him in the firmament of His power," Tehillim 150:1b) — that is the sphere [galgal]; and because there is in it more composition [הרכבה], he mentioned in it the "glory" [הכבוד?] —

PDF p. 178 (folio 90r)

— it, this is the world of generation and corruption [עולם ההויה וההפסד]; and therefore he spoke in the plural: **הללוהו גבורותיו** ("Praise Him [for] His mighty acts," Tehillim 150:2a), on account of the many composites within it. **הללוהו כרב גדלו** ("Praise Him according to His abundant greatness," Tehillim 150:2b) (interlinear: כולם) — as if to say [that all proclaim His praise] [?].

He said "according to His **abundant** greatness" — he did not say "according to His greatness," and not "as His greatness," but rather "according to His **abundant** greatness"; and this is [addition upon addition — מוסיף אחר מוסיף?] [?].

Another interpretation: let each of the existents praise according to what it has attained — [as?] its greatness and its power. [Its attainment] [?], as received in the heart [?] as [in] human beings [כאנוש], is not like [the attainment of] the sphere; and [that of] the sphere is not like [that of] the spiritual beings. Therefore let every existent praise according to what it has attained — such as its greatness and its power.

הללוהו בתקע שופר ("Praise Him with the blast of the shofar"), **הללוהו בנבל וכנור** ("Praise Him with harp and lyre," Tehillim 150:3); **הללוהו בתף ומחול** ("Praise Him with timbrel and dance"), **ומזמור** [and song?], **הללוהו במנים ועגב** ("Praise Him with strings and pipe," Tehillim 150:4); **הללוהו בצלצלי שמע** ("Praise Him with clear-sounding cymbals"), **הללוהו בצלצלי תרועה** ("Praise Him with resounding cymbals," Tehillim 150:5). These are nine kinds [of instruments]; he stated them corresponding to the nine spheres [galgalim]. And these are established in the science of music [חכמת המוסיקא] [?] ... and each [corresponds] to a sphere [?] ... the timbrel corresponds to Jupiter [צדק] [?].

The timbrel [תוף] corresponds to Jupiter [צדק]. And therefore: **ותקח מרים הנביאה אחות אהרן את התף בידה** ("And Miriam the prophetess, Aaron's sister, took the timbrel in her hand," Shemos 15:20) — a sign that her prophecy was through Jupiter [צדק]. And [the rest of] the women went out after her with timbrels and dances (cf. Shemos 15:20b). The dance [מחול] corresponds to Mars [מאדים] — a sign that there was no evil [?] in the prophecies [?], but rather those women's intent was directed toward [true] knowledge; that planet [כוכב] indicates concerning them. And therefore it is written [?] ... **ותירא** [?] ... [lemma uncertain].

"...and dances" — they did not hear [?] of any [other] kind; he said [only] "dance," which belongs to Mars [מאדים]. Yet in order to serve [?] HaKadosh Baruch Hu through the forms of all the planets — [each turning] to the service of the Creator — **תשמח בתולה במחול [אז]** ("Then shall the maiden rejoice in the dance,"

Yirmeyahu 31:13). "Strings" [מנים] [connote?] delight [עונג], for it indicates many kinds [of instruments]; from it, "song" [זמר]. [Return to His name? — שוב לשמו? [?]]. "Clear-sounding cymbals" [צלצלי שמע] — for the servant [?] should ring out over [its] motion [?] … It is written "Aaron's sister" because Aaron belonged to Jupiter [צדק], and therefore he merited [the element of] air [?]; and [he was] perfect [ותמים], as it is written [?] … he shall speak before [?] … [ולישועתו? [?]].

[Scribal end-formula: **תחזק** ("be strong").]

[Red-ink section marker:] **פרק — ספר משלי** ("Book of Proverbs"): it contains [numeral uncertain: ט׳/ט״ז [?]] discourses [מאמרות] on/from the sciences [מחכמות].

[Foot of p. 178: pencil foliation "89".]

[The opening line and a half conclude the proem to the Proverbs commentary and are only partly legible:] …their virtues [ומעלותם] and [?], and [?] the [?] that are performed [?], and the acts of kindness [והחסדים] and the pieces of knowledge that ought to come [i.e. the prerequisites] for the sake of every science, from its premises [?] … [the acts of kindness — כמו קרנה עינים?] [?]; some of them are particular [?] [כלומר?] [?] … in its own completeness and in its perfection alone [?], and what is required to complete [?] from the [sons? / branches?] [?] … [שבנו לבן כמקום?] [?]. And afterward, by the [?] that a human being [?] should understand, [?] and the customary orders [והנעימוסין / νόμος?], he directed [how? — נדרך איך] and commanded [?] … he began and said:

לדעת חכמה ומוסר להבין אמרי בינה — "To know wisdom and instruction; to comprehend the words of understanding" (Mishlei 1:2). We have already said that the root *ḥ-k-m* ("wisdom") points to divine wisdom [ḥokhmah elohit — metaphysics], and this is what is called simply "ḥokhmah." In this verse he mentioned [three?] kinds of wisdom: the divine, which is called "ḥokhmah"; and the [natural?] sciences [ḥokhmot], [so called] because they bear upon sensible things [ha-murgashin] — things that are not stable in their own nature, being composed [?] … [degree? — מעלה] and [?] and [?] — [subject to] the kinds of motion, namely: generation and corruption [הויה והפסד], increase and decrease [ותוספת וחסרון], alteration [וקלקול], and translation [local motion — והעתקה]. And because these [pass over / are transferable — ונעתקים] for human beings, he called them "the wisdom of instruction" [ḥokhmat musar].

[As for] "the words of understanding" [amrei binah], this is *tevunah* [understanding]; and they are called "words of understanding" because they are matters [received? — נעשות מקובל] in the mind alone, not false [?], as [they said?].

And because their concern is [grasped] in the heart [i.e. in understanding], he called them "words of understanding" [imrei binah].

He mentioned the sciences [not?] in the order in which they are [truly] arranged ... and he will mention them afterward in order ... [and he arranged them?], meaning: the divine wisdom [ḥokhmah elohit] is prior to natural science [ḥokhmat ha-teva]; but [in the order of learning — סדר לימוד] it is natural science that [comes first — התובע הטבע קודם?] [?]. Therefore he prefaced, to make known first [?] ... the [device? — תחבולה] of natural science, and said:

לקחת מוסר השכל צדק ומשפט ומישרים — "To receive the discipline of the intellect, justice, and judgment, and equity" (Mishlei 1:3). Meaning: it is fitting that you first take [?] ... and know natural science [ḥokhmat ha-teva] — this is what he said, "receive the discipline of the intellect." He mentioned the manner of receiving it — how it is — and said that it is intellect [sekhel] ... [that] you should first acquire [תקנה] the fitting virtues [middot ha-hagun]: "justice, judgment, and equity." *Tzedek* [justice] is the middle measure [the mean — ha-midah ha-emtza'it]; *mishpat* [judgment] is the [?]; and *meisharim* [equity] is [?]; and he called it "meisharim" [?] because it is composed of the mean [ha-emtza'it] and the [?].

because it is by its nature [?] prior [?] ... [before?] it is done, and when it has been done it is [?] compelled [i.e. necessary — mukhraḥat]. And afterward he said:

לתת לפתאים ערמה לנער דעת ומזמה — "To give prudence to the simple, to the young man knowledge and discretion" (Mishlei 1:4). Meaning: after natural science yields [its results?] into your hand — [as if?] to [nurse it? — נפשה] [?] — there will come up into your hand from it prudence [ערמה] ... and it will yield into your hand the premises [ha-hakdamot], which he called "da'at" [knowledge] ... [to the youth from his youth? — לנער מנעוריו] [?], as in "and the youth [na'ar]..." [?] — meaning: this one who was [ignorant? — נבער] before he knew natural science, and afterward knew from it the matter [?] ... and [set him upon? — וקושרו] the straight path [orach yesharah], the premises, and likewise "da'at" [knowledge]. "And discretion" [u-mezimah] — that one may be able to begin [?] in divine wisdom [ḥokhmah elohit]. And afterward:

ישמע חכם ויוסף לקח ונבון תחבולות יקנה — "That the wise man may hear and increase in learning, and the man of understanding may attain wise counsels" (Mishlei 1:5). Meaning: by the premises that came up to him from that [natural] science, "the wise man will hear" the divine [wisdom] ... [and increase — ויוסיף]. The divine wisdom and its [?] is called *ḥefetz* [desire?] and *da'at* [knowledge], as it

is written "and he added" [?] — in the third treatise, [drawn] from that wisdom. "And the man of understanding [u-navon] … shall acquire wise counsels [taḥbulot yikneh]": he calls the wise man "navon" with respect to the science of all excellent things [?], just as that [divine] science is called "*bonah* / *binah*" [builder / understanding] … [it is said?] of the divine wisdom that it is the double [?] "sophia" [σοφία, "wisdom"] [?].

The first [of the two] — from it are taken the premises for the mathematical sciences [ḥokhmot limudiyot]; [this is a matter?] greater than the [division? — ha-ḥeluk] and [its?] partitioning [?] — for the premises of the [mathematical] sciences are [set / engraved? — nitba'in] by degrees [bi-ma'alot], [there? — שם] in the manner of [that] science; and he called the [conceptions of? — de'ot] the mathematical sciences "taḥbulot," from the root *ḥevel* [cord / measuring-line]; and likewise [it stands? — קם] from [what is necessary? — mukhraḥ] — this is geometry [ge'ometria] [Greek: γεωμετρία] — [ordered] this by that and this after that, in sequence [al ha-seder]; [in the operation of? — ma'aseh] motion [?] [?] … a matter that requires an understanding one [mevin], brief in [expression? — meʿut], deep in words. And there is no science fitting for [?] except [what comes] from the mathematical science [ḥokhmah limudit], which is called "binah" and "ma'aseh" [operation].

It is also called "tevunah." This is what he said: "wisdom and understanding [ḥokhmah u-tevunah]"[?]. "Wisdom" [ḥokhmah] here is divine wisdom, for the sake of knowing the judgment [?] [that] the Holy One, blessed be He [?], [ordained?] to be done with instruments [?] — and it is a great secret; and "tevunah" [understanding] is the quality of their making [i.e. how they are done] … which is from the mathematical science, called geometry [ge'ometria]. That is: "ḥokhmah" is to know, and "tevunah" is to make; and just as the mathematical science [ḥokhmah limudit] …

[Text breaks off mid-sentence at the foot of the written area; the sentence continues on the following folio. The lower portion of the leaf is blank.]

[Foot of p. 180 (outer margin): pencil foliation, reads approximately "81" — 90/91 expected by sequence.]

[Pencil foliation "82" visible at the lower outer corner of the second page; folios tracked by PDF page.]

—it is [alludes to?] [?] divine wisdom [metaphysics]. Likewise, [not…] [?]; and one is able [?] … knowledge is [the allusion to] divine wisdom … but rather wise in the Talmudic science, and so, like … [is] understanding[?], wisdom rests. And this is

what our Sages, may they rest in peace, said: "If there is no knowledge, there is no understanding; if there is no understanding, there is no knowledge" (Avot 3:17).

To understand a proverb and an epigram (*lehavin mashal u-melitzah*, Mishlei 1:6). A *mashal* (parable) is a statement uttered about one matter which has another sense, deeper than what appears from its plain meaning; and a *melitzah* (figured saying) is likewise elevated [?] ... except that the *mashal* is a statement composed of the words of the [?] [יונה], while the *melitzah* is its companion, and it is what is rendered [translated] [?] from one language to another. And so Solomon, peace be upon him, did in this Book of Proverbs: he set within it words that signify in one language a single matter, while he intends by them a figure (*kinui*) — on account of another matter he framed it — for it is like calling the silver "wealth" and the soul "a woman" [?], as is depicted ... for your sake [?]. And from what he said, **apples of gold in settings of silver, a word fitly spoken** (Mishlei 25:11) — he means three aspects: the first, the plain, visible [meaning]; the second, philosophical speculation; and the third, the secret of the mysteries of the Torah, which were not permitted to the philosophers. And whoever is able to delve deep [?] into this Book of Proverbs will find in every verse of it one of these three aspects that we mentioned.

And afterward he said that what is bound to [?] the reward [?] of these three sciences is the fear of God; and therefore he said **The fear of the LORD is the beginning of knowledge; wisdom and instruction** (Mishlei 1:7). He said "beginning" (*reshit*) and not "start" (*techilah*), because the word *reshit* is more precise [true], like the head; and just as the point (*nekudah*) is the beginning of the line, so the fear of the LORD is the beginning of wisdom and instruction. **fools despise** (*evilim bazu*) — that is, this sense that we mentioned, that the fear of the LORD is the beginning of knowledge, wisdom, and instruction, fools despise; and not essentially [?] ... for they despise it, and one may attain [?] the sciences [only through it]; and be wise [?]. "And anyone whose fear of sin does not precede his wisdom, his wisdom does not endure" (Avot 3:9).

The term *evil* ("fool") is said of one who conceives a matter contrary [in a change] to its true nature. [?] Folly is of two kinds: the first, folly regarding the essence of the matter, and this is the *kesil* (dolt); and the second [continues below] —

— one who conceives the matter in another way; rather it is said of him ... and this is the *evil* (fool): he does not wish to turn back from his folly but holds fast to it, as it says, **Though you should pound the fool in a mortar** etc. (*im tikhtosh et ha-evil ba-makhtesh*, Mishlei 27:22).

And he began the [latter?] [?] portion [with] the natural science [?] of the Talmud, which is the prologue of instruction (*musar*); and he said **Hear, my son, the instruction of your father, and forsake not the teaching of your mother** (Mishlei 1:8). Reverence [?] is the father, and the soul is the mother. The heart [?] says that just as one pours [?] into instruction … it is [wrong?] for the soul to be empty of Torah, and not for the Torah to be empty of the soul; and therefore he said "and forsake not the teaching of your mother," meaning: let your study not be in [?] the natural science [as] a Torah emptied of the parable [?]. And so it appears from this verse, because he set first the Torah of the soul and joined it to instruction, for the Torah is more precise [true] than the [essence?] [?] of nature, or [more precise is instruction] than the soul [?] …

Since the soul is found for your sake [?], **for they are a graceful wreath for your head** (*ki livyat chen hem le-roshekha*, Mishlei 1:9). *Liwyah* is a term of entwining [?] and joining … "for your head" (*le-roshekha*) means "for your beginning," for their beginnings [?] are the Torah and the soul. And the sense of this saying [?] … like the composition that is the joining of the soul and the Torah, when the composition [?] is a good one — and this is what he called "grace" (*chen*) here — meaning: that same composition confers grace [?], namely that the Torah is impressed upon the soul; provided your deeds are set right and no perversion is seen in you.

My son, if sinners entice you, do not consent (*im yefatukha chata'im al tove*, Mishlei 1:10). And [in?] this section … your heart, the benefit [?] … from [?] nature; and this is instruction (*musar*): it is to guide your impulse (*yetzer*) always, so that the soul be a servant compelled to the Torah. And when you ascend by this path the science of instruction, and the good graces [virtues] [?] through it … they are a strength [?] upon the soul; if you are worthy to attain divine wisdom.

And he began now to speak of [?] … and said **Wisdom cries aloud outside** etc. (*chokhmot ba-chutz taronah*, Mishlei 1:20). And likewise he compared, in this verse, to the degree of the [soul?] of man that is esteemed [?]; and he designated [?] those who attain [it] by the degree of "outside." Similar to it in the Talmud [is]: "Ben Zoma is still outside" (Chagigah 15a). And the one lesser than him [is] "in the streets" (*ba-rechovot*); and the [greater?] than him, "the head of the bustling streets" (*rosh homiyot*); and the [greater?] than him, "at the openings of the gates in the city" (*bifthei she'arim ba-ir*) (Mishlei 1:21).

[The recto (right page, f. 82v) continues, from the foot of the preceding page, the exposition of the "places" in which Wisdom calls out (Mishlei 1:20–21).] …and this

resembles the verse **פתחו שערים ויבא גוי צדיק** — "Open the gates, that a righteous nation may enter" (Yeshayahu 26:2); and it is for the sake of this that he said:

אשרי אדם אשר שומע לי לשקוד על דלתותי יום יום — "Happy is the man who listens to me, watching daily at my gates" (Mishlei 8:34). He said this because he had [also] said, **שמעו מוסר וחכמו ואל תפרעו** — "Hear instruction and be wise, and do not neglect it" (Mishlei 8:33): that is, first hear the wisdom of instruction (*musar*), and only afterward "be wise." Meaning: learn [?] the divine wisdom, and "do not neglect it" — that is, do not make light of it [?]; study it, and let the divine wisdom be beloved [?] to you, for it is the degree above all the [other] sciences. And of it is said, **רבות בנות עשו חיל ואת עלית על כלנה** — "Many daughters have done valiantly, but you have excelled them all" (Mishlei 31:29). It is not fitting [?] … until a person has become greatly practiced in the rest of the sciences, so that his [evil] inclination is subdued, conquered, and vanquished before the Torah, as we have said — for such is the order of study [?].

And comparable to this is what is told in the Talmud concerning the Account of the Chariot (*Ma'aseh Merkavah*) [?] … expounded [it] before … [?]. … And whoever keeps this order and listens to me — happy is he, for by … [?] he is [able] to be "watching daily at my gates," to keep … [?] … [Illegible: ~1 line of connective prose, f. 82v] … this world and the World to Come; that is, just as you [secure?] [?] yourself in this world, so [too] … [?] … [Illegible: ~1 line, f. 82v] … that you may enter [the World to Come] [?].

And he said at the end of the passage: **אז יקראוננני ולא אענה** — "Then they will call me, but I will not answer" (Mishlei 1:28); and so it is fitting — [this being] the reverse of what he said [here], "I called and you refused" [cf. Mishlei 1:24] … [?].

And after he had admonished concerning the wisdom of instruction (*musar*) and the divine wisdom, he now [turned], in the passage that follows, to join to them the mathematical sciences (*ḥokhmat ha-limmudim*), and said: **בני אם תקח אמרי** — "My son, if you receive my words" (Mishlei 2:1). Consider (*ʾiyyen*) how he said "my words" (*amaray*), just as he called them at the beginning of his book **אמרי בינה** — "words of understanding" (cf. Mishlei 1:2) … [?]. They are not [like] mere "sayings" [?]; that is [to say], wisdom in the heart [?] … in his heart … [?]. Everything that has for them an existence [?] outside … is fit to be called "words" (*amarim*) … [?]. For there is [a difference] between [?] the mathematical sciences … and, likewise, the reckoning of the seasons (*tekufot*), the fixings [of the calendar] [?], and the [new] months. **להקשיב לחכמה אזנך תט לבך לתבונה** — "To incline your ear to wisdom, and turn your heart to understanding" (Mishlei 2:2).

[The foot of the recto ends here.]

[Verso, left page, f. 83r:]

אם תבקשנה ככסף וכמטמונים תחפשנה — "If you seek it as silver, and search for it as hidden treasures" (Mishlei 2:4). Consider (*ʾiyyen*) how, from this verse, [it is shown] that this is the mathematical sciences (*ḥokhmat ha-limmudim*), which are fit to raise [?] a person of himself once he first knows the premises (*ha-haqdamot*); and there is no need [for anything] but that … [?]. For if he knows only the premises, [when they are] complete they yield the cause (*ha-ʿillah*) [?] … together; and afterward … [?] his knowing of it, and he need not labor [?] … [to grasp it]. "If you seek it as silver" etc. — that is, you [attain it] of yourself; and it is not so — he did not say this [?] — with instruction (*musar*) and [divine] wisdom, for these require an eminent master (*rav muvhak*) who has received a complete tradition (*qabbalah shelemah*).

This is what he said in the passage after this one: **בטח אל ה' בכל לבך ואל בינתך אל תשען** — "Trust in the Lord with all your heart, and do not lean upon your own understanding" (Mishlei 3:5). That is: the knowledge of the Creator, may He be blessed — which is the trust in Him with all the heart [?] … "[do not lean] upon your own understanding." **אז** — "then you will understand the fear of the Lord" (Mishlei 2:5): that is, after you know instruction (*musar*), which he set forth [?] in the first passage, and wisdom, which he mentioned in the [second] passage [?], and understanding (*binah*), which he has [just] mentioned now — then you will be complete, and "you will understand the fear of the Lord, and **ודעת אלהים תמצא** — the knowledge of God you will find" (Mishlei 2:5). **כי ה' יתן חכמה** — "For the Lord gives wisdom; from His mouth [come] knowledge and understanding" (Mishlei 2:6). That is … [?] of yourself; but the divine wisdom you require [to receive] by tradition, man from the mouth of man, [and ultimately] from the mouth of the Almighty (*mi-pi ha-Gevurah*), as it says, "from His mouth [come] knowledge and understanding."

וצפן לישרים תושיה — "He stores up sound wisdom (*tushiyah*) for the upright" (Mishlei 2:7). *Tushiyah* is the craft (*melakhah*) of the intellect — and not this [?] … but rather it rests upon another [thing], and it is a measure (*mishqal*) [?] by which the divine wisdom is known through discourse. And the *tushiyah* [is what is] measured [?]. The labor of this craft is to draw [?] the paths of number [demonstration] [?] — that is, to keep the ways of demonstration (*ha-mofet*); and this is what he called "judgment" (*mishpat*) [cf. Mishlei 2:8, "to guard the paths of judgment"], and it is the necessary measure (*ha-middah ha-muḥraḥat*).

כי תבא חכמה בלבך ודעת לנפשך ינעם — "When wisdom enters your heart, and knowledge is pleasant to your soul" (Mishlei 2:10). He calls it "wisdom" inasmuch as a person knows [?] that it is knowledge (*daʿat*); that is, that his soul has become settled by it [?] … his soul is called … [?]. **מזמה תשמר עליך תבונה תנצרכה** — "Discretion (*mezimah*) will watch over you, understanding will guard you" (Mishlei 2:11) — that is, understanding will guard you [?] … from evil ways; **מאיש מדבר תהפכות** — "from the man who speaks perverse things" (Mishlei 2:12); **העוזבים ארחות יושר** — "who forsake the paths of uprightness" (Mishlei 2:13) etc.; **אשר ארחותיהם עקשים** — "whose paths are crooked" (Mishlei 2:15) etc.

[Pencil foliation "83" in the lower outer margin of the left page.]

"To deliver you from the strange woman" (Mishlei 2:16) — this is the external sciences (*ḥokhmot ḥitzoniyot*), such as the making of idols (*tzelamim*) and the like. And of this it is said, **"he who consorts with harlots wastes his substance"** (Mishlei 29:3). We have already explained that in just this way — on account of [?] — a person "wastes" wisdom [?] in the making of idols; for these [sciences] are like harlots, and it was not fitting for him to serve [?] with any wisdom except through knowledge of the Creator, as it is said, "Behold, God [is great, and we know Him not]" [?] [proof-text; the letters are only partly resolvable — cf. Iyov 36:26].

"who makes her words smooth" (Mishlei 2:16) — this is the wisdom of heresy (*minut*): they make [their teachings] appear at first to be true, and they draw a person's heart, like some of the words of Aristotle, who speaks of the eternity of the world (*qadmut ha-ʿolam*). But in truth [?], in these matters it is not so. [Consider the two directions of demonstration:] whether one proceeds from the later things up to the things prior in nature — for these later things, which are the composite ones, are better known to the senses than the simple things, yet it is more hidden how to derive the prior things from them — or, conversely, from those innate, hidden things that come to be [known] as in the mathematical sciences: he [Aristotle] has already explained this whole matter. And these are the things prior in nature and in essence, [yet] prior only to our knowledge — provided the innate starting-point be complete, as complete as it is in the mathematical sciences.

And Aristotle says that the things known in completeness and rectitude, in which there is no defect (*dofi*), are found only in a single man among all men — and these are the pious; just as the perfectly healthy man is found only [rarely] [?] … of men. All this is the wording of his own words.

And he said further, in these same words, that the things known to us are not [equally] known to others; and even for one man himself, at a given moment, they vary [?]; for the sensible things are known to children, whereas the universal intelligibles are better known to the aged. Thus far the wording of his words.

And from all this you see, by his own account, that the knowledge of a thing to [full] clarity [?] belongs only to the pious. But we, the people of the true faith, know the things prior in nature before the later things — the very things that are "later" [for him] — first, in our own wisdom. And this [First Intellect] is the end of Aristotle's wisdom; for the whole of what Aristotle demonstrated is the existence of a First Intellect (*muskal rishon*).

[Left page, f. 84r — the same argument continues.]

And we too know — it having been made clear to us from the very outset — that there is a First Existent, a Creator; and [the Torah] brought us these deep matters with ease. And what we opened with earlier, in the verse **"Hear instruction and grow wise, and do not neglect it"** (Mishlei 8:33) — which [Scripture] calls "the wisdom of instruction (*musar*)" — is a wisdom that rises above [even] the divine wisdom [?]. This is not [merely] a tradition of ours that Solomon [established] [?]; rather it is the divine [wisdom], of which Aristotle explained [only] a portion, for [he was but] a lover of [it] [?].

As for Aristotle, we have already said that you will not attain from it more than the existence of a First [Intellect], and nothing further. [Our tradition] has already reached the First Intelligible; whereas Aristotle, because he lived among the idolaters (*ha-Kutim*) — [who worshipped] their Creator as was the manner among them [?] — and they say "It is not He" [?], he had to labor to explain its cause; and that [alone] is the height of his wisdom. But the very first thing we teach a child, as soon as he begins to speak, is that he say **"Hear, O Israel: the Lord our God, the Lord is One"** (Devarim 6:4), and likewise **"In the beginning God created…"** (Bereishis 1:1), and so forth. Consider, then, that we [hold to] this premise — the beneficial one, in which there is nothing hidden — and such is our wisdom; while those who go out by [another] way go by the way in which Aristotle stumbled: **"all who go to her do not return, nor do they reach the paths of life"** (Mishlei 2:19). For you will not attain from his wisdom more than the existence of a First Intellect and a First Cause [?] — the two of them being close to one another by only a little; and this [was reached] by way of [demonstrating] a first cause [?].

[All this is said] so that you may see that even in the rest of the matters he engaged with, [things] were not brought to completion for him — as you have seen in all the books that they wrote: in the *Book of the Images* (*Sefer ha-Tzelamim*) and [the book of] *the World*, [there are] many things [for which no reason can be found] [?] … unless he has other books that have not reached us, so that we do not know upon what his opinion finally settled. And although it is not fitting to boast of what he accomplished — for his intention was only to uphold the truth on his own, and he arrived at recognizing what we have said — nevertheless, on this account, "they are altogether brutish and foolish" (cf. Yirmeyahu 10:8): the eternity of the world is his [doctrine] [?], and all who follow after him have strayed from it [?]; whereas the holy [Torah] illumines the way of truth, and it is **"a lamp to our feet and a light to our path"** (cf. Tehillim 119:105), so that it may be seen, when one examines [?], in all their paths [?] … that the universals recount [?] …

so that he gains from them no further knowledge — only a diminishing of his faith. May the Holy One, blessed be He, return us in complete repentance to His door.

And I have seen fit to delve here into what I touched upon above — doubts [deep] upon [deep] — for even [this] is neither generated nor corrupted. Rather, what we say is this: even if his proofs be true, we need not fear the deception of the senses, for the sense is not [the arbiter] [?]; and we need not fear the deception of the senses so as to be shown a way that is not perceived by the senses at all. For His ways are not like our ways, nor His thoughts like our thoughts (cf. *Yeshayahu* 55:8). And of the spiritual it is now said: **עין לא ראתה אלהים זולתך יעשה למחכה לו** — "No eye has seen, O God, but You, what He will do for the one who waits for Him" (*Yeshayahu* 64:3). There is no need to elaborate further.

But discerning men will grasp [its truth] [?], that they are true according to the reckoning of man, since its foundation is sense-perception, as we said. Yet in this way — as much as we are able to estimate about it from our proofs — this weighty matter, out of His wisdom, let us keep; and it shall be accounted a merit for us. And whoever adds to the keeping of it, a blessing shall come to him, and he shall reason [rightly]. (interlinear: יעצור [?])

אמר [display initial]. He said, in the first treatise of the book of [?title], [and Kohelet?] [?]: that every thing generated and corrupted comes to be from its contrary and passes away into its contrary; and both [of them] must have a common thing [a shared substrate], [being] contraries [?]. And this is one premise. Add to it another premise, namely that the revolving body has no

contrary. And there follow from it [and from] these premises [nine?] [?] conclusions —

namely, that the revolving body is neither generated nor corrupted. In this manner: every thing generated and corrupted has a contrary; the sphere has no contrary; therefore it is neither generated nor corrupted — [rather it is] eternal. And when we are aided by this [premise] [?], it will follow that the sphere is not generated or corrupted.

[As for] the first premise, namely that every thing generated and corrupted is [transformed] from contrary to contrary — we [bear witness] [?] to this by [?] [?], since it was [always something in potential] [?]. But if it were [?] [?] according to our belief, it would not be [emptied] out [?]. And [as for] the explanation of premise [nine?] [?], namely that the revolving body has no contrary — in this manner: the bodies, [when] the contraries [?] [are set opposite], it necessarily follows that their [rest-places?] are contrary [?]; and thus [it is done?] [?] [?], for the inversion of the contraries is also [a form of] contrariety, and [?] [?] [?] to an end. [Thus] whatever whose motion is not contrary [to another motion] is itself without a contrary. And afterward [comes] the explanation [?]:

Since the circular motion has no contrary, it follows therefrom that the generated [?] body will have no contrary. And this reasoning is confirmed: thus the sphere — its motion has no contrary; and that whose motion has no contrary, its body has no contrary; therefore the sphere — its body has no contrary.

Now let us return to our subject and say: this contrariety among the natural bodies — on account of which their motion must be contrary — what is it? Is it a contrariety in all their qualities, or not? If you say that this contrariety is in all their qualities, you should know that fire is not contrary to earth in all its quality, since dryness is found in both of them. Therefore the cause of the contrariety of motion — [the contrariety of fire's motion] to the motion of earth — is not that it is contrary to it in all its quality.

And if you posit [?] an exchange — [that of] earth [and] water — and you say that the motion of fire is contrary to the motion of water because of its contrariety in their qualities, we say: rather, [although] it is contrary to water in its quality, it is not contrary to it entirely in motion; for fire is light [?] and water is heavy, [but] not in the absolute sense. And it has already been said, in the definition of them, that they are contraries [?] [because] [?] the distance between them and the [heaviness?] [?] of the distance. Therefore there is no cause for [?] the contrariety of motion — which is [the contrariety] of the bodies that are [generated?] [?] [?].

Therefore it does not necessarily follow — except [in the case of?] contrary motions — [that they belong] only to the contrary bodies; for fire and earth are contraries and their rest-places are contrary. And also it does not necessarily follow that contrary motion [belongs] to contrary bodies — as fire and water, [which] are contraries yet their rest-places are not contrary. Therefore, that some motion of the bodies is [as] contraries — [being] also in contrariety — is not necessary. Therefore, also [that a body has] a contrary [?] [?] — and yet also, [if] their motion is not in contrariety, it is without a contrary; it is without [?]…

[Red ink: **פרק**] [Chapter — unnumbered]. And I have seen fit to record here the premises and the secrets of Aristotle, upon which he built his demonstration and his proofs. These premises he did not set down in the order in which we have set them down here; rather, they are scattered throughout his books, and I have gathered them one by one. And you will see all his premises — for there are a few of them that are unsound, because certain [?] objections [?] against them [have already been raised] at the outset; and this [?]…

[This continues, without a new rubric, the red **פרק** opened at the foot of the previous folio, in which the author announced that he would gather Aristotle's scattered premises one by one.]

There are [premises that are easy and all but self-evident,] and there are others whose hidden import [?] makes his words harder for the intellect [to grasp] than these — so that we must bring proof and demonstration on their behalf. And on this account we are astonished: given how the senses [attest] to the truth of things, how can proof, sign, and demonstration issue concerning the very easiest of matters — a thing that is almost a first intelligible [?] — [?] the intellect [?] plants within it [?]. And you will find that most of our premises — or rather his own statements — are still more difficult, such that the intellect does not perceive them at once; yet he took [just such a matter] as a foundation and built his teaching upon it: that whatever is a first intelligible, and is not conceived by any other science, [is to be granted], as we shall see.

And these are they:

1. [First] The existence of motion.
2. [Second] The existence of nature.
3. [Third] Nature is [the principle / source] of motion and of rest.

4. [Fourth] [?] it does not receive part by part, nor does one part receive [?] from the other; for [?] the heat does not act upon [?], nor does [the cold] receive it. [content largely uncertain — [?]]

5. [Fifth] Nothing comes to be [from what is not] [?]; this is a thing that occurs [?], which does not come to be out of nothing.

6. [Sixth] Everything that comes to be or passes away has a substratum — from which it comes to be, or into which it passes away.

7. [Seventh] The natural motions [?] [rest?] by nature. [content largely uncertain — [?]]

8. [Eighth] [?] [content largely illegible — [?]]

9. [Ninth] Potency and actuality are distinct one from the other.

10. [Tenth] Everything moved with rectilinear motion has a place proper to itself.

11. [Eleventh] [?] the part within it is one in species [?]. [content largely uncertain — [?]]

12. [Twelfth] [?] a first place [?] [content largely uncertain — [?]]

13. [Thirteenth] [?] [content largely illegible — [?]]

14. [Fourteenth] That which is revolved is [something] revolved, not [itself] revolving [?]; the change [of place] in motion [?] is a change [?]. [content largely uncertain — [?]]

15. [Fifteenth] Every motion is either by nature, or by [will / essence] [?], or forced (violent).

16. [Sixteenth] [Given] two things in motion, the one swifter than the other, we say that the ratio of the [motion of] the one to the [motion of] the other is either [the ratio of] the power of the [one] mover to the [other] mover, or of the [one] recipient to the [other] recipient, or a composite of the two ratios.

17. [Seventeenth] The [motion?] [?] does not stand opposed [to itself] in advance and in delay. [content uncertain — [?]]

18. [Eighteenth] One says that a thing is "in time," meaning that time encompasses it.

19. [Nineteenth] The circular motions [?] [?] from it — and what are these still [?]. [content largely uncertain — [?]]

20. [Twentieth] [?] by nature as nature [?], in time as [?], as a revolving time [?] to the single self-moved thing. [content largely uncertain — [?]]

21. [Twenty-first] Motion is [?] toward the contrary [?]; [continuous / contiguous, joined] [?]. [content uncertain — [?]]

22. [Twenty-second] [?] [short; content largely illegible — [?]]

23. [Twenty-third] The swifter completes, in one [and the same] time, a greater path than the slower completes; and it does not complete, in an equal time, the path that the slower completes.

24. [Twenty-fourth] Everything [extended?] — part of it in [?] from it, and part of it in [?] these — and it is in time, [passing] from thing to thing. [content uncertain — [?]]

25. [Twenty-fifth] Everything that moves does so of itself, not from another; and likewise it comes to rest — likewise of itself, not from another.

26. [Twenty-sixth] The change that occurs in quality is alteration [?].

27. [Twenty-seventh] Not every motion has its cause in every [other] motion, nor is its ratio [to be reckoned] by [?]; the motion of quality is not [commensurable] [?] with the motion of quantity, nor [is it comparable to it] [?], because it is not equal to it.

28. [Twenty-eighth] That which is moved on account of a mover from without is moved in a determinate [way], in a determinate time; and not every mover [moves] every moved, nor by every way that may occur, nor in every time that may occur. And everything moved in a time that has a determinate limit is moved with a motion that has a limit, in a way that has a limit.

29. [Twenty-ninth] The power of motion is prior in time to the motion itself; for a thing whose nature it is to move is prior in potency to its being moved in actuality — that is, [the potency] is reckoned prior in time to the act, in everything that comes forth into existence.

30. [Thirtieth] That all things are in motion, or that all are at rest, is false.

31. [Thirty-first] The circular motions are not [?] [?]. [content uncertain — [?]]

32. [Thirty-second] Rectilinear motion is deficient and circular [motion] is complete, since it admits neither addition nor diminution.

33. [Thirty-fourth (as written) [?]] Everything generated and corrupted comes to be from [a thing] and is corrupted into its contrary; and there is between them another thing, a substratum common to both [?].

34. [Thirty-fifth] The simple bodies [that are round?] [?] — their motions are circular.

35. [Thirty-sixth] A mover does not complete [a motion?] [?] that has no determinate limit.

[The numbered catalogue of Aristotle's premises for the eternity of the world, opened on the preceding folios, here reaches its close (premises 37–48), after which the author declares the list complete, surveys the philosophers' disagreements, and turns to his own resolution.]

Thirty-seventh. The circular body, when its lines are drawn out [?] to more than one place, such that those lines move until they return to the place from which they were reckoned to be moving; and if we reckon that one of them [is at rest?] and the other [revolves along?] the circle, such that the moving things move until they overtake them [?]. [Only the noun-frame — the moving lines returning to their point of origin — is secure; the connective predicates are at the semicursive ductus floor.]

Thirty-eighth. When from a thing that has a limit [חקר] a part that has a limit is taken, the remainder likewise has a limit.

Thirty-ninth. The revolving body completes its revolution in a time that has a limit.

Fortieth. Everything that has no limit — and whatever resembles it — has no end [?].

Forty-first. Every body is either composite or simple.

Forty-second. [Concerning that which is set opposite?] perpetually, which is not found at all. [Reading uncertain.]

Forty-third. The perfection [?] of straight motion is the contrariety [?] found in straight motion.

Forty-fourth. The subsisting motion [התנועה הקיומית] is [set apart from / greater than?] all [other] motion. [Reading uncertain.]

Forty-fifth. The motion of the circular body is swifter than the motions of the rest of the bodies.

Forty-sixth. The change of a motion is due either to the mover, or to the moved, or to both of them together.

Forty-seventh. Softening [הריכוך] is a weakening [חולשא], and the weakening is a thing that departs from nature.

Forty-eighth. The [?] is found in the simple bodies — like flesh and the bones — and is not found [in the composite?], like the hand and the foot; and [it is found?] only in the simple motions. [Reading uncertain.]

These are the foundations upon which he built his arguments. And you will see that there are many of them which are [so in every case?], and it would be fitting to say [of them …?]. [Connective clause at the ductus floor.]

Now among the earlier philosophers there are great disputes on this matter — the eternity of the world. Some of them hold that the matter is clear beyond doubt; some are in doubt about it; some already [reject?] his proofs; some rebut the objector; and some rebut this rebutter in turn. The gist of the matter [is this?]: [why should a man?] busy himself with such things — [to bring?] this [to proof?] and draw it forth from [the straight/plain sense?], so that the intelligible [conclusion?] should become as famous as [its like?], when the students of the mathematical disciplines [?] cannot grasp it? And what have we, before God, to investigate a thing that has no end? And why should the holy, perfect [Torah?] burden the heart concerning that which cannot be comprehended, so that we should vainly spend all our strength to descend into it and explore it? [This whole transitional passage — the survey of the philosophers' positions and the rhetorical protest against pursuing an endless inquiry — is heavily abbreviated semicursive at the ductus floor; the argumentative frame is recovered, but many connective predicates are flagged.]

[f. 87r — the author's positive resolution, closing the disputation with a chain of citations from Proverbs in praise of wisdom.]

Cling rather to it [wisdom], and hold fast to it, *"so that thou mayest walk in the way of good men, and keep the paths of the righteous"* (Mishlei 2:20). That is to say: once there is first engraved in your heart the existence of the Creator, and His unity, and the greatness of His power — that He created everything *yesh me-ayin*,

out of nothing — then the beginning of your wisdom will be the fear of Him, as it says, *"The fear of the LORD is the beginning of knowledge"* (Mishlei 1:7); and you will grow wise *"to know wisdom and instruction"* (cf. Mishlei 1:2). Reflect upon acts of piety and what is exalted [?] by them — and this is the subduing of the soul [כפיית הנפש] — until [your bodily need?] is subdued [?] and the remainder of your thought is left free, pure and clean of all toil and vanity. And then seek after the divine wisdom, which is a tradition [kabbalah] in our hands, man from the mouth of man, [reaching back to?] the mouth of the Almighty [mi-pi ha-Gevurah]; for *"the LORD giveth wisdom; out of His mouth cometh knowledge and understanding"* (Mishlei 2:6). And go on to sharpen [the intellect?] by degrees — not with haste and not with agitation, but calmly, little by little, according to what your mind can bear — as with the parable [?]: [beginning?] with what is nearest first, and afterward with the remote things, and from there [ascending?] to the highest [?] gates, until you come to be *"watching daily at my gates"* (Mishlei 8:34). This is what he meant when he said, *"My son, if thou wilt receive my words"* (Mishlei 2:1) — in order to sharpen the intellect, so that you may be the better able to understand that wisdom, as it says [?], *"in the heart of him that hath understanding wisdom resteth"* (Mishlei 14:33). And when it comes into your hand [?], then *"shalt thou understand … the knowledge of God" — "then shalt thou understand the fear of the LORD, and find the knowledge of God"* (Mishlei 2:5) — and you will not [be occupied?] with the rest of the books of falsehood, and of idolatry, and of [abomination?], in which you might suppose you would find wisdom, though there is none in them; for *"her house sinketh down unto death, and her paths unto the dead [refa'im]"* (Mishlei 2:18). This [?] is the straight path, and by it you shall *"walk in the way of good men, and keep the paths of the righteous"* (Mishlei 2:20). *"For the upright shall dwell in the land"* — that is, the world to come — *"and the perfect shall remain in it"* (Mishlei 2:21) — meaning, the remnant of the rational soul; *"and the wicked shall be cut off from the earth"* (Mishlei 2:22). And he said further: *"My son, forget not my teaching … for length of days, and years of life, and peace shall they add to thee"* (Mishlei 3:1–2). And he said: *"Let not kindness and truth forsake thee"* (Mishlei 3:3) … *"Happy is the man that findeth wisdom"* (Mishlei 3:13) … *"She is a tree of life to them that lay hold upon her"* (Mishlei 3:18) … *"The LORD by wisdom founded the earth"* (Mishlei 3:19) — akin to *"In the beginning God created …"* (Bereishis 1:1) … so that this whole world endures, standing firm [?] and never overstepping [its order]; and this is the perpetual motion of the sphere — the continuous motion in which there is neither swiftness nor lag, but which is uniform for all time. And these were the words.

[Pencil foliation "87" in the lower outer margin of the left page (f. 87r); the text block ends about a third of the way down the leaf, the remainder blank parchment.]

[…all the things made] for the sake of that motion, which endure in this world, stand as an ordered whole; and their very making teaches that it was with wisdom and with understanding that they were made — and He who created them from nothing (*me-ayin*), may He be blessed.

Of the earth, Scripture drew out its word and said *"He founded"* (*yasad*), because the earth is stable and does not move; but of the heavens it said its word *"He established"* (*konen*), from the root of *"understanding"* (*tevunah*) — alluding to the revolving [spheres?] and the [ordered motions?] that turn in revolution without end and without limit [le-ein ḥeqer]. And we have already investigated whether the [measures?] of the heavens can have a determinate limit [ḥeqer], and we have found that they can; and yet [that number?] does not reach so far as to exhaust the fullness of the sphere [bi-melo ha-kadur] [?].

[…He] made an order enduring in the world, the like of which He has not made [before], and He will make [yet] another day, until the circuit [ha-haqqafah] returns to its beginning [?], should God — may He be blessed — wish to establish [renew?] His [work?]. And no [natural] act enters into this; also, because the miracles [ha-nissim] are another matter, departing from the natural order [ha-teva / ha-matbea].

And now he says: what is the way to know and to investigate the knowledge of the configurations [ha-ma'arakhot], setting it out for oneself [?]? [Consider:] when you divide the sphere into sixty parts — and since the planet Saturn [Shabtai] [moves] [?]… one degree… — and [you take] the combination [?] of each one with [each other]…, [each planet] in each degree indicates a matter other than what it indicates [elsewhere], according to what it indicates when it is completed in one degree; for every single degree has [its own signification] with us, [each planet] like itself, as they said concerning the nature of this science. But [consider] what one single planet by itself indicates in one single degree, and another planet in a known degree; and then, [when] the light of the other planet [passes] from [its] degree to another degree, the configuration that [results from] this [changes]. And what the configuration [indicates] [?] when it is [reckoned] with one degree

— also with each one of the deeds [ma'aseh] [?] of it — [we must] reckon [nevatel / nekhatel?] the number that comes out for us now. In a year the whole will be five thousand thousand [= 5,000,000] [?] [tam'ani?] [numeral: ?]; and

afterward, when you gather [them] [?], there will be from them a degree [signifying] everything that it indicates when [a planet] is completed in one degree. And Jupiter [Tzedek] in one degree is not equal to what it indicates when it is completed in the second degree; and if Jupiter [stands] in one [degree] of its arc, we must reckon [le-vatel] the [general?] number [ha-mispar ha-kelali]. [We] set [these] as [factors?] [?], and by it the number of the configurations [ha-ma'arakhot] [?] is completed — and it is [a thousand thousand thousand = a thousand million; and six hundred thousand thousand = six hundred million; and thirty-five thousand thousand thousand (?)] [numeral: ?].

[Enlarged display lemma:] **בלב נבון תנוח חכמה** — *"In the heart of him that hath understanding wisdom resteth"* (Mishlei 14:33). One who wishes to know the divine science [ḥokhmat elohut = metaphysics] must first [learn] from the mathematical sciences [ḥokhmat ha-limmudim], and [then] divine wisdom will rest in his heart soundly [al buryah]. But one who has not first learned from the mathematical sciences — and who is called a fool [kesil] — yet wishes to drink of the divine wisdom: it will not settle in his heart as is fitting; or [else] he will apprehend [it] only from [a hasty grasp?] [?]... These are the [principles?] of order [?].

[Enlarged display lemma:] **אל תמנע** טוב מבעליו — *"Withhold not good from him to whom it is due"* (Mishlei 3:27). And he means: when you learn wisdom of [high] rank [ma'alah], if you are an understanding person and a vessel fit to receive this wisdom, and worthy of it — do not withhold it from him. And know that this rank of study [ma'alat ha-talmud] is a great rank, and not [attained by] every sage [?]. And [here he says] [?] that there is one whose deed's rank is to benefit only himself, and there is one whose deed is to benefit others — as it is said, *"and [My word] shall be like fire"* [cf. Yirmeyahu 23:29] — in his deeds.

[Enlarged display lemma:] **אל תאמר** לרעך לך ושוב ומחר אתן ויש [אתך] — *"Say not unto thy neighbour, Go, and come again, and to morrow I will give; when thou hast it by thee"* (Mishlei 3:28). He is [saying?] [?]: Know that of some of the sciences there is a [particular] year in which a person attains in it more than he attains in a year at another time — as [?]... the [fitting] time; and according to what is fitting for him, a year fitting for reckoning [?], it was granted to him — like the meaning of [?]. And one ascends from matter to matter [in learning] over the course of time, so that a person may see a year [so precious] that it is not right to neglect it in any way in the world — that he should fail to learn in it — for it would be a loss [?] on account of a mere few hours. And, by way of figure [melitzah], he calls the thought of the heart [maḥshevet ha-lev] *"thy neighbour"* [re'akha], as if to say:

if you have a good heart [lev tov]; and he used *re'a* ("neighbour") in the sense of *tov* ("good"). And many sciences [are given?] to you [?]… like [?] a knocking [refiqah?] at the heart, and [a hint?] to give [?]… [final ~2 lines abraded/very cursive] [?]

[Text block ends about two-thirds down the leaf; remainder blank parchment. Pencil foliation "88" in the lower outer margin.]

> Script: Sephardic semicursive (scribe Sasson ben Menashe). Continuous prose; segmentation is by enlarged in-line scriptural-lemma display words, drawn in sequence from Mishlei 3–4. This leaf continues the pedagogical proem to the science half; no numbered structural rubric (שער/פרק/מאמר/סימן) and no start of the Euclid/astronomy material appears here. …your thought will yearn for it at once; do not defer it to the morrow, but immediately, at that very hour, the matter [ha-inyan?] [?] is opened up — and all the more with what may occur, [precious] as a watch in the night [ka-ashmurah ba-laylah].

[Enlarged display lemma:] **אַל תַּחְרֹשׁ** עַל רֵעֲךָ רָעָה וְהוּא יוֹשֵׁב לָבֶטַח אִתָּךְ — *"Devise not evil against thy neighbour, seeing he dwelleth securely by thee"* (Mishlei 3:29). That is: do not let the thought of your heart yearn after idle matters that the moment offers, since you are able to occupy it with something else "securely by you" — meaning, with what will benefit yourself. And these are the sciences [ha-ḥokhmot?] [?]; the external matters are apart from you [me-'imekha?] [?]. The meaning of this verse concerns the heart: the thought that is in the heart is one, and it cannot think of two things at once. And so it is — arrange that this single thought be upon matters that will benefit you, and [thereby] benefit [others].

[Enlarged display lemma:] **אַל תָּרִיב** עִם אָדָם חִנָּם — *"Strive not with a man without cause, if he have done thee no harm"* (Mishlei 3:30). Now of contention, some is permitted, and there is a permitted [form of] disputation, as we said in the book of [?]. And here he means: if your contention is not of the permitted kind but is "without cause"… This is [the sense]: if you hear a statement that is not made clear to you in the response set against it, do not take [issue] with him, since no harm is found — for he has said nothing that is against your faith [belief].

[Enlarged display lemma:] **אַל תְּקַנֵּא** בְּאִישׁ חָמָס — *"Envy thou not the man of violence, and choose none of his ways"* (Mishlei 3:31). He [is one who] babbles [mefatpet?] [?] and [plunders?] [?] in his ways. Even though you may see in some of his words something sound [nekhonah?] [?], do not choose any one of them.

[Enlarged display lemma:] תוֹעֲבַת ה' נָלוֹז וְאֶת יְשָׁרִים סודו **כִּי** — *"For the perverse is an abomination to the LORD; but His counsel is with the upright"* (Mishlei 3:32). And "the perverse" [naloz] is the flatterer [ḥanef]; "His counsel" [sodo] — like a secret [sod] [?]…

[Enlarged display lemma:] [וּנְוֵה צַדִּיקִים יְבָרֵךְ] בְּבֵית רָשָׁע ה' **מְאֵרַת** — *"The curse of the LORD is in the house of the wicked; but He blesseth the habitation of the righteous"* (Mishlei 3:33). …to make known [le-hodia'?] [?] … the wicked … so that it should not [prosper / rise up] [?]…

[Enlarged display lemma:] [שִׁמְעוּ] בָּנִים מוּסַר אָב [וְהַקְשִׁיבוּ לָדַעַת בִּינָה] **שִׁמְעַ** — *"Hear, ye children, the instruction of a father, and attend to know understanding"* (Mishlei 4:1). … the meaning of "the teaching of thy mother" [torat imekha]… and it is all together, and it is the beginning of the wisdom of moral instruction [ḥokhmat ha-musar]. But here, once you have known the wisdom of moral instruction and the wisdom of the intelligibles [ha-tevunin?] [?], and the order that we mentioned, it is fitting for you to begin from the revealed [min ha-nigleh]… [?] in the heart. And therefore he mentioned here "the father" alone, which is the [hidden]; and he did not mention "the mother," which is the revealed [ha-nigleh].

[Second folio side:]

[Enlarged display lemma:] נָתַתִּי לָכֶם תּוֹרָתִי אַל תַּעֲזֹבוּ **כִּי לֶקַח טוֹב** — *"For I give you good doctrine; forsake ye not My teaching"* (Mishlei 4:2). [Interlinear/superscript corrections above these lines, partly legible: "…מנוחות…", "…עלינו" (?)] It is [in the manner of] the expressions [ha-leshonot?] [?] … in form, and to be cast [?]… as when it is said [in the midrashic pattern]:

Let the Mighty One come [יבֹא אַדִּיר], and plant for the mighty ones [ויטַע לַאַדִּירִים], from the mighty ones [מֵאַדִּירִים], among the mighty ones [בַּאַדִּירִים]. "Let the Mighty One come" — this is Jacob, as it is written, *"the LORD on high is mighty"* [addir] (Tehillim 93:4). "And plant for the mighty ones" — or [it is] Israel, as it is said, *"and the mighty ones [addirei], in whom is all my delight"* (Tehillim 16:3). "From the mighty ones" — or [it is] Egypt, as it is said, *"they sank as lead in the mighty waters"* [mayim addirim] (Shemos 15:10). "Among the mighty ones" — or [it is] the waters, as it is said, *"above the voices of many mighty waters"* [mayim rabbim addirim] (Tehillim 93:4).

Let the beloved come [יבֹא יְדִיד], son of the beloved, and let the beloved build for the beloved, in the portion of the beloved, and let beloved ones find atonement through it. "Let the beloved come" — this is Solomon, as it is said, *"and he called his name Yedidyah"* (2 Shmuel 12:25). "Son of the beloved" — this is Abraham, as it

is said, *"what hath My beloved to do in My house?"* (Yirmeyahu 11:15). "And let the beloved build" — this is the Temple, as it is written, *"how beloved are Thy dwelling-places"* (Tehillim 84:2). "For the beloved" — this is the Holy One, blessed be He, as it is said, *"let me sing now for my well-beloved"* (Yeshayahu 5:1). "In the portion of the beloved" — this is Benjamin, as it is written, *"of Benjamin he said: The beloved of the LORD"* (Devarim 33:12). "And let beloved ones find atonement through it" — or [it is] Israel, as it is written, *"I have given the dearly beloved of My soul"* (Yirmeyahu 12:7).

Let the good one come [יבֹא טוֹב], and let him receive the good, from the Good, for the good ones. "Let the good one come" — this is Moses, as it is written, *"and she saw him that he was good"* (Shemos 2:2). "And let him receive the good" — this is the Torah, as it is said, *"for I give you good doctrine"* [ki lekaḥ tov] (Mishlei 4:2). "From the Good" — this is the Holy One, blessed be He, as it is said, *"the LORD is good to all"* (Tehillim 145:9). "For the good ones" — or [it is] Israel, as it is said, *"do good, O LORD, unto the good"* (Tehillim 125:4).

Let "this one" come [יבֹא זֶה], and let him receive "this" from "this one" for the sake of "this." "Let this one come" — this is Moses, as it is said, *"for this Moses, the man…"* (Shemos 32:1). "And let him receive this from this one" — "this" is the Torah, as it is written, *"and this is the Torah"* (Devarim 4:44); "from this one" — this is the Holy One, blessed be He, as it is written, *"This is my God, and I will glorify Him"* (Shemos 15:2). "For the sake of this" — or [it is] Israel, as it is written, *"the people that Thou hast gotten"* [am zu kanita] (Shemos 15:16).

[Source of the fourfold midrash: Talmud Bavli, Menachot 53a–b.]

Why are Israel likened to [an olive] [?]…: just as the olive yields no oil except by crushing [ketishah], so too Israel do not return to the good [le-mutav] except through afflictions [yissurin]. [cf. Menachot 53b]

[Marginal note: **ונחזור לענינו** — "And let us return to our subject."]

[Enlarged display lemma:] **כִּי בֵן** הָיִיתִי לְאָבִי רַךְ וְיָחִיד לִפְנֵי אִמִּי — *"For I was a son unto my father, tender and only beloved in the sight of my mother"* (Mishlei 4:3). [The enlarged word reads כי כן by the glyphs; recte כי בן per the verse — bet/kaf.] That is: at the outset [the matter] requires being in form [tzurah] and in matter [gelem]; and for this reason he mentioned in this verse both "father" and "mother," and expressed it in the past tense, "I was" — and in the end it came into my hand [i.e., it turned out well].

[Text block ends here; remainder of the leaf is blank parchment. Pencil foliation "89" in the lower outer margin.]

The pedagogical proem to the science half continues, expounding Proverbs chapter 4 verse by verse. Each new scriptural lemma is written in enlarged display script (**קנה**, **ראשית**, **סלסלה**, **תתן**, **שמע בני**, **החזק**, **וארח**) and then drawn into the exposition of the sciences.

[Enlarged display lemma:] **קְנֵה** — "And He taught me and said to me… *acquire* wisdom, acquire understanding; do not forget, and do not swerve from the words of my mouth" (Mishlei 4:4–5) [וַיֹּרֵנִי וַיֹּאמֶר לִי… קְנֵה חָכְמָה קְנֵה בִינָה אַל־תִּשְׁכַּח וְאַל־תֵּט מֵאִמְרֵי־פִי].

Explanation: that is, acquire these sciences — the divine science (*ḥokhmah elohit*) and the mathematical science (*ḥokhmat ha-limmudim*) — a wisdom that a person does not forget [once he has acquired it]. And because such [wisdom] is not forgotten, [Scripture] says "do not forget"; "and do not swerve from the words of my mouth."

[Enlarged display lemma:] **רֵאשִׁית** — "The beginning of wisdom is: acquire wisdom; and with all your acquiring, acquire understanding" (Mishlei 4:7) [רֵאשִׁית חָכְמָה קְנֵה חָכְמָה וּבְכָל־קִנְיָנֶךָ קְנֵה בִינָה].

Now he makes known by this how the sage rises in wisdom, what he must do, and whether he may be called wise. He said, "the beginning of wisdom is: acquire wisdom" — meaning that you should receive the chapter-headings (*rashei perakim*) from a sage of the received tradition (*me-ḥakham mekubbal*). "And with all your acquiring, acquire understanding" — meaning: those chapters which you have received, you must labor to understand in your heart until they enter [your mind]—

[Enlarged display lemma:] **סַלְסְלֶהָ** — "Exalt her, and she will lift you up; she will honor you when you embrace her" (Mishlei 4:8) [סַלְסְלֶהָ וּתְרוֹמְמֶךָּ תְּכַבֶּדֶךָּ כִּי תְחַבְּקֶנָּה].

"[*Salselah*]" is akin, in its wording, to *shalshelet*, a chain [?] — that is, he said [the word carries the sense of] "chain" (*shalshelet*), meaning: make of it a chain, namely, to understand one matter from within another, as our Rabbis, of blessed memory, said: "[…] rope by rope (*ba-ḥevel*) and cord by cord (*ba-meshiḥah*)," and so on [?]. "And she will lift you up" — [this is] the [?] speech [directed] to that saying [?]; and he means: just as you raise [her], so you shall raise your own name (*u-teromemekka*). And likewise —

[Enlarged display lemma:] **תִּתֵּן** — "…she will place upon your head a garland of grace" (Mishlei 4:9a) [תִּתֵּן לְרֹאשֵׁךְ לִוְיַת חֵן].

This concerns the number of the faculties: for there are in the brain of the head three faculties — imagination (*dimyon*), thought (*maḥashavah*), and memory (*zekher*). And in the conjunction of the three, [he refers to] the thought to which a person cleaves in order to act. Therefore he inclines here [to say], "she will place upon your head"—"a garland of grace": that is, [grace comes about] when there is a joining of those three faculties in your head [in a good conjunction]. Similar to it is "in all your ways know Him" (Mishlei 3:6), and so on. And therefore he said here the expression "she will place" (*titten*), and did not say "to your head" [in the same way] as he said [earlier] regarding the first [science] by its nature. For there he was speaking of the instrument [of the body], since the body of man is composed of matter (*gelem*) and form; and [Scripture] there recounts how its composition is, and therefore he spoke as he did there. But here it is a different matter — a matter of [what one is] to do — and therefore he said "she will place" (*titten*). And all of this pertains to speech, like [?] "she will honor you"—

[Enlarged display lemma:] **שִׁמְעַ֣ בְּנִ֔י** — "Hear, my son, and receive my sayings, [and the years of your life will be many]" (Mishlei 4:10) [שִׁמַע בְּנִי וְקַח אֲמָרָי].

[Faint continuation of the verse below the display line:] "…and the years of your life will be many" — here written **וְיוֹסִיפוּ֣ לְךָ֣ שְׁנ֣וֹת חַיִּ֑ים** ("they shall add to you years of life"), the form of Mishlei 9:11, where the Masoretic Text of 4:10 reads **וְיִרְבּוּ֣ לְךָ֣** ("they shall multiply for you") [?].

**

Because he had already mentioned, before this, what a person must do — and whether this great and excellent wisdom will come into his hand *(interlinear: תעלה — "will rise / be attained")* — he now recounts in this passage what the reward is of one who occupies himself with it, along the path of which he spoke, and what its essence *(interlinear: ומהות — "and its essence")* and its end are. And since he had opened his ordering *(interlinear: הראשונה — "the first")* with the telling of the three sciences, and had mentioned their arrangement in [the order of] their nature and their arrangement in [the order of] their study, he mentioned, in [the order of] nature: first, the natural science (*ḥokhmat ha-musar*); second, the divine science (*ḥokhmah elohit*); and third, the mathematical science (*ḥokhmat ha-limmudim*); and in the fourth he warned against the science of heresy (*ḥokhmat minut*) and idolatry (*avodah zarah*), and commanded [instead] to engage in Torah, and afterward that it is good to learn what is fitting. And

afterward he made known in what way to acquire this wisdom, according to [one's] capacity.

He now began to recount the excellence of this wisdom and its attainment. He said, "and the years of your life will be many" (*ve-yirbu lekha shenot ḥayyim*): not [merely years] — [rather] in [these] years he adds [true] life; for there are years that have no [true] life. [These are] the life of this world; but the life of the World to Come — those are the ones that are truly called "life," because they are a life in which there is no death at all; rather the soul endures and delights in the radiance of the Shekhinah (*nehenet mi-ziv ha-Shekhinah*).

[Enlarged display lemma:] **הַחֲזֵק —** "Hold fast to instruction, do not let go; guard her, for she is your life" (Mishlei 4:13) [הַחֲזֵק בַּמּוסָר אַל־תֶּרֶף נִצְרֶהָ כִּי הִיא חַיֶּיךָ].

"Hold fast to instruction (*musar*)" — which is the mathematical science (*ḥokhmat ha-limmudim*); "guard her, for she is your life" — she is the divine science (*ḥokhmah elohit*).

[Enlarged display lemma:] **וְאֹרַח —** "And the path of the righteous is like the light of Nogah" (Mishlei 4:18) [וְאֹרַח צַדִּיקִים כְּאוֹר נֹגַהּ] — [that is,] the planet Nogah (Venus). And [this is apt,] for this star never departs far from the sun: its approach [to and from it extends] up to forty-eight degrees (*arba'im u-shemoneh ma'alot*). At [one] time it is eastern (*mizraḥi*) — that is, when it is seen at dawn (*ba-shaḥar*); and at [another] time it is western (*ma'aravi*) — that is, when it is seen toward evening. He has here likened the state of the righteous in this [life], which is comparable to it. And afterward there arrives the complete perfection (*ha-shelemah*), which is after the separation of the form from the matter (*hivvadlut ha-tzurah me-ha-gelem*) — [analogous to] the light of this star that is eastern, in the sense that this star, when it is eastern, its light is joined (*ratzuf*) to the light of the sun: meaning, it comes immediately after it, and is not far from it by much. So too the path of the righteous, in their life — while the soul is [joined] with the matter (*gelem*) — is comparable to the light of this star that comes after the light of the sun that belongs to it. And likewise the perfect one (*ha-shalem*); and the [final] attainment of the righteous, after the separation of their form from the matter (*hivvadlut tzuratam me-ha-gelem*), which is likened [to Venus], will be a strong light (*na'or ḥazak*), according to its measure, from the sun [?] that has risen for it here, like this.

The end (*ha-shalem*).

[the] light of the sun [is greater] than the light of Venus (Nogah). [?] For one who is engaged [only] with part of the human sciences is in a confused darkness. But if

he begins in those sciences and studies them properly, by the paths of those who provide the introduction to that science, and light begins to be drawn forth over it — then, in this way, he begins to emerge from that darkness little by little. And if that science is continuous, without interruption — as he said, "[guard her,] for she is your life" — then that increment [?] keeps adding, and the light keeps increasing [?] until it reaches the light of the sun, which is the full, established day.

And see how he said "[niglah? — the word] *with a dagesh*" [?] — which is a pleonastic expression, meaning: do it in any case. It is an expression of exertion, and likewise [?] and the like. [Compare:] "And they said, No; but we will lodge in the street" (Bereishis 19:2) [וַיֹּאמְרוּ לֹא כִּי בָרְחוֹב נָלִין]; "and you shall be guiltless before the Lord and before Israel" (Bamidbar 32:22) [וְהְיִיתֶם נְקִיִּם מֵה' וּמִיִּשְׂרָאֵל] — [read] with a dagesh. For this is a necessary matter — that they discharge their obligation toward other people, [so as to] "find favor and good understanding in the eyes of God and man" (Mishlei 3:4) [וּמְצָא חֵן וְשֵׂכֶל טוֹב בְּעֵינֵי אֱלֹהִים וְאָדָם]. And [when] you conduct yourself in such a way, [you are] cut off [?] from that [reproach].

[Enlarged display lemma:] **בֵּן** — "My son, attend to my words; incline your ear to my sayings" (Mishlei 4:20) [בְּנִי לִדְבָרַי הַקְשִׁיבָה לַאֲמָרַי הַט אָזְנֶךָ].

This whole passage commands regarding the practical [virtues] (*ha-ma'asiyyim*) [governing noun uncertain: written כמדות/כחסדים?], which are the preliminaries for attaining the intellectual [virtues] (*ha-madda'iyyim*); and one cannot attain those except [by way of] these. It resembles what is in the words of our Sages, may they be remembered for blessing: "anyone whose deeds exceed his wisdom [— his wisdom endures]," etc. (Avot 3:9). And [where] the [virtue] [?]... there is a place [in which Scripture] calls the [virtuous] deed a natural act [?], [performed] after perfection in those branches of knowledge.

And he said:

[Enlarged display lemma:] **אַל** — "Let them not depart from your eyes; keep them within your heart" (Mishlei 4:21) [אַל יַלִיזוּ מֵעֵינֶיךָ שָׁמְרֵם בְּתוֹךְ לִבֶּךָ] — "for they are life to those who find them, and healing to all their flesh" (Mishlei 4:22) [כִּי חַיִּים הֵם לְמֹצְאֵיהֶם וּלְכָל בְּשָׂרוֹ מַרְפֵּא].

[Enlarged display lemma:] **מִכֹּל** — "Above all that you guard, keep your heart, for from it are the issues of life" (Mishlei 4:23) [מִכָּל מִשְׁמָר נְצֹר לִבֶּךָ כִּי מִמֶּנּוּ תּוֹצְאוֹת חַיִּים].

[That is:] of everything that is fit to be guarded against — [therefore] "keep your heart." And because the heart is the chief organ, and [it governs the rest] [?], since it is the root, [he warns one] to keep far the [corrupt] opinions and the [evil] desires [?]. And afterward he spoke of that which one must guard against — and it is of many aspects: there is a part [that lies] in the power of deeds (*bi-khoaḥ ha-ma'asiyyot*), and there is a part [that lies] in the power of [the perceptions/faculties] [?]. Therefore he began first with the correction of the opinions (*be-tiqqun ha-de'ot*), and said:

[Enlarged display lemma:] **הָסֵר** — "Put away from you crookedness of mouth, and perverseness of lips put far from you" (Mishlei 4:24) [הָסֵר מִמְּךָ עִקְּשׁוּת פֶּה וּלְזוּת שְׂפָתַיִם הַרְחֵק מִמֶּךָ].

Meaning: the first [requirement of the character] [?] of whoever would grasp this glorious wisdom is to be trustworthy in his speech, so that his "yes" be righteous and his "no" be righteous [cf. Bava Metzia 49a]. The meaning of "crookedness of mouth" is [saying] one thing with the mouth and another in the heart. And the meaning of "perverseness of lips" is [?]... and [in] truth, that his fellow should know that he himself [?]...

[Margin/interlinear, above first line: **בעשר** [?] — reading uncertain.]

it is fitting to keep far from speaking falsehood — any falsehood. And after this thought [?], let us not perform [?] anything that has passed [?]; and [one must] not set upon it a design by way of oppression [?]... And therefore he said [?]: your [?] will bring [?]... and your [?] will [?]... [these clauses are largely illegible — several words [?]]... And he came down to speak of the iniquity [?] of the truth [?]... to enter [?]... and not backward.

[Enlarged display lemma:] **פַּלֵּס** — "Weigh carefully the path of your feet, and all your ways will be established" (Mishlei 4:26) [פַּלֵּס מַעְגַּל רַגְלֶךָ וְכָל דְּרָכֶיךָ יִכֹּנוּ].

"Weigh carefully" [*palles*, from the balance] [?]: the sense is [to weigh?] every act [?]... in the middle way (*ba-derekh ha-benoni*) — [establishing] every deed between the hard and the soft [?] [i.e., the mean between the extremes].

[Enlarged display lemma:] **אֲלֵיכֶם** — "To you, O men (*ishim*), I call, and my voice is to the sons of man" (Mishlei 8:4) [אֲלֵיכֶם אִישִׁים אֶקְרָא וְקוֹלִי אֶל בְּנֵי אָדָם].

When [Scripture] applies the term *ish* [in this heightened sense], [it denotes] an honored, holy [man] [?]; for this is said of the complete man: "a good [man]" [?]; "a man in whom is spirit" (Bamidbar 27:18) [אִישׁ אֲשֶׁר רוּחַ בּוֹ] — that is, a man of spirit; [and there are other such usages] [?]; "there was a man in the land of Uz"

(Iyyov 1:1) [אִישׁ הָיָה בְּאֶרֶץ עוּץ]. And it comes near [?] in the [term]... [namely,] whoever examines what that "man" is — meaning, a complete man (*adam shalem*), [perfected in the] practical and intellectual [virtues]. And you will find, when one examines what that man is — [he is called] "a good son" [?]... "between" [?]... [as] Jacob is called [?]... that one likewise [is] "a man," a good one [?]; and [Scripture calls him] "a man of deed" [?], and [?], and "a man of [?]"... [several words [?]].

[Scripture says] "so-and-so, a man of you" [?]... And [where] it said [?] "and a man [who is]... [firm/tested] [?] from the womb — that in him it was good [?] until [?]..."

He said here: "To you, O men, I call, and my voice is to the sons of man." There is [a distinction] between "I call" and "my voice." The sense of "I call" is a calling of eminence (*qeri'ah le-ma'lah*), as it is written, "and He called to Moses" (Vayikra 1:1) [וַיִּקְרָא אֶל מֹשֶׁה]. Therefore he said [?]... "To you, O men, I call" — meaning: you who are already complete, [whose perfection] has [been imparted] to you [?], come up to your fitting rank; and you have come [?] [as] "sons of man" who are not yet complete — rather [I set?] within [?] your heart [?]... [and] I raise [?] my voice to you, to guide you [?]... [several words [?]] within it [?].

[the men complete] by nature [?], and they are called *ishim* — as though he calls the complete ones [?]... the "sons of man" [?]; and the one complete by nature [is called] *ish*. Therefore he said, of the *ishim*, [that they are] "near" [?]: [they do] not [need] the raising of the voice [to be] called, unlike the son of man who is still far [?] and needs the raising of the voice [to be] called; therefore he said, "and my voice is to the sons of man." And why did he call the one who is complete by nature *ish*? — this will be explained in the natural[-science] part of this book, in chapter [10?] [numeral: ?], with the help of Shaddai, may He be exalted.

[Pencil foliation "91" at the foot of the page.]

Judah ben Solomon HaKohen, Parma 2769 (NLI Ktiv; scribe Sasson ben Menashe). Sephardic semicursive.

The proem to the science half continues: a homiletic exposition of Mishlei 8:6–8 (on *tzedek*, righteousness, as the mean between the two extremes *niftal* "twisted" and *iqqesh* "crooked"), passing into a discussion of *adam* and *ish* and the perfections of man. No structural rubric (פרק / מאמר / שער) appears on either leaf; the enlarged words are unnumbered display-script scriptural lemmata.

[The first line runs up into the binding at the head of the leaf and is largely cut: "…the Torah(?), which is good, and even more [above?]…" — the opening words are not recoverable [?].]

they are permitted [to say] that this [element] is elevated — and it is the fire, which is yet more elevated and estimable than the rest of the elements, as Aristotle said [and as our teacher(?) said (?)] — for fire is the form of the rest of the elements. Therefore, one who raises objections… And when [men] beheld such perfections, [the term] was applied to them, and one is called *ish* (a man). Just as one who has not been corrupted at all [is a "man"], [so one who is base(?)] is called *ish ra* (a bad man) in every respect. As our Rabbis, may their memory be a blessing, said… to pay a good reward to the righteous who uphold the world, and so forth.

[Enlarged display lemma:] **בְּצֶדֶק** — "In righteousness are all the words of my mouth; there is nothing twisted or crooked in them" (Mishlei 8:8) [בְּצֶדֶק כָּל אִמְרֵי פִי אֵין בָּהֶם נִפְתָּל וְעִקֵּשׁ].

For "twisted" (*niftal*) and "crooked" (*iqqesh*) are two matters that are the [two] extremes relative to *tzedek* (righteousness); for righteousness is the middle way, the mean between the two extremes — the one being "twisted" and the other "crooked." It is therefore said of one who bends and twists, meaning: one who alters his conduct to the utmost extreme deserves recompense [at] the opposite extreme. Just as one who was [wealthy/grasping(?) [?]] does not depart from the world until he loses his money in a single [transaction(?) [?]]; and one who spent his money on things that were not necessary — likewise he will come to a craving such that he will need bread and even beg…

[Margin, right side, at this passage: a marginal word, reading uncertain — **איטמרך**[?]; further identification requires further verification.]

And so [with] the other [traits(?) [?]], in each one of them. And he made known that here [?]… — that the evil extremes are "twisted" and "crooked," and the mean, which is *tzedek*, is the straight middle way.

[Enlarged display lemma:] **שִׁמְעוּ** — "Hear, for I speak noble things, and the opening of my lips is right things" (Mishlei 8:6) [שִׁמְעוּ כִּי נְגִידִים אֲדַבֵּר וּמִפְתַּח שְׂפָתַי מֵישָׁרִים].

"*Negidim*" (noble things) [is related to] "*neged*" (opposite), meaning the pairs of opposites — such as truth and falsehood, good and evil, bitter(?) and sweet, and the like. Therefore the mean is called "*neged*," because it mediates amid the

claims of the disputants, who are one opposite the other. And he said here, "Hear, for I speak noble things" —

[Enlarged display lemma:] **כִּי אֱמֶת** — "For my palate utters truth, and wickedness is an abomination to my lips" (Mishlei 8:7) [כִּי אֱמֶת יֶהְגֶּה חִכִּי וְתוֹעֲבַת שְׂפָתַי רֶשַׁע].

[meaning:] "I will make known the parallels"; for he now makes known the parallels of righteousness. And he said, "For… truth"; he said "and an abomination…" [?]… for [truth's opposite(?)] is wickedness [?] [several words here are corrupt and not securely readable [?]]… he does not hate the utterance that is not upright [?]… [?]. [Cited:] "…refined silver" — "[the words of the LORD are] pure words, refined silver" (Tehillim 12:7) [אִמְרוֹת יְהוָה אֲמָרוֹת טְהוֹרוֹת כֶּסֶף צָרוּף].

[Centered beneath, in small script:] *kesef tzaruf* — "refined silver."

[Foot of leaf: binding board; this is the verso of the leaf foliated 91 (pencil "91" appears at the foot of the facing recto in the prior opening).]

[Enlarged display lemma / discussed term:] **לְהַתְחִיל** — "to begin."

[After beginning them(?) [?]]… we have already said that there are signs (*otot*) there that indicate [the] two perfections, or the sensible perfections. Therefore he said: the beginning of what the [images/figures (*tzelamim*)] convey is [the] two perfections — namely, *musar* (moral instruction) and *binah* (understanding), the [matter] he investigated in several places. And after that [comes] the upper world, and in it he becomes complete. This is what he said: "and I will fill their treasuries" (Mishlei 8:21) [וְאֹצְרֹתֵיהֶם אֲמַלֵּא] — meaning: I will make complete, and we shall be at rest in them, through the knowledge of the upper world; and [then] he becomes an *ish* (a [complete] man). After he had… in the heart, for these correspond to the lights of the upper world — therefore they are three perfections…

the ranks: [an] *adam* [and an] *ish*. "*Adam*" is what one is before he knows the sciences in actuality, while they are within him potentially. Therefore Scripture said, "You are men (*adam*)" (Yechezkel 34:31) [אָדָם אַתֶּם], meaning [they are fit] to be and to become *ishim* (men). But the common people [remain?]… are not [men]. And whatever of those sciences he raises into actuality — bringing it out from potency into act — enters him into the rank of *ish*; and afterward, at the end, he becomes complete and is an *ish*. Therefore he said:

[Cited:] "The sum of the matter, when all is heard: Fear God and keep His commandments, for this is the whole of man" (Kohelet 12:13) [סוֹף דָּבָר הַכֹּל נִשְׁמָע אֶת הָאֱלֹהִים יְרָא וְאֶת מִצְוֹתָיו שְׁמוֹר כִּי זֶה כָּל הָאָדָם].

[He said:] "...find(?) [the] signs [?]" — "Fear God, keep [His commandments]" — meaning: the purpose (*takhlit*) of this species called *adam* is that he fear and sanctify himself... and keep His commandments; and then he is called *ish*, and he is the complete one within his species, called the upper rank.

He mentioned here the expression "to begin"... [the] two perfections, because they are sensible. Therefore it is a matter fitting for a person to know of himself — just as an inheritance [passes] fittingly from father to son, so [these], which are sensible and visible. Therefore there is [one who]... a person has the possibility to know them of himself, so that he may rise [beyond] the thing... by himself; for this intellect of [a] person lacks nothing, but only needs to hear it... and he is capable of them by himself. And if he falls short in this, he must search it out within his heart...

and to make firm(?) [the] intellect [?] [in every?] contest(?) [?] — [these] are the two sensible perfections. And of this one who falls short it is said, "We do not see our signs" (Tehillim 74:9) [אוֹתֹתֵינוּ לא רָאִינוּ] — and this verse is a complaint against the son of man who did not [set his mind to] them all... [several words here not securely readable [?]]. And there is in it a sign that instructs concerning it, namely that he calls the signs [as if] to bring proof from one thing to another, until he arrives at what is sought of them.

[Foot of leaf, outer margin: pencil foliation **92**.]

because, as we have said, the knowledge of these two perfections is in a man's own hand [i.e. attainable by his own effort]. Therefore he said, "he sought to bequeath" [בקש להנחיל, "he sought to give as an inheritance"]. But the upper wisdom, since it is not attained by sense-perception, he does not speak of it [as attainable in that way] — for they did not perceive it, and man's intellect [?] falls short of it. Rather he said [?] that He brought it out [into the open], for He gave him of this wisdom [?]; and therefore he said of it [?] ... [I will fill (אמלא)?] [?] — meaning that the knowledge of this spiritual perfection is not from the [doing / nature (?)] of man [?], but is a gift from Him to whomever He wills.

Therefore the prophets, peace be upon them, and the pious began to pray to the Creator, may He be blessed, for this good gift that a man has over against [?] his fellows. And they do not pray over the knowledge of the [lower] perfections; nor is a prophet found who prays to make known the nature of the elements (*yesodot*) and the like — because a man has the intellectual power [?] to attain these by himself.

Similar to this is [the verse] "House and wealth are an inheritance from fathers, but from the LORD comes a prudent wife" [בַּיִת וָהוֹן נַחֲלַת אָבוֹת וּמֵה׳ אִשָּׁה מַשְׂכֶּלֶת] (Mishlei 19:14). He called this lower perfection "house" (*bayit*), and the [knowledge of the] upper world "wealth" (*hon*). Therefore he said that the knowledge of the lower perfection is [like] "house and wealth, an inheritance from fathers," as we have explained; but the knowledge of the divine wisdom — this is what he called "a prudent wife," as in "and from the LORD [comes] a prudent wife," meaning that it ascends above all [?]. This is what is [given] from the Name, may He be blessed.

Now, [as to] why he called this [lower] perfection "house": because it is the land of a man's birth, the house in which he was born; whereas the knowledge of the sphere (*ha-galgal*) is like wealth to him. Just as a man cannot do without two things — namely a house and wealth, which he needs in his life — so too the knowledge of the two [worlds is necessary] for him [?]. For in it lies the intellect that he takes to himself [?]. And thus he called the divine wisdom simply "wealth," as in "The wealth of a rich man is his strong city" [הוֹן עָשִׁיר קִרְיַת עֻזּוֹ] (Mishlei 18:11), [meaning] that he is exalted in his intelligibles. That is: only one who knows the two worlds is called "rich," for he has wealth and a "strong city," as we said. And [such a one] still does not [fear (?)] [?] in his flesh, and is not afraid, like one who has a firm wall in his fortress [?].

[New sentence, initial letter enlarged:] And moreover [?] he grows rich [מתעשר]. But not every man who [claims to (?)] need the divine wisdom to know [?] ... the perfection prior to the natural [?] science — [such a one] is found "feigning [wealth]" [?]: he makes himself wise [in his own eyes] out of the divine wisdom, yet has nothing of the other sciences at all — "one who feigns riches yet has nothing" [מִתְעַשֵּׁר וְאֵין כֹּל] (cf. Mishlei 13:7). And there is one who knows nothing of it [outwardly], and he is the one called "one who feigns poverty yet has great wealth" [מִתְרוֹשֵּׁשׁ וְהוֹן רָב] (Mishlei 13:7) — even though he knows of the wisdom of the sphere, which is called [?] "great wealth."

[f. 93r]

Indeed [?], for this reason the sphere (*ha-galgal*) does not change like the things composed of the four elements. These [composite bodies] are the ones called "vanity" (*hevel*), as he called them in the book of Kohelet; and concerning them he said, at the end of this his book [?] ... "and the four never said 'Enough'" [?] — meaning that the four qualities (*eichuyot*) are not [?] ... in the sphere, which he called [?]. Behold, for he stated the beginning of the verse: "The leech has two daughters: 'Give! Give!'" [לַעֲלוּקָה שְׁתֵּי בָנוֹת הַב הַב] (Mishlei 30:15) — these are two

[active] qualities [?] … [Margin: "and this is the first principle (*ha-kelal ha-rishon*)."] … which are the hot and the cold. "Three things are never satisfied; [four never say 'Enough']" (Mishlei 30:15) — he hinted [רמז] at [?] … regarding them, as we wrote in the Book of Generation and Corruption [ספר ההויה וההפסד = *De Generatione et Corruptione*]: for the water receives [the form of (?)] [?] the air or the earth that is upon them; and the [conversion (?)] of air to earth is upon them [?] — the fire or the water.

And afterward he said that these four qualities are one matter, apart from the sphere. "But one who gathers by hand increases it" [וְקֹבֵץ עַל יָד יַרְבֶּה] (Mishlei 13:11) — meaning that, even though it [each element] does not change [?] … so [too] "one who gathers over it increases." That is, [although each of the elements] is [something] particular [?], nevertheless the upper sphere is the one that gathers together all those motions, and they [the lower motions] are [set in motion (?)] for its sake. And afterward he explained [?] … which power, or [which] motions, and said that they are [contained] in its meaning [?], as he said "to the fools" [לכסילים] [?]; and it is what he said [at] the beginning [of the verse, enlarged lemma:] "Hope deferred makes the heart sick" [תּוֹחֶלֶת מְמֻשָׁכָה מַחֲלָה לֵב] (Mishlei 13:12) — a hint that their motion is by "drawing" (*meshichah*, playing on *memushakhah*, "deferred/drawn out").

In another verse [he hinted] that it [the sphere's motion] is like the motion of the wheel (*ofan*). That is what he said, "and [he] sat, master of the wheel [?]" [?] — he attributed [?] to them the power of the sphere, whose motion [?] … [there is] a chariot (*merkavah*): in it there is an act [?], a hint at the motion of the sphere, for it is like a wheel, as we explained concerning the Torah [?], and so I said; the statement here resembles [?] … [it] as [?] … "hand" [?] — meaning that the upper sphere is [also] called "hand" (*yad*) [as in "gathers by *hand*"]. It is [also called (?)] [?] … and it is the heaven; and it endures [?] … [several words here not securely readable] [?]. For His throne [?] … is the spiritual perfection, as it is written [?] … "His throne" [כסאו] [?].

PDF p. 205 (folio side 1)

[Enlarged display-script opening phrase:] **How many good degrees there are** [כמה מעלות טובות] in engaging in wisdom — the perfecting of oneself! For [consider]: what Elijah [?] [אליהו], may he be remembered for good, attained, Isaiah [ישעיה], peace be upon him, did not attain; and what Moshe, peace be upon him, attained, Aharon, peace be upon him, did not attain. And the prophecy attainable by man [?] … [several words uncertain] — the [attainment of] wisdom has no [exhaustive] fathoming [ein cheker], yet it has a bound that the human

intellect cannot break through. And because of that bound [?] … [the Sages taught]: "Into what is too wondrous for you, do not inquire," and so on [במופלא ממך אל תדרוש] (Ḥagigah 13a). Up to this point the human intellect can attain, and no further; and up to this point attained the master of all the prophets, Moshe our teacher, peace be upon him. But wisdom, in its own nature, has no limit [ein lah cheker].

And I will set out for you a parable. It is like a king who has many servants (*shamashim*), as numerous as the sand that is upon the seashore: some of them are horsemen (*parashim*), and some archers [rokhvei keshet]; some [officials], some officers (*shoterim*), and some keepers of the weaponry (*klei zayin*); and some are dancers (*merakdin*), and some [?] …; and some officers, and some keepers of the records (*shomrei ha-ketavot*) — and each one of them is at his task. Now another man came from a distant land to see this matter [/ this king]. He heard [?] … that [the ranks] were passed [?] …; after he had prepared himself as was fitting, he attained to see the keepers of the records — and that is what he is able to see, and no more.

Now this king had other attendants (*mesharetim*) who were below [these], and they were like servants of servants (*avdei avadim*). And that man began [to perceive] [?] … that they are servants of servants, and he longed to see their masters; and he attained to see the keepers of the gate (*shomrei ha-petaḥ*) [?] — and that is his rank. And when he sees them, he now sees a thing far more important than those servants-of-servants that he had known before. And likewise, those keepers of the gate are — in importance — three thousand two hundred [3,200] times [greater] than those servants-of-servants that he had known at the first.

And you will find a hint for this matter in the words of our Rabbis, of blessed memory, in [the chapter on] *Eruvin* [?] [עירובין]: and behold, a step [?] …, that is to say, like a step of [numeral: ?] [תרנ"ס?]. Take [numeral: ?] [ע"ף / פ'?]: its length is twenty cubits and its breadth is ten cubits; and when you hear this, they will be [?] … by ten cubits, and the cubit there [?] … — therefore they will be eighty [?] by twenty [?], and [remainder] [numeral: ?] eight [?]; and in area (*tishboret*), two thousand six hundred [?] [numeral: ?] …

PDF p. 206 (folio side 2)

And Yeḥezkel, peace be upon him, said: "and it was written on the front and on the back" [וְהִיא כְתוּבָה פָּנִים וְאָחוֹר] (Yeḥezkel / Ezekiel 2:10) — in all, a total of three thousand two hundred [3,200]. And since Scripture said, likewise, "and the

heavens He meted out with a span" [ושמים בזרת תכן] (Yeshayahu / Isaiah 40:12) [?] — [this "span" is] the mathematical sciences (*ḥokhmat ha-limmudim*); and what is in its nature is called a "span" (*zeret*), and it is what a man is able to attain — a full nine [spans / units] [?] [מלוא תשע שלמות]. We say that what one is able to attain of that [higher] world is [only] three thousand two hundred [3,200] of this [lower measure], and that is [called] "short," for it is what the master of all the prophets, Moshe our teacher, peace be upon him, reached. "And it is written on the front and on the back" — a hint that it is not fitting to inquire into that wisdom except by way of riddle and figure (*ḥidah u-melitzah*), for it is a thing that has a front and a back.

And it is written "these" [אלה] — see how he said "these" [אלה] and did not say "concerning it" [עליה] nor "in it" [בה]. [He wrote] "these," meaning [?] that the wisdom of … the Name [?] … their steps [?] … leads on to that wisdom [?] …. [These] are [?] … : this is the complete [world] of generation and corruption [ha-shalem shel havayah ve-hefsed]; and behold, the perfect [?] …, and so it is written: "and the work of His hands the firmament declares" [ומעשה ידיו מגיד הרקיע] (Tehillim 19:2) [?] — and that is the fixed perfect one (*ha-shalem ha-kavua*) [the firmament]. And therefore he said [?] … [a further scriptural clause, uncertain] [?] …, for the superior benefit of the prophets [?] … this … [they] compare [?] it and reckon it in relation to [?] … their masters — which is [the point of] the parable. And therefore David, peace be upon him, said: "and He set my feet upon a rock" [ויקם על סלע רגלי] (Tehillim 40:3). How great is this — [it is] among the roots [ʿiqarim] [?] …

[Enlarged display-script lemma:] **"It is the glory of God to conceal a matter"** [כבוד אלהים הסתר דבר] (Mishlei 25:2) — meaning that you should not speak of it at all [?] …, and this is His glory, as our Rabbis, of blessed memory, said: "whoever has no regard for the honor of his Maker," and so on [וכל שלא חס על כבוד קונו] (cf. Ḥagigah 11b / Mishnah Ḥagigah 2:1). And "glory" [kavod] is a garment [malbush]; "the concealing of a matter" [hester davar] means that you must [take care] [?] to speak of the separate intellects (*ha-sekhalim ha-nivdalim*) [only concealedly] — and that is [why] he called it a "garment" (*malbush*).

[Enlarged display-script lemma:] **"The heavens for height and the earth for depth"** [שמים לרום וארץ לעמק] (Mishlei 25:3) — [and there is no fathoming] [?], as it is written in the Talmud [ba-gemara]: "were all the marshes [?] [האגמים — gimel in the scribe's nun-like form] pens, and all the heavens parchment-sheets (*yeriʿot*), and a man came to write" [them] — "they would none of them suffice to

write" [its] measure [?] (cf. b. Shabbos 11a). And this is a riddle and a parable about the world [?].

[Enlarged display-script lemma:] **"Who has ascended to heaven and come down,"** and so forth [מי עלה שמים וירד וגו'] (Mishlei 30:4). Here he recounted the shortfall of its motion [?] … in the divine science. And therefore he said at the outset [?] … [uncertain clause] … wisdom [?] … : the holy ones [ha-kedoshim] [?] — these [?] are [?] the perfected spheres (*ha-galgalim ha-mushlamim*) [?], as was already explained, that the sphere has, within the sphere, [that which is] already separate [muvdal].

[Foliation: pencil "94" in the lower margin — modern librarian foliation.]

[The lower portion (below the final ruled line) and is blank parchment; the upper edge of both leaves is obscured by the black binding-board mount.]

This much Aristotle explained in his wisdom. But what the arrangement was among the spheres of the stars [he did not touch upon] [?] — the order in which they were created, rank above rank, [?] above [?] — and likewise the rest; or whether this motion is the source [?] of the motion [?]. This is a matter Aristotle did not explain. And so it appears that Solomon, peace be upon him, did not [claim to] comprehend it either: *"Who has gathered the wind in his fists"* (Mishlei 30:4), and so forth — meaning the motion, or the elements and the powers of the earth: whether this is necessitated on account of all the powers, or [whether it is] the spheres, in the conjunction of their motions together; or whether it is necessitated on account of some of them, or on account of one of them alone.

And if that necessitation is on account of one of them — *"What is his name"* (Mishlei 30:4), meaning the name of the separate intellect that is particular to it; *"and what is his son's name"* — the name of that intellect on whose account [it exists], that is, the sphere belonging to that separate intellect that moves it; for they [?] are called "heavens," and the spheres [are called] "the heaven of heavens," like [?] [the doubled forms] [?], or the two [forms] that are written. For thus all is reckoned to the Father as the servant [is reckoned] to the master. And afterward he said:

Every word of God is refined (Mishlei 30:5), and so forth. For the *heh* of "Eloah" [?]... is the end of the verse [?]; for it joins [?] with the verse that follows [?]. And its meaning is that it is dependent [?] — that is to say, the divine [word] [?] is "refined," meaning [fashioned] [?] with intention and wondrous arrangement, and nothing of it is in vain. And it appears [?]... that His providence [?] [comes into] act [?], and from the [?] [it comes about] that it is everlasting [?]; and He is a

shield, *"and He is a shield to those who take refuge in Him"* (Mishlei 30:5). And if [His] providence [extends] in action down as far as man, and yet is not corporealized [?] except by command — a fortiori how much more [?] does that providence [pertain], more and more, in that higher [realm] [?]. If so, how much [?] was there a purpose that they be ordered thus. And he replied:

Add not to His words (Mishlei 30:6), and so forth — meaning: up to here [alone] [?] is it [permitted] to you [?] to speak [about the matter]. [*"lest He reprove you and you be proved false"*] [?]... and providence [operates] in act [?] as far as man; whether [?]... to be intermixed [?], if it be intermixed [?]...

Two things I have asked of You (Mishlei 30:7), and so forth: *"do not withhold from me"* [?] before [I die] [?].... it hangs [?] in the secret [?] — for [these are] but [?] [a few] [?] words, taken by themselves; for they include [?] all the requests that are the need of the soul and the body, for [?] the sons of [?] [men] [?].

And now he explains some of the things that follow necessarily, on account of which he said, *"lest I be full,"* and so forth (Mishlei 30:9). And he first explained:

Falsehood (*shav*) **and lying words remove far from me** (Mishlei 30:8). It appears that "falsehood" (*shav*) is the lie — the [deed / assertion] [?] that is impossible. And so our Rabbis, of blessed memory, said: Which is a "vain oath" (*shevu'at shav*)? One who swears to alter that which is [self-evidently] known to man — [as when] one swears that a pillar of marble is [made] of gold. And he mentioned here the two kinds of falsehood that Aristotle set forth [?] in the second treatise of the Book of [?]: the natural [falsehood] [?] and the [complete / perfect] [?]. And they are: the natural lie (*ha-kazav ha-tiv'i*) and the voluntary lie [Arabic: al-ikhtiyārī, "the chosen / voluntary"] [?] — that which is impossible [in itself]; while the voluntary [?] is a [deliberately] lying word. And they are called [?]... [something] else. This, then, is the one request. And the second request is: *"and riches [?] give me not"* [Mishlei 30:8: "poverty and riches give me not"]. And this request depends upon the first, for he first sought to hold in his hand true premises — in the [necessary] mode [Arabic: al-iḍṭirārī] [?] and in the voluntary mode [Arabic: al-ikhtiyārī]; and after there should come into his hand [either] [?] the [complete] [?] premises [?]... upon knowledge and inquiry, and the [conclusion] [?] by which he may stand, and that he not seek more.

And he calls investigation and inquiry "riches" (*osher*); and he calls [meager inquiry] [?] "poverty" (*rash*). That is to say, that I should not be [cut off] [?] from inquiry, and also that I should not inquire into that which has no limit (*le-ein ḥeker*); for if, God forbid, one inquires [?] endlessly [?], without limit — and this is

what is called *"lest I be full"* (*pen esba*) — meaning: I inquire and investigate to excess, [and] it will bring him to denial, and to say *"Who is the Lord?"* (Mishlei 30:9). For this too is [a kind of] inquiry. So it is with everyone who gazes upon the four things [Chagigah 2:1], and so forth.

And also that I should not be [too sparing] [?] in all my inquiry, for this too brings [?] sloth, and it is what is called "poverty" (*rash*) — meaning one who impoverishes himself of inquiry: it brings him to [error] [?], and to suppose [wrongly] [?] things that are not so — like [the matter of] the souls [?] and [?]. This is what he said: *"lest I become poor and steal, and profane the name of my God"* (Mishlei 30:9) — meaning, to suppose concerning Him something that is not so; and this is what is called "stealing and profaning" [?].

And [he asks to] turn back [?]... [neither poverty nor] wickedness [?]; only the good [?]; and understanding [?]... [*"feed me my allotted bread"*] [?] (Mishlei 30:8) — meaning that I should inquire according to what [is within] [?]... human [capacity] [?], and stand by it; and this is "my allotted portion" (*ḥuqqi*). That is to say [?]... And on account of this, [my] acceptance [?] in inquiry is what [?]... [I shall] proclaim [?]... [with love of] [?] righteousness [?]. [end mark] [?]

[Pencil foliation "95" at the foot of the left-hand page.]

in the portion of [?]... as we wrote there [?]. [...] It is not [fitting] for a man to inquire without any limit; and, moreover, that the intellect not be defiled at all — since it is bounded [?] — [...]. Rather, let inquiry proceed by the intellect only up to a known limit. And this is what is called "righteousness" (*tzedeq*) and "allotted bread" (*leḥem ḥoq*) [cf. Mishlei 30:8]. [...] for this is the limit of which he spoke here: the matter of inquiry set out here is only [according to the measure of] man [?]; and before [...] [?].

[...] [the foundation / the rock] [?]. But as for the other inquiry spoken of here, it is the inquiry of the human intellect [?]. Here [belongs] the term "perfection" (*shelemut*) — that one is able to investigate an intelligible — as we wrote concerning the object of desire (*ba-ḥashuq*) [?], and so forth. And the sign of the matter is that this inquiry, which we have transmitted here, is [meant] for a man to become truly a man [?] [...]. And he says that this inquiry spoken of here — if a man pursues after [?] continually and does not guard [himself], and does not [...] [?] — will in any case bring him to heresy (*kefirah*). This is what is said in the Torah: **"and you shall not go about after your own heart,"** and so forth [Bamidbar / Numbers 15:39] — that he not act as Aristotle did, together with the disciples and those who occupy themselves after him [?]. [...] [as it were, from the

words of the prophecies] [?] — for the Creator, may He be exalted, is not [corporeal / thus] [?], as it is said [Scripture — unidentified] [?]; for in [His] uniformity [?]... [He is] unique in His essence alone, admitting no division whatsoever.

Blessed is the Lord forever, Amen and Amen.

[Enlarged display rubric] The author says: As we wrote in the first treatise of [the section on] the divine science [the metaphysics] [?], concerning what Aristotle said [?] — [and] just as we give thanks to one who is above us [a benefactor] for [furnishing us] even a small premise [?], obliging us to preserve anything whatsoever (*kol dehu*) [Aramaic], since without the prior the posterior would not come to be — and if [such a benefactor] is [so] good, how much more must we, the adherents of the holy and true faith, give thanks to the One who is above us. Therefore I acknowledge [before You] and affirm —

— that the honored treatise, the Book of the Guide [of the Perplexed] [?]... there is written that which [blazes / is elucidated] [?] before the eyes in the books of the philosophers, until this undertaking came into my hand [?]. And it declares in truth that the intent of its author was not [what some have supposed] — he being the sage, the divine philosopher, the great Rav, our lord, our Gaon, our teacher and our master, **[enlarged display script] Moses son of the Rav, the Dayyan, Rabbenu Maimon, the Sephardi** [followed by an honorific abbreviation, unread [?]] — but rather to bring back and restore whoever has erred in the words of Aristotle, so that he hold fast to our holy Torah; and not to suppose [...] [?] as some people of [our] generation have supposed, and as some of them have imagined concerning his honored work, the Book of the Guide of the Perplexed, regarding the matter of inquiry [?] [...].

[Enlarged display initial] This is [borne out by] what is said: **"Ten cubits from the one brim to the other... and a line of thirty cubits did compass it round about"** [1 Melakhim / 1 Kings 7:23]. Now, lest you say — and infer from this — that the circle [i.e., its circumference] is exactly three [times the diameter] [?], the matter is not so; for it has already been demonstrated that it is three and about one-seventh of the diameter. Therefore the encompassing line [circumference] must be more than thirty-one [cubits] [?]; and this is why it is written *v'qaveh* [וקוה, with a *heh*], as [...] [?]. And if you wish to derive from this very verse how much [greater] the circumference is than the diameter itself, you proceed in this way. We must say that the measure of that diameter was ten [cubits] together with the thickness of the [molten] sea — which was a handbreadth on this side and a handbreadth on that [...] [?] — and the encompassing line was [measured]

from within, the thickness not being reckoned in the total. And so they said in tractate Eruvin [14a]: **"when he reckons, he reckons from the inside"** [Aramaic]. Yet even this is not [exact] [?]; [...] [?] apart from the reckoning of the walls [the thickness]. And we say that [...] [?] a finger, and you reduce this [figure] — [as] Scripture wrote *v'qaveh* with a *heh* — meaning that the encompassing line around it was five fingers [?]: the thickness of the wall four, and [...] one [?]; [...] therefore there is subtracted five fingers on this side and five fingers on that, which are two handbreadths and a half [?] [...].

[Pencil foliation "96" at the foot of the second page.]

Judah ben Solomon HaKohen. Witness: Parma 2769 (NLI Ktiv; scribe Sasson ben Menashe). Sephardic semicursive hand; clear at native resolution. Foliation (pencil): this opening carries "97" at the foot of the second page.

[continuation of the molten-sea computation]

Let the diameter of the cavity of the sea be fifty-seven and a half handbreadths — for the cubit was six [?] handbreadths — and the encompassing line [circumference] one hundred and eighty [?] handbreadths [numeral: ? — the trailing figure is uncertain], which is a whole and a seventh of forty-seven [?] approximately. That is to say: had the encompassing line been one hundred eighty-one (קפ״א) [?] less three-sevenths and a seventh of the diameter exactly, [it would fit]; but he made it out to have only one hundred and eighty [handbreadths] alone. Therefore it is less than one hundred eighty-one [?] according to this approximation, which cannot be brought to an exact close.

And this reckoning is more precise (*metzumtzam*) than that of Ptolemy, which he mentioned in the treatise — [namely] what is in the book of the *Almagest* (מגסטי [Arabic: al-Majisṭī]) concerning eclipses, when he spoke at the time of the eclipse and said, in this version, that the diameter line is one part of three parts and eight [minutes] and a half [i.e., Ptolemy's ratio 3;8,30] of the circumference.

And likewise we can say [?] that, [taking] a cubit of four handbreadths [?], he states: the width of the cavity is nine and a fifth cubits and the encompassing line thirty [cubits]; and this is close to the steps of reasoning that a certain discerning man made. For he said: make the encompassing line like it [?], and the line [...] [?]; and it is a line like it. If you multiply thirty by its own kind [30 × 30], they come to nine hundred, and their tenth is ninety; and [take] nine [?], and divide [...] [?] approximately.

Blessed be the Merciful One, who has helped us. [Aramaic: *barukh raḥamana de-sayye'an* — a section-closing formula]

[Enlarged display lemma] "And Moses was a hundred and twenty years old when he died; his eye was not dim" [Devarim / Deuteronomy 34:7].

"His eye" — meaning his very self (*atzmo*); and "[nor his freshness fled]" [?] — meaning that his essence did not change; his essence, and nothing whatever was diminished from it, as it is said [...] [?]. "His eye" — for his essence was, toward perfection, ever increasing until the day of his death. And when it reached that [final] moment — it being impossible in the course of nature to add anything further — [he passed] at once [?] to that perfection; and that moment was the point of equalization between this [worldly] perfection and the perfection to come, [...] [?] when he reached his end-goal (*takhlit*) and its inquiry [was complete] [?].

[...] [?] the Holy One, blessed be He, wished to grant [him] merit at that very moment and to raise him to his [true] rank, so that — God forbid — his remaining together with his soul should not any longer [entail] anything diminished from his essence. Therefore He raised him up at that moment [...] [?], and this is the exaltation of man; it is the end of ceasing [from labor] in this world and the beginning of [...] judgment [?] in that [other] world. And like it is what R. [?] [rashag / Rasag?] said upon the verse **"But the path of the righteous is as the light of dawn, that grows ever brighter until the full day"** [Mishlei / Proverbs 4:18].

Be strong and blessed [?]; forever, amen and amen.

[beginning of the Second Part: Euclid's *Elements*]

[Vocalized display heading; motto from Mishlei / Proverbs 1:2]

"To understand words of understanding" — The Second Part of the book *Midrash ha-Ḥokhmah*: a summary (*kelalot*) of the *Book of the Elements* (*Sefer ha-Yesodot*) of Euclid.

He set down [?] at the opening of his book forty-six [?] premises [definitions]; and these are they:

First: The point (*nekudah*) is that which has no part.

Second: The line (*qav*) is length without breadth, and its two ends are two points.

Third: The straight line (*qav yashar*) is that which lies evenly stretched (*ha-matuaḥ*) in the correspondence of each of the two points at its two ends, the one opposite the other.

Fourth: The surface (*shatuaḥ*) is that which has length and breadth only; and the ends of the surface are lines.

Fifth: The plane surface (*ha-shatuaḥ ha-matuaḥ*) is that which lies evenly stretched in the correspondence of the lines at its two ends, part to part.

Sixth: The angle (*zavit*) is when there is an inclination of two lines, the one toward the other, and they meet upon a surface but their joining is not upon a straight [line].

Seventh: When the two lines enclosing the angle are straight, that angle is called a rectilineal angle (*zavit yesharat ha-qavin*).

Eighth: When a straight line stands upon a straight line and the adjacent [?] angles on the two sides of the line come out equal to one another, each of them is a right angle (*nitzevet*).

Ninth: The line standing upon the [other] line is called perpendicular (*nitzav*) to the line upon which it stands.

Tenth: The angle that is greater than a right angle is called obtuse (*mervaḥat*), and the one smaller than a right angle is called acute (*ḥadah*).

Eleventh: The boundary (*gevul*) is the extremity of the thing.

Twelfth: The figure (*tzurah*) is that which is surrounded by a boundary or by boundaries.

Thirteenth: The circle (*ha-ʿagulah* [scribal form, with a nun-like gimel]) is a figure surrounded by one line, which is called the circumference (*ha-qav ha-mesovev*); and within the circle there is a point, [and] all the lines going out from [that point] to the circumference are all equal to one another; and the center (*merkaz*) of the circle is that point.

Fourteenth: The diameter (*alakhson*) of the circle is a straight line passing through its center and touching [the circumference at both ends] [?] [and dividing it into two halves].

[The] semicircle (*ḥatzi ha-ʿagulah*) is the figure surrounded by the diameter of the circle and half of the circumference. [The definition-number is not clearly inked at this point.]

[The definitions continue onto the following folio.]

Midrash ha-Ḥokhmah — The Second Part (Euclid's *Elements*, Book I)

[16] [continuation of the preceding definition] …or smaller than it.

[17] Rectilinear figures (*ha-tzurot ha-yesharot ha-qavin*) are those enclosed by straight lines.

[18] Among them is the three-sided figure, which is that enclosed by three lines.

[19] And among them the four-sided, which is that enclosed by four lines.

[20] And among them the many-sided [?], which is that enclosed by more than four lines.

[21 (?)] Of the three-sided figures: among them is the equilateral triangle (*ha-meshullash shaveh ha-tzelaʿot*), which is the one whose three sides are equal to one another.

[22 (?)] And among them the isosceles (*shaveh ha-shoqayim*, "equal-legged"), which is the one only two of whose sides are equal.

[23 (?)] And among them the scalene (*meshunneh ha-tzelaʿot* [?], "unlike-sided"), which is the one whose three sides — no one of them is equal to another.

And among them the triangle that has a right angle [the right-angled triangle].

[24–25 (?)] And among them the [obtuse-angled? — reading uncertain]; and among them the acute-angled (*ḥad ha-zavit*), which is the one whose three angles are acute.

[26] And the four-sided figures: among them is the square (*ha-meruba*), which is the one whose sides are equal and whose angles are right.

And [among them] the oblong (*ha-maʾarikh*, the rectangle), which is the one whose angles are right but whose sides are unequal.

And among them the rhombus (*meʿuyyan*), which is the one whose sides are equal but whose angles are not right.

And there is the one resembling the rhombus (the rhomboid), which is the one whose opposite sides and angles [are equal] only, but not all of whose sides are equal and whose angles are not right.

And whatever is other than what we have mentioned is called a *netuyah* (trapezium / "slanted [figure]").

And the parallel lines (*ha-qavin ha-negdiyyim*) are the lines that lie on one surface and that, if they are produced in both directions, do not meet — even if they are extended to no end [infinity].

[The postulates.] And he requested at the outset [that one be granted] five things, and these are they:

That one may draw a straight line from any point to any point.

And that one may produce the given finite straight line [continuously] in a straight direction without end [?].

[The remaining postulates run to premise **[39]** at the foot of the recto; several of their numerals and some wording are at the limit of legibility on the scan and are not committed here.]

[39] […] …two straight lines do not enclose an area.

[40] Things each equal to one [same] thing — each of them is equal to the other.

[41] And if [something] equal is added to [something] equal, the whole [sum] is equal.

[42] And if [something] equal is subtracted from [something] equal, the remainder that is left is equal.

[43 (?)] And [if unequal is added] to equal [?], the whole is unequal.

[44] Things each of which is the double of one thing, or each of which is the half of one thing — each of them, too, is equal to the other.

[45] And everything that is laid [superposed] one upon another and coincides, neither exceeding the other — it is equal to the other.

[46] The whole is greater than the part.

Proposition I.1

He wished to explain how one constructs an equilateral triangle upon a given straight line — namely **אב**.

We describe, upon center **א** and at the distance **אב**, a circle; and we describe, upon center **ב** and at the distance **בא**, a circle [**גדב** (?)]. From the point of intersection we draw the sides — namely **גא** and **גב** — [together with] line **גב**. Now we say that the triangle **אבג** is [equilateral], just as we wished.

And the confirmation [*ha-motav* (?)] rests upon the premise that… and upon premise [45 (?)] …

Diagram. Two equal overlapping circles (the *vesica* figure) sharing the common radius **אב**; the left circle centered on **א**, the right on **ב**. A triangle is inscribed on the base **אב** with its apex at the upper point where the two circumferences intersect. The construction of Proposition I.1.

- א (base endpoint): center of the first circle
- ב (base endpoint): center of the second circle
- ג (upper intersection of the two circumferences): apex of the equilateral triangle
- ד [?] (lower intersection of the two circumferences)

Proposition I.2

[He wished to explain] how one draws, from a given point, a line equal to a given line.

upon center **ל** [?] and at the distance **דם** [?] …[the circle] **ה** [?]… Now we say that line **אב** is [equal to the given line], just as we wished. And the confirmation is by the premise that [two straight lines do] not [enclose an area] [?], and by premise [45 (?)], and by the first figure.

Diagram. A large circle with an inscribed triangle (apex at the top), and a smaller circle tangent to / overlapping the triangle near its lower-left vertex. The construction of Proposition I.2.

- א [?] (apex, top of the figure)
- ב [?] (lower vertex)
- ג [?] (lower vertex)
- ד [?] (on the small circle / near the base)
- ה [?] (on the small circle)

[More than two labels are uncertain]

Proposition I.3

[He wished to explain how,] given two lines, one cuts off from the longer line — **אב** — [a portion] equal to the shorter line, **ל** [?]. It meets at the point [?]… [and produces] a line equal to line **ל** [?], namely **אה** [?].

Diagram. A circle with its center marked; two radii drawn to the center and a horizontal line running out to the left from the circumference. The cutting-off construction of Proposition I.3.

[More than two labels are uncertain]

[The lower portion of the folio side is blank.]

[Script: Sephardic semicursive, one clear brown-ink hand; construction figures and the base-lines of the triangles are drawn in a lighter red-brown ink. Each proposition is numbered only by a single overlined letter in the outer margin (ד =) 4, ה = 5, ו = 6, ז = 7, ח = 8, ט = 9, י = 10, יא = 11, יב = 12 — the continuation of the Book I proposition-count begun in the prior opening (I.1–I.3). There are no display or red-ink rubrics.]

[The internal back-references in the proofs confirm the numbering: I.5 is proved "by the fourth figure," I.7 is invoked in I.8's proof as "the seventh figure," and I.9, I.11, I.12 are each proved "by the eighth figure" — so ד…יב correspond to Euclid *Elements* I.4…I.12.]

[Completion of Proposition I.3, from the foot of the previous opening.]

and we describe, at the distance **אב**, the circle **דהג** [?]; therefore line **א[?]** [is equal to the shorter line], just as we wished. And the demonstration rests upon [the ? tenth] figure [?] and upon the truth of the premises that [?]… and [premise] four [?]…

Proposition I.4 [margin: 4 = ד]

When the sides **אב**, **אג** of triangle **אבג** are equal to the sides **דה**, **דז** of triangle **דהז**, each to the one corresponding to it, and angle **א** is equal to angle **ד** — we say that base **בג** will be equal to base **הז**, that angle **ב** is equal to angle **ה** and angle **ג** [equal] to angle **ז**, and that triangle **אבג** is equal to triangle **דהז**.

The demonstration: when the straight lines and the figures are superposed one upon another, [each] upon [a figure] equal to it, the one will not exceed [the

other]; [thus] line **בג** [falls] upon line **הז**, since they are straight lines, and two straight lines do not enclose an area [between them]. [This rests upon] premise [45 (?)].

Diagram. Two triangles drawn side by side (the left one and, to its right, the second), each on a horizontal base, apex above — the two congruent triangles **אבג** and **דהז** of the side-angle-side proposition. The figure-internal letter-labels are very small and are not securely legible even under magnification; the prose names them **אבג** (sides **אג ,אב**; base **בג**; angle **א**) and **דהז** (sides **דז ,דה**; base **הז**; angle **ד**).

- apex and base vertices of the right-hand triangle: labels not securely legible [?]
- apex and base vertices of the left-hand triangle: labels not securely legible [?]

[Figure-internal labels illegible; the label-set is supplied by the prose.]

Proposition I.5 [margin: 5 = ה]

Triangle **אבג** is isosceles (equal-legged). We say that the two angles **ב, ג** which are upon the base are equal; and also, [when the equal sides are produced,] the [angles] beneath the base are equal.

The demonstration: we produce the two lines **אב, אג** to **ד** and to **ה** [?]; [we cut off equal segments and] we take points **נ**[?]; and we join line **נ[?]**; and angle **א** [being common,] equal to [angle] **ה**[?] … triangle **א[?]** [equal to] triangle **א[?]**; therefore, by the demonstration of the fourth figure [I.4], angle **אגד** is equal to angle **אבה**, and [what remains ?]… angle **זגב** [?] is equal to angle **חבג** [?]. And then the two lines **בג**[?]… By the same demonstration, angle **זבג** [?] is equal to angle **חב[?]**; and there remains angle **אבג** equal to angle **אגב**.

Diagram. A tall triangle with its two sides produced downward below the base, and internal lines crossing in an X between the produced legs — the classic isosceles-triangle ("pons asinorum") construction. Figure-internal labels are faint and not securely legible; the prose names the apex **א**, the base vertices **ב** and **ג**, the produced points **ד** and **ה**, and interior points **ח ,ז** [all readings uncertain in the figure itself].

- apex: label not securely legible [?]
- base and produced-leg vertices: not securely legible [?]

[Figure-internal labels illegible]

Proposition I.6 [margin: 6 = ו]

We say: [when] angle **ב** is equal to angle **ג**, side **אב** will be equal to side **אג**.

The demonstration: [if not,] we cut off from **אב**, **אג** [the greater, and] we produce [it] by the requisite amount [to] a line equal to **אג**; and that is one side; and we join line **בג** … [?]**קן** [and they] coincide [?]. But we already established that the angles **ב**, **ג** are equal; therefore, by the [reductio,] the smaller triangle **בגד**[?] would be equal to the whole triangle **אבג**, the greater — and this is impossible.

Diagram. A small triangle on a horizontal base, apex above, with a short internal line — the reductio figure for the converse of the isosceles proposition. Figure-internal labels not securely legible [?].

Proposition I.7 [margin: 7 = ז]

On line **אב**, from its two endpoints, two lines **אג**[?] … meet at point **ג**[?]. We say that it is impossible to draw, from those same [endpoints], two other lines that are equal to those [first] lines, each to the one corresponding to it, [meeting] at another point upon the [same] side of line **אב**.

And if you say that it is possible — [that they meet] just as [the first pair] at point **ג**[?] — [a contradiction follows].

Diagram. Two triangles sharing a common horizontal base, one above the other (apex pointing up), illustrating the impossibility of two distinct pairs of equal lines meeting on the same side of a given base. Figure-internal labels not securely legible; the prose names endpoints **א**, **ב** and vertices **ג**, **ד** [uncertain in the figure].

- base endpoints and apexes: labels not securely legible [?]

[Figure-internal labels illegible]

[Completion of Proposition I.7, top of the second folio side.]

and let line **אד** be equal to line **אב**, and line **בד** [equal ?] to line **א[?]**; therefore, by the fifth figure [I.5], angle **אבד** will be [equal] … and then angle **ב[?]**, the greater, will be equal to angle **בגד**, the smaller — and that is impossible.

Proposition I.8 [margin: 8 = ח]

When each of the three sides of triangle **אבג** is equal to [its counterpart] of triangle **דהז**, [each to] the one corresponding to it, we say that the angles of the

one are equal to the angles of the other triangle, each to the one corresponding to it, and that the triangle is equal to the triangle.

The demonstration: we superpose [the one triangle] — line upon [line] — one upon the other, and they coincide. And if you say "no, [they do] not [coincide]" — [then] there would be superposed and drawn, as **ז ,ה[?][?]**, [a configuration] contrary to this, which we demonstrated [to be impossible] in the seventh figure [I.7].

Diagram. Two figures: at the left, a quadrilateral crossed by its two diagonals forming an X; to its right, a plain triangle on a horizontal base. Together they illustrate the side-side-side congruence and its superposition proof. Figure-internal labels not securely legible; the prose names triangles **אבג** and **דהז** [uncertain in the figures].

- vertices of both figures: labels not securely legible [?]

[Figure-internal labels illegible]

Proposition I.9 [margin: 9 = ט]

[To bisect] angle **באג**: we cut off two equal lines **אד ,אה**; and we make upon **דה** an equilateral triangle upon it — **דהז** [?]; and afterward we join **א[ז]**, and thereby the angle **באג** is divided into two halves. For, by the eighth figure [I.8], angle **דאז** [is equal] to angle **האז**.

Diagram. A triangle on a horizontal base with a line drawn from the apex to the base (the bisecting line) — the angle-bisection construction. Figure-internal labels not securely legible; the prose names apex-related points **א**, base **ה ,ד**, and **ז**.

- apex and base vertices: labels not securely legible [?]

Proposition I.10 [margin: 10 = י]

How we bisect line **אב** into two halves: we construct upon it an equilateral triangle, and we bisect [its vertex angle] **נ**[?]; and the [bisecting] line, [dropped to the base,] will be a perpendicular [?] …

Diagram. A triangle on a horizontal base with a line from the apex down to the base — the line-bisection construction (an equilateral triangle whose apex-angle bisector meets the base at its midpoint). Figure-internal labels not securely legible [?].

Proposition I.11 [margin: 11 = יא]

we bisect [it]; from the point **נ**[?] which is on line **אב**, [to erect] a line standing perpendicular upon it: we cut off from the point two equal lines **נה** ,**נד**; and afterward we make upon **דה** an equilateral triangle, and we join **ח**[?]; and by the eighth figure [I.8], **ח**[?] will be the perpendicular.

Diagram. A triangle standing on a horizontal base with a vertical line rising from a point on the base to the apex — the erection of a perpendicular at a point on a line. Figure-internal labels not securely legible; the prose names base-point **נ**, endpoints **ה** ,**ד**, and apex **ח**.

- base point and apex: labels not securely legible [?]

Proposition I.12 [margin: 12 = יב]

How we draw, from a point [not on] a line whose measure is unbounded — namely **אב** — a perpendicular **[to it]**: we set upon one side of line **אב** a point **נד**[?]; and [we describe] upon **בג**[?] … and at the distance **נ**[?] we make the circle **דה**; and we bisect **ה**[?] into two halves, and we join **ג**[?], and it is as we wished, as will be stated at length. And it is proved by the eighth figure [I.8]; and by the truth of the premises **[?]** … and the ninth [figure ?].

Diagram. A circle crossed by a long horizontal line (the given unbounded line **אב**) that passes through it as a chord/diameter, with a point marked above at the top of the circle and a short line dropped from it to the horizontal — the dropping of a perpendicular from an external point to a line. Figure-internal labels not securely legible; the prose names line **אב**, the external point, and the circle **דה**.

- endpoints of the horizontal line and the external point: labels not securely legible [?]

[Figure-internal labels illegible]

[Librarian foliation "39" [?] pencilled at the lower outer corner of the second folio side.]

[The lower portion of the second folio side is blank below the last line.]

[Euclid, *Elements*, Book I (*Sefer ha-Yesodot*, Second Part) — continuing the sequence of propositions; each is numbered by an overlined single/double letter in the outer margin. The propositions on this opening run I.13–I.22. The construction figures accompany the prose to their right (recto) or left (verso); their interior letter-labels are drawn in faint light red-brown ink and are, in the

great majority of cases, not legibly recoverable — only labels actually visible are transcribed, the rest marked [?].]

Proposition I.13 [margin: 13 = יג]

When the straight line **אב** stands upon the straight line **גד**, [it is stated] that the [two] angles on the two sides are either right angles or [together] equal to two right angles. For if it stands perpendicular, each of them is a right angle. And if it is not a perpendicular, we draw from point **ב** a perpendicular, namely **ב[?]**; then the two angles **[?]** [and] **[?]**, each of them a right angle, and they are equal to the two angles **א[?]ד**, **א[?]ז** [?] … when we draw from the line **אב**, from point **ב** …

Diagram. A short line standing upon a longer horizontal line, forming the two supplementary angles — a line set up on a straight line. Figure-internal labels in faint red ink, not securely legible [?].

Proposition I.14 [margin: 14 = יד]

When from the line **אב**, from point **ב**, we draw two lines on two sides, extended to **[?]** and **[?]**, and the two angles on the two sides of **אב** are [together] equal to two right angles, we say that **ב[?]ד** and **א[?]ג** [lie] in a straight line. For if you say that this is not so, and that instead **[?]** [would be] **ב[?]ג**, then the two angles **א[?]ב**, **א[?]ג** would be equal to two right angles — making the greater [equal] to the lesser, which is impossible.

Diagram. Two lines drawn to opposite sides from a point on a horizontal base, forming adjacent angles — the converse construction (two lines making adjacent angles equal to two right angles are in a straight line). Figure-internal labels not securely legible [?].

Proposition I.15 [margin: 15 = טו]

When the two lines **א[?]ב[?]ג** cross at point **[?]ה**, we say that angle **א[?]ב** equals the opposite angle **ב[?]ג**, and angle **א[?]ד** [equals] angle **ב[?]ג**; and the four angles [together] are equal to four right angles. This will be shown by the complete figure, the tenth [?].

Diagram. Two straight lines crossing at a single point (an X-figure), forming the two pairs of vertically opposite angles. Figure-internal labels not securely legible [?].

Proposition I.16 [margin: 16 = טז]

When we produce the side **א[?]ב[?]ג** in a straight line, the exterior angle **א[?]ב[?]ג** is greater than either of the two [interior] angles within the section [of the triangle]. The proof: we bisect line **א[?]ב** into two halves at [point] **[?]**, and we draw **ב[?]ה** straight until **ה[?]ז** equals **ה[?]ב**; and because the two vertically opposite angles **[?]** are equal … [and] by the four-sided [rectangular] figure … angle **[?]** equals angle **א[?]**; therefore angle **א[?]ד** is greater than angle **א[?]**. And it is shown that it [the exterior angle] is likewise greater than angle **ב**: for we bisect line **ב[?]ג** into two halves, and **א[?]ב** meets [it] at the point of bisection, and we produce it straight until it is [equal to?] **[?]** …

Diagram. A triangle with its base produced beyond a vertex and a line drawn from the apex to (and beyond) the midpoint of a side — the exterior-angle construction. Figure-internal labels not securely legible; more than two labels are illegible [].

Proposition I.17 [margin: 17 = יז]

Any two angles of a triangle together are less than two right angles, because the exterior [angle] is greater than the [interior] one opposite to it; and the exterior [angle] together with **[?]** — whether they [stand together] at one [point] or upon two **[?]** of the triangle — [are equal] to two right angles. Therefore the two interior angles of the triangle are [each pair together] less than two right angles.

Diagram. A right-angled-looking triangle standing on a horizontal base with a line from the apex — accompanying the theorem that any two angles of a triangle are less than two right angles. Figure-internal labels not securely legible [?].

[The lower portion of this folio side is blank below the last line. A pencil librarian mark is faint at the lower outer corner.]

Proposition I.18 [margin: 18 = יח]

If side **א[?]ב** is longer than side **א[?]ג**, then angle **ב** is greater than angle **ג**. And the proof: we cut off **א[?]ה** [equal to the shorter side], … angle **ג[?]**, and we join **ב[?]**; then the two angles **א[?]בה**, **א[?]ב** are equal to one another, and the exterior angle **א[?]ב** is greater than the interior angle; therefore angle **ב** is much greater than angle **ג**. And [the converse] is [proved] within the figure, and it is shown by the returning [converse] proof easily.

Diagram. A triangle with a segment cut off along its longer side and joined to the opposite vertex — the "greater side subtends the greater angle" construction. Figure-internal labels not securely legible [?].

Proposition I.19 [margin: 19 = יט]

[The greater angle of a triangle is subtended by the greater side.] … it is shown by the returning [converse] proof easily.

Diagram. A plain triangle accompanying the converse theorem (the greater angle is subtended by the greater side). Figure-internal labels not securely legible [?].

Proposition I.20 [margin: 20 = כ]

The [two sides] of a triangle, when joined together, are longer than the [remaining, shorter] one. And if [the three sides] are not all three equal … they are not equal, and let the longer be **בּ[?]ג**; we draw **א[?]ל** straight, equal to **ה[?]ג**; then angle **ד[?]** equals angle **א[?]ג**; therefore angle **ב[?]** is greater than angle **ג[?]**. And by the premise set out before it, side **כ[?]ב** is longer than side **ג[?]ב**, and it — **כ[?]ב** — is equal to the two sides **א[?]ג** ,**אב**.

Diagram. A triangle with a side extended and an isosceles construction upon it — the "two sides together greater than the third" construction. Figure-internal labels not securely legible [?].

Proposition I.21 [margin: 21 = כא]

When from the two ends of side **בּ[?]ג** of the triangle **א[?]בּ[?]ג** we draw two lines, and they meet within the triangle at point **ד[?]**, we say that they [together] are shorter than the two lines **א[?]ג** ,**א[?]ב**; yet angle **ד[?]** is greater than angle **א[?]**. [As set out] in the premise before it, we join **ב[?]ה** straight; and in the preceding figure the two lines **ב[?]ה** ,**ב[?]** are longer than **ב[?]ה[?]**, and the two lines **ג[?]** are not longer than **ג[?]**; therefore the two sides **א[?]ג** ,**א[?]ב** are much longer than **ג[?]ה** ,**ב[?]**. And it is shown that angle **ד[?]** is greater than angle **א[?]** in the same figure, since it is greater than the exterior angle **ד[?]** of the triangle **ב[?]ה**, which is greater [still] …

Diagram. A triangle with two lines drawn from the ends of its base to a point inside it — the interior-point construction. Figure-internal labels not securely legible [?].

Proposition I.22 [margin: 22 = כב]

When there are three lines such that any two of them combined are longer than the third: we wish to make a triangle whose three [sides] equal in length these three given lines. We begin by drawing a line **ד[?]** straight; and we set off **כ[?]ה** equal to **ב[?]** the shorter, and **ז[?]ל[?]ג** [and] **ח[?]ל[?]א**; and afterward we describe upon **ה[?]**, at the distance **[?]**, [an arc] that rises [to] **[?]**; and at the distance **ג[?]**, [an arc] that rises [to] **ד[?]ב**; and where they meet — at **[?]** — we say that the triangle **ב[?]ז[?]** is as we wished; and what will be shown by the thirteenth premise …

Diagram. A large circle intersected by a smaller circle, with a base line drawn through both and a triangle inscribed at their intersection — the construction of a triangle from three given lengths by two intersecting arcs. Figure-internal labels not securely legible [?].

[A pencil librarian foliation "100" is visible at the lower outer corner of the second folio side. The lower portion of the second folio side is blank below the last line.]

Proposition I.23 [margin: 23 = כג]

[Enunciation — to construct, at a given point on a given line, an angle equal to a given angle.] We wish, upon the point **ה[?]** of the line **אב**, to make an angle equal to a given [rectilinear] angle. We mark off upon the [given] line two points **[?]**, draw the line **ק[?]** between them, and afterward, upon the line **אב**, construct [a triangle] whose sides are equal [to those of the given triangle]. Then, by the eighth premise [*Elements* I.8], the angle so formed is equal to the given angle — which is what we wished [to make]. Its sides, being equal, make the enclosed angles equal.

Diagram. Two triangles side by side. The left triangle carries an apex label **א[?]**; the remaining vertex labels (base letters near **ה**, **ד[?][?]**) are in faint brown ink and not securely legible. *[— more than two labels illegible.]*

Proposition I.24 [margin: 24 = כד]

[Enunciation — the "hinge" theorem.] When there are two triangles having two sides equal to two sides, each to its counterpart, but the angle enclosed by the two sides of the one is greater than the angle enclosed by the two sides of the other, then the base of the first is longer than the base of the second. We say that the base **בז[?]** is longer than the base **ה[?]**, [the surplus falling] at point **ל[?]**. Since

angle **דח[?]** equals angle **אב[?]**, the base **הח[?]** is as **בז[?]**; and by the fifth figure [*Elements* I.5] angle **דח[?]** is as **דז[?]**, so that angle **[?]** is much greater than angle **הח[?]**. Therefore **הח[?]** is longer than **[?]**, and **[?]** is as **בז[?]**; hence **[?]** is greater than **בז[?]**, as claimed.

Diagram. A four-sided figure with both diagonals drawn (crossing within). The vertex labels are faint and not securely legible [?]. *[— labels illegible.]*

Proposition I.25 [margin: 25 = כה]

[Enunciation — converse of I.24.] When there are two triangles having two sides equal to two sides, each to its counterpart, but the base of the one is longer than the base of the other, then the angle enclosed by the two sides of the first is greater than the angle of the second. [Proof by contradiction:] for if you were to say that one of them [the angles] were not greater — the two remaining [sides] being equal to the two remaining, each to its counterpart, and [the one] angle [equal] to the [other] angle — [it would follow] that one of the bases is longer, [say] from **דה[?]**; and we cut off **בנ[?]** equal to **הד[?]**, and reach a contradiction. Hence the angle is greater, as shown in the fourth figure [*Elements* I.4].

Diagram. Two right-angled triangles set side by side, each with an internal line (cevian/altitude) drawn. Base and apex labels are faint brown and not securely legible [?]. *[— labels illegible.]*

Proposition I.26 [margin: 26 = כו]

[Enunciation — the ASA / AAS congruence theorem.] When there are two triangles having two angles equal to two angles, each to its counterpart, and one side equal to one side — whether the side that lies between the two [equal] angles, or a side subtending one of them — then the remaining sides are equal to the remaining sides, each to its counterpart, the remaining angle is equal to the remaining angle, and the two triangles are equal, one to the other. [If we suppose] one of them longer, as the base **[?]**, we cut off **בנ[?]** as **הד[?]**; then angle **[?]** equals angle **[?]**, and by the fourth figure [*Elements* I.4] a contradiction follows, so they are equal.

Diagram. An elongated four-sided figure (a "plank") crossed by a slanting transversal line, with a faint compass-drawn circle behind it. The endpoint labels (**ה[?]** at the corners) are not securely legible. *[— labels illegible.]*

Proposition I.27 [margin: 27 = כז]

[Enunciation — alternate angles equal imply parallel.] When a straight line falls upon two straight lines and makes the two alternate angles equal to one another, then the two lines are parallel [first occurrence of the term rendered here as "parallel": **נכחיים[?]**, alongside the relational **כנגד**, "opposite/parallel to"]. We say that line **אב** is parallel to line **גד[?]**: for if they were not parallel, they would meet, and the alternate angle **[?]** would be [both] equal to and greater than [its counterpart] — which is impossible. Therefore they are parallel.

Proposition I.28 [margin: 28 = כח]

[Enunciation — corresponding angles / co-interior angles imply parallel.] And if [the line falling upon two lines] makes the exterior angle equal to the interior and opposite angle, or if the two interior angles on the same side [together] are equal to two right angles, then the two lines are parallel. We say that line **אב** is parallel to line **גד**; and the reasoning follows the premise set out before it.

Diagram. Two parallel horizontal lines crossed by a slanting transversal, the intersection points marked. The endpoint labels are faint brown and not securely legible [?]. *[— labels illegible.]*

Proposition I.29 [margin: 29 = כט]

[Enunciation — the converse: parallels cut by a transversal.] Because the two lines are parallel, the straight line falling upon them makes the two alternate angles equal to one another, makes the exterior angle equal to the interior and opposite angle, and makes the two interior angles on the same side [together] equal to two right angles. For [if the alternate angles were not equal], the two interior angles on the same side would be [more or less than] two right angles, and the lines would meet — contrary to their being parallel.

Diagram. Two parallel lines crossed by a transversal (companion to the previous figure). Labels faint and not securely legible [?]. *[— labels illegible.]*

Proposition I.30 [margin: 30 = ל]

[Enunciation — lines parallel to the same line are parallel to one another.] When line **אב[?]** is parallel to line **גד[?]** and line **גד[?]** is parallel to a third line, then the two [outer] lines are parallel to one another. The [transversal] falling upon them makes the alternate angles equal; therefore the outer lines are parallel, as was shown.

Diagram. Three parallel horizontal lines crossed by a single slanting transversal. Endpoint and intersection labels are faint brown and not securely legible [?]. *[— labels illegible.]*

Proposition I.31 [margin: 31 = לא]

[Enunciation — to draw a parallel through a given point.] When we wish to draw, through the given point **[?]** and upon the line **[?]**, a line parallel to a given line: we take upon the line the point **[?]**, draw the line **[?]** from it, and make at the point on the line an angle equal to [the given angle], as we did earlier — [namely] angle **[?]**; and this is [the parallel] we wished [to draw].

Diagram. A small parallelogram-like figure: a short parallel pair joined by a connecting transversal (the parallel drawn through the given point). Vertex labels faint and not securely legible [?]. *[— labels illegible.]*

Proposition I.32 [margin: 32 = לב]

[Enunciation — the exterior-angle / angle-sum theorem.] When one side of a triangle is extended, the exterior angle so formed is equal to the two interior and opposite angles [taken together]; and the three interior angles of the triangle [together] equal two right angles. [The proof draws, through one vertex, a line parallel to the base, so that the alternate angles are equal and] the exterior angle equals the two [interior] angles; therefore, adding the third, the three angles of the triangle are equal to two right angles — as is shown in the [figure] drawn upon the point **[?]**, angle **אב[?]** being as angle **[?]** and angle **הב[?]** as **[?]**.

Diagram. A triangle standing on a base line, with the base extended and a second (smaller) triangle adjacent — the exterior-angle construction, a line drawn through the apex parallel to the base. Vertex labels are faint brown and not securely legible [?]. *[— labels illegible.]*

Sefer ha-Yesodot (Euclid's *Elements*), Book I — Second Part. Propositions I.33–I.43, each with its labeled construction figure. Small Sephardic semicursive; propositions marked only by an overlined numeral in the outer margin (continuing the Book I count from I.32). Scribal quirks in force: gimel written nun-like; tav written tet-like; *משולש* (triangle) and *שטח* (parallelogram/surface) in their scribal forms *שתח* / *משולם*.

[Continuation of Proposition I.32, occupying the first line at the head of the folio side:] And further, if the three angles [of the triangle] are equal to [?], [?] it is

likewise shown that they are equal to [?]. *[First line; several words abraded — reading uncertain [?].]*

Proposition I.33 [margin: 33 = לג]

[Enunciation — the lines joining the extremities of equal and parallel lines, toward the same side, are themselves equal and parallel.] The lines that join [the ends of] the parallels [?] are equal. When we join [line] **אב** to [line] **גד** [?], [the transversal makes] the alternate angles [?] equal, so that line **אב** and **גד** [?] are parallel and equal — as is shown in the figure of the twenty-ninth [proposition]. *[Several construction phrases abraded [?].]*

Diagram. A narrow parallelogram (a pair of equal parallel lines joined by two equal oblique lines). Corner labels are faint red-brown and not securely legible; the prose names the construction letters **גד** / **אב**. *[— figure-interior labels illegible.]*

Proposition I.34 [margin: 34 = לד]

[Enunciation — in a parallelogram the opposite sides and opposite angles are equal, and the diameter bisects it.] When the sides of **אבגד** are equal [and] parallel, [and] the diagonal **אל** [?] cuts it, [it makes] the angles [?] equal; and we make angle **[נ]אד** [?] equal to angle **אלב** [?]. Thus triangle **אנד** [?] equals triangle **אלב** [?], and the diagonal divides [the figure] into two equal parts. *[Interior letter-readings uncertain [?].]*

Diagram. A parallelogram with one diagonal drawn, dividing it into two triangles. Corner labels faint [?]; prose construction letters **אבגד**, diagonal **אל** [?]. *[— labels illegible.]*

Proposition I.35 [margin: 35 = לה]

[Enunciation — parallelograms on the same base and in the same parallels are equal.] When we set **אלבג** [?] and **[?]** upon a single base and between two parallel lines, they are equal — [this is] the foregoing premise; for, by the figure of the twenty-nine[th], the [cut-off] angle equals angle **ג**, the exterior [angle], and by the figure [of the twenty-]four[th proposition] the two [parallelograms] **בד** [and] **אל** [?] [are equal]. *[Chain of letter-references uncertain [?].]*

Diagram. A rectangle/parallelogram with both diagonals drawn (an X inside); below it a right triangle inscribed in a rectangle (the shear construction). Corner and center labels faint [?]. *[— labels illegible.]*

Proposition I.36 [margin: 36 = לו]

[Enunciation — parallelograms on equal bases and in the same parallels are equal.] When the two [parallelograms] אלבג [?] [are] parallel, [standing] on equal bases and between two parallel lines, they are equal; the lines בד חם [?] joining [the ends] fall parallel upon the bases, [which are] equal, and between two parallel lines — so the [parallelograms] are equal; and the demonstration [is as before]. Therefore, by the [preceding] figure, the two [figures] אלבג [?] are equal, each to the other. *[Letter-labels uncertain [?].]*

Diagram. A rectangle with a single diagonal (the equal-base parallelogram construction). Corner labels faint [?]; prose letters include חם, בד [?]. *[— labels illegible.]*

Proposition I.37 [margin: 37 = לז]

[Enunciation — triangles on the same base and in the same parallels are equal.] The two triangles אלבג [and] דבג [?] [stand] upon [the same] base and between two parallel lines; we say that they are equal. By the foregoing [premise] we draw line אל [?] [and complete] the two [parallelograms], setting הב against אל and ום [?] against בד [?]; then, by the preceding figure, parallelogram אהב [?] and בד [equal] דם בג [?], and by the thirty-four[th proposition] triangle אהבד [?] is half of parallelogram אהבג [?], and triangle דבג [?] [is half of] דם בג [?]. Therefore triangle אלבג [?] equals triangle דבג [?]. *[Many interior letters uncertain [?].]*

Diagram. A low trapezoid with an internal X (two triangles on a common base between the same parallels). Corner labels faint [?]. *[— labels illegible.]*

[The lower portion of the folio side is blank below the last line of text.]

Proposition I.38 [margin: 38 = לח]

[Enunciation — triangles on equal bases and in the same parallels are equal.] When the two triangles אלבג [and] דגה [?] [stand] upon equal bases and between two parallel lines, they are equal; for each of them is half of the parallelogram אל בד [and] דה גה [?] [respectively]. *[Interior letters uncertain [?].]*

Diagram. A low trapezoid subdivided by internal lines into two triangles meeting apex-to-apex (a star-like figure) — two triangles on equal bases between the same parallels. Corner labels faint [?]. *[— labels illegible.]*

Proposition I.39 [margin: 39 = לט]

[Enunciation — equal triangles on the same base and on the same side are in the same parallels.] Triangles אלבג [and] דבג [?] are equal and [stand] upon one base, between two parallel lines, [with] line אל against בג [?]. Were we to say [otherwise — that some other line, not] אל [is] against בג — it would follow that triangle אלבג [equals] הבג [?], hence [equal] to דבג [?]; but that is impossible. *[Reductio; interior letters uncertain [?].]*

Diagram. A rectangle with both diagonals (an X inside), representing equal triangles on the same base shown to lie in the same parallels. Corner labels faint [?]. *[— labels illegible.]*

Proposition I.40 [margin: 40 = מ]

[Enunciation — equal triangles on equal bases and on the same side are in the same parallels.] When the triangles are equal upon equal bases [and lie on the same side], [it follows], between two parallel lines, that line אל [is] against בג [?]; and it is impossible [for it to be] otherwise — [proved] by the converse demonstration. *[Interior letters uncertain [?].]*

Diagram. A triangle with internal cevian lines (equal triangles on equal bases, same-parallels construction). Corner labels faint [?]. *[— labels illegible.]*

Proposition I.41 [margin: 41 = מא]

[Enunciation — if a parallelogram and a triangle stand on the same base and in the same parallels, the parallelogram is double the triangle.] When parallelogram אלבג [?] and triangle הגד [?] [stand] together upon one base and between two parallel lines, the triangle is half of the parallelogram; for by the figure of [proposition] thirty-seven [?], triangle הגד [?] equals triangle אל [?], which is half of the parallelogram. *[Interior letters uncertain [?].]*

Diagram. A rectangle with an internal X together with an adjoining triangle (parallelogram and triangle on the same base). Corner labels faint [?]. *[— labels illegible.]*

Proposition I.42 [margin: 42 = מב]

[Enunciation — to construct a parallelogram equal to a given triangle in a given angle.] [We wish] to make a parallelogram equal to the [given] triangle [built] on the parallels [?]; [we make] angle אל [?] equal to angle ג [?], and [the figure so made] is equal to triangle אלבג [?]. [It is] known [?] [that] מב [?], line קובג [?] [is

bisected] into two halves at **הה** [?], and we draw **אל** [?] and construct upon line **הנ** [?], at point **ה** [?], an angle equal to angle **ג** [?]; and [there] is angle **נהם** [?]; we draw out **הה** [?] against **בהנ** [?]. Then, by the preceding figure, triangle **אלבג** [?] [equals] parallelogram **אלבנ** [?], for parallelogram **אלבד הם** [equals] parallelogram **הם נה** [?]; and this is **נה** [?] as triangle **אלבג** [?]. *[Construction highly abbreviated; many interior letters uncertain [?].]*

Diagram. A low trapezoid/quadrilateral with an internal triangle and connecting lines (the parallelogram-from-triangle construction on a bisected base). Corner labels faint [?]. *[— labels illegible.]*

Proposition I.43 [margin: 43 = מג]

[Enunciation — in any parallelogram, the complements of the parallelograms about the diameter are equal to one another.] [In a parallelogram] whose diagonal is [the line through] **אלבנג** [?], the two [parallelograms] about it are parallel; the [remaining] parallel complements filling out the [whole] parallelogram are **אלהם טבחד** [?]; we say that they are equal. For, by the thirty-four[th] figure, triangle **אלבנ** [?] equals triangle **הבה** [?]; and likewise triangle **הם** [?] equals **חם** [?]; and since the parallelogram **טם טב** [?] is equal [on both sides], the complement **אלהם כב** [?] equals **טב חד** [?]. *[Complement-letters uncertain [?].]*

Diagram. A rectangle crossed by its diagonal and subdivided by a horizontal and a vertical line meeting on the diagonal, forming the two parallelograms about the diameter and the two complements. Several corner and interior labels are faint red-brown; visible marks at the corners and at the diagonal's crossing point are not securely resolvable [?]. *[— labels illegible.]*

[Pencil librarian foliation "102" is visible at the lower outer corner of the second folio side. The lower portion of that folio side is blank below the last line of text, which ends within Proposition I.43.]

[Continuation of the proof of the preceding proposition (I.43 [margin: 43 = מג]).] …we obtain; there remains figure **אהה** [?] equal to figure **חלז** [?] **זב** [?].

Proposition I.44 [margin: 44 = מד]

[Enunciation — to apply to a given straight line a parallelogram equal to a given triangle, in a given rectilinear angle.] To construct upon line **אב** a right-angled figure [שטח נצב הצלעות — a rectangle/parallelogram] [?] whose sides are equal [to the figure], equal in area to triangle **נגה** [?], and whose angle is equal to angle **ז** [?]: we draw out line **אב** as far as **ח** [?], and construct upon line **בח** [?] a figure

equal [to the triangle]. *[The construction is heavily abbreviated; several interior letters are uncertain [?].]*

Diagram. A long, low rectangle divided near its right end by a vertical line into a small cell and a larger field (the parallelogram applied to the given line, with the given triangle drawn below). Corner and divider labels are faint red-brown; the marks I can resolve are:

- top-right corner: **ד** [?]
- at the vertical divider: **ח** [?]
- lower-right / lower-middle: **ב** ,[?] **ה** [?]
- top-left corner: **ז** [?]

[— more than two labels illegible.]

Below the rectangle stands the given triangle, drawn with small marks at its three vertices [?].

Then — its sides being equal, and its angles equal — we draw out line **אבּ** [?] **קוּ** as far as **ח** [?] and construct upon line **קוּ** [?] a figure **בחּ** [?] equal [to the given triangle]. *[Interior letters uncertain [?].]*

Proposition [I.45] [margin: 45 = מהּ]

[This proposition, numbered 45 in the margin, corresponds in content to Euclid, *Elements* I.46 — to describe a square upon a given straight line. Standard I.45 appears to be absent from this recension; see the numbering anomaly below.]

[Enunciation — upon a given straight line to construct a square.] …in the placement of the preceding figure [?]: when we wish to construct a square [שטח מרובע] upon line **אבּ**, we draw from point **א** a line **אגּ** equal to **אבּ**, and erect [a perpendicular] upon it in the placement of the second figure; and after it is made, we likewise draw from point **ג** [a line] parallel to **אבּ**, and from **ג** a line parallel to **אגּ**, which is **בדּ**. Thus the square is made, and its placement has been explained by what preceded.

Diagram. A small square with a diagonal, its four corners labeled. The resolvable corner marks are:

- upper corners: **ו** ,[?] **ד** [?] (or **נ** [?])
- lower corners: **ב** ,[?] **א** [?]

[— corner labels faint; the diagonal-cross labels are not securely resolvable [?].]

Proposition [I.47 — the Pythagorean theorem] [margin: מו״ = 46 [?]]

[This proposition, marked 46 in the margin, corresponds in content to Euclid, *Elements* I.47 — the Pythagorean theorem; from here the margin numbering runs one behind the standard count. See the numbering anomaly.]

[Enunciation — in a right-angled triangle, the square on the side subtending the right angle equals the sum of the squares on the sides containing the right angle.] When triangle **אבג** is right-angled, we say that the square [on the side subtending the right angle] equals, taken together, the squares **בס** [?] **נט** [?] [erected] on [each of] its [other] sides. For line **אב** [?] and line **[אב]** [?] are one, laid as base beneath the two [squares] [?]; angles **הא** [?] which serve [?] on the two sides of line **אג** [?] are each of them right; and we draw **אמל** [?] parallel to **בג** [?] and join **אל** [?]… *[The chain of point-letters in this proof is heavily overlined and abbreviated; interior letters are largely uncertain [?].]* …in its placement, since angle **אבג** [?] is equal to angle […], each of the two [squares] is equal [to the corresponding rectangle], and so the square **אג** [?] on side [the hypotenuse] is equal to the two squares **בד** [?] together.

Diagram. The distinctive "windmill" figure of the Pythagorean theorem: a central right triangle with a square erected outward on each of its three sides (the two smaller squares on the legs set at a slant to the upper left and upper right, the larger square on the hypotenuse below), crossed by the internal construction lines from the apex. Labels are faint red-brown; the marks I can resolve are:

- apex / upper vertices of the leg-squares: **ה** ,[?] **ד** [?]
- base vertices of the triangle: **ג** ,[?] **ב** [?]
- right-angle vertex: **א** [?]
- lower square corners: **ח** ,[?] **ז** [?]

[— more than two labels illegible; the interior construction-line labels are not securely resolvable.]

Thus line **לג** [?] equals line **בד** [?]; and by the placement, the two [squares] on the sides **אג** [?] equal the square **בג** [?] on the [hypotenuse]. And the matter is proven: line **לג** [?] and the two squares… *[reading of the closing letters uncertain [?].]*

Therefore square **מל** [?] — the placement — is equal to the two squares on line **אב** [?], and the square on line **דג** [?] together with the square **אג** [?] [equal] the square on line **בג** [?]. And so it is [likewise] proven for the remaining side **אג** [?] **טב** [?]. *[Interior letters uncertain [?].]*

Proposition [I.48 — the converse] [margin: 47 = מז]

[This proposition, marked 47 in the margin, corresponds in content to Euclid, *Elements* I.48 — the converse of the Pythagorean theorem. Book I closes here in this recension, at proposition 47.]

[Enunciation — if in a triangle the square on one side equals the sum of the squares on the remaining two sides, the angle contained by the remaining two sides is right.] …the square נבּ [?] [is] again like the square [on] the [two] sides נאּ אבּ [?] [?], [then] that one angle is a right angle. We draw אד equal to אבּ, and make angle נאבּ [?] a right angle, and join דג [?]; and the matter is evident [?], for the two squares נאּ אבּ [?] are like the two squares נאּ אד [?]. Therefore square נג [?] is like square נבּ [?]; therefore line נג [?] equals line נבּ [?]. And we prove [the proposition]: since that angle נאבּ [?] is like angle נאד [?], and angle באד [?] is a right angle, therefore angle נאבּ [?] is a right angle.

Diagram. A triangle with an internal line (altitude/erected perpendicular) dropped from the apex to the base, dividing it into two parts (the converse-construction figure). Resolvable labels:

- apex: א [?]
- base vertices: ב [?], ג [?]
- foot of the internal line: ד [?]

[— apex and interior labels faint.]

המאמר השני — [The Second Treatise = Euclid, *Elements*, Book II]

[Display heading in enlarged black script, centered on p. 224.]

[Definitions.] Every figure equal-sided and right-angled [שטח שוה הצלעות ונצב הזויות — a rectangle/right-angled parallelogram] is enclosed by its two lines, the [pair] enclosing [its] right angle [?]. And in every figure, [the parallelogram about the diagonal together with the two complements filling it out] — that whole is called [a gnomon] [?].

[Proposition II.1] [margin: 1 = א]

[Enunciation — if there are two straight lines and one of them is cut into any number of segments, the rectangle contained by the two lines equals the sum of the rectangles contained by the uncut line and each of the segments.] We say that

the two figures [rectangles] which stand upon its diagonal [?] and the remaining [rectangle]… are reckoned such that when one of them is added to the other [?]… the completing figures which stand upon the two sides of the diagonal — the whole of them is [equal to the rectangle]. Line אבג [?] is divided at its divisions בד דה הג [?]; we say that the [rectangle contained] by נא with בג [?] [equals] the [sum of the rectangles contained] by א with each one of בד דה הג [?] taken together. For we draw line חט [?] נא [?] and נה [?] at right angles, and each of them is equal to line א [?]; therefore the matter is seen: that the figure נה [?] is the [product] of בג [?], and figure נה [?] is one [product] with בד [?], and figure דג [?] is one [product] with בג [?], and figure בה [?] is one [product] with בד [?], and figure הה [?] is one [product] with הג [?]. *[Interior letters heavily abbreviated and largely uncertain [?].]*

Diagram. A tall rectangle divided by vertical lines into several adjoining cells (the whole line cut into segments, with the rectangles standing on each segment). Resolvable corner/divider labels:

- ז [?], ה [?] along the top
- ד [?], ב [?] along the bottom

[— cell-divider labels faint.]

[Proposition II.2] [margin: 2 = ב]

[Enunciation — if a straight line is cut at random, the sum of the rectangles contained by the whole line and each of its two segments equals the square on the whole line.] Line אב is cut at part בה [?] (that is, at נ [?]); we say that the [product] of אב by itself [the square on the whole] equals the [sum of the rectangles] by [the whole with] each of the [segments]. And the matter is evident [?].

Diagram. A wide rectangle divided by a single vertical line into two cells (the square on the whole line partitioned according to the two segments). Resolvable labels:

- ז [?], ה [?] at the top
- ב [?] at the lower corner

[— labels faint.]

[Proposition II.3] [margin: 3 = ג]

[Enunciation — if a straight line is cut at random, the rectangle contained by the whole and one of its segments equals the rectangle contained by the two segments together with the square on the aforesaid segment.] Upon line אב [we make] a square, and then we draw within it line נם [?] as a perpendicular [?]; line אב is divided into its two parts at נ [?]. We say that the [rectangle contained] by אב with [one segment] equals [the rectangle contained] by אנ בנג [?] together with the [square] of אג [?] by itself, taken together. We draw a perpendicular אד [?] [parallel] to אנ [?], and likewise we draw [another]; and it is plain that the whole figure בד [?] — which is the [product] of אב by אנ [?] — comprises figure נב [?], the [product] of אנ by itself, and figure נה [?], which is the [product] of אנ by נד [?]… *[The proof breaks off here; interior letters largely uncertain [?].]*

Diagram. A wide rectangle divided into cells by internal lines (the square-and-rectangle decomposition of II.3). Resolvable labels:

- ז ,[?] ה [?] along the top
- ב [?] at the lower corner

[— interior labels faint.]

[Pencil librarian foliation "103" is visible at the lower outer corner of this folio side. The lower portion of the folio side is blank below the last line of text, which ends within Proposition II.3.] ### [Proposition II.4] [margin: 4 = ד]

[Enunciation.] Line אב (AB) is divided into two parts at ג (C). We say that the square on אב (AB) equals the two squares on אג (AC) and גב (CB) taken together with twice the rectangle contained by אג (AC) and גב (CB).

[Construction and proof.] We construct the square upon [line AB], and we draw the perpendicular גח [?] (CḤ); we join [a line] equal to בג [?] (BC), draw a further perpendicular, and complete [the figure]. Since the figure is so drawn, the matter is evident: that the square הד [?] is the square on [one segment] by itself, and the square בם [?] is the square on בג [?] (BC) by itself; and the two areas [?] [?] are equal — by the [?]th proposition of Book I [the reading of the citation-numeral is uncertain; the equality of complements is Elements I.43] — and each of them is the rectangle contained by אג (AC) and גב (CB). The totality of the four areas — the whole of this square — is the square on אב (AB) by itself. *[Interior figure-letters largely uncertain [?].]*

Diagram. A square with a diagonal drawn from the upper-left to the lower-right corner, its sides subdivided by internal lines into two smaller squares and two equal rectangles (the gnomon decomposition of II.4). Resolvable faint red-brown labels:

- **ז** ,[?] **ה** [?] along the top edge
- **ד** [?] on the right side
- **ה** ,[?] **ב** [?] along the bottom

[— more than two interior labels illegible.]

[Proposition II.5] [margin: 5 = ה]

[Enunciation.] Line **אב** (AB) is bisected at **ג** (C) and cut into two unequal parts at **ד** (D). We say that the rectangle contained by **אד** (AD) and **דב** (DB), together with the square on **גד** (CD) by itself, combined, equal the square on **גב** (CB) by itself.

[Construction.] We construct upon **גב** (CB) the square [?], and we return within it the square [?]… *[the interior letter-chain of the construction is largely uncertain [?]].* And line [?] equals **דב** [?] (DB); and because [the complement about the diagonal is equal], the area [?] upon the diagonal is as [?].

Diagram. An elongated horizontal rectangle with a diagonal, and a small square set at the lower-left within it (the square-on-the-half with the rectangle of the unequal segments). Resolvable labels:

- **ז** / [?] **ד** [?] at the top left
- **ם** [?] within the figure
- **ב** [?] at the lower corner

[— interior labels faint.]

[Proposition II.6] [margin: 6 = ו]

[Enunciation.] Line **אב** (AB) is bisected at **ג** (C), and the line **בד** (BD) is added in a straight line along its length. We say that the rectangle contained by **אד** (AD) and **דב** (DB), which equals [together with the square on **גב** (CB) by itself] the square on **גד** [?] (CD) by itself.

[Construction.] The square **מה** [?] is the square on [the whole] by itself, and it comprises all these areas… *[the interior construction letters are largely uncertain [?]].* And all these areas make the square **לה** [?], which is as the square [on CD] by itself; and this is what we wanted.

Diagram. A horizontal rectangle with internal partition lines and a small loop/circle mark at the right end (the added-line construction of II.6). Resolvable labels:

- **ז** / [?] **ד** [?] at the top left
- **ם** [?] within the figure
- **ב** [?] at the lower corner

[— interior labels faint.]

[Proposition II.7] [margin: 7 = ז]

[Enunciation.] Line **אב** (AB) is cut into two unequal parts at **ג** (C). We say that the square on **אב** (AB) by itself and the square on **בג** [?] (BC) by itself equal what results from twice the rectangle contained by **אב** (AB) and **בג** (BC), together with the square on **אג** (AC) by itself.

[Construction.] For as a side we set the square **בם** [?]… *[interior construction letters uncertain [?]].* Therefore the two areas **בם** [?] and **הס** [?] are as twice the rectangle **אב** (AB) by **בג** [?] (BC), and the square **לה** [?] is the square on **אג** (AC) by itself; and comprising all these areas is the square **בד** [?], which is the square on **אב** (AB) by itself.

Diagram. A square with a diagonal drawn corner-to-corner and internal subdividing lines (the II.7 decomposition). Resolvable labels:

- **ז** ,[?] **ה** [?] along the top
- **ה** [?] on the right
- **ב** [?] at the lower corner

[— more than two interior labels illegible.]

[Proposition II.8] [margin: 8 = ח]

[Enunciation.] Line **אב** (AB) is divided into two parts at **ג** (C), and they add along its length the line **בד** (BD) equal to **בג** (BC). We say that four times the rectangle contained by **אב** (AB) and **בג** (BC), together with the square on **אג** (AC) by itself, combined, equal the square on **אד** (AD) by itself.

[Construction and proof.] We mark within it the areas [?]… *[interior construction letters uncertain [?]].* And the matter is evident, that all [the gnomon] is the rectangle **אב** (AB) by **בג** (BC) four times, and the square **סם** [?] is the square on **אג**

(AC) by itself; and comprising all those areas is this square [on AD]. And this is what we wanted.

Diagram. A large square with a diagonal, several vertical dividing lines, and a circle/loop mark at the lower-right corner (the four-rectangles-and-square figure of II.8). Resolvable labels:

- **ח** [?] at the upper-left corner
- **ם** ,[?] **ם** [?] stacked on the left side
- **ד** [?] at the foot

[— interior labels faint.]

[Proposition II.9] [margin: 9 = ט]

[Enunciation.] Line **אב** (AB) is bisected at **ג** (C) and cut into two unequal parts at **ד** (D). We say that the square on **אד** (AD) by itself and the square on **דב** (DB) by itself are as twice the square on **אג** (AC) [by itself] and the square on **גד** (CD) [by itself], combined.

[Construction and proof.] We erect the perpendicular [at C] equal to [half the line]… and we draw [the joining lines]. Since angle **ג** (C) is right, and the two angles at [the base] are [equal] — right, because the angles of the triangle [sum to two right angles] — and since angle **ד** (D) is [half a right angle], then by the [sixth [?]] proposition of Book I the leg **דם** [?] (DḤ) equals the leg **דב** [?] (DB). And by the forty-seventh proposition of Book I [Elements I.47, the Pythagorean theorem] the square on **אם** [?] (AḤ) equals the two squares on **אג** (AC) and **גם** [?] (CḤ)… each [of the base angles] being half a right angle; and since angle [?] is right, therefore the two squares on **אם** [?] (AḤ) and **הם** [?] equal the square on **אה** [?]… *[the proof continues to its conclusion; interior figure-letters largely uncertain [?]. The text ends near the foot of the folio side, the lower margin left blank.]*

Diagram. A triangle with internal cevians (the right-triangle / isosceles construction used to prove II.9), the base divided by the section-points. Resolvable labels:

- **ם** [?] at the apex
- **ה** [?] at an internal point
- along the base: **ב** ,[?] **ד** ,[?] **ג** ,[?] **א** [?]

[— more than two labels illegible.]

[Pencil librarian foliation "104" is visible at the lower outer corner of this folio side.]

[Euclid, Elements, Book II — continued] (המאמר השני)

[Conclusion of Proposition II.9.] …and therefore the square on **אה״** [?] (AH) is [equal to] the product of **א[?]** and **דב״** [?] (DB), each by itself, taken twice. And that is what we wanted.

[Proposition II.10.] [margin: overlined proposition-letter for II.10]

[Enunciation.] Line **אב״** (AB) is bisected at **ג״** (C), and to its length is added **בד״** [?] (BD). We say that the square on **אד״** [?] (AD) and the square on **דב״** [?] (DB), each by itself, [together] equal what results from the square on **אג״** (AC) and the square on **גד״** [?] (CD), each by itself, taken twice.

Diagram. A right-triangle construction: a low, wide triangle with its base along the bottom, a vertical line rising from an interior point of the base to the apex, and a diagonal (hypotenuse) drawn from the apex down to the right-hand vertex. The base carries the section-points of line AB produced. Resolvable letter-labels (faint red-brown):

- **ה** [?] near the apex
- **ג** [?] beside the apex / top of the vertical
- **ב** [?] at the upper-left
- **ד** [?] at an interior base-point
- **א** [?] at the right-hand vertex

[— more than two interior labels are uncertain.]

[Construction and proof.] We draw out the perpendicular **נ[ה?]** [?] equal to half [the line] … and we complete [the figure]. Since [angle **ג״** (C)] is right, and the two [base angles] are each half a right angle … [and] by the [relevant] proposition of Book I the leg **[?]** equals the leg **[?]**; and by the forty-seventh proposition of Book I [Elements I.47] the square on **[?]** equals the two squares on **אג״** (AC) and **[?]** … *[the proof runs to its close; the interior figure-letters are largely uncertain [?]. It concludes:]* …each of them by itself, taken twice; and that is what we wanted.

[Proposition II.11.] [margin: 11 = **יא״**]

[Enunciation.] Line **אב״** (AB) — we wish to cut it with a division such that the product of **אב״** (AB) by one of its two parts equals the square on the [other] part by

itself. We say: line אבּ (AB) is [to be] divided at a point ג [?] (C) such that the product of אבּ (AB) by בגּ [?] (BC) equals the square on אגּ [?] (AC) by itself.

Diagram. The golden-section figure: a square at the right (upper right), subdivided by a horizontal and a vertical rule into a smaller square and rectangles, with an oblong rectangle extending to the left; a diagonal is drawn across the oblong from the lower-left corner to the upper-right region. Resolvable letter-labels (faint):

- **ד** [?] and **ה** [?] stacked at the upper-right corner of the square
- **ח** / [?] **ז** [?] on the right-hand vertical
- **ב** [?] at the upper-left of the oblong
- **ג** [?] at the foot / division-point
- **[?]** at the lower-left corner

[— more than two labels uncertain.]

[Construction and proof.] We complete the square on אבּ [?] (AB) — the square אבּ**[?]**דּ — and we bisect **[?]**א at ה [?] (E), and we draw הבּ [?] (EB). We erect upon it the square … and since the line אבּ (AB) has been [bisected] at **[?]** and **[?]** added to it, then by the sixth proposition of this book the product of **[?]** by **[?]**, together with the square on **[?]** by itself, equals the square on **[?]** by itself … *[the proof continues; the point-letters of the interior gnomon are largely uncertain [?]. It concludes:]* …and so the product of אבּ (AB) by one of its parts equals the square on the [remaining] part; and this is what we wanted.

[Proposition II.12.] [margin: יבּ = 12]

[Enunciation.] In every obtuse-angled triangle, the square on the side subtending the obtuse angle is greater than the [sum of the] squares on the two sides containing the obtuse angle by twice [the rectangle contained by] one of the sides about the obtuse angle — [namely] the side onto which the perpendicular falls — and [the length] that is cut off outside [the triangle by that perpendicular].

Diagram. A triangle drawn with a horizontal base and an apex, with a line dropping to (or extending beyond) the base — the obtuse-angle construction in which the perpendicular falls outside the triangle. Resolvable letter-labels (faint):

- **[?]** at the apex
- **ד** ,[?] **א** [?] toward the base / the foot of the perpendicular
- **ג** ,[?] **ב** [?] along the base

[— apex and base labels uncertain.]

[Construction and proof.] We draw out from **[?]** the perpendicular **[?]** … because it falls outside the triangle, since the angle [at the vertex] is obtuse. By the [relevant] proposition it will fall outside the triangle. And the square on the side subtending the obtuse angle [is] greater than the two squares on **אג֯** [?] (AB) and **בג֯** [?] (BC), each by itself, by twice the product of **[?]** by **[?]** … *[the argument runs to its close; interior letters uncertain [?].]*

[Proposition II.13.] [margin: 13 = **יג֯**]

[Enunciation.] In acute-angled triangles, the square on the side subtending the acute angle is less than the [sum of the] squares on the two sides containing that acute angle by twice [the rectangle contained by] one of those sides — the one onto which the perpendicular falls — and [the segment] cut off toward the acute angle. And this is what we wanted [to show]; and the demonstration [is] like the demonstration of [the] first [case].

Diagram. A triangle with a horizontal base and a peaked apex, with an interior line (the perpendicular dropped inside the triangle — the acute-angle case). Resolvable letter-labels (faint):

- **[?]** at the apex
- **ב** ,[?] **א** [?] along the base
- **ג** [?] toward the right base-vertex / foot of the perpendicular

[— apex label and one base label uncertain.]

[Construction and proof.] We draw out from the apex the perpendicular; because the triangle is acute-angled, the perpendicular falls within the triangle. And the square on the side subtending the acute angle [is] less than the two squares on **אג֯** [?] (AB) and **בג֯** [?] (BC), each by itself, by twice the product of one of them by [the segment cut off]. And this is what we wanted; the demonstration is as before.

[Proposition II.14.] [margin: 14 = **יד֯**]

[Enunciation.] We wish to make a square equal to a given rectilineal figure. So let the given figure be **[?]** … We construct a rectangle equal to it — [the rectangle] **[?]** … and if its [two sides] are equal, then it is [already] a square, and we have what we sought. But if they are not equal, we produce one of its sides in a straight line and set off upon it a length equal to the [other] side, and we bisect the whole [line] at **[?]** and describe upon it a semicircle. We produce the [common] side as a perpendicular up to the arc of the semicircle, and the square on that perpendicular is equal to the [given rectangle]; and at [that] distance … the semicircle …

Diagram. The squaring construction: a rectangle (drawn as an open box at the bottom) surmounted by a semicircle; a vertical line (the mean-proportional perpendicular) rises from the base line through the rectangle to meet the arc, and a horizontal diameter divides the semicircle from the rectangle below. To the left stands a separate small triangle — the given rectilineal figure to be squared. Resolvable letter-labels (faint):

- **ה** [?] at the top of the vertical / crown of the arc
- **ב** [?] and **ד** [?] along the diameter
- **ז** [?] toward the right
- **ג** ,[?] **א** [?] at the foot corners of the box
- **ג** [?] at the small triangle

[— more than two labels uncertain.]

[The text closes at the foot of the folio side within the II.14 construction; whether an end-of-Book-II formula or a Book III opening rubric follows could not be confirmed on this page — the last legible words continue the squaring construction ("…and at [that] distance … the semicircle …"). No Book III definitions or heading are visible within this opening.]

[Pencil librarian foliation "105" is visible at the lower outer corner]

[Continuation — the close of Euclid's *Elements* Book II (the construction of a square equal to a given rectilineal figure, II.14), followed by the opening of Book III.]

[Conclusion of the squaring construction (Elements II.14).] …and we construct from them the whole. Therefore, by the fifth figure of this treatise [Elements II.5], the rectangle **דה** [?] together with the square on **כה** [?] by itself, taken together, equals the square on **כ** [?] by itself — that is, [the square on] the whole line by itself. And the rectangle **לה** [?] with **הה** [?]; therefore [it is] equal to the square on **לה** [?] with **בהח** [?], and **הה** [?] by itself equals the square on **כה** [?]. The remainder, **לה** [?] with **הה** [?], equals the square on **הל** [?] by itself. Therefore **הל** [?] is [the side of] the square area that we wished [to construct]; and this is what we wanted.

Diagram. At the foot of the folio side, a figure showing a semicircle (dome) set upon an open rectangular box, with a horizontal line dividing the arch from the box below and interior lines rising to the arc; a small triangle stands to the right. This matches the squaring construction of Elements II.14 (the mean-proportional semicircle over the rectangle, with the given rectilineal figure — the triangle — to

be squared); it may equally be serving the Book III segment-definitions immediately above it. Some of the fainter strokes may be show-through from the facing leaf. Visible letter-labels (faint red-brown, largely illegible):

- **[?]** near the crown of the arch
- **[?]**, **[?]** along the dividing line / box corners
- **[?]** at the small triangle

[— labels not resolvable; figure-association (II.14 vs. Book III definitions) uncertain.]

המאמר השלישי — The Third Treatise [Euclid, *Elements*, Book III]

[Book II → Book III transition. The display rubric המאמר השלישי ("The Third Treatise") stands in enlarged script mid-column Book III restarts the proposition count with single Hebrew letters.]

[Definitions.] The intent here is to make known that [circles are equal] when all their diameters are equal and the lines going out from their centers to the encompassing line [circumference] are equal. And when a line passes by a circle and touches it from outside but does not cut anything from it, that line is called the tangent to the circle. Equal circles are those [whose radii are equal]; the one does not cut the other. Circles are called equal [to one another] when [they are constructed] upon [equal] lines, and the perpendiculars going out from the center to those [chords] are equal — [then] the lines are equal, because their distances [?] from the center are equal. And [the chord] farther from the center is the one whose perpendicular is longer.

A segment of a circle is [the figure] enclosed by a straight line — [the straight line] is called a chord — and a portion of the circumference, which is called an arc. The angle of the segment is enclosed by the chord [and the arc]. And [an angle stands] in a segment when a point [is taken] upon the line of the arc and two lines are drawn from it to the extremities of the chord, the chord serving as its base — [this being] the angle at that point. And if lines encompass [a region], this is [a figure] set upon the line of the chord.

The angle called "central" [?] is that which two lines going out from the center enclose, reaching to the circumference. And the acute angle [?] [is that] which is enclosed upon [a point other than] the center of the circle. As for segments of a

circle: when each segment's angles are equal to the angles of the other segment, the [contained] chords are equal; and equal segments are those whose angles are — each segment — equal, the angles of the one segment [equal to] the [angles of the] other. And similar segments of a circle are those that contain equal angles. We know that similar segments are those each of which is [the same part] of its circle as the other is [of its circle] — a third and a third, a quarter and a quarter [?] **ערב עאא** [?] — [when] the line going out from the center of the one to the circumference equals the line going out from the center of the other to the circumference.

[Proposition א — to find the center of a given circle.] [margin numeral obscured near gutter]

We stand a circle **אבג** [?] before us, and we wish to find its center. We draw in it a line, **אב [קו]** [?], and bisect it into two halves at **ה** [?]; and we erect upon it a line, **הז** [?], [reaching] to the circumference, and bisect it in half at **ט** [?]. We say that the point **ט** [?] is the center, and none other. For if you say it were otherwise, we draw the lines **[?]** and **הט** [?]; therefore triangle **דהט** [?] would be like triangle **הטן** [?], [so that] the [two] angles at **ה** would each be a right angle — [which is] impossible. Therefore **ט** [?] is the center, and this is what we wished.

Diagram. A circle with a vertical line (the perpendicular through the bisection point) running from the top of the circle to the center, and an inscribed triangle (a chord in the upper part with two lines meeting at the center). Visible letter-labels (faint red-brown):

- **[?]** at the top of the vertical line
- **ה** [?] at the mid-chord / bisection point
- **[?]**, **[?]** at the chord's ends
- **ב** [?] toward the foot / center

[— more than two labels uncertain.]

[Proposition ב — the line joining two points of the circumference falls within the circle.] [margin: **ב** (?)]

[the line lies] wholly [within]; a right angle — this is impossible. For when in a circle a single line does not cut [the circle] into two [outside itself]… upon a right angle **[?]** … about the center of the circle. As we marked upon them [the points]: in circle **אבג** [?] we mark the points **ג ד** [?] and join a line between them, [and] the line **[falls within]**. For [if part of it lay outside]… therefore, by the seventh

figure of the first treatise [Elements I], side **אד** [?] would be longer than side **[?]** — and this is impossible.

Diagram. A circle with an inscribed triangle — a chord near the top and two lines descending to the center — and a vertical line through the center. Visible letter-labels (faint):

- **[?]** at the top
- **[?]**, **ג** [?] at the chord's extremities
- **[?]** at the center / apex

[— labels not resolvable.]

[Proposition ג — a diameter that bisects a chord cuts it at right angles, and conversely.] [margin: **ג** (?)]

In circle **[?]אב** [?] a line **דג** [?] is drawn within it, and afterward there is drawn, through its center, [the line] **זהב** [?], and it bisects it into two halves. We say that it bisects it at a right angle. For when [the radii are joined]… **זל** [?]; and by the eighth figure of the first treatise [Elements I.8], the angle **ה** [?] is a right angle.

And conversely: if the angle **ה** [?] is a right angle, [then] the line **דה** [?] equals the line **הב** [?] — by figure twenty-nine [?] of the first treatise [Elements I].

Diagram. A circle with a vertical diameter and an inscribed triangle whose apex is at the center and whose base is a lower chord. Visible letter-labels (faint):

- **[?]** at the top of the diameter
- **ג** ,[?] **ד** [?] along the base chord
- **ה** [?] at the center / foot of the perpendicular
- **[?]** at the lower rim

[— more than two labels uncertain.]

[Proposition ד — two chords not passing through the center do not bisect one another.] [margin: **ד** (?)]

And if [two lines] cut one another at **ל** [?], and neither of them passes through the center, they do not bisect one another into two halves. For if you say that **הה** [?] equals **[?]חה** [?], we construct the diameter **גה** [?] as before; and by the preceding figure, each of the [angles] **אחה, אחה** [?] would be a right angle. And by that same figure the angle **ההא** [?] would be one right angle [too] — [which is] impossible.

Diagram. A circle divided by several straight lines meeting near the center into a number of sectors (a "pie" of segments), with chords across the rim. Visible letter-labels (faint red-brown, around the rim and at the center):

- **[?]** at the top
- **[?]**, **[?]** at the rim on the left and right
- **[?]** at the center
- **[?]** at the lower rim

[— labels not resolvable.]

[Pencil librarian foliation "106" is visible at the lower outer corner]

[Script: Sephardic semicursive, single scribe (Sasson ben Menashe). Single-column body text with in-line geometric figures set into the right/inner side of the text-block, the prose lines running to their left. Scribal quirks as noted for this hand: gimel with a nun-like descender; tav frequently formed like tet. Both upper margins are masked by the photographer's black bar — no running header is inked.]

[Proposition ה (III.5) — Two circles that cut one another do not have one and the same center.] [margin numeral obscured by the black bar]

Any two circles that cut one another do not have one and the same center. For if you say that point **ה** is the center of the two circles — circle **אבג** [?] and circle **א[ז]ד** [?] — then, since **ה** is [posited] the center of circle **אבג**, it follows that [radius] **ה[א]** [?] equals **ה[?]**; and, since **ה** is [also] the center of the second circle **א[ז]ד** [?], the [radius] **א[?]** [?] equals **ד[ז]** [?]. Hence two lines drawn to one and the same circle [would be] equal, and you would be forced to say that line **[?]** equals line **א[ב]** [?] — and this is impossible. `[Rubric marker in the line; reading of the marker word uncertain: "סימנו" (?)]`

Diagram. Two overlapping (mutually cutting) circles; within the left circle an inscribed triangle whose apex reaches toward the region of intersection, and radial lines from the interior point. Visible letter-labels (black ink, faint):

- **ה** at the top (above the point of intersection)
- **[?]**, **[?]** at the intersection region and along the triangle's base (illegible)

[— more than two labels uncertain.]

[Proposition ו (III.6) — Two circles that touch one another do not have one and the same center.] [margin numeral obscured]

[Likewise,] if the two circles touch one another and neither passes through the [center of the other], they do not have one center. For if you say [that point **ה** is the common center], … then line **דב[?]** [?] **[?]** would equal **אב[?]** [?] — and this is impossible. `[Rubric marker; word uncertain – "סימנו" (?)]`

Diagram. A larger circle with a smaller circle set inside it and touching it (internal tangency), a straight line drawn through them. Visible letter-labels (black ink, faint):

- **ה** at the top
- **[?]** at the point of contact / mid-figure
- **[?]** at the lower rim

[— labels not resolvable.]

[Proposition ז (III.7) — If a point is taken on the diameter of a circle, other than the center, and from it straight lines fall to the circumference, the longest is the one nearer the center and the shortest the one farther from it.] [margin numeral obscured]

Take point **ה**, which lies on the [diameter [?] — the source here reads "המרכז"/"המרכן", the center], and draw from it the lines **הא[?]**, **הב[?]**, **הג[?]**, **הד[?]** [?]. We say that the longer line is the one nearer to the center, and the shorter is the one farther from it. And because two sides **[?]**, **[?]** [of the triangle are together greater than the third], by the twentieth figure of the first treatise [Elements I.20], [line] **[?]** is longer than **[?]** … so a triangle **[קטה]** [?] is formed … and by the twenty-fourth figure of the first treatise [Elements I.24], [the longer side subtends the greater angle]. And further we say: when we draw a line **[?]** equal to **אה[?]** [?] … [and] make angle **[?]** equal to angle **[?]**, then the base **[?]** equals **[?]**; and it is impossible to draw from point **ה** a [second] line equal to **[?]** except **[?]** alone. And if you say [otherwise], it would be forced that angle **[?]** equal angle **[?]** — and this is impossible. `[Rubric marker; reading "סימנו נקודה ל" (?) uncertain]`

Diagram. A circle enclosing a many-pointed (roughly seven-/eight-rayed) star: numerous straight lines drawn from an interior point outward to marked points on the circumference. Faint letter-labels at the rim vertices:

- **[?]** at each of the rim points (individual letters not resolvable)

[— more than two labels uncertain.]

[Proposition ח (III.8) — If a point is taken outside a circle, and straight lines are drawn from it to the circle, then of the lines to the concave

circumference the greatest is the one through the center, and of the lines to the convex circumference the least is the one on the line to the center; and of the rest the nearer is greater than the more remote.] [margin numeral obscured]

[A point is taken] outside circle **אב[?]** [?], and there are drawn from it the lines **[?]** … By the twenty-fourth figure of the first treatise [Elements I.24]: line **נ[?]** [?] is longer than **נ[?]** [?], and **נ[?]** [?] [longer] than **נ[?]** [?]. And then we shall explain that in the outer lines [i.e. those to the convex arc] the reverse of this [holds] — that is, **נ[?]** [?] is the shortest of them all, and the one nearer to it is shorter than the more remote. Therefore **נ[?]** [?] is shorter than **נ[?]** [?], and **נ[?]** [?] than **נ[?]** [?]. Likewise, since the lines **[?]** … drawn from point **נ[?]** [?] … [by the twentieth figure of the first treatise, Elements I.20 …]. So it is not possible for two lines drawn from that point to the [near arc] to be equal, save the two on either side of the one through the center. `[Rubric marker; word uncertain]`

Diagram. A "teardrop" figure: a circle above from whose interior a fan of straight lines radiates, the lines converging below to a single external point (with additional chords crossing inside the circle). Faint red-brown letter-labels around the circle and at the external point:

- **ה** at the top
- **[?]** at the rim points and the lower (external) vertex (illegible)

[— more than two labels uncertain.]

[Proposition ט (III.9) — If a point is taken inside a circle, and from it more than two equal straight lines fall on the circumference, that point is the center of the circle.] [margin numeral obscured]

[We mark] within circle **אב[?]** [?] a point **ג**, and there are drawn from it to the circumference more than [two] … [equal] lines, and the lines **נ[?] נ[?]נ[?]** [?] are equal. We say that point **ג** is the center. For [proceed] as follows: … we draw out **[?]** and bisect **[?]** at **[?]**; therefore, because triangle **[?]** … is isosceles, its base angles are equal to one another … Likewise triangle **[?]** … so the two [remaining] angles are each [equal] … Therefore the base **[?]** … so that line **[?]** passes through the center. And thus the [several] equal lines … therefore point **ג** is the center. `[Rubric marker in the line]`

Diagram. A circle crossed by several straight chords/diameters meeting near its center, dividing it into sectors. Faint letter-labels at the rim and center:

- **[?]** at the rim points and center (a central point and rim letters of the series **א/ב/ג/ד** [?] are indicated but not securely legible)

[— labels not resolvable.]

[Proposition י (III.10) — A circle does not cut a circle in more than two points.] [margin numeral obscured]

A circle does not cut [another] circle in more than two places. And if you say that circle **אבג** cuts circle **נ[?]** [?] in [more than two] places **[?]**, **[?]**, **[?]** [?] — [then] we draw the lines **[?] [?]** and bisect [them] at **[?]**, and draw out the line **[?]** … And by the third figure of this treatise [Elements III.3], the two centers would [both] lie on **[?]** [the perpendicular that bisects the chords] — [so that the two circles would share a center, which is impossible]. `[Rubric marker; reading uncertain]`

Diagram. Two large overlapping circles forming a lens ("globe"/vesica) figure, crossed by a horizontal line and a vertical line (like a globe with an equator and a meridian). Faint letter-labels around the two rims and at the crossing points:

- **[?]** at the rim and crossing points (letters of the series **ב/ג/ד/ה/ו/ז** [?] appear distributed around the figure, but individual letters are not securely legible)

[— more than two labels uncertain.]

[Later-hand / librarian marks at the foot : a faint pen scribble in a modern hand (letters not legible), and pencil foliation **"107"** at the lower outer corner.]

This opening continues Euclid's *Elements*, Book III (*המאמר השלישי*, on the circle). The propositions are numbered by single overlined Hebrew letters in the outer margin — here legible as **יא through (18–11) יח**, continuing directly from proposition י (III.10) at the close of the prior opening. Each proposition carries a labeled construction diagram in the outer column, with faint red-brown letter-labels. Proposition ends are marked by a small rubric flourish (the same in-line marker read tentatively as a scribal punctuation in the prior opening). The manuscript's own numbering runs one behind the Greek Euclid from proposition יב onward (III.11 and III.12 appear to be combined under margin יא); tentative Greek correspondences are given in brackets.

The upper lines of the first page complete the proof of the preceding proposition (י / III.10 — that a circle does not cut a circle in more than two points): if it did, the two circles would have to share a single center, which is impossible, as was shown in the fifth figure [of this Book] [?].

[Proposition יא (III.11–12) — If two circles touch one another, the straight line drawn through their two centers passes through the point of contact.]

[We posit] two circles **אב[ג]** [?] which touch one another, and we draw a line through their two centers. We say that it passes through the point of contact — and this point is the contact [itself] — and that this is the line **אב[ג]** [?]. And if you say [otherwise]: let the center of the larger circle be **ה** and the center of the smaller be **ג** [?] … [then two unequal lines would be forced equal], so that line **הזל** [?] would be longer than **הא** [?], while **הא** equals **הה** [?]; therefore **קזל** [?] would be longer than **הזל** [?] — which is impossible. `[Rubric marker in the line]`

Diagram. A "globe" figure: a large circle with a smaller circle inside it, the two meeting (internally tangent) at the top; a horizontal chord and a vertical diameter cross the interior. Faint red-brown letter-labels around the rims and at the crossing points (prose names the center of the large circle **ה** and the center of the small circle **ג**):

- **[?]** at the top (point of contact) — illegible
- **ג** [?] at the lower left / inner center
- **ה** [?] at the lower point
- **[?]** at the remaining rim points

[— more than two labels uncertain.]

[Proposition יב (III.13) — A circle does not touch a circle in more than one point, whether internally or externally.]

A circle does not touch a circle except in one place, whether from within (**מבפנים**) or from without (**מבחוץ**). If you say that circle **אבג** touches circle **נג** [?] in [more than one] point — [let] the center of circle **אבג** be **ה** [?] and the center of circle **נג** [?] be **ג׳** [?]; then it would follow that **הנ** [?] equals **הל** [?] equals **הג**, and thereafter that **זג** [?] equals **זל** [?] — which is impossible. And it is likewise impossible from without, as was shown in the [ninth?] figure [?] of this Book (*מזה המאמר*). `[Rubric marker]`

Diagram. Two equal overlapping circles forming a lens (vesica) with a vertical line of centers, and a small third circle set externally tangent at the upper right (the external-contact case). Faint letter-labels around the three rims and at the crossing points:

- **[?]** at the rim and contact points (letters of the series **ב/ג/ה/ל/נ** [?] appear distributed around the figure, but individual letters are not securely legible)

[— labels not resolvable.]

[Proposition יג (III.14) — In a circle, equal chords are equidistant from the center; and chords equidistant from the center are equal.]

In circle **אבג**, [let there be] two lines [chords] **[?]**, **[?]** equal [to one another]. We say that their distances from the center **ח** [?] are equal. As is proved: because the perpendicular **חצ** [?] equals the perpendicular **חב** [?] … therefore angle **ג** [?] equals angle **ה** [?], and **[?]** equals **[?]**; [the triangles being congruent], the two perpendiculars **[?]** … And further, if the perpendicular **חצ** [?] equals the perpendicular **חב** [?], we say that [the chord] **[?]** equals [the chord] **[?]** — [the converse], so that [chords] equally distant from the center are equal, as [was] said. `[Rubric marker]`

Diagram. A circle enclosing a six-pointed star (two overlapping triangles) formed by two chords together with radii and perpendiculars drawn from the center to each chord; a central point is marked. Faint letter-labels at the rim and center:

- **ח** [?] at the center
- **[?]** at the rim points (letters of the series **א/ב/ג/ה/ל** [?] are indicated but not securely legible)

[— more than two labels uncertain.]

[Proposition יד (III.15) — The diameter is the greatest of the lines in a circle; and of the rest, the one nearer the center is greater than the one more remote.]

The diameter is longer than the [other] lines drawn [in the circle], and the line nearer to it [the center] is longer than the more remote — and [the more remote] is shorter [?]. [As proved:] let the whole diameter **[?]** [be taken] … and by the [fourth?] figure of Book I (*מהמאמר הראשון*), let **נג** [?] be equal to the two lines … [where a triangle has two sides equal to two, the one containing the greater angle has the greater base]; and by the same figure, **סג** [?] is longer than **חג** [?]. `[Rubric marker]`

Diagram. A circle with a diameter, two chords parallel to it (successively shorter), and radii drawn to their endpoints (comparing the lengths of chords by their distance from the center). Faint letter-labels at the endpoints and center:

- **[?]** at the rim and center (letters not securely legible)

[— labels not resolvable.]

[Proposition טו (III.16) — The straight line drawn at right angles to the diameter of a circle, from its end, falls outside the circle; no other straight line can be interposed between it and the circumference; and the angle of the semicircle is greater than, while the remaining (horn) angle is less than, any acute rectilineal angle.]

[Let a line] go out from the end of the diameter **נהד** [?] at a right angle **[?]**. We say that it falls outside the circle. And if you say [it meets the circle]: [it would] touch [it] at line **אד** [?], and because [that triangle has] … [equal to] **הא** [?], and [its base] angle **[?]** is right and angle **אד** [?] is right — [two right angles in one triangle], contrary to what was shown in figure 32 [ל״ב] of Book I (I.32). Therefore it falls outside; and it is **לט** [?]. And [the text] says that no other line can fall between it and the line of the circumference; for if you say that [some line] falls, then angle **הדח** [?] [would be] open … [and] the circumference … and there is drawn from **ה** the perpendicular **הט** [?]; and by figure 19 [י״ט] of Book I (I.19), let **כב** [?] be longer than **הא** [?] — let **קב** [?] alone be as **הא** [?] — which is impossible. And thereafter we prove that the whole angle contained by the circumference and the diameter is greater than any [acute] angle **חלה** [?], while [the horn angle] **הלה** [?] is smaller than any angle **חלה** [?]; for if you do not say so, [a line] would fall between line **זל** [?] and the circumference — [which is impossible]. It is also shown that the line going out from the end of the diameter at a right angle touches the circle. `[Rubric marker]`

Diagram. A circle with a diameter, a triangle inscribed on it, and a tangent line drawn at the end of the diameter at a right angle (with radial lines to the rim). Faint letter-labels at the diameter-ends, center, and tangent point:

- **א** [?] at the upper right
- **ד** [?] at the center
- **[?]** at the remaining rim points (letters of the series **ב/ה/ז/ל** [?] indicated, not securely legible)

[— more than two labels uncertain.]

[Proposition טז (III.17) — From a given point to draw a straight line touching a given circle.]

[We now show] how to draw, from a given point, a line touching a circle. If [the point] **[?]** is to touch circle **בג** [?] whose center is **ל** [?]: we describe about it [a

circle], and at distance **דא** [?] [we describe] circle **אה** [?]; we draw **דא** [?], and from **ז** [?] we draw out the perpendicular **זח** [?] … and **[?]**. We say that it is a perpendicular upon line **נבד** [?]; and if **[?]** be not a perpendicular … [then a contradiction follows] `[Rubric marker]`

Diagram. Two concentric circles (an outer and an inner) with an external point, a chord/radius drawn to the point of contact, and a triangle formed by the construction lines (the standard tangent-from-a-point construction). Faint letter-labels around the rims and at the contact point:

- **[?]** at the rim and contact points (letters of the series **א/ב/ג/ד/ז/ל** [?] appear, not securely legible)

[— labels not resolvable.]

[Proposition יז (III.18) — If a straight line touches a circle, the line joining the center to the point of contact is perpendicular to the tangent.]

If a line touches circle **בג** [?] [at a point], and its center is **ל** [?] … and we draw from the center **[?]** to the point of contact **[?]** and from **ז** [?] the perpendicular **זח** [?] — we say that [the joining line] is a perpendicular. And if it were not a perpendicular … [then the angle would not be right, forcing a contradiction] `[Rubric marker]`

Diagram. A circle with a tangent line at its lower rim, a radius drawn to the point of contact, and a right-angle mark; a perpendicular is dropped, forming a triangle. Faint letter-labels:

- **[?]** at the contact point, center, and rim (individual letters not securely legible)

[— labels not resolvable.]

[Proposition יח (III.19) — If a straight line touches a circle, and from the point of contact a perpendicular is drawn to the tangent, the center of the circle lies on that perpendicular.]

[Let a line touch circle **בד** [?] at a point, and from that point let a perpendicular be raised. We say the center lies on it.] For if not — [suppose the center lies elsewhere] — then by figure 19 [י״ט] of Book I (I.19), **כב** [?] would be longer than **הא** [?], which is impossible. But if the perpendicular is at **ה** [?], we say that the center lies upon it; for if it were [elsewhere], it would be required that [some] angle be a right angle, and then angle **הבד** [?] would [also] be a right angle — which is impossible. `[Rubric marker; end of proposition]`

Diagram. A circle with a tangent line, a perpendicular raised at the point of contact passing through the center, and a triangle formed by the radius and construction lines. Faint letter-labels at the contact point, center, and rim:

- **ה** [?] at the center / on the perpendicular
- **[?]** at the remaining points (letters of the series **א/ב/ד** [?] indicated, not securely legible)

[— more than two labels uncertain.]

[Pencil foliation **"108"** at the lower outer corner A faint bleed-through of the facing page's text is visible in the lower blank margin of p. 234; not transcribed.]

[Continuation of the Third Discourse — Euclid, *Elements*, Book III (circle geometry). Structure is carried by single overlined proposition-numerals in the outer margin, each opening a new proposition; there are no display/rubricated section headings. The recension's numbering runs behind the Greek Euclid: margin numeral *n* corresponds roughly to Greek III.(*n*+1), the offset widening to +2 once three propositions are bundled under margins כה–כז.]

[Margin: (19) יט — Greek III.20: the central angle is double the inscribed angle on the same arc]

angle **ד** at the center and angle **א** on the circumference, both standing on a single arc, namely **בג** [?]. We say that the angle **בג** [?] [at the center] is double the angle **בא** [?] [at the circumference]; and this is explained by the third figure of Book I (Euclid, *Elements*, Book I).

Diagram. A circle with an inscribed angle at the upper apex, two lines drawn to a point near the center, and a chord across the lower part; the construction of the central-angle/inscribed-angle relation. Visible letter-labels:

- **א** [?] at the apex
- **ד** [?] at the center
- **ה** ,[?] **ג** ,[?] **ב** [?] around the lower rim

[Margin: (20) כ — Greek III.21: angles in the same segment of a circle are equal]

אב [?] … in its segment: [we say] that the inscribed angles [standing in one and the same segment] are equal. Let there be angles **נ** ,[?] **נ** [?]; we say they are equal. For when [we mark] the center of the circle …, then by the preceding

figure the angle **ח** [?] [at the center] is double each of the two angles [at the circumference]; therefore the two are equal.

Diagram. A circle with two chords crossing in an X, forming an inscribed quadrilateral — two angles subtending a common arc. Visible letter-labels:

- **ב** ,[?] **ה** [?] at the upper rim
- **ד** ,[?] **ג** [?] at the lower rim

[Margin: (21) כא — Greek III.22: the opposite angles of a cyclic quadrilateral]

אבגד [?] is a figure having four sides, and it is [inscribed] in a circle. We say that the two opposite angles **ג** ,**א** [?] are equal to two [right angles], and likewise the two angles **ד** ,**ב** [?]. When **אבגד** [?] is [inscribed in the circle], then by the preceding figure and by the third figure of Book I it is explained.

Diagram. A circle with an inscribed quadrilateral and its diagonals drawn, illustrating the opposite-angle relation. Letter-labels faint at the four vertices; individual letters not securely legible **[?]**.

[Margin: (22) כב — Greek III.23: no two similar unequal segments on the same side of a line]

It is impossible, upon one line, [to construct] two segments of a circle similar [to one another] on one side, one greater than the other. For if we say it is possible — upon line **אב** [?], segments **אזב** [?] similar — and we draw out a line **אהד** [?] and produce [it], then by the premises of this treatise it would follow that the exterior angle **אזב** [?] equals the interior angle **אזב** [?], the interior one — and that is impossible.

Diagram. A circle with a chord and two arcs (segments) on the same side of it, with construction lines to a rim point. Letter-labels of the series **ד** / **ה** / **ז** / **ב** / **א** [?] indicated at the chord-ends and rim; not securely legible.

[Margin: (23) כג — Greek III.24: similar segments on equal lines are equal]

the segments of the circle are similar and are [set] upon equal lines: [then] the segments too are equal to one another. For one is superposed upon the other, and it is impossible for it to be otherwise, as was explained in the preceding figure.

Diagram. Two segment-domes (arcs on equal base-chords), drawn for the superposition argument. Visible rim/base letters faint **[?]**.

[Margin: (24) כד — Greek III.25: to complete a segment into the whole circle]

To complete a segment of a circle [into the whole circle]. If it is a semicircle, we divide the [base-]line, which is a diameter, in half, and that point [is the center]; for the center [lies there].

Diagram. Two segment-figures (a low arc-dome and a taller one) with apex and internal radii, and, at the left, a kite/quadrilateral inscribed in a circle — the three cases of completing a segment. Visible letters faint at apex, base-midpoint, and rim **[?]**.

And if it is greater than a semicircle — it being the segment **אזב** [?] — the other [part] is divided: we bisect the chord **בג** [?] at **ד** [?] and draw out the perpendicular **בה** [?]; and by figure 18 of Book I the angle **בג** [?] is greater than the angle **בא** [?], and it will be as at **בהא** [?]. And since the middle-part **בהכ** [?] is [as the whole?], they will be [equal], and by the ninth figure of this treatise the point **ה** [?] is its center.

And if it is less than a semicircle, as the segment **אבג** [?] — [we do] according to what we did in the other [case]; and by what was explained in the seventh figure of this treatise, [a line runs] from **אל** to the end from **ב** [?]; and by the [figure] of Book I the angle **א** [?] is greater than the angle **ב** [?]. And we make the angle **אזב** [?] equal to **בהה** [?], and we produce [it], and it is explained that the point **ה** [?] is [the center].

[Margin: (27 ,26 ,25) כה כו כז — Greek III.26–28: in equal circles, equal angles stand on equal arcs; and equal chords cut off equal arcs]

that the circles **דהז** ,[?] **אבג** [?] are equal, and the two angles [**ד**] ,**א** [?] standing on the circumference are equal: we say that arc **בג** [?] equals arc **הז** [?]. For [when] chord **בג** [?] equals arc **הל** [?] [chord], the angle **א** [?] is as [angle] **תה** [?], and the [arc] **א** [?] is as **א** [?]. And [that it is] impossible otherwise — for if it were so, arc **בג** [?] would be smaller than arc **הז** [?].

And [if] the circles **דהם** ,[?] **אבג** [?] are equal, and the chords **הז** ,[?] **בג** [?] are equal, we say that arc **בג** [?] equals arc **הז** [?], and arc **אבג** [?] equals arc **דהל** [?].

And if chord **בג** [?] is greater than chord **הז** [?], then arc **בג** [?] is greater than arc **הז** [?] — and this is easily shown. And if arc **בג** [?] equals arc **הז** [?] and the segments are equal, then chord **בג** [?] equals chord **הז** [?].

Diagram. Two equal circles side by side, each with an inscribed triangle standing on a chord, drawn to compare the arcs cut off by equal angles / equal chords. Visible letter-labels:

- Left circle: **א** [?] at apex, **ג** ,[?] **ב** [?] at the base
- Right circle: **ז** / [?] **ה** / [?] **ד** [?] at apex and base

[Margin: (28) כח — Greek III.30: to bisect a given arc]

To bisect an arc into two halves. We divide the chord **בג** [?] into two halves at **ד** [?], and draw out the perpendicular **אד** [?]; and it touches [the arc] at **נא** — [?] **טה** [?]. The matter is clear from what precedes: arc **טא** [?] equals arc **אנא** [?].

[Margin: (29) כט — Greek III.31: the angle in a semicircle is a right angle]

The angle **אלב** [?] … drawn in a semicircle — we say that it is a right angle; [this holds] when the center is marked upon it. For since **הב** [?] equals **הד** [?], the angle **הדב** [?] equals the angle **ב** [?]; and the angle **הדב** [?] is double the angle **ב** [?], and likewise the angle **הדא** [?] is double the angle **א** [?].

Diagram. A semicircle on a horizontal diameter, with an apex point on the arc joined to both ends of the diameter and to the center by a perpendicular radius — the right-angle-in-a-semicircle construction. Visible letter-labels:

- **א** [?] at the apex
- **ד** [?] at the center / base-midpoint
- **ג** ,[?] **ב** [?] at the ends of the diameter
- **ה** [?] on the perpendicular

[At the foot two faint uninked circles show through from the facing page (bleed-through); not transcribed. Pencil foliation **"109"** at the lower outer corner]

Euclid, *Elements* Book III (*המאמר השלישי*), final propositions.

Script: Sephardic semicursive, one hand (Sasson ben Menashe), single column. Structure carried by overlined proposition-numerals in the outer margin, each opening a Euclid proposition. Upper margins of both folio sides are masked by the photographer's black bar (no inked running header). Proposition

enunciations and constructions are keyed to the labeled circle-diagrams. The point-labels are 2–3-letter overlined clusters in cursive; the connective geometric prose reads clearly, but many individual labels are genuinely ambiguous and are flagged [?].

[Margin: (30) ל — Greek III.32: the tangent–chord angle equals the angle in the alternate segment] …therefore, just as the exterior angle **אהב** [?] equals the whole angle **הדב** [?], so the exterior angle **בהד** [?] equals the whole angle **אהג** [?]. And since [together] they are equal to two right angles, so too the double of the angle **אהב** [?] … is a right angle; and there remains the angle **ב**, which falls in the further part of the semicircle — an acute angle. Therefore the two angles at **ב, ג** [?] equal two right angles.

Diagram. A circle with an inscribed triangle standing on a chord, and a straight line running out to the upper left that touches the circle at one point (the tangent) — the tangent–chord construction. Visible letter-labels (faint red-brown interior marks):

- apex / point of tangency (top): **א** [?]
- base of the inscribed triangle: **ג** ,[?] **ב** [?]
- interior / center: **ד** ,[?] **ה** [?]

within the semicircle they are extended [?]. And what is evident is that the angle [subtended] by the circumference over arc **בג** [?] and the line [?] — since it differs from a right angle and lies in the further part of the semicircle — [and] that the angle **אהד** [?], over which the circumference stands with arc **אהד** [?] and chord **אל** [?], is smaller than a right angle and lies in the segment [greater than] a semicircle. This is made clear when we produce the line **בד** [?] in a straight line as far as **ה** [?] … [in] circle **אהב** [?], and when we set the line **הבד** [?] equal upon [it].

Diagram. A semicircle on a horizontal diameter with a raised perpendicular — the alternate-segment (acute vs. obtuse) case of the tangent–chord proof. Two faint uninked circles show through here from the facing page (bleed-through); not transcribed. Visible letter-labels:

- ends of the diameter: [?], [?]
- apex on the arc: [?]

- foot of the perpendicular / center: [?]

[We take] the center, and it cuts the circle; and we say that the two angles … are equal. The chord **זבה** [?] stands upon it like the arc … the angle that falls [in the segment]. When the segments of the circle are equal, the angle **זבד** [?] is like the one falling in segment [?], and the angle **זבה** [?] is like the one falling in segment **זטב** [?].

How we mark upon the circumference a point **ה** [?]: we lay down the lines ,[?] **אה זב** [?], and the diagonal **אהב** [?]; and by the figure made from this…

Diagram. A circle with an inscribed triangle (a chord subtending an inscribed angle). Visible letter-labels:

- apex (top-right, inside): **ה** [?]
- base points: **ד** ,[?] **ב** [?]
- further point: **ז** [?]

The proposition: the angle **אבה** [?] is a right angle, and by it the foregoing premise is equal to **ה** [?] … [in] the segments **אהב** [?]; and when we make the angle **זבב** [?] like the angle **זהב** [?], then by [proposition] [numeral: ?] of this book the remaining angle **א** [?] falls in segment [?], and it is the segment [equal] like segment **זבה** [?].

[Margin: (31) לא [?] — Greek III.33: on a given line, construct a segment of a circle admitting an angle equal to a given angle]

[Right-angle / remaining-angle case:] …to the segments **אהב** [?]; and when the angle is made equal, and by the twenty-first [?] [proposition] of this book … the remaining angle **א** [?] falls in the segment, and it is the segment admitting an angle like the angle **זבה** [?].

[Acute-angle case.] And if we wish to make upon it a segment that will admit an angle equal to the given angle **ט** [?], and it be smaller than a semicircle: we first set the angle **לאב** [?] equal to the given angle **ט** [?]; we produce the perpendicular **א…** [?]; we set the angle **ב** equal to the angle **מהב** [?] and draw **מב** [?]; we set [the compass] upon the point **מ**, which is the center, and at the distance **אמ** [?]; and by the figure **מב** [?] of this book [an arc] is produced to the …. And by the foregoing figure, segment **אלב** [?] — the smaller — admits an angle equal to the angle **לטב** [?], which equals the given angle **ט** [?].

Diagram. Two circles side by side at the foot of the page, each with an inscribed triangle standing on a chord and a straight line running outward (tangent / produced perpendicular) — the paired cases of constructing, on a given line, a segment that admits the required angle. Visible letter-labels:

- left circle: apex [?], base **ג** ,[?] **ב** [?]
- right circle: apex [?], base [?], [?]
- external line endpoints: **ט** ,[?] **ל** [?]

[Right-angle case, top of the verso.] And if we wish to make upon it a segment that admits a right angle: since the segment [built] on line **אב** [?] admits an angle like the angle in the semicircle, and it is [therefore] a right angle, we first set the angle **לאב** [?] equal to the given right angle, and complete the construction as before.

And if we wish [instead] to make upon it a segment admitting the acute angle **ה**, and it be greater than a semicircle: we set the angle **טאב** [?] equal to the angle **ה**, and erect the perpendicular **אק** [?]; we set the angle **ב** equal to the angle **קאב** [?], and describe upon the center a circle at the distance **קב** [?]; and by the eleventh [?] [proposition] of this book [it] is drawn to the …. And by the foregoing figure, segment **אגב** [?] — the greater — admits an angle equal to the angle **טב** [?], which equals the acute angle **ה**.

[Obtuse-angle case.] And if we wish to make upon it a segment that admits [an angle] like the obtuse angle **ה**, and it be smaller than a semicircle: we first set the angle **לאב** [?] equal to the obtuse angle **ה**; we produce the perpendicular **אק** [?]; we set the angle **ב** equal to the angle **מהב** [?]; we set [the compass] upon the point **מ**, and at the distance **אמ** [?]; and by the figure **מב** [?] of this book …. And by the foregoing figure ….

[Margin: (32) לב [?] — Greek III.34: to cut off from a given circle a segment admitting an angle equal to a given angle]

And if we wish to cut off from [a circle] a segment that admits an angle like the given angle **ה** [?]: we lay the line **אב** [?] [tangent to the circle], and make [an angle] like its angle [?] … reckoned in the circle upon its point; we say that its figure is [?] — these [cases] alone. And if their place is the diameter [?] …. And if one of them lies at the center of the diameter, it being external [?] … and upon the center [?], and upon the angle **מד** [?] … we do this, and [it] touches [?] …; by [proposition] two [it] takes [?] ….

Diagram. A small circle with a chord / inscribed triangle on the left of the column — the segment cut off from the given circle. Visible letter-labels:

- points on the circumference / chord ends: [?], [?]
- apex: [?]

[Margin: (33) לג [?] — Greek III.35: intersecting chords — the rectangles under the segments are equal (with numbered case-figures)]

he takes **קונב** [?] and produces [?] …, and the matter is as seen, that they intersect [?] …. And [when the two lines] stand upon the point [?], we say that its figures [?] rest upon the point [?] — for its figures [?] are so. And if [there are] two points where the diameter is intersected [?] …. And if one [line] lies at the center of the diameter and it cuts, it being external [?] … upon the center [?], and upon the angle [?] … and this is done. Its figure: he takes [?] ….

Diagram. Two circles side by side, each with two chords crossing inside (an X / star), captioned above with the ordinals **ראשון** [first] and **שני** [second] — the first two configurations of the intersecting-chords case. Interior letter-labels: several small marks, not individually resolvable [?].

The proposition: [he takes] … **יקח** [?] … and this and that [?] are equal [in respect of] their rectangles [?], for their surfaces [?] are equal, as the figure shows. And if the point [?] is at the center — as in figure **ה** [?] — the [product of the] intersection [is equal]; the figure [?] shows [it]. And if [neither passes through the center], and the point [is such] that a diameter [drawn to it] is bisected [?] … the center, which is the point **מ** [?], and at the distance [?] … and by [one figure] equal to the [other] figure …. And a further figure of this book … [it] draws to the segment ….

Diagram. Three circles across the foot of the verso, each with two chords crossing inside (star / triangle figures), captioned with the ordinals **שלישי** [third], **רביעי** [fourth], and (lower) **חמישי** [fifth] — the remaining configurations of the intersecting-chords proposition. Interior letter-labels: small marks, not individually resolvable [?].

for the four-sided figure [?] is equal … the square [built] on the four-sided [?] … [the rectangle] equal to this equals that [?]. And if [neither line passes through the center], and every [chord] intersects the point [?] … [Text continues onto the following folio.]

(The page opens mid-argument, continuing the intersecting-chords proposition and its several case-figures from the preceding folio. The two-letter point-labels are written as tiny overlined letter-pairs; at this hand most of them cannot be resolved letter by letter and are flagged individually. The connective mathematical prose, by contrast, is legible.)

we draw out the perpendicular **[label: ?]** and the right angle **[label: ?]**, and we set up the rectangle **[label: ?]**. By the construction of the second proposition [?], let **[label: ?]** be **[label: ?]**, together with the rectangle **[label: ?]** and the rectangle **[label: ?]** — just as the rectangle **[label: ?]** and **[label: ?]** are equal to the rectangle **[label: ?]**. And since the angle is a right angle, the two rectangles **[label: ?]** and **[label: ?]** are together as the rectangle **[label: ?]**. In the same way, let **[label: ?]** be **[label: ?]**, and this rectangle is equal to the rectangle **[label: ?]**, which is equal to **[label: ?]**; and therefore the rectangle **[label: ?]** is as the area of **[label: ?]** [?] and the rectangle **[label: ?]**. Hence, when this added part is taken away, there remains **[label: ?]**, equal to **[label: ?]**.

For neither one of them lies upon [the center], the center being between the two of them [?]; and the one **[label: ?]** …

And likewise it will be shown, as the figure makes plain, that **[label: ?]** … By the construction its area is equal [to the other], and the rectangle **[label: ?]** [equals] the rectangle **[label: ?]**; so this too remains **[label: ?]** [?]. And when this added part falls away, there remains **[label: ?]** as **[label: ?]** [?].

And we draw out from it two lines: the one cutting [the circle], and it is **[label: ?]**, and the other **[label: ?]**; and we say that the area of **[label: ?]** at the point [of intersection] is as the rectangle **[label: ?]**, when we draw the line **[label: ?]** passing through the center — which is the point **ה** [?] — and at the distance **[label: ?]**, so that by one figure it equals the other figure [?].

[Margin: (35) לה [?] — tentative Greek Euclid III.36: a point taken outside a circle; the rectangle under the whole secant and its external segment equals the square on the tangent]

Diagram. Three circles set in a row across the lower half of the page, each mounted on a long vertical stroke that runs down toward a common external point — the tangent-and-secant lines drawn from a point *outside* the circle. Small ordinal captions and letter-labels stand between and beside the circles. Visible interior/adjacent labels are faint two-letter pairs, individually unresolved:

- circle 1 (right): points on the circumference [?], [?]
- circle 2 (middle): caption above [?]; points [?], [?]
- circle 3 (left): points [?], [?]
- shared external point (foot of the stems): [?]

Its figure: **its point is outside** (*סימנו נקודתו מחוץ*). We draw to it [the circle] two lines — the one **[label: ?]**, and the other, which touches [it] — and the one **[label: ?]** [?]; and we say that the area of **[label: ?]** [is] as the rectangle **[label: ?]** at the intersection, as when we draw out the line **[label: ?]** passing through the center, which is **ה** [?], and we make **[label: ?]** [?] …

(Faint triangular outlines recur in the left portion of both folio sides in the same relative position; these are offset/show-through of a heavily inked figure, not figures belonging to this side, and are not transcribed as diagrams.)

from the second proposition [?], let it be **[label: ?]**; … these [being] the tangent [?]. There remains **[label: ?]** [equal] to the rectangle **אד** [?]. And afterward we set **[label: ?]**, [which is] no longer [?] as the center, but above it; and we draw out the two perpendiculars **הח** and **הא** [?], and [each] touches **הר ,הל** [?]. And likewise it will be shown that the area of **בד** [?], **[label: ?]**, and the rectangle **[label: ?]**, equal to **הא** [?], [equals] the rectangle **הד** [?], which is equal to the two rectangles **אה, אד** [?]. When this tangent-part falls away, there remains **[label: ?]** as the rectangle **אד** [?].

And afterward we set **[label: ?]** beneath the center — and it is **ה** [?] — and we draw out the two perpendiculars **הא, הח** [?], and [it] touches [?] the whole of **[label: ?]**. And likewise it will be shown that the area of **בל, בלג** [?], and the rectangle **הא** [?] [equals] the rectangle **[label: ?]**, equal to **הא** [?], as the rectangle **אד ,אה** [?]. When this tangent falls away, there remains **[label: ?]** as the rectangle **אד** [?].

[Margin numeral not clearly inked — tentative Greek Euclid III.37: the converse — if the rectangle under the whole secant and its external part equals the square on the drawn line, that line touches the circle]

And so we say likewise of this: namely, if we make the area of **[label: ?]** equal to the rectangle **אד** [?], the intersection being as the rectangle **אל** [?], we say that the line **אד** [?] touches the circle. And it will be shown, as the figure itself makes

plain, that the angle **[label: ?]** is a right angle; therefore [it touches] — as [is seen] in the fifteenth figure of this treatise [?]. And it is understood by the figure [?].

(No explicit "the third treatise is completed" colophon is separately inked here; the text passes directly from the last proposition of Book III into the display heading of Book IV below.)

המאמר הרביעי — The Fourth Treatise [Euclid, *Elements*, Book IV]

(Display heading, enlarged script. To its right stand smaller words that are not resolvable: [?].)

And the [rectilinear] figures are three-…[sided and more] [?]. **[Definitions.]** [A figure is said to be] equal-…[to another] [?] when the angles of the inner figure [each touch the outer]; it is said that the inner [figure] revolves [is inscribed] within [the outer], turning inside it [?]; and likewise it is said of one [figure] that it is circumscribed [about another when its sides touch the inner one].

And it is said that a figure is **inscribed** (*חקוקה*) in a circle when every line of the circumference touches the extremities [angles] of the inscribed inner figure. And it is said that a figure is **circumscribed** (*חקוקה על*) about a circle when the sides of the inscribed figure touch the circumference from outside [?]. And [likewise a line is said to be inscribed in a circle when its ends lie on] the circumference [?].

[Proposition IV.1 — to fit into a given circle a straight line equal to a given straight line not greater than the diameter.] We have heard [it asked] that … [there be given] a circle whose diameter is longer [than the given line], and we wish to fit into it a line equal to [the given line].

Diagram. A circle at the foot of the column with internal chords/lines drawn to it, and a separate short vertical stroke standing to its left — the given straight line set beside the circle into which an equal line is to be fitted. Visible letter-labels are faint two-letter pairs, individually unresolved:

- points on the circumference: [?], [?]
- endpoints of the given line (left stroke): [?], [?]

Let there be made in it its diameter [?]; for if [the given line equals the diameter] it is [already] done. We draw out its diameter, and it is **בג** [?]; and if the line **ד** [?] is shorter than it, we take from it [from the diameter] **ז** [?], equal to the line **ד** [?];

and we make **[label: ?]** … [with] the center, at a distance [radius], and describe upon it, at the distance **[label: ?]** [?], the circle **הח** [?]; and it cuts the circle **אבכ** [?] at **[label: ?]** [?]; and we make **[label: ?]** [?]. And the matter is evident — that it [the fitted line] is equal to the line **ד** [?], just as we wished.

[Foliation, lower outer corner p. 240: "111" (modern pencil)]

[Continuation of *המאמר הרביעי* — the Fourth Treatise = Euclid, *Elements*, Book IV. This opening carries propositions IV.2–IV.9. Book IV is not completed here, and no Book V rubric appears.]

[Proposition IV.2 — to inscribe in a given circle a triangle equiangular with a given triangle]

Diagram. At the head of the column, a small free-standing triangle — the given triangle — with two small marks (dots) set inside it.

- ד (beside the figure): label of the given triangle
- interior points: [?], [?]

Diagram. A circle with an inscribed triangle; a straight stroke (the tangent line) is drawn touching the circle to its left.

- ב (apex): vertex of the inscribed triangle
- ד (right vertex): [?]
- further vertex / tangent-endpoint labels: [?]

We have before us a triangle **דהו** [D-H-W] and a circle **אבג** [A-B-G], and we wish to inscribe in the circle a triangle whose angles are equal to the angles of triangle **דהו**. We draw a line **טח** [T-Ḥ] [?] tangent to the circle at point **א**. At that point we make the angle **טאב** [T-A-B] equal to angle **[ה?]**, and the angle **חאג** [Ḥ-A-G] equal to angle **[ו?]**; the remaining angle **באג** [B-A-G] then equals the remaining angle **[ד?]** of triangle **דהו**. And so the inscribed triangle has its angles equal to the angles of the given triangle, as we wished.

[Proposition IV.3 — to circumscribe about a given circle a triangle equiangular with a given triangle]

Diagram. A circle with a triangle drawn about it, its sides tangent to the circle; lines run from the centre outward, and a small separate triangle stands to the lower right (the given triangle).

- centre / tangent-point labels: [?]
- ל, ג (on the lower tangent line): endpoints of tangent **לג** [?]
- small triangle labels: [?]

And if we wish to circumscribe about the circle a triangle whose angles are equal to the angles of the known triangle **דהו**: we draw the line and extend it to **ג**; and we draw from the centre — which is [at] half the circumference [i.e. the radius] — as required, namely **חב** [Ḥ-B] [?]. At point **ח** we make an angle **[?]חמו** equal to the exterior angle **דהח** [?] — this being angle **בחג** [B-Ḥ-G]; and angle **אחו** [A-Ḥ-W] equal to the exterior angle **דהכ** [?]. Then we pass, through the points **א**, **ב**, **ג**, straight lines tangent to the circle, namely line **לג** [L-G] and line **נמ** [N-M] [?]. With this the triangle is completed, as we wished — since, likewise, its [three] angles together are equal to four right angles [?], and each one of them… [the proof continues:] a right angle to a right angle; therefore, since angle **ה** equals the exterior angle **דהח** [?], which equals two [right angles?], it remains that angle **[?]מל** equals the interior angle **ה**; and likewise it is shown that angle **ג** equals the interior angle **ו**, and the remaining angle **ל** equals angle **[?]ד**.

[Proposition IV.4 — to inscribe a circle in a given triangle]

(Margin numeral: ד)

Diagram. A triangle with a circle inscribed within it, touching the three sides; lines (radii) are drawn from the centre of the inscribed circle to the three points of contact, giving the figure a star-like appearance.

- centre of inscribed circle: [?]
- vertices / points of contact: [?], [?], [?]

We have a triangle **אבג** [A-B-G] and we wish to inscribe within it a circle. To do so we bisect the angle at **ב** [and the angle at **ג**] into two parts, by the two lines **בד**, **גד** [?], which meet at **ד**; and then from point **ד** [?] we drop the perpendiculars **זח**, **דז** [?], and describe upon **ד** [as centre], at the near distance [radius], a circle.

We say that triangle **אבג** touches it [the circle], as is already clear before you: for the angle **[?]חמא** equals the angle **זבד** [?], and the right angle at **ח** equals the [right] angle at **ד**, so that **זב** [?] remains [equal]; therefore, as in the first treatise, this equals this and this equals this. And, as in the ninth figure of the third treatise, let point **ז** [Z] be the centre; and since the angle **[?]הלח** is evident before you, [the circle] touches the line of the triangle.

[Proposition IV.5 — to circumscribe a circle about a given triangle]

(Margin numeral: ה)

Diagram. A circle enclosing a triangle, with internal construction lines running from an interior point (the centre) to the vertices and to the midpoints of the sides, so that the interior reads as a many-pointed star.

- ה (upper margin, beside figure): [?]
- interior centre point: [?]
- vertices: [?], [?], [?]

And we wish to circumscribe about the triangle a circle that surrounds it. We bisect two of its sides, **אב** and **אג**, at two points; and from them we erect two perpendiculars **[הז?]** and **[טח?]**, [which meet]. By [the proposition of] the first treatise, the three lines **דא**, **דב**, **דג** [are equal]; and, as in the ninth figure of the third treatise, let **ז** [Z] be the centre. We then describe about it a circle that surrounds it, as we wished. But **[אב?]**, **[בג?]**, **[נג?]** [?] — and the matter is seen to be that they are equal.

[Proposition IV.6 — to inscribe a square in a given circle]

(Margin numeral: ו [inferred; not clearly legible])

Diagram. A circle with an inscribed square set as a diamond (vertices at top, bottom, left and right), its two diagonals drawn as a crossing pair of diameters meeting at the centre.

- ה (apex / centre region): [?]
- vertices א, ב, ג, ד of the square: [?] (individual placements not resolvable)

And if we wish to inscribe a square in a given circle: we draw within it two diameters, **אג** and **בד** [?], crossing one another at right angles, their [common] centre being **ה** [H]; and then we join the lines **אב**, **בג**, **גד**, **דא**, and it is a square. [Its four sides are equal] and its angles are right, since the diameters cross at right angles and the [four] segments are similar — and the matter is seen to be that they are equal.

[Proposition IV.7 — to circumscribe a square about a given circle]

(Margin numeral: ז)

Diagram. A square with a circle inscribed within it, touching the four sides; a cross (the two diameters at right angles) is drawn through the centre.

- corner labels of the square: [?], [?], [?], [?]
- centre: [?]

And if we wish to make about the circle a square that surrounds it: we draw two diameters [at right angles], and pass through their endpoints straight lines tangent to the circle. These tangents meet, and the figure they enclose is a square with right angles [?]. And it is shown that its sides are equal — [the proof turns] on the seventeenth [?] figure of the [third] treatise.

[Proposition IV.8 — to inscribe a circle in a given square]

(Margin numeral: ח [inferred; not clearly legible])

Diagram. A square with an inscribed circle touching the four sides; the two lines joining the midpoints of opposite sides cross at the centre.

- corner labels of the square: [?], [?], [?], [?]
- midpoints / centre: [?]

We have a square **אבגד** [A-B-G-D] and we wish to inscribe within it a circle. We bisect each of its four sides into two halves at the points **[?]הזטח** [?], and draw the line **[?]הט** and the line **[?]זח**; these meet at the centre, and about that centre, at [the corresponding] distance, we describe a circle. It touches each of the four sides, since each of the four [strips] is equal [?]; therefore [the circle is inscribed], as we wished.

[Proposition IV.9 — to circumscribe a circle about a given square]

(Margin numeral: ט)

Diagram. A circle with an inscribed square set as a diamond, its two diagonals drawn; a fainter outer circle is sketched around it.

- vertices of the square: [?], [?], [?], [?]

- centre: [?]

And when there is a square **אבגד**, and we wish to make about it a circle that surrounds it: we draw its two diagonals as the two lines **אג, בד** [?], which meet [at the centre]; we take that meeting-point as centre, and at the distance **[?]הא** [i.e. to a corner] we describe the circle. And it is as we wished. The rest is evident from these lines [?] — [the square being] inscribed within the circle.

[Foliation, lower outer corner p. 242: "112" (modern pencil)]

Midrash ha-Ḥokhmah — Judah ben Solomon HaKohen (Parma 2769)

Script: Sephardic semicursive, single hand (Sasson ben Menashe). Scribal quirks in force: gimel written nun-like; tav often shaped like tet. Upper margin of both folio sides masked by the photographer's black bar (no running header inked). Proposition numbers are carried by overlined numerals in the outer (right) margin, several in red-brown ink.

[Conclusion of Proposition IV.9 — circle circumscribed about a square]

(Continued from the foot of the previous folio.)

[Marginal gloss, upper right, small hand: יחקק בתוכה [?] — "let it be inscribed within it"]

so that it [the circle] contains the whole square, the square being inscribed within it. Therefore the [inscribed] square is [?] … of the semicircle. And this is the premise [ההקדמה].

[Proposition IV.10 — an isosceles triangle whose base angles are each double the apex]

(Margin numeral: י [?] — faint)

Diagram. A small triangle drawn in red-brown ink, standing beside the main figure; it carries three vertex-letters, now largely faded.

- apex: [?]
- base-left: [?]
- base-right: [?]

Diagram. A circle enclosing a downward-pointing inscribed triangle; a fainter concentric circle is sketched outside it, and a point is marked at the lower centre.

- upper vertices of the inscribed triangle: [?], [?]
- lower vertex: [?]
- centre-point: [?]

We wish to construct an isosceles triangle in which each of the two angles at the base is double the remaining [apex] angle. We take a line and cut it so that the rectangle contained [by the whole and one segment equals the square on the other segment] — as is stated in Book II [the golden section, *Elements* II.11]. We make one endpoint a centre and, at [that] distance, describe the circle **אבגדה** [A-B-G-D-H]. In the first figure we draw within it a chord [?] equal to the line **אזג** [?], and [?]. And we say thus: that upon **ב** [B] we make the angle **אנב** [?].

[The proof runs through the equality of angles:] each of these angles — the angle **בדג** [?] [B-D-G] equal to the angle **א** [A] — and we set the angle **נגא** [?] equal to the angle **[?]**; the angle **בגא** [B-G-A] equal to the angle **נגא** [?] [and to] **א** [A]; therefore they are equal to the angle **בג**[?]. Hence the angle **בנד** [?] equals the angle **ב** [B] [?], and likewise [?]; and the angle **נבא** [?] is [?], while the whole angle **נבא** [?] is double the angle **בגא** [B-G-A], and so too the angle **ג** [G] is equal to it — [each base angle being] double the angle **א** [A].

And thus we have made [the triangle] we set out [to make], and we wished [thereby] to inscribe within it a pentagon.

[Proposition IV.11 — to inscribe a regular pentagon in a given circle]

(Margin numeral: [11] יא)

Diagram. A circle enclosing a five-pointed star (pentagram), its five chords drawn as the diagonals of the inscribed pentagon; the vertex-letters around the circumference are faint.

- vertices around the circle: [?], [?], [?], [?], [?]

We wish to make within it [the circle] an equilateral, equiangular pentagon [מחומש]. We set up the five equal arcs, so that their chords are equal, and the triangles [formed] are equal [?]. And in the manner we have explained, let the figure of the pentagon [מחומש] be set out. Its base [?] [is drawn], and thus [it is] inscribed, and so shall the [side] of the pentagon [מחומש] be. And when it is [?], one steps around [it]. Thus is the pentagon [מחומש] made, as is shown in the [foregoing] figure — the five [equal] arcs.

[Propositions IV.12–IV.14 — pentagon and circle (circumscribe pentagon about a circle; inscribe a circle in a pentagon; circumscribe a circle about a pentagon)]

(Margin numerals, upper outer corner: [12, 13, 14] יב יג יד — grouped; gimel written nun-like)

Diagram. A pentagon [drawn slightly heptagon-like] with a circle inscribed within it; straight lines run from the centre to each vertex and to the mid-points of the sides. Small arrow-marks and vertex-letters are set around the figure, mostly faded.

- vertices of the pentagon: [?], [?], [?], [?], [?]
- centre: [?]

[IV.12:] We place the points [that are] the vertices [ראשי] of the pentagon inscribed within it [the circle]; and let the points be [ה]**אבגד** [?]. We draw through them the lines [tangent] … [?]; and thus the [circumscribed] pentagon is completed, since [each tangent] touches the circle at [?] one [of the] points. And because the parts of the pentagon are equal, the angles [?] are equal [?] — as [shown] in the figure … [of Book III], and by what we mentioned at the end of the Third [Book]. So let **קמא** [?] be [?].

Just as we make [?] the [tangent] … [?], and its like … [?] equal to … [?], so let the whole [?] pentagon be equal. And by what we have already mentioned, at the last [?] figure [?] it shall be **[?]**; likewise it is proved [ויתבאר] for all five sides — the whole is equal — and so it is proved [ויתבאר] of the whole; and thus is proved [ויתבאר] the figure of the pentagon.

[IV.13:] And if the pentagon [מחומש] be made, and we wished to inscribe within it a circle [with sides] equal all round: we bisect its angles, and likewise we bisect its sides at the points [ה]**אבגד** [?], and draw from [them] perpendiculars [עמודים] [?] so that the lines meet at [the centre] **מ** [M]; and we make it [M] a centre and, at [that] distance, [describe] a circle. And it is complete; and it is shown in full from the figure that the [radii to the] sides of the pentagon [are equal] [?], and that the triangles and the halves [?] and the lines [?] … [?]. Therefore the point **מ** [M] is the centre of the circle; and because the angles at [?] are right [נצבות], the sides of the pentagon [?] reach [?] to it.

[IV.14:] And if we wish to circumscribe about it [the pentagon] a circle [with sides] equal all round: we bisect two of its angles [?], and the lines meet at **מ** [M];

and thus [also] for the rest of its lines [?]; therefore the point **מ** [M] is the centre, and it is shown that [the distances] are equal … [?].

[Proposition IV.15 — to inscribe a regular hexagon in a given circle]

(Margin numeral: [15] טו)

Diagram. A circle enclosing a hexagon; from the centre **מ** [M] lines run to the vertices, and a second, equal circle is drawn overlapping the first below it (the compass-arc by which the radius is stepped around). A point is marked at the top centre.

- centre: **מ** [M]
- upper-left vertex: **ה** [H] [?]
- further vertices around the hexagon: [?], [?], [?], [?]

for the [given] circle [is] the one drawn [המסובבת], and its centre is **ה** [H] [?]; and [we wish] to inscribe within it an equilateral hexagon [משושה]. We set [the compass] upon **ב** [B], **ג** [G], and at the distance **ה** [H, the radius] [describe] the arc **אהב** [?]; and we set [it] upon **ב** [B], **ה** [H], and at the distance **ג** [G] [describe] the arc [?] — [stepping the radius around the circle]. … [The construction continues; the foot of the folio is interrupted by the figure and the black masking bar.]

[Foliation, lower outer corner p. 244: "113" (modern pencil)]

Sefer ha-Yesodot (Euclid's Elements): close of the Fourth Treatise (Book IV) — the hexagon corollary (IV.15) and the inscription of the fifteen-angled figure (IV.16) — followed by the opening of the Fifth Treatise (Book V), the theory of ratio and proportion.

[Book IV, continued — the hexagon (IV.15), its corollaries, and the fifteen-gon (IV.16)]

(Sephardic semicursive; single hand throughout. Scribal quirks per this witness: gimel written nun-like, tav written tet-like.)

and afterward we divide [ואחר כן נחלק] [?] one arc [קשת] [?] into [?] parts [בשבע חלקין [?]] [line largely illegible]. …the sides [צלעות], and it is **אחב** [?], a right angle [נצב] [?]; as we saw, that [it is] an equilateral triangle [משולש שוה הצלעות] and the pentagon [החמשית — possibly "the sixth" (הששית) [?]]. …And [we have] the [right] angles [נצבות]; and one angle [?] **גשמן** [?], three [שלשה] [?], the remaining right angle [נצבת נשארת]; …one angle **גהד** [?] is a right angle and a third [?]; and since one arc **אחד** [?] is like [?] the whole [?]; …from the two angles **דהח** [?] [and]

דהקטע [?], two [is] two-thirds of a right angle [שני שלישי נצבת] [?]; and since they are among the sides [שמן צלעות הם] [?] …

they are equal [שוין], [and] it will be [?] an equilateral triangle [משולש שוה הצלעות] whose angles are equal, and each of the angles is a right angle and a third [נצבת ושלישית] [?]. And it has also been shown that the side of the hexagon [צלע בעל השש] is like the line drawn from the center to the circumference [i.e., the radius]. Likewise we can inscribe [לחוק] [?] within it [the circle] a hexagon [בעל שש] [?] [equal in] its sides and its angles [?]; and also, when we bisect [the arcs of] the hexagon, we inscribe within it [?] … a circle [עגולה], as we did with the pentagon [כמו שעשינו במחומש].

Diagram. A small plain circle drawn in the right portion of the text block (the circle for stepping the constructed side around). No interior lines resolve; any vertex-marks are too faint to read. Labels illegible.

[IV.16 — to inscribe in a given circle a fifteen-angled figure that is equilateral and equiangular:] We wish to inscribe in a circle [a figure] of fifteen [?] sides [numeral: ?] whose base-segments [תושבת] are equal [שוות] [?]. We inscribe [נחוק] in it the portion [החלק] [?] … the side of the pentagon [צלע המחומש], and it is **אב** [?]. So we produce from the point **מ** [M] [?] the side of the pentagon, which is **אב** [?]; let it fall upon the arc **הב** [?] [as] two sides [?], divided into two halves [נחלקה לחצאין] — in a figure like this [כזה] — upon **ד** [?]. And let all the sides of the figure be equal [שוין], and we produce [in] the problem [?] [lines] equal to the line **הב** [?], as [shown] in the first figure of this Fourth Treatise [בצורה הראשונה מזה המאמר הרביעי].

Diagram. A circle with an inscribed triangle: a horizontal chord near the lower part of the circle and two lines rising to an apex, forming a triangle within the circle (the inscribed equilateral triangle by which the one-third arcs are marked off for the fifteen-gon). Faint vertex-marks are present but no label reads.

[End of the Fourth Treatise (Book IV).] [The transition is marked in the source only by the display heading that immediately follows; no separate "נשלם" colophon is inked. The closing sentence above cross-refers back to "the first figure of this Fourth Treatise."]

המאמר החמישי — The Fifth Treatise [Book V]

(Display heading, enlarged script. Book V — the theory of proportion; definition-heavy and figure-free.)

[1] (marker ׳**א**) A part [החלק] is the measure of the smaller [taken] from the greater, when it measures the greater [כאשר ישעיר לגדול] [?] … [and the remaining smaller numbers] [בעל הקטנים מספרים] [?]. And it is possible [ואפשר] [?] that it add a multiple [כפל] [?] …

[The definitions of the multiple, the ratio, and "magnitudes having a ratio" occupy the next, badly compressed lines; no gershayim markers ׳**ב**-**ד** resolve clearly here.] …[the magnitudes] are called [proportional] [?] because they are in one ratio [יחס אחד] — the first to the second and the third to the fourth. They are those for which one takes of the first and the third equal multiples [כפלים שוין], and takes for the second and the fourth other equal multiples — whatever multiples they may be — and one finds [that] the double of the first and the third,

[5] (marker ׳**ה**) — whether they exceed [מוסיפין] the double of the second and the fourth together, or are equal to them together, or fall short [מחוסרין] of them together, when they are taken as adjacents, one against another. And when the double of the first and the third likewise exceeds the double of the second and the fourth, or falls short of them together, or equals them together — when they are taken in order, part for part [על הסדר מן קצתם למקצתם] — then the ratio of the first to the second is as the ratio of the third to the fourth.

[6] (marker ׳**ו**) When the equal multiples in their product [בתשבורתם] — the double of the first — exceed the double of the second, and the double of the third does not exceed the double of the fourth, then the first is said to have a greater ratio to the second [יקרא רב יחס אל השני] than [the ratio of] the third to the fourth.

[7] (marker ׳**ז** [?]) When there are three magnitudes [שלשה שיעורין] in one ratio, the ratio of the first to the third is called double the ratio [כפול היחס] that the first has to the second. And if there be four [magnitudes proportional]…

[8–9] (markers ׳**ט** / ׳**ח** [?]) …[the ratio of the first to the fourth is compared] to the second, equalized [?] in its measure [מושוה במקדורא [?]]. And if there be four proportional magnitudes [ארבעה שיעורין מתיחסין], the ratio of the first to the fourth is called [triple the ratio] … [these lines are abraded and the exact numbering is uncertain].

[10] Composition of the ratio [הרכבת היחס]: it is [the ratio formed] as the antecedent [המוקדם] [together with the consequent] is to the consequent [אל השני].

[11] (marker **יא׳**) Separation of the ratio [פירוק היחס]: it is the ratio of the excess by which the antecedent exceeds the second [כח תוספת המוקדם על השני] [?], [taken] to the second.

[12] (marker **יב׳**) Inversion of the ratio [היפוך היחס]: it is the ratio of the antecedent to [its excess over] the second — the excess of the antecedent over the second [תוספת המוקדם על השני].

[13] (marker **יג׳**) The ratio of equality [יחס השויה]: it is the ratio of the extremes [הראשים], part to part, when the magnitudes are more than two, paired with other magnitudes equal to them in number, [all] in one ratio, and the intermediate terms [המספרים האמצעים] are removed alike [ex aequali].

[14] (marker **יד׳**) The corresponding ratio [היחסות ההוה [?]]: it is the ratio of antecedent with antecedent, and the ratio of the second with the second.

[15] (marker **טו׳**) The ordered ratio [היחסות הסדורה]: it is when the antecedent stands to the second as [one thing] stands to another thing [כאשר המוקדם אצל השני והשני אצל דבר אחר]. [And] the perturbed ratio [היחסות השוה [?]]: it is when the antecedent stands to [the second]… [the definition runs to the foot of the folio and is cut off there].

[Margin, left of p. 246, three stacked words in the text-hand, glossing the ratio-operations — Arabic technical names transliterated into Hebrew: **מנתסבה** [?] [Arabic: mutanāsiba, "proportional"], **מעכוסה** [?], **מנתסמה / מנעכסה** [?] [Arabic: maʿkūsa, "inverted"]. Verbatim transcription; the exact readings are uncertain and the Arabic identifications require further verification.]

[Foliation, lower outer corner p. 246: "114" (modern pencil) [?].]

(Continuing the Fifth Treatise = Euclid, Elements Book V. The folio opens with the close of the Book V definitions — the perturbed proportion — and then runs through the opening propositions, which are argued verbally. Magnitudes are drawn as short horizontal line-segments labeled either by letter (א, ב, ג, ד, ה, ז) or by ordinal name — "the first," "the second," … "the sixth." These segment-figures are the "figures" [צורות] the proofs refer back to.)

[Definition, concluded — the perturbed proportion.] …as [the antecedent] is to the second, and the second to another thing as another thing is to [the antecedent] [?]. [The final clause of the definition is faint; the sense is the standard "perturbed" arrangement in which the correspondence of terms is disturbed.]

[Proposition 1] [Marginal marker at the head of the diagram: **א׳** [?].] If the magnitudes אב and גד [?] are taken as multiples of ה, and [גד] as multiples of ז — and the amount that is in אב of multiples of ה is as the amount that is in גד of multiples of ז — then we say that what is in אב and גד together of multiples of ה and ז together is as much as what is in אב of multiples of ה. [That is: if אב is the same multiple of ה that גד is of ז, then אב and גד together are the same multiple of ה and ז together.]

Diagram. Two horizontal magnitude-segments, each shown divided into equal parts by short vertical ticks, representing the equimultiples of the enunciation.

- Upper segment: labeled **ה** [?]
- Lower segment: labeled **ב** / part-mark [?]
- [Two further labels illegible.]

Proof. For as much as is in אב of [copies of] ה, so much likewise is in גד of [copies of] ז; and, as is shown in the first figure, [each copy of ה paired with a copy of ז yields a magnitude equal to ה and ז together, and these are equal in number to the copies in אב] [?]. Therefore אב and גד together are the same multiple of ה and ז together.

[Proposition 2] If the first, which is אב, is a multiple of ה [the second], [and] as is likewise in the third, which is [גד] [?], a multiple of ז the fourth — we say that what is in the first and the fifth together, which is [numeral: ?], is a multiple of the second; and it is [numeral: ?], as much as is in [the third] and the sixth together; [and this is] a multiple of the fourth, which is ז. And as is shown in the first figure: as is in the first, the first is a multiple of the second; the second [?]; as is in the third, the third is a multiple of the fourth, the fourth. [The enunciation: if a first magnitude is the same multiple of a second that a third is of a fourth, and a fifth is the same multiple of the second that a sixth is of the fourth, then the first-plus-fifth is the same multiple of the second that the third-plus-sixth is of the fourth. The two standalone letters read here as counts are uncertain and are flagged.]

Diagram. A set of horizontal magnitude-segments, several divided by ticks, labeled by ordinal for the six magnitudes of the proposition.

- Segment: **ראשון** ("first")
- Segment: **שני** ("second") [?]
- Segment: **שלישי** ("third")
- Segment: **רביעי** ("fourth") [?]

- Segment: **חמישי** ("fifth")
- [Sixth-segment label illegible.]

[— more than two labels flagged [?].]

[Proposition 3] …and equimultiples were taken of the first and the third [ולקחו לאחד ולשלישי כפלים]; they are equal, and it is [as] the first was written, so [too] the [multiple], a multiple of the third [?]. We say that what is in [the multiple of] the first is a multiple of the second, as much as what is in [the multiple of] the third is a multiple of the fourth. And as is shown in the fifth figure — that we make [it] as first and fifth, and take third and sixth [?] [reading uncertain; the letters run to "first / fifth / third / sixth"]. [Enunciation: if a first is the same multiple of a second that a third is of a fourth, and equimultiples be taken of the first and third, then, ex aequali, the magnitudes taken are equimultiples respectively of the second and the fourth.]

Diagram. Horizontal magnitude-segments, some tick-divided, for the first/second/third/fourth magnitudes and their equimultiples.

- Segment: **ראשון** ("first") [?]
- Segment: **שני** ("second")
- [Remaining labels illegible.]

[Proposition 4] …the first [is] to the second as ג [?] the third is to ד [?] the fourth, and it is [numeral: ?] [of] the first and the third [?]. [Then equimultiples are taken and compared.] We say that the ratio of [the multiple of the first] to גד is as the ratio of אב to גד [?] … and they are equal [יהיו שוין]. [Enunciation, in the standard form: if a first has to a second the same ratio that a third has to a fourth, then equimultiples of the first and third have the same ratio to equimultiples of the second and fourth, taken in corresponding order. The internal letter-chains of the proof are largely at or below the reading threshold and are flagged.]

Diagram. Two long horizontal magnitude-segments with a shorter pair, tick-divided.

- Segment: **ה** [?]
- [Remaining labels illegible.]

[— labels largely illegible.]

[Proposition 5–6] …a multiple of ה [?]; and one takes away by itself the second and the fourth, multiples [of] כה … and it is חט [?]. We say that … [the remainders]. And a subtraction was made from גד and from אב, and there was in

[the remainder] a multiple [of] ... We say that the ratio of [the remainder] is as the ratio of אב to גד [?] ... Therefore, we say that the multiples of חב [?] ... the remainders [of חב] — either they are equal, or they are multiples [of them]. [This is the enunciation of the "remainders" proposition: if two magnitudes be equimultiples of two magnitudes, and magnitudes taken away be equimultiples of the same, then the remainders are either equal to those magnitudes or equimultiples of them. The letter-labels are heavily abbreviated and several are illegible.] ...or that it be a remainder, a multiple of ה, as much as is in [גד] a multiple of אב, equal [?].

Diagram. Horizontal magnitude-segments with tick-marks indicating parts taken away (the "remainders").

- Segment labels: **ב** ,[?] **ה** [?]
- [Remaining labels illegible.]

[— labels largely illegible.]

[Proposition 7] ...the magnitudes אב are equal [?]. We say that the ratio of each of the two of them to ג is one and the same, and that the ratio of ג to each of them [is one and the same]. [Enunciation: equal magnitudes have the same ratio to the same magnitude; and the same magnitude has the same ratio to equal magnitudes.] For each of them was equated [reading uncertain] to another straight [magnitude] [?] ...

Diagram. Horizontal magnitude-segments; a tick-divided upper bar labeled with ד above and ב below at one end, and a longer bar beneath.

- Segment: **ב** / [?] **ד** [?]
- [Further labels illegible.]

[Proposition 8] [Marginal marker **ח**׳ [?].] ...and אב is greater than ג [?]. We say that the ratio of אב to [ה/ד] [?] is greater than the ratio of ג to [the same]; and the ratio of [the same] to ג is greater than [its ratio] to אב. [Enunciation: of unequal magnitudes, the greater has to the same a greater ratio than the less has to it; and the same has to the less a greater ratio than it has to the greater.]

Diagram. Horizontal magnitude-segments of unequal length, tick-divided.

- Segment labels: **ג** ,[?] **אב** [?]
- [Further labels illegible.]

[Proposition 9] [Marginal marker **ט׳** [?].] If the ratio of א to ב is as the ratio of ג to ב itself, we say that א and ג are equal. And if the ratio of the first [to a magnitude equals the ratio of the second to it, the two magnitudes are equal] [?]. [Enunciation: magnitudes which have the same ratio to the same magnitude are equal to one another; and magnitudes to which the same magnitude has the same ratio are equal.]

Diagram. Horizontal magnitude-segments, tick-divided.

- Segment labels: **ב** ,[?] **א** [?]
- [Further labels illegible.]

[Proposition 10] …if the ratio of א to ב is greater [than the ratio of ג to ב], then א is greater than ג [?] … the ratio of ג [?] is greater [reading uncertain] … If the ratio of א to ב were equal, [the magnitudes would be equal]; but it was [greater] [?] … [Enunciation: of magnitudes having a ratio to the same magnitude, that which has the greater ratio is the greater; and that magnitude to which the same has the greater ratio is the less.] …greater than [the ratio of] ג to ב … the multiple [of ב] … as the magnitude of אב and א [?]. And if the ratio of א to ב were greater than the ratio of ג to ב, then א would be greater than ג [?] …

Diagram. A cluster of horizontal magnitude-segments, several tick-divided, comparing the greater and lesser ratios.

- Segment labels: **ג** ,[?] **ב** ,[?] **א** [?]
- [Further labels illegible.]

[— labels largely illegible.]

** ** …the ratio of א to ב [?] … "let it be" [reading: כשיהא / כשיקא [?]] … the ratio [is] greater … from [the standpoint of] a difference [?], they will be [numeral: ?]. … the ratio of א to ב is as the ratio of ב to ד ,ג [?]. And if the ratio of [אג] [?] be greater than the ratio of ג — …the ratio of אב [?] … and [if] אה to הב be greater than the ratio of גא to הב [?] … [The argument runs on to the foot of the folio, still within the greater-/lesser-ratio propositions of Book V. The letter-chains here are dense, heavily abbreviated, and several letters are illegible; the passage] [The text is cut off at the foot of the folio; Book V continues.]

[Foliation, lower outer corner p. 248: "115" (modern pencil).]

The Fifth Treatise (Euclid, *Elements*, Book V) — concluding propositions

[The page opens in mid-proof, continuing the ratio-and-magnitude propositions of Book V. The proofs are argued over small horizontal magnitude-bars (tick-divided line segments) drawn into the text column; these are represented below as schematic figures with their visible segment-labels only. The letter-label chains in this stretch are dense, heavily abbreviated, and frequently at the legibility floor — individual labels are flagged [?] where genuinely unresolved, while the sentence-level argument is rendered where it is legible.]

[Proposition — *ex aequali* comparison (≈ Euclid V.20).] Let the ratio of אב to בה, by composition, be greater than the ratio of גד to דה [?]; the magnitudes being אב and גד. Let us cut off from אב [the part] אה, and from גד [the part] זח [?], so that the ratio of אב to [?] is as the ratio of אה to גנ [?]. We say that [the first is] greater than [?]; and if this is equal to it, this too is equal to it; and if it is less than it, this too is less; and if the ratio is equal — that is to say, [that] א to ב is as the ratio of ה to ב, and let ג to ב be as the ratio of ד to בה [?] — we say that if א, the first, is greater than ג, the third, then ד, the second, will be greater than ו, the [fifth/sixth] [?]; and if it were less than it, likewise this is less than it; and if equal, equal.

Diagram. Horizontal magnitude-bars of unequal length, tick-divided, set into the text column to represent the compared magnitudes and their cut-off parts.

- Segment labels visible: **אה** [?], **גד** [?], **אב** [?]
- Marginal side-notes beside the lower bars: **חמש** ("five") [?], **שלש** ("three") [?]
- [Further internal tick-labels illegible.]

[— most labels below the legibility floor.]

[Proposition — the antecedents and consequents taken together (≈ Euclid V.12 / componendo).] …we say that the ratio of א to ב [?] … and let א to ב be as the ratio of ה to ב, and the ratio of ב to ג as the ratio of ד to [?]. We say that the ratio of אב to בג is as the ratio of גד to בג [?], which is as the ratio of אה to בג, [and] as the ratio of דה to ו [?]. We say that the ratio of א, ב, ג together to בג is as the ratio of ד, ה, ו together to בג [?] — that is, as the ratio of each one of the antecedents to its consequent, so is [the ratio of] all of them together.

Diagram. A cluster of horizontal magnitude-bars, tick-divided, representing the several antecedents and consequents summed "together" (יחד).

- Segment labels visible: **גד** ,[?] **בג** ,[?] **אב** [?]
- [Further labels illegible.]

[— labels largely illegible.]

[Proposition — the greatest and the least (≈ Euclid V.25, the final proposition of Book V).] The magnitudes אב, גד being proportional [?]: [let אב be] the greater and [?] the greatest which [is proportioned] … and let ד be the least among them [?]. We say that the greatest and the least [together] are greater than [the remaining two] [?].

Diagram. Three stacked horizontal magnitude-bars of decreasing length, tick-divided, comparing the greatest and least magnitudes against the two intermediate ones.

- Segment labels visible: **גד** ,[?] **אב** [?]
- Marginal numeral beside the figure: **ל** [?]
- [Further labels illegible.]

[— labels largely illegible.]

[No explicit "the Fifth Treatise is completed" colophon is inked; the close of Book V is marked only by the display heading that immediately follows.]

The Sixth Treatise (Euclid, *Elements*, Book VI)

[Display heading in enlarged script, lower left of p. 249:] **המאמר הששי** — *The Sixth Treatise.* [The heading is written large, spanning two text-lines; it marks the opening of Book VI on similar rectilineal figures.]

[Definitions.] …[Similar figures are those] whose [angles are] equal, each to [?] the [corresponding] one, and whose sides surrounding the equal angles are proportional; and [reciprocally-related] figures are those whose sides are proportional [?]. And the extent [?] between the similar [figures] is not [interchanged] [?], for the similar [figures] … one takes from the side of the figure [הצורה] the one side … in the antecedent from the first … and so on until the sides of the figure are completed [?].

[Definition — the height of a figure.] …the height of a figure is the perpendicular [עמוד] drawn from its apex to its base.

Diagram. An apex point above a horizontal base line, with several straight lines drawn from the apex down to points dividing the base, and a central vertical stroke (the perpendicular / height) from the apex to the base. The figure illustrates the height-of-a-figure definition and the base-ratio of the proposition that follows.

- Apex label: **א** [?]
- Base points (right to left along the base): **ט** ,**ז** ,**ו** ,**ה** … [?] **ב** ,**ג** ,**ד** [?]

[— more than two labels uncertain.]

[Definition — a line cut in extreme and mean ratio.] He says: a line is cut in "one ratio, [into] a mean and two extremes" when the ratio of the whole to the greater of its parts is as the ratio of the greater [part] to the lesser.

[Proposition 1 (≈ Euclid VI.1) — triangles and parallelograms of the same height.] Let there be two [triangles] … and their sides still [equal in height], and two triangles [on] אבגד [?] upon בג; and by the [prior] premise let the perpendicular be אנב [?]. We say that the ratio of base [to base] … [is as] the triangle to the triangle.

[Proof:] …[Consider] the ratio of base בג to base גד [?]; let us make the line גד into several equal parts [?], and in the [construction] divide בג [likewise], and so each part equal to the next, [each] like בג; and we draw אה [?] … And in the figure … from the first, there will be triangles … each one of them equal to triangle אבג [?], and likewise each one of them a triangle … equal to triangle אבד [?]. And by the fifth premise [?] of the Fifth [Treatise] … Let the ratio of base בג to base [?] … be made … and in the first figure, and by figure ז [?] of the Fifth [Treatise] … This is shown in figure ג [?] of the Fifth [Treatise].

[Proposition 2 (≈ Euclid VI.2) — a line parallel to one side of a triangle cuts the sides proportionally.] …from the first: triangle אבג [?], its angle being divided [?] … in one line [drawn] … We say that the ratio of דנ [?] to בד [?] is as the ratio of [one side to the other] [?]. [Let] … [a line] be drawn parallel to דה [?], and drawn out in a straight line until it meets at ג [?]; and in the preceding figure, [we have] the ratio of דל [?] to רב [?] as the ratio of אה to אב [?]. And if we show that אה equals או [?], it will be shown … as in figure גב [?] of the First [Treatise], that angle א [?] is divided into two halves.

Diagram. A triangle with an internal line drawn across it (a transversal parallel to one side), dividing the two other sides; internal cevian-lines are also drawn.

- Visible labels: **ה** ,[?] **ד** [?] (upper), **א** / **ה** [?] (base corners)

- [Interior labels illegible.]

[— more than two labels uncertain.]

[Proposition (≈ Euclid VI.3 — bisection of the vertical angle) / equiangular triangles.] …the matter [is shown] in the figure [?]: triangle אבגד [?] … angle ל [?] of the one [triangle] as angle א [?] of the other, and angle ה [?] as angle [?] …

Diagram. A wide, low triangle with an internal line (cevian) from the apex to a point on the base, illustrating the division of the base by the bisector.

- Visible labels: **ה** ,[?] **ד** [?] (upper), **ה** [?] (lower-left corner)
- [Interior labels illegible.]

[— more than two labels uncertain.]

Diagram. A second triangle, lower on the folio, with an internal cevian; it accompanies the equiangular-triangles argument.

- Visible labels: **ה** ,[?] **ד** [?]
- [Interior labels illegible.]

[— more than two labels uncertain.]

[Book VI (similar figures) continues. No decorated המאמר heading appears on this leaf; the propositions run on, marked internally only by the recurring cross-reference formula "ובצורה השנית / הרביעית / המוקדמת" ("and in the second / fourth / foregoing figure"). No Book-VII (number-theory) rubric opens here.] …as the ratio of [line] א[?] to דה, and as the ratio of אב to בג. We set line [?] and draw out בג[?] until they meet at ז[?] — for these are the sides enclosing the [corresponding] angles [?]. For if the sides are proportional, then [line ?] is as דב and דה[?] as א[?]; and in the second figure the sides will likewise be proportional. And if the sides are proportional, then their angles are equal, each to its counterpart.

[The reciprocal enunciation, ≈ Elements VI.5/VI.6 — proportional sides imply equal angles:] [We wish to show that when] the sides enclosing [the equal angles] are proportional — the ratio of side אבג[?] to דח[?] as the ratio of אג[?] to דא[?], and the ratio of אג[?] to דח[?] [as the like ratio] — we say that the one angle equals the other. We construct angle [?]דח[?] equal to [angle א?], and make side דח[?] as [side ?]; and in the fourth figure the sides of triangle אבג[?] and דח[?] will be proportional. And in the fifth[?] figure דה[?] will be as דח[?]; therefore [the two

triangles are equiangular], each of the angles of triangle דח[?] equal to its counterpart in the [other] triangle.

Diagram. A pair of small triangles set at the right edge of the text-block, illustrating two similar triangles: the right-hand triangle stands on its base (apex uppermost); the left-hand one points downward (apex at the foot).

- Apex and base-corner letters of both triangles are in very faint brown ink; individual vertices not securely legible [?].
- Small letters ח / [?]ז[?] stand beside the inverted (downward) triangle.

[— more than two labels uncertain.]

[Right-triangle / altitude proposition, ≈ Elements VI.8 — the perpendicular from the right angle divides the triangle into two triangles similar to the whole and to one another.]...and it is not the [true] perpendicular; [otherwise] it would fall outside. Of necessity, therefore, the perpendicular drawn falls within [the figure]. We say of triangle אבג[?] that its angle א[?] is a right angle, and we drew from it a perpendicular [to the base]. We say that the [line] which falls [divides the figure] within, and that the interior [angle at its foot] is a right angle — accept this. And this figure [shows] its [construction from] the interior angles, [as] in the fourth figure. [Consider] the two smaller triangles at the [foot]: we say that each of them is similar to the whole and to one another; and this is made clear from the [equality of] the interior angles, as in the fourth figure.

Diagram. A right triangle (right angle at the base) with a perpendicular dropped from the right angle to the hypotenuse, dividing it into two smaller right triangles similar to the whole and to one another. A small index letter — reading ח[?] — stands in the right margin beside the figure.

- Margin index letter: ח[?].
- Apex, foot-of-perpendicular, and base-corner letters are faint; individual vertices not securely legible [?].

[— more than two labels uncertain.]

[≈ Elements VI.13 — to find the mean proportional between two given lines.] We wish now that the [line] proportional [to them] be [found]; we set it thus. We have two lines, אב[?] and בג[?], and we wish to produce a line that is the mean proportional between them: such that the ratio of the first to the mean equals the ratio of the mean to the second. This is explained by the construction of the figure in the fourth[?] figure; and it is further explained that the perpendicular set up at the point [dividing the base] is the mean [proportional]. We set line א[?] and line

בג[?] [end to end], and set up from the point [of division] a perpendicular [reaching the semicircle drawn upon them]; and by what was shown in the [foregoing] figure, and by the preceding premise, בג[?] will be as [the mean between them]. This is our example.

Diagram. A semicircle drawn on a diameter (base line), with a perpendicular raised from a point of the diameter to the arc and a chord joining that point to an end of the diameter — the standard mean-proportional (angle-in-a-semicircle) construction. A small index letter — reading ט — stands in the right margin.

- Margin index letter: ט.
- Ends of the diameter, foot and top of the perpendicular: faint; individual vertices not securely legible [?].

[— more than two labels uncertain.]

[≈ Elements VI.9/VI.10 — to cut off a stated part of a line, and to divide a line in a given ratio.]...so that the line proportional to it should be [found]; we set it thus. Lines אב and בג[?] enclose an angle. We set אב, and draw out בג[?] in a straight line as far as ה[?]; we set אה[?] as בג[?], and draw the line [?] opposite אב[?]. And in the second figure נג[?] will be [as...] — the ratio of אב to בג[?] as the ratio of בג[?] to נ[?] — as in our example. We have line אב, and we wish to cut off from it a known part; and afterward we make another line equal to it, which is [?], and let the three lie in a straight line. We set נג[?] and draw דז[?] opposite נג[?]; and in the second figure חז[?] will be as in our example. We have line אג[?] [divided into] a known part, and we wish to divide line אג[?] [in the same ratio]...

Diagram. A triangle with a single straight line drawn across it parallel to the base, cutting the two sides proportionally. A small index letter stands in the right margin.

- Margin index letter and the apex / base-corner / cut-point letters: faint; not securely legible [?].

[— more than two labels uncertain.]

[The construction continues — dividing a line into stated parts.]...into [equal] parts [?]. And in the second figure it will be [so]. We set נג[?] and draw [?] opposite it. [Consider] line אנג[?] [to be] divided; we wish to divide line אנג[?] into [the given] parts [?], as in this [figure]. And we see [how] to divide line אנג[?] into parts: we make [the division] clear, [namely] the ratio [of one part] to [another]; and we draw [the parallels]. And in the second figure [?] will be [as...]; the parts

will be proportional. And in the figure [we] divide the line אב[?] at the point [?] according to the ratio of [?] part...

Diagram. A triangle with two internal lines drawn across it parallel to the base, dividing the sides into three proportional segments — the construction for dividing a line into a stated number of parts / in a given ratio. Below it begins a rectangle (see the following figure).

- Apex, base corners, and the interior division-points: faint; not securely legible [?].

[— more than two labels uncertain.]

[≈ Elements VI.14/VI.15 — equal parallelograms have their sides about the equal angles reciprocally proportional.] [Two parallelograms whose] sides [?] are parallel; they are equal, and angle ג[?] of the one [is] as angle ג[?] of the other. We say that their sides enclosing the equal angles are reciprocally proportional: the ratio of בג[?] to בה[?] as the ratio of נ[?] to נג[?]. On the [same] side we set [them] in a straight line and complete the figure. And since the figure [?]... the ratio of דה[?] [is] one ratio equal [to the other]; and in the first figure [?] will be [as we said].

Diagram. A rectangle divided by a line into two adjoining rectangular cells (with faint internal diagonal strokes), a letter set in each corner region — illustrating two equal parallelograms with reciprocally proportional sides. A pair of index letters stands in the left margin.

- Corner letters of the two cells: faint; not securely legible [?].

[— more than two labels uncertain.]

[The reciprocity restated.]...they are equal, and the practice with them is one and the same; [these are] the two [figures] whose sides are parallel, and they are equal in area [?]. And since angle ג[?] of the one is [as] angle ג[?] of the other, we say that the ratio of [?] to [?] [is reciprocal...]. [Consider] the ratio of דה[?] — one ratio equal [to another]; and in the first figure it will be [so].

Diagram. A rectangle with its two diagonals drawn, forming an X inside it, the four corners lettered — the figure for the rectangle contained by the extremes equaling the rectangle contained by the means (four proportional lines). A small index letter — possibly ב[?] — stands in the left margin.

- Four corner letters: faint; not securely legible [?].

[— more than two labels uncertain.]

[≈ Elements VI.16 — if four lines are proportional, the rectangle of the extremes equals the rectangle of the means.]...the ratio of בג[?] to [?] as the ratio of [?] to אנג[?]; and if this be the mean[?], we say that [they] are equal. [The figures] אנ[?] and נ[?] are equal, and the practice with them is one. [Consider] the two triangles אבנ[?] [and] גדה[?]: angle ג[?] of the one is equal to angle ג[?] of the other, and the [one] triangle equal to the [other] triangle; we say that the ratio of הנ[?] [to...] [is as] גדה[?]. There are two lines [?], דנב[?] and הנא[?]; [they] intersect [?], and [we prove] this, and return to it as was explained in the foregoing figure. [If] four lines — אב, אג[?], [?] — are proportional, the ratio of אב[?] to אג[?] [as] the ratio of ה[?] to [?], we say that the product [rectangle] of אב[?] [by...] equals the product of אב[?]... equal to the product of נג[?] by בה[?].

[The Sixth Treatise (Euclid, *Elements* Book VI — similar figures) continues; its final propositions run on this opening, followed by the author's editorial note and the heading of the Eleventh Treatise. No decorated מאמר rubric interrupts the Book VI propositions themselves; they are marked only by the recurring enunciation formula "we say that…" and cross-references to "the foregoing figure."]

[≈ *Elements* VI.16, conclusion — if four lines are proportional, the rectangle of the extremes equals the rectangle of the means.] …we draw the perpendicular נב [equal] to ה, and [set a base] equal to ז, and we complete these two [figures]. And since the area [contained] by the sides of the perimeter [?] is equal to the [other], for they are equal areas — the base being the rectangle of אב by בג, [equal to] the rectangle of בד[?] — thus it is shown; and this is its proof.

Diagram. At the top right, two small squares (rectangular cells) drawn side by side, each with a letter set in its corners — the figure for the rectangle contained by the extremes and the rectangle contained by the means. Immediately below them a set of stacked horizontal line-segments (the proportional straight lines) belonging to the next proposition. A marginal figure-number stands to the right.

- Corner letters of the two squares: faint; not securely legible [?].

[— more than two labels uncertain.]

[≈ *Elements* VI.17 — if three straight lines are proportional, the rectangle contained by the extremes equals the square on the mean.] And if there be three lines in proportion — one ratio [of the first] to [the mean, and the ratio of] ב to ג

— we say that the rectangle of א by ג equals the square of ב by itself; for line ל is [set] equal to ב. And this is shown as in the foregoing figure.

[≈ *Elements* VI.19 — similar triangles are to one another in the duplicate ratio of their corresponding sides.] The triangles אבנ [and] דהֿ[?] are similar. We say that the ratio of triangle [אבנ] to triangle דהֿ is as the ratio of the base בח[?] to the base [?]. We set out [the construction] and draw נב[?]..., as [in] the tenth[?] figure. Therefore the ratio of בן to [?] is as the ratio of [?] to אבח[?]; and we prove triangle אבח[?] equal to [triangle] דהֿ, and the ratio of triangle אב[?] to triangle אבח[?] is as the ratio of בן[?] to אח[?]. And thus it is shown to hold generally, as was explained. [If there are] lines...

Diagram. Two triangles drawn side by side (the pair of similar triangles), each with an apex letter and two base-vertex letters. A marginal figure-number stands to the right.

- Apex and base letters: faint; only partially legible [?].

[— more than two labels uncertain.]

[≈ *Elements* VI.20 — similar polygons are divided into similar triangles equal in number, and the polygons are to one another in the duplicate ratio of their corresponding sides.] ...[the two figures] are similar. We say that they are divided into triangles [equal in number], and [the triangles are] similar; and because of what is partitioned off from the one [there is a like partition] as the number of what is partitioned off from the other. We construct [?] מא[?], כל, כל, נל, אח, הנ; and by the sixth[?] figure the two triangles מחל [?]אבה[?] are similar; and likewise triangle אבן[?] is [to] triangle זאנ[?] as triangle בנה חמל[?] is to triangle אזה[?] — as triangle אזה[?] is to triangle [?] — [the] smaller. And triangle בנה is to triangle אזה as [?]; [so] the triangles of the one [figure] are as the number of the triangles of the other. Moreover we say that the ratio of each of the triangles of the one figure to its fellow among the triangles of the other figure is one and the same ratio; and this is shown by the sixth figure, and by the first, and by the conversion of the ratio [convertendo] in [proposition] ... of the fifth [treatise]. And from this it is likewise shown, as in the foregoing figure, that the ratio of the [whole] area אבנדהחמ[?] is the duplicate of the ratio of side אב[?] to side חמ[?] as base.

Diagram. Two polygonal figures drawn side by side, each with its diagonals crossing inside (an X within the outline) so that the figure is divided into triangles — the pair of similar rectilinear figures resolved into similar triangles. Several

vertex-letters set around each outline. A marginal figure-number stands to the right.

- Vertex letters: faint; more than two not securely legible [?].

[— more than two labels uncertain.]

[≈ *Elements* VI.33 — in equal circles, angles have the same ratio as the arcs on which they stand, whether the angles stand at the centers or at the circumferences.] The circles אבנ [and] דהֿ are equal, and there are [angles standing] on the circumference — which are angles אד[?] — and [angles standing] at the center — angles חמ[?]. We say that the ratio of arc [אד?] to arc הן[?] is as the ratio of angle א to angle ל[?], and [as the ratio of] angle [?] to angle מ[?]. We take, for arc בן[?], the first [multiple], and for [?] the [equal multiple]…, as Ptolemy[?] [makes them] equal; and they are arc מל [?]נא[?] and angles מלט [?]חלה[?]…

Diagram. Two equal circles drawn side by side, each containing an inscribed triangle with additional chords drawn from the vertices (so that an angle stands both at the circumference and toward the center) — the figure for angles proportional to their subtending arcs. Vertex-letters set on each circle. A marginal figure-number stands above.

- Circumference and center letters: faint; more than two not securely legible [?].

[— more than two labels uncertain.]

[≈ *Elements* VI.31 — in a right-angled triangle, the figure on the side subtending the right angle equals the [sum of the] similar and similarly-described figures on the sides containing the right angle; proved here by the perpendicular dropped from the right angle.] …[the ratio of] arc [?], as the ratio of angle א to angle [?]. And from the extremity we draw אל[?] upon it, as [line] אב[?], and we prove [?]עת א, בֿ; and at the distance חֿ, [?]אל, [we describe] a circle [?] נצב[?]; and we prove ה [?]עת[?], the perpendicular אב[?]; and we bisect בֿ at the midpoint ה עֿ[?], and we set up upon [it]…; and of the triangles, [the square] קב[?] is greater than קל[?]. Therefore we make הֿ[?] equal to הל[?], and we say that the ratio of אב[?] to אח[?] is as the ratio of the square of את[?] to [the square of] קב[?] as side, by the figure [proved] in [proposition] … of the second treatise. Let the rectangle of נ[?] … equal the rectangle of נ[?] …, [equal] to the square of … [equal] to the rectangle of בא[?] by ח[?]; [so] the square of הא[?] is compounded [?]. And by the third figure of the second treatise, let the rectangle of נ[?] by בזה[?] equal the square of אל[?] together with the rectangle of נל[?] by טא[?]. Therefore the square of אב[?] —

equal to [that] — is as the square of אל[?] together with the rectangle of אל by טא[?]. And by the second figure derived from it, let the square of אב[?] be as the rectangle of טל[?] by אב[?]. Therefore the rectangle of אב[?] by גב[?] — [that is] באח[?] — together with the square of אל[?], equals the rectangle of אב by [?]טל נא[?] [the] remainder, together with the rectangle of בנ[?] by נל[?], [being] the rectangle of the remainder [?] compounded of the square of אל[?] with the rectangle of אל by נבא [?]בם[?]. And by the seventh figure derived from this, the ratio of אל ,[?]אב[?] to אל[?] is as the ratio of אאל[?] to גב[?] — [and this is] complete[?], blessed [be He?] [?].

Diagram. A semicircle standing on a horizontal diameter, with two lines drawn from a point on the arc down to points on the diameter and a perpendicular dropped to the base — the figure for the right angle with its perpendicular, dividing the base into segments. The diameter's endpoints, the foot of the perpendicular, and the apex are lettered. A marginal letter stands to the right.

- Base and apex letters: partially legible — along the base ה ,[?]ב[?], and the apex letter; more than two not securely legible [?].

[— more than two labels uncertain.]

Said the author: The treatises that come after this one, up to the end of the tenth treatise, deal with number [arithmetic]; and there is not so much [of geometrical matter] in them [?] … [?], and therefore we had no need [of them]. [We proceed instead] to begin now with another treatise, which [treats] of what is essential[?], in [its] completeness [?].

The Eleventh Treatise. [Euclid, *Elements* Book XI — solid geometry.] A solid[?] is that which has length, breadth, and depth.

[The Eleventh Treatise opens here with the definition of the solid; its propositions are not yet reached on this leaf.]

[Modern pencil foliation "118" appears at the lower outer corner of the second folio side; a faint "79" mark stands at the top of the first.]

[The Eleventh Treatise = Euclid, *Elements* Book XI (solid geometry) continues. The epitome runs through the remaining definitions of Book XI — perpendicular lines and planes, parallel planes, similar and equal solids, the pyramid, the sphere, the cone, the cylinder, and the solid angle — and then begins the propositions.]

And the extremities of a solid are surfaces.

[ג] A line perpendicular to a plane is [defined as follows]: all the lines standing in the plane that meet[?] that line, and it makes equal angles with them — [then] the perpendicular line and the lines lying in the plane [form] right angles.

[ד] A plane perpendicular to a plane is [defined as follows]: all the perpendiculars[?] drawn from the line that is the common section — the section along which they intersect, [where] one of the two planes [cuts] the other from a single point of it — and they are two [mutually] enclosing planes; [the one is] perpendicular, since the plane stands upon the plane, and they are enclosed[?] within it as a right angle.

[ה/ד?] The parallel planes are those whose two sides do not draw near [to meeting], even if they are extended so as to go out to infinity.

[ה] [Equal and similar] solid figures are those such that there encloses each solid of them a number of planes equal [to the number] enclosing the other, and each plane of the one is similar and equal in its magnitude to the plane opposite it in the other solid, and [equal] in its form.

[ו] [Similar] solid figures are those enclosed by similar planes, of one form and of one number.

[ז] The pointed figure[?] upon its diagonal[?] is that which is enclosed by three planes [of equal?] sides and by [six?] triangular planes. [Reading of the face-counts uncertain — the figure is a solid bounded by triangular faces.]

[ח/ז?] The erected, composite figure [the pyramid] is that which is enclosed by planes and rises from one plane up to a single point opposite it.

[ח] The sphere is [formed] when one takes a semicircle and sets it up upon the fixed axis so that [the axis] does not move, and rotates the arc — which is the [half-]circumference that revolves — until it returns to its place; and that which [is enclosed] beneath the arc is the sphere. And the center of the sphere and the center of the [semicircle][?] are one.

[ח] The pointed column [the cone] is [that which is generated] when a right-angled triangle is [rotated] — when one sets it up upon one of the sides [containing] the right angle and rotates the triangle until it returns to its place, [the cone] being a part [swept out] by it.

And if the fixed side is equal to the other, rotating side, then the cone is right-angled, and its acute angle — that is, the angle at its apex — is such that you would reckon it, at the moment of its bisection, [as dividing] into two halves. And

if the fixed side is longer than the rotating one, [then the angle] subtending the rotating side is less than half a right angle, and therefore its double is an acute angle. And if the fixed side is shorter than the rotating one, and the rotating side subtends an angle greater than half a right angle, then therefore its double is obtuse. And the axis of the cone [is the fixed side…]

Diagram. A small right triangle drawn in the upper margin, associated with the generation of the cone/cylinder by rotation. A single Hebrew word stands above it as a caption.

- Marginal caption above the figure: מחודד[?] ("pointed"[?]).
- Vertex labels: not securely legible [?].

the fixed side, and it is called [the axis][?].

[ט] The [cylinder] (קטירה[?]) is [that which is generated by] a right-angled quadrilateral [rectangle], which are planes, and it is equal[-sided][?] in its angles[?]; and it is made [by rotation of] the perpendicular sides, right-angled, when one sets it up[?] on that which is [fixed] of the sides, right-angled in its angles, and rotates part[?] of it until it returns to the place from which it [began]; and the axis of the cylinder is the fixed side, and the planes that are in it are called circles.

And this aforementioned cylinder, the [circular one], is [such that there encloses it planes and circles][?].

[י] The solid angle[?] is that which is enclosed by [more than] two plane angles, and not every plane [of them lies] in one [plane]; and the angles enclosing it gather at a single point.

[יא] The [similar] solid figures[?] made … [as the ratio of] the diameters … [text here at the limit of legibility]. And the [pointed solids][?], the similar ones, are those enclosed by similar planes[?] [along?] the diagonal, and their [bases?] are equal[?]: the ratio of each figure to [its] diagonal[?] [is] as the ratio of the section[?] of the other cylinder to [its] diagonal.

The propositions of the Eleventh Treatise

[Proposition — ≈ Euclid XI.1]. A straight line cannot [have] one part of it in a plane and [another] part elevated [above the plane], as will be made clear with His help.

Diagram. In the left margin, two straight lines crossing one another in an X, with a further line and a small triangle drawn below the crossing — the figure for two lines cutting one another lying in a single plane, and for the triangle in one plane. Several letter-labels are set at the ends of the lines.

- Visible labels near the figure: ל ,[?]ב ,[?]א ,[?]ה ,[?]ג[?]; more than two of the labels are not securely legible [?].

[— more than two labels uncertain.]

[Proposition — ≈ Euclid XI.2]. [If two lines][?] אב[?] [cut one another] at [point] א[?], we say that [they bound][?] one plane; and every triangle is [in] one plane. And this will further be made clear in the [aforesaid?] figure.

[Proposition — ≈ Euclid XI.3]. [If] two planes[?] intersect one another, [their common section] is a straight line — that is to say, every [line drawn along it] is said [to be] a line; [any line] that is not [this common] line does not touch[?] the [common section][?]. And this will be made clear in the [reverse?] figure.

Diagram. In the left margin, a cross-shaped figure: an upright rectangle crossed by a horizontal rectangle, forming four projecting rectangular panels, with a shaded lens/oval at the center where they cross — the figure for two planes intersecting in a common straight line. Small letter-labels stand at the corners of the panels.

- Corner labels: present at the panel corners but not securely legible at this resolution [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.4]. [If a straight] line נד[?] is [erected] upon [two lines] ש ,ק ,ו ,צ[?] — upon [point] ב[?] of the line אב[?] — at a right angle, then we say that [it stands at a right angle upon] the plane in which the [two] lines [lie] at a right angle.

Diagram. A small rectangular (box-like) figure in the left margin, with corner labels, for the construction of the perpendicular to the plane of two intersecting lines.

- Corner labels: partly legible — ה[?], and others not securely read [?].

[Construction, at the limit of legibility:] We strengthen[?] [the equal segments] ב, ל ,ז ,ג[?] … equal; and we place on the line אב[?] a point מ[?], and we draw out a line ב ,ל ,ט[?], and we make [equal segments] … חג ,מב[?] ,מא[?] ,חה[?] ,מא[?][?]

…; and we construct upon נ ,ה[?] … And the matter is evident from the acute angles[?] and the similar sides, as [Euclid?] said[?]: for טא ,חמ[?] … ב[?] ,ל[?] are equal … [and] לב ,ט[?] ,ז[?] is equal to [the like of it][?].

[The proof of this proposition continues beyond this leaf.]

[Modern pencil foliation "119" appears at the lower outer corner of the second folio side; a faint librarian mark "79" stands at the top of the first.]

The Eleventh Treatise (Euclid, *Elements*, Book XI) — continued. Solid geometry: lines and planes perpendicular and parallel. The page runs on continuously, with no rubricated proposition-headings; each demonstration is keyed to a numbered figure ("in the third figure," "in the fourth figure," etc.). The hand is a small Sephardic semicursive; the geometric point-letter chains are at the limit of legibility, and many are flagged.

[Conclusion of the preceding proposition — ≈ Euclid XI.4]. …and thus the angle חבב[?] equals the angle חבא[?] [and each of them?] is a right angle. And by the [foregoing] premise, the line אב[?] stands perpendicular upon the plane of the two lines.

[Proposition — ≈ Euclid XI.5]. The lines בג ,בד ,בה[?] meet one another at [the point] ב[?], and אב[?] is erected upon [them], each [of the three] at a right angle. We say that the three lines lie in one plane. This will be shown externally [i.e. by an outside construction]. And in the third figure, [there are] three…

Diagram. At the top of the right margin, a three-dimensional pyramidal figure: several straight lines converging to an apex above a quadrilateral/triangular base, for the construction of a perpendicular erected on three concurrent lines lying in one plane.

- Apex: a mark is present but the label is not securely legible [?].
- Base vertices: ד[?] (upper left), ב[?] (lower), ג / [?]ה[?] (right); more than two labels are not securely read [?].

[— more than two labels uncertain.]

Diagram. Below the pyramid, a sheaf (fan) of straight lines radiating from a single lower point — an angle figure for the perpendicular set upon the concurrent lines.

- Visible label: ה[?] near the vertex; the remaining labels are faint [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.6]. The lines אב, בד[?] are erected upon a plane at right angles [each]. We say that they are parallel. We pass [a line] along the given plane and draw דה[?] a perpendicular upon the plane, [with segments] דב[?] equal; and we pass [the line] דה[?]… And it will be shown from the fifth figure [that they are the same?] — that they are parallel.

Diagram. In the right margin, an upright rectangle crossed by its diagonals (an X within the frame), for two lines perpendicular to one plane.

- Corner labels: ד[?] (upper), ה[?] (lower); further labels not securely read [?].

[Proposition — ≈ Euclid XI.7]. The two lines אב, בד[?] are parallel; and we mark upon אב the point ה, and upon בג[?] the point ז. We say that the line drawn between the two points lies in the plane of the two lines. And it will be shown by a proof of reversal [reductio ad absurdum, lit. "the demonstration of the reverse"]: for were it [lying] apart from them, and were it as [posited], it would contradict the [thirty-ninth?][?] premise of the First Treatise [Elements, Book I].

Diagram. A box-like figure with internal diagonals and a curved (domed) top edge in the right margin, for the line joining two points on the parallels.

- Labels: ה ,ד[?][?] at the corners; remainder not securely legible [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.8]. The two lines אב and גד[?] [are parallel, and one of them is] perpendicular upon a known plane. We say that the [other] line is [likewise] perpendicular upon that plane. And its figure is like the sixth figure, [as] constructed upon it. Therefore the matter is clear: that [there] stands a perpendicular upon [both?].

[Proposition — ≈ Euclid XI.9]. The two lines בד, נד[?], intersecting[?] [המתחתכין] [?], are parallel to the line אב, and they are not in one [same] plane. And in the fourth figure let there be a perpendicular upon ה[?]. The two lines בד, נד[?], which are parallel to אב and are not in one[?] [plane]… we say that they are parallel [to one another].

Diagram. A horizontal straight line bearing short verticals, for lines parallel to one and the same line.

- Labels: ג ,ב[?], ה[?], ד[?][?] along the line; not all securely read [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.10]. The two lines אב, בד[?], which differ[?] [i.e. meet], are parallel to two lines [דה?, הה][?] that intersect one another and are not in one plane. We say that the angle אבג equals the angle דלה[?]. We draw from the point ה[?] the two lines ה [?]נל[?]… a perpendicular… and in the fourth figure let אב be a perpendicular upon [the plane]. And the figure will be as the foregoing, [with] נל[?] in one plane; and in the [ninth?] figure they will be parallel.

Diagram. An elongated hexagonal prism (a long box) with internal diagonals at its end, in the right margin, for two pairs of intersecting lines respectively parallel.

- Corner labels present (ג ,ב[?], ה[?], ד[?][?]) but not securely legible [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.10, continued]. The two lines אב, בד[?], intersecting[?], are parallel to the two lines לה, הה[?] that intersect and are not in one plane. We say that the angle אבג[?] equals the angle דלה[?] [the like of it]. The lines are [cut] equal.

Diagram. Near the foot, two horizontal parallel lines joined by a slanting (oblique) connector — a Z-shaped figure for the equal angles between the two pairs of parallels.

- Labels: ג ,ב[?], ה[?], ד[?][?]; not all securely read [?].

Diagram. A parallelogram with a diagonal and a perpendicular dropped to a horizontal base line, at the upper right of the leaf, illustrating the equal-and-parallel line-pairs of the preceding proof.

- Labels visible: ד[?] (at the top of the slant), ג ,ב[?], ט[?], ה[?][?]; not all securely legible [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.11]. [It is required] to draw, from the point א[?] which is in the air [i.e. an elevated point], a perpendicular upon a known plane. We draw in the plane a line בג[?] and [its continuation?]. So too we draw from א a perpendicular upon it, as we explained in the First [Book]; and it is [the line] אל[?]. And afterward we draw from ג a perpendicular דך[?]; and afterward we draw אב a perpendicular upon [the plane]. Thus we say that it is a perpendicular upon the plane. We draw [the section] חת[?] like בג[?], as was shown in the First [Book]. And in the fourth figure, each one of חל ,[?]בל[?]…

Diagram. In the right margin, a horizontal line meeting a rising oblique with a small right-angle mark — the perpendicular dropped from an external point to a plane.

- Labels: ב ,[?]ד ,[?]ה[?] at the ends; not all securely read [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.12]. …stands perpendicular upon the plane מבל[?]. Now [there is] a point א[?] set in the plane, and [one] wishes to draw from it a perpendicular upon it. We draw from a point ג[?] in the air a perpendicular בג[?] upon the plane; and afterward we draw from א a line like [i.e. parallel] over against it…

Diagram. An L-shaped (right-angle) figure with a short horizontal foot in the right margin, for erecting a perpendicular from a point lying in the plane.

- Labels: ה ,[?]לב[?]; further labels not securely legible [?].

[Proposition — ≈ Euclid XI.13]. …[from] one point a [second perpendicular] cannot stand upon a known plane… upon two perpendicular [sections?]. And this will be shown externally, with ease.

[Proposition — ≈ Euclid XI.14]. …the line אב[?] is perpendicular upon two [planes lying] over against [one another?]. We say that the two planes are parallel. And if you say that once[?] [they meet]… then the two [planes] are still [meeting?]… and it does not hold for it… [segments] מב ,[?]מל[?]. Therefore the point מ[?] [would lie] in both planes, and the two angles אב[?] [would be] right angles — and that is impossible.

Diagram. Two horizontal rectangular panels overlapping at the center, with a triangle rising between them, for two planes perpendicular to the same line (hence parallel).

- Labels: ד[?] (upper left), ה ,[?]לד[?] (apex), ב ,[?]ג[?] at the panel corners; not all securely read [?].

[— labels uncertain.]

[Proposition — ≈ Euclid XI.15]. The two lines אב, גד[?] intersect one another; likewise the two lines דה, הה[?] intersect one another, and they are [not] in one plane. We say that [the plane through] אבג equals [is parallel to the plane through] דהה[?]. And it will be shown from what preceded: the plane of every [line] from חבב[?] … [the segments] חב ,[?]הה ,[?]נד ,[?]אבגד[?] are still [equal];

and [we] divide the figure… we say that [it is] like… like לב[?]. And if you say that they [the planes] will meet… as the two [planes] אבג, הה[?], חב[?] would meet — and that is impossible.

Diagram. Below the preceding, an arrow-like (double-headed) figure crossing a fainter triangle, and a second pair of overlapping rectangular panels with a triangle between them, for two intersecting-line pairs whose planes are parallel.

- Labels: טו ,[?]ד[?] (in the margin), ב ,[?]ג[?], ה[?][?]; not all securely legible [?].

[— labels uncertain.]

[Modern pencil foliation "120" appears at the lower outer corner of this leaf. The Book XI series continues beyond this leaf (roughly XI.15); no close of Book XI and no opening of the Twelfth Treatise (Book XII) appears in this opening.]

Eleventh Treatise = Euclid, Elements *, Book XI (solid geometry), continuing the compressed proposition-and-figure sequence. The propositions are unrubricated; each is keyed to its numbered construction figure. The running figure-marks in the outer margin appear to continue the treatise's figure count (≈ 27–34 on this opening), while the geometric content corresponds to Euclid XI.16–XI.23.*

Source page 259 (folio 121r)

[Top of the leaf is covered by the black binding-support bar; no Hebrew running header is visible.]

[Proposition — ≈ Euclid XI.16.] *[Outer-margin figure-mark: 27 = [?]כז.]* …the lines cut off by the [parallel planes] — the sections are parallel [הנכחיים]. [We say] that the lines אב[?] and גד[?] [meet the planes so that] the sections are parallel. And this is shown: the plane of every [line drawn]… the lines אלב[?], בד[?], רה[?] are parallel; and by what was set down in the earlier premise, the lines אב[?], בד[?] are parallel. And from what was explained in the preceding figure… And if you say that they [the planes] would meet — that is impossible.

Diagram. Three parallel horizontal rectangular panels, stacked, crossed by a single diagonal transversal running from the upper right down to the lower left.

- Top panel: ד[?] (left), א[?] (right)
- Middle panel: ב[?] (left), ג[?] (right)
- Bottom panel: ב[?] (left), ד / [?]ג[?] (right)
- Along the diagonal: ה[?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.18.] *[Outer-margin figure-mark: 28 = [?]כ״ח.]* If all the planes erected upon the line אב[?] be so [perpendicular], then they too stand perpendicular upon that plane at right angles [זויות נצבות]. We draw the common section [הפרק השותפת] that belongs to the plane standing upon the line אב[?] and to the [given] plane, and let it be נ[?]; and from that point we draw from it a perpendicular in the plane אלב[?]; and this perpendicular is the one [set] over against אלב[?], and it is necessary that it be so — for it is a perpendicular upon that plane. And likewise it is shown for the two lines drawn upon גנ[?] and from the plane אלב[?].

Diagram. A small right-angle (L-shaped) bracket figure with a short foot, for a line perpendicular to a plane and the planes erected upon it.

- Labels: נ[?][?], ל

[Proposition — ≈ Euclid XI.19.] *[Outer-margin figure-mark: 29 = [?]כ״ט.]* …[the two planes standing] on right angles; we say that [the common section] stands [perpendicular] upon that plane. And this is shown by the outer figure [במופת החיצון].

Diagram. A cross- / plus-shaped figure (the unfolded faces of a rectangular solid) with several lines radiating from the central point.

- Radiating from center נ[?]; arm-labels ב[?], ג[?], ד[?], ה[?], ו

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.20.] *[Outer-margin figure-mark: 30 = [?]ל.]* Three plane angles [שלש זויות שטוחות] [meeting at a solid corner] — we say that any two of them, [taken] together, are greater than the remaining angle [גדולות מהזוית הנשארת]. How so: if the [three] angles be equal, [then] one of them with the third is greater than the other; and if [one] be greater [than the base]… and it is the angle אבד[?]. We say that the angles אבג[?] and גבד[?] together are greater than the angle אבד[?].

Diagram. A triangle with cevians drawn from the apex to the base, for a solid angle contained by three plane angles.

- Apex: ב / א[?][?]
- Base corners: ב[?][?], ג[?], ד

[— more than two labels flagged [?].]

Source page 260 (folio 121v)

[Top of the leaf is covered by the black binding-support bar; no Hebrew running header is visible. Modern pencil foliation "121" at the lower outer corner.]

and the angle [at ב] is equal to the angle [at ג]; therefore the angles אבב[?] and גבד[?] together are greater than the angle אבד[?]. And likewise it is shown for the remaining angles: that any two of them joined together — whichever they be — are greater than the remaining angle.

[Proposition — ≈ Euclid XI.21.] *[Outer-margin figure-mark: 31 = [?]לא״.]* A solid angle [is] surrounded by plane angles [יסובבו בה זויות שטוחות], and they are הבד, הבב[?][?]; we say that they are less than four right angles [קטנות מארבע זויות נצבות]. From the enclosing plane [the lines] הד, זד[?], קוי הד[?][?]; and we set in the plane הד[?] [a point] ט[?], and we draw ק[?] at the points הד[?]. Therefore the three angles ט[?]… [at the base are less than four right angles]; and it is shown by the preceding figure and by what was explained at first, that the three [plane angles of the solid angle are less than four right angles].

Diagram. A triangular pyramid (tetrahedron) with a fainter rectangular box (cube) sketched behind it, for a solid angle whose plane angles are less than four right angles.

- Apex: ד / ב[?][?]
- Base corners: ה ,ג[?], א[?][?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.22.] *[Outer-margin figure-mark: 32 = [?]לב״.]* If there be three plane angles, of which any two — whichever they be — are greater than the remaining angle, and the lines that subtend them are equal [each to each], then it is possible [that a triangle be constructed] from [lines equal to] those [subtending them]. How so: we take, of three plane angles, [any] whose two angles are greater than the [third] angle among them; and the lines אב[?], גב[?], חב, זב[?][?]… we make the line אב[?] [as base], and it is explained by the premise; and by what was explained at first, that the three [subtending lines form a triangle].

Diagram. A row of small triangles — one bearing internal crossing lines and two plain — set out for constructing a triangle from three given plane angles.

- Labels at the triangle vertices: חב, בג[?], גב[?], אב[?][?] (small and not all securely legible [?])

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.23.] *[Outer-margin figure-mark: לג״ן = [?]33]* To construct a solid angle from three plane angles [such that] the three angles together are less than four right angles, and any two of them are greater than the remaining. [We proceed as] was explained in the preceding [proposition], and by what was explained at first, so [we do here]. The lines that surround them being equal, we make [a triangle]; the lines זב ,[?]כג[?]… we set as זב[?], like זל[?]; and from מגד ,[?]זל[?] we set up a perpendicular ט[?] [and carry it to the apex]. And there remains [the figure] as the outer one.

Diagram. A row of three small triangles beside a circle with an inscribed triangle — the plane-angle triangles and the circle circumscribed about the base for the solid-angle construction.

- Circle center and inscribed-triangle vertices: לג[?], and vertex-marks not securely legible [?]

Diagram. A circle with an inscribed triangle and an apex point set below it (lines running from the circle to the lower apex) — the completed solid-angle construction: the circle circumscribed about the base triangle, its center found, and the perpendicular erected to the apex.

- Upper vertex on the circle: ל[?]
- Center point and lower apex: not securely legible [?]

[— more than two labels flagged [?].]

[closing line, largely illegible] בג [?]מק[?] קמון[?] כי לג[?][?].

[The Book XI proposition series continues beyond this leaf. No close-of-Book-XI formula and no opening of the Twelfth Treatise (Euclid Book XII) appears in this opening.]

[Sephardic semicursive, single hand (Sasson ben Menashe). The Eleventh Treatise (Euclid, Elements Book XI — solid geometry) runs on as continuous, unrubricated prose; the propositions are keyed to labeled 3-D box (parallelepiped) construction figures, each carrying a two-letter proposition-number in the outer margin. The top of each leaf in this opening is covered by the black binding-support bar, so no running header is visible on either page.]

[Continuation of the preceding proposition (≈ Euclid XI.23), whose construction carries over from the foot of the previous leaf.] And afterward we draw out from point ס[?] a perpendicular upon the surface [?], and let it be like אב; and there

ס[?] meets at point ג[?], and let there be a right-angled [triangle?] upon the perpendicular, and let אב be equal to the perpendicular. And it is made clear, from the equality of the surfaces and of the angles, that angle ג[?] is the right angle — as we claimed.

[Proposition — ≈ Euclid XI.24.] *[Outer-margin figure-mark: 24 = [?]כד.]* We say that the opposite parallel surfaces [of a solid bounded by parallel planes] are equal and are [parallelograms]; for in the figure [face] אב is opposite to הה[?], and [face] נחם[?] is opposite to נא[?], and likewise the remaining ones. And in the figure the opposite sides are equal [angle א[?] equal to angle ג[?]], and in the same way the equality of the angles is shown. Therefore the parallel surfaces are equal and opposite [parallelograms].

Diagram. A rectangular box (parallelepiped) drawn in oblique perspective, its eight corners each marked with a small letter for the proposition that the opposite faces are equal parallelograms.

- Corner labels: present at the box's corners but too small to resolve individually [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.25.] *[Outer-margin figure-mark: 25 = [?]כה.]* [If a parallelepiped solid be cut by a plane parallel to the two opposite planes,] the base is to the base as the solid is to the solid. Let the surface גד הה[?], with the surface parallel to it, חבא[?], be set out. We say that the ratio of the [one] base [to the other] is made … as [is stated] by the fifth premise of the Fifth Treatise [Euclid, Elements Book V]; and it is completed upon line אב at the point …

Diagram. A rectangular box divided across its middle by a horizontal plane parallel to its top and bottom faces — the parallelepiped cut by a plane parallel to the opposite faces.

- Corner and dividing-plane labels: small letters at the corners, not securely legible [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.26.] *[Outer-margin figure-mark: 26 = [?]כו.]* To construct, upon a given line אב at a given point [ה?] on it, a solid angle equal to a given solid angle. We mark upon line אב a point ח[?], and we draw out from it … we set up a perpendicular חב[?] upon the surface … and there remains [the figure] as the outer one.

Diagram. Two small triangle-shaped figures side by side, each drawn with internal crossing lines (cevians) representing a trihedral angle — the given solid angle and the solid angle constructed equal to it.

- Vertex and internal labels: small and largely illegible [?]

[— more than two labels flagged [?].]

Diagram. A tall rectangular box divided into three stacked sections by two horizontal planes parallel to its base — a parallelepiped cut by parallel planes, illustrating the proportion of base to base as solid to solid.

- Corner and dividing-plane labels: present at the corners and along the dividing lines, not individually resolvable [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.27.] *[Outer-margin figure-mark: 27 = [?]כז.]* How we describe, upon line אב, a [solid] similar to the [parallelepiped] solid נג[?] with respect to its opposite surfaces: we first make a solid angle like angle ל[?] of the given [solid], namely angle עגלב[?] like angle הנ[?], and angle עאלב[?] like angle הנ[?] …; and we set the sides surrounding [the angle] in the surface הנ[?] proportional, and we complete [the figure].

Diagram. Two small rectangular boxes drawn side by side in oblique perspective — the given parallelepiped and the parallelepiped described similar and similarly placed to it upon the given line.

- Corner labels: small letters at the corners of each box, not securely legible [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.28.] *[Outer-margin figure-mark: 28 = [?]כח.]* And it is a [parallelepiped] solid similar to the solid נג[?], of the same kind as figure כד[?]. Its opposite surfaces being cut, the surface זח [?]נג[?] is cut upon the two diagonals נג [?]פה[?], which are the diagonals of the surfaces אב [?]מנ[?] and [?]נב הה[?]. We say that the [cutting] plane divides the solid into two halves; and this is made clear from the equality of the two [prisms], so that the divided [part] equals the divided [part].

Diagram. A rectangular box with a diagonal plane drawn across it (a diagonal line from corner to corner of a face carried through the solid) — the parallelepiped bisected by the plane through the diagonals of its opposite faces.

- Corner and diagonal-endpoint labels: small, not securely legible [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.29.] *[Outer-margin figure-mark: 29 = [?]כט.]* [Two parallelepiped solids upon the same base and of the same height, whose edges terminate on the same straight lines, are equal.] The two [solids] with their opposite surfaces set out upon two equal bases — namely הה [?]גד [?]אב[?] — and their heights equal, completed upon their two bases at right angles: we say that the two [solids] are equal, and this is made clear from the equality of the opposite surfaces; therefore the divided [part] equals the divided [part].

Diagram. A long, low rectangular box drawn in oblique perspective — two parallelepipeds on the same base and of equal height, shown as one elongated solid.

- Corner labels: ל[?] at one upper corner; the remaining corner letters not securely legible [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.30.] *[Outer-margin figure-mark: 30 = [?]ל.]* And we set the [solid] whose base is גד [?]אבג[?], and we make … and draw out …; and even if [the two solids] be made upon one base, [with their edges] not upon one line, we say that they are made equal, and it is shown … [close].

Diagram. A second long rectangular box drawn in oblique perspective, with faint internal edge-lines — two parallelepipeds of the same height whose edge-ends do not lie on the same straight lines.

- Corner labels: ל[?] at one upper corner; remaining letters not securely legible [?]

[— more than two labels flagged [?].]

[Proposition — ≈ Euclid XI.31.] *[Outer-margin figure-mark: 31 = [?]לא.]* [Parallelepiped solids upon equal bases and of the same height are equal to one another.] The opposite surfaces set out upon two equal bases — namely [?]אב חטב [?]הה [?]גד[?] — and their heights equal, completed upon their two bases at right angles: we say that they are equal.

Diagram. A small, faint rectangular box sketched at the foot of the leaf — a parallelepiped on an equal base and of equal height.

- Corner labels: too faint to resolve [?]

[— more than two labels flagged [?]; figure very faint.]

[The Book XI proposition series continues beyond this leaf. No close-of-Book-XI formula and no opening of the Twelfth Treatise (Euclid Book XII) appears in this opening; the text breaks off within Book XI (≈ XI.31).]

[Pencil foliation "122" at the lower outer corner of the second page.]

The Eleventh Treatise (Euclid, *Elements* Book XI) continues here as unrubricated prose, keyed to oblique-box construction figures in the outer and right-hand margins. The propositions run on without display headings; the small two-letter proposition-marks stand in the margins beside their figures.

[Continuation of the preceding construction / ≈ Euclid XI.31–32.] *[Outer-margin figure-mark beside the top box: 32 = [?]לב.]*

We draw two lines [?] and [?] upon [?] [as a straight line]; and we cut off [?] equal to [?], and we make angle [?] equal to the angles [?]. Then we cut off [?] equal to [?], and we draw [the line] opposite [?], and we complete the solid [?]. It will then be seen, from the parallelism [מקבילות] of the sides and of the planes and from the displacement [translation] of the solid depth, that solid [?] equals [?]. And if they were, as we said, [solids] whose [edges] do not stand upon [equal bases] at right angles, we draw perpendiculars within them; and it will be shown, as in the preceding figure, [that the two solids are equal].

Diagram. A tall rectangular parallelepiped drawn in oblique perspective, standing at the head of the leaf; the proposition-mark (32) [?]לב is written above its upper-right corner.

- Upper-right corner: לב[?] (proposition-mark, not a vertex label)
- Corner vertices: mostly small and faint; only [?] securely legible

[— more than two labels flagged [?].]

Diagram. A second parallelepiped below the first, drawn with vertical edge-lines carried down (a box set on projected "legs"), representing the solid whose base has been extended / bisected for the proportion argument.

- Corner labels: ל[?] at one lower corner; remaining vertices not securely legible [?]

[— more than two labels flagged [?].]

[Enunciation (≈ Euclid XI.32).] *[Parallelepiped solids of the same height are to one another as their bases.]*

For the two solids are set upon their bases, and we say that the ratio of the base אבגד to the base מ[?]ד[?] is taken as the ratio of solid [?] to solid [?]. And base מ[?]ד[?] equals [?]; and we complete solid [?]. Therefore the ratio of the base אבגד to the base דמ is as the ratio of solid [?] to solid [?].

Diagram. A small cube-like box to the right of the text, one of the two equal-height solids compared in the proportion.

- Corner labels: too small to resolve securely [?]

[— more than two labels flagged [?].]

[Enunciation (≈ Euclid XI.34).] *[In equal parallelepiped solids the bases are reciprocally proportional to their heights; and those solids whose bases are reciprocally proportional to their heights are equal.]*

And [when] the two [solids] are equal, their heights [being set] upon their bases at right angles, we say that the magnitude of the base [?] is [to the base?] as the magnitude of the height א[?]מ[?] to [?]. And if נ[?]מ[?] were equal [and the box stood] on [equal] angles, [it is so]; but if [one edge] were longer, we cut off from it [a part] equal to [?], and we complete solid [?]. And in the preceding figure the ratio of the base [?] to the base ל[?]עג[?] will be as the ratio of א[?]מ[?] to solid [?]; and in the first figure, from the [equality of the planes], the ratio of the base [?] to [?] [will be as before].

Diagram. A rectangular box with faint internal edge-lines drawn in oblique perspective — a parallelepiped shown with its interior diagonal/edge framing for the reciprocal-proportion argument.

- Corner labels: ה[?] at one corner; remaining vertices not securely legible [?]

[— more than two labels flagged [?].]

Diagram. A tall box with a smaller cube beneath it near the foot of the leaf — the pair of solids of unequal height compared by their bases and heights.

- Corner labels: too small and faint to resolve [?]

[— more than two labels flagged [?]; figures small.]

Diagram. A very small, faint box sketched at the very foot of the leaf, above the binding bar.

- Corner labels: not resolvable [?]

[— figure very faint.]

[Continuation of the reciprocal-proportion argument.] …the ratio [of base to base] is as [the height], and [the solids] are made equal one to another; and it is shown by this figure the [required] result. So the ratio of the base [?] to the base עמ[?] is as the ratio of solid [?] to [?]. And if this be [a mean], we say that solid ב[?]א[?] equals the base ג[?]נ[?]; and by another geometrical construction [we say the like].

[Enunciation (≈ Euclid XI.33).] *[Similar parallelepiped solids are to one another in the triplicate ratio of their corresponding sides.]*

The two [solids] being similar [in figure], we say that the planes of their bases stand at [their] angles [proportionally], each as the magnitude of the height א[?]מ[?] to [?]. The base עמ[?] is as the magnitude of the height ל[?]עג[?] [to] the height [?]. Upon the base אבג[?] we draw the perpendiculars ג[?]ל[?]מ[?].

Diagram. A cube drawn in oblique perspective with an interior diagonal and internal cross-lines (the "framed" cube) set in the left margin — the reference solid of the similarity / triplicate-ratio argument.

- Corner labels: ט / [?]ה[?] at the upper corners; remaining vertices not securely legible [?]

[— more than two labels flagged [?].]

And in the [third figure], solid [?] equals [?] to the base ד[?]נ[?]; and in the preceding figure the magnitude of the base ל[?]מ[?] [to] the base [?] will be as the magnitude of the height [?] [to] solid ג[?]נ[?]. And by [another] construction it is found that the ratio of the base [?] to the base עמ[?] is as the ratio of solid ג[?]נ[?] to the base [?]. [If it] be a mean, solid ב[?]א[?] will equal the base ג[?]נ[?], because by another construction [the like follows].

Diagram. A cube subdivided by a grid of internal lines into smaller cubes (the "gridded" cube), drawn in oblique perspective — the standard figure for the triplicate ratio of similar solids. A word stands in the outer margin beside it: עשה[?]מ[?] [reading uncertain; possibly a construction-label, not a numeral].

- Interior label: [?] יתב[?] written within the grid
- Corner labels: not securely legible [?]

[— more than two labels flagged [?].]

Therefore the ratio of solid [?] to the base [?] is as [the ratio of] the segment [חתיכה] [?] [to] [?] of the [cube]; and it is shown from the equality of the planes and the [magnitudes] that solid [?] [is] to the base ג[?]נ[?]. Therefore the ratio of solid ל[?]מ[?] to the base ג[?]נ[?] is as the ratio of [?] to [?], [of the] cube.

Diagram. Three boxes in the right and lower part of the leaf: a subdivided (gridded) cube, a small cube, and a long low parallelepiped drawn in oblique perspective — the corresponding solids compared in the triplicate-ratio / mean-proportional argument.

- Corner labels: ל ,[?]ה[?] at several corners; the remainder small and not securely legible [?]

[— more than two labels flagged [?].]

[the ratio of the base] [?] to the base [?], [of] the [cube] figure, is as [before]; solid ל[?]ב[?]א[?] [is] each as the magnitude of the height [?], as [?]. Therefore the ratio of solid [?] to the base [?] [holds], for the segment [חתיכה] [?]…

[The text breaks off here within Book XI; the Twelfth Treatise (Euclid Book XII) does not open on this leaf. The remainder of the lower margin is blank.]

Diagram. A long, low rectangular parallelepiped at the foot of the leaf, drawn in oblique perspective — an elongated solid for the final proportion. Modern pencil foliation "123" stands at the lower outer corner.

- Corner labels: ה / [?]ל[?] at the visible corners; remaining vertices not securely legible [?]

[— more than two labels flagged [?].]

The Eleventh Treatise [Euclid, Elements Book XI], continued — the final propositions on solid angles and similar parallelepipeds in compound/triplicate ratio. The text runs on as continuous, unrubricated prose; no new section rubric and no end-of-Book formula appears on this opening.

Source page 265

[The leaf opens mid-argument, continuing the solid-angle / triplicate-ratio construction begun on the preceding leaf.]

two remaining segments [חתיכות] are equal, and they are אבגד and דהם, which stand [?] upon them. Two lines, בם and הם — the line [?] enclosing [סובבין] them

— are at equal angles, each one to its counterpart: the [angle] אבגד as [the angle] דהם, and the angle חבג as the angle דהם. From the two lines בם and הם they drew out two perpendiculars [עמודים], in this manner, upon the two planes אבגד and דהם.

Diagram. A vertical group of narrow oblique solids (two or three slim figures drawn tall and narrow, each with an apex-point at the top from which lines cross and splay down to a base) set in the upper right margin — the similar/proportional solids of the triplicate-ratio argument, seen in oblique view.

- Apex/corner marks: ב ,[?]א ,[?]ה ,[?]ז[?] beside the figures; the remaining vertices small and not securely legible [?]

[— more than two labels flagged [?].]

We say that the angles [?] are equal to נהל, since the ratio of [?] is as בם. We draw out a perpendicular [?], and we set up upon them two perpendiculars מל and מק, and two perpendiculars עד and נש; and we [erect?] קב and פב, and we make [ונגעל?] תא, and they are equal [חד].

And we make use of [ונשתמש?] the last figures [הצורות האחרונות] of the [Eleventh?] Treatise [ממאמר …]: each of the angles is found [התמצא] at the [point?] to be a right angle [נצבת]. And in its figure [ובצורתו], from it, [the line] הם is as ופב [?], and [?] as נהל [?]; and likewise [ונס בן?] as נהל [?] — and its figure is like this [כמו זה].

And in the fourth figure [ובצורה הרביעית], from it the angle [?] is like [the angle] פהב [?].

And again, since the angles [?] at בקהם [?] are right angles, and the two angles at [?] קהם are equal, therefore the remaining angle קפט [?] is like the angle שדל [?]; its figure is like [this], from the first [figure] [מן הראשון] …

[the line] הם, and [the line] קם is as על [?], and קב [?] is like this [כמו שם]. And so too [ואחר כן?] the last figures of the [Eleventh?] Treatise, from it: as [?] like this. Therefore the line לע and בב [?] are as הם, and מלב [?] as [?], so that this figure [תהא צורה זו] is like [the figure] מלב, according to the figure [כצורת] …

The line [?] אבג [?] intersecting [מתחתכין] — its ratio אבס [?] is as the ratio [of] ב[?] to [?] — for we say that the point revolves [שיסובבנו], or that the [base?] revolves [שיסובבנו] a point [קוין] [as] each one — what [is] equal [שוה] to [?].

Diagram. A cube drawn in oblique perspective, its front and rear faces shown with the connecting edges, set in the middle of the right margin — the reference cube of the similarity argument.

- Corner labels: ה[?] and ד[?] at the right-hand corners; the remaining vertices small and not securely legible [?]

[— more than two labels flagged [?].]

and its [magnitudes/perpendiculars] are equal, and its two angles are equal. We set for it [נשים לה] like א, and we draw [ונקיס?] the angle [?], the marked one [הנקדת], like the angle א; and we turn [ונפנה?], and let [חד] be like ב, and [ונעד?] like ג. We complete the planes דל, and afterward we draw like ב, and we draw the angle כל, the marked one [הנקדת], like the marked angle ד. And let [חד] the angle עלה [?] be like the angle נלבמ [?]; and the angle נלס [?] עלה [?]; and the acute angle [וזוית חדה] like the angle פלא [?]. And it will therefore be an angle up to על [?], like the angle נלבמ [?] — and the acute angle [?].

Source page 266

And each one of them is [equal] to לכל [?]; and we complete [ונשלים] like ב, and we complete now [ונשלים עתה] to לכל [?]. We say that now רב [?] is equal to the [base?] [שופט?] לכל [?].

It has been made clear from what we premised [ממה שהקדמנו] that the ratio of this to the whole מגל is as the ratio of מגל to the whole דבו [?]; and in figure [?] of the Sixth Treatise [ממאמר ששי] [Euclid, Book VI] [it is shown] that [the ratio of] עלב [?] is as [the ratio of] מגל to עגד [?]. And in the foregoing figure [ובצורה המוקדמת] the [few?] perpendiculars [העמודים המועטים?] from [?] to the two [?] חל [?] — these עלבא [?] are equal.

Diagram. Two small cubes drawn side by side in oblique perspective in the upper-left region of the leaf — a pair of corresponding (similar) solids.

- Corner labels: not securely legible [?] (small marks at the near corners of each cube)

And in the figure [ובצורה] לכל [?], since the two perpendiculars of רב [?] equal to לכל [?] are equal, [and] the lines אבגד [?] [?] intersecting [מתחתכין] — and their magnitude [ושיעורו] upon each one of them [is the same] — now the faces [הפאות/הנופים] were similar [דומים], and the two [?] [rest] upon a single construction [בריאה אחת]. And let them be אבג and נבל [?] [and] חל [?]. We say that, in the straight [line] [בישר], the face אבג with its [solid?] [אצטבועתו?] נבל is as the magnitude [כשיעור] of the faces הם [?] beside [אצל] the faces חל [?]. We set [it] as a straight [line] [נשים כישר]:

- as [?] נג [?] אצל, so the ratio of נג [is] to אצל [?], and the ratio of

- ל [is] to אצל ע [?]; and the ratio of הם [?] [to] אצל חם [?] is as the ratio of חם
- [to] אצל ב [?]; and the ratio of ל [to] אצל ק [?]. And in the figure נל [?]

Diagram. Two rectangular parallelepipeds (long low boxes) drawn side by side in oblique perspective in the middle-left of the leaf, with short ruled straight-line segments beneath them carrying letter-labels — the corresponding solids and the straight lines representing their proportional ratios.

- Solid/segment labels: חם ,[?] נג ,[?] אבג [?] at the boxes; ק ,ב[?] ,ל[?] [?] beneath the segments; further labels small and not securely legible [?]

[— more than two labels flagged [?].]

And let the ratio of אבג — the first [הראשון] — to אצל ע [?] be the [fourth?] [הרביע?] taken from [מן] the ratio of הל [?] beside [אצל] חם [?], the added [one] [הנוסף] that comes from the first [שיהיה מן הראשון], namely אבג, to the added [one] that comes from the plane [למן השטח], namely נל [?]. And [ונח?] likewise let the ratio of הל to ק [?] be as the ratio of the face of הל [?] to the [base?] [שופט?] חל [?]; and the [equal?] ratio [ונחס השוה] to [?] — let the ratio of אבג to נ [?] be as the ratio of הל to אלמ [?].

And [in order] that there be [ושתהיה], as is fitting [כראוי], the ratio of the faces of אבג to the [base?] [שופט?] נל [?] found to be as the ratio of the faces of מל [?] to the [base?] [שופט?] חל [?] — and that this be a mean [מוצע] — [it follows] that the ratio of אבג to אלבג [?] is as the ratio of הן [?] to חם [?]. And this will be made clear by the returning [reciprocal] proportion [במושב?/במותב? החוזר].

For the cube [כמעוקב אבג] אבג, we divided it [חולקנו], and there remains in it [וישאר בו] [?] in [certain?] portions [בילות?] — in the [operations?] [במעשים?]: [the line] עלג נ [?] נה [?] עלב [?] נ [?]; [?] עלג [?] חם מגל [?]; עב [?] עלמ [?] נג [?] גד [?] עד [?] אזד [?] [?]; and we drew out [והוציאו] the diagonal [אלכסון] of אבג [?], and we divided it [וחולק] by בם [?] upon [על] [?] — upon [על] עלרם [?] נמשים [?] — and we make [והנעל?]; they are [הם] [?].

Diagram. A large parallelepiped (elongated box / oblong solid) drawn in oblique perspective at the foot of the leaf, with internal diagonal lines drawn across it (one long diagonal running from an upper corner to the opposite lower corner) — the cube/parallelepiped divided by its diagonal in the concluding proposition. Its corners are labeled with single letters.

- Corner labels (reading around the figure, several small/abraded): ה / [?]ז[?] at the upper-left corners; ד[?] at the far corner; ב ,[?]ל[?] at the left; ,[?]ג

א[?] at the lower corners; מ[?] at the lower-right corner; interior points near the crossing of the diagonals not securely legible [?]

[— more than two labels flagged [?].]

[Modern pencil foliation "124" stands at the lower outer corner of the leaf. The remainder of the lower margin is blank parchment.]

[The Eleventh Treatise (Euclid Book XI) continues past this opening; no end-of-Book formula and no opening rubric for the Twelfth Treatise (המאמר השנים עשר) appears on this leaf.]

Conclusion of the Eleventh Treatise [Euclid, Elements Book XI]

is drawn along the diagonal — that is to say, in this manner the two [solids] are divided into equal parts. The figures are congruent, the one falling exactly upon the other, as is shown from the equality of the lines and of the angles; and it is further shown that the line of the diagonal is a single straight line, by figure 14 of the First Book [Elements I.14]. It is shown, too, from the figure of the treatise that נב and אח, which are opposite [faces], are equal, and likewise that נא and בח are equal. Their sections are therefore equal — namely נא and בם — being equal and opposite; and the matter is plainly seen.

For as סף is, so too is בף; and such are the two prisms sawn apart, אב, נג, הן, חן, חל. The base of the one — the one whose sides are opposite, namely בנ, בל, דה — is double the base taken for the whole triangle, and is accordingly equal [to it]; that is to say, the two sawn prisms are equal. So too שם, אח and חל, and in figure [32] לב they are equal; and therefore the sawn line אב, נג, הן, חן was cut off. Its counterpart חל is itself sawn off, and each section is equal on both sides. Thus far the treatise.

Diagram. An elongated parallelepiped (oblong box) drawn in oblique perspective at the upper right of the leaf, with an internal diagonal line running from one upper corner to the opposite lower corner — the parallelepiped bisected by its diagonal plane in the concluding proposition of Book XI. Its corners bear single-letter labels, small and largely abraded.

- Corner labels (reading around the figure): several faint marks at the upper corners [?]; ב [?] at the lower left; further corner letters not securely legible [?].

Diagram. A second parallelepiped, of the same oblong form, drawn just below the first, likewise crossed by an internal diagonal from an upper to the opposite lower corner. This is the companion solid of the same proposition.

- Corner labels: small letters at the corners, mostly abraded [?]; one mark resembling ז [?] at an upper corner; the remainder not securely legible [?].

המאמר השנים עשר [The Twelfth Treatise — Euclid, Elements Book XII]

Similar rectilineal figures inscribed in circles are to one another as the squares on the diameters of the circles.

Let there be inscribed the circles חן, הן, נג, אב, in each of which [a similar figure is drawn]. I have set בם upon נם. We say that the ratio of the square [of the one diameter] to the square [of the other] is as the ratio of אב, [which has] the greater number of angles, to חן, [which has] the many angles. And we draw [the lines] אם, עם, חל; and by what we have laid down, and by figure two of the [same] treatise, the two triangles אבם [and] חתם will be similar, and the angle הא, אב will be equal [to its counterpart].

Therefore triangle אבם is similar to triangle חתם, and the second [pair of] angles of the two triangles are each equal to the corresponding angle of the other; and the two angles at בם, being opposite within, [make] the two triangles נאם and עתם similar and proportional. When we complete [the argument], it results that the ratio of נב to על is as the ratio of בם to אלב. Therefore the ratio of the square of בם to the square of על is as the ratio of the square of אב to the square of על, which is as the ratio of the figure אב — having the many angles — to the whole figure חן. And by the reciprocal proportion in the second [book, Book V]...

Diagram. A circle with an inscribed polygon (a pentagon) and interior chords drawn across it, at the lower middle of the leaf — one of the two similar inscribed figures of XII.1. Single-letter labels stand at the vertices.

- Vertex labels (reading around the circle): ד [?] at the left; ל [?] at the lower left; the remaining vertices marked but not securely legible [?].

Diagram. A second circle with an inscribed pentagon and interior chords, drawn beside the first — the companion similar figure of XII.1. A letter stands at the apex, with further labels around the circumference.

- Vertex labels: א at the apex (top of the circle); ה [?] at the right; ב [?] and further vertex letters below, small and partly abraded [?].

Therefore the ratio of the square of גב to the square of על is as the ratio of one square to another. Such are the circles חן ,הן ,נג ,אב, [reckoned] according to the whole of them. We say that the ratio of the square [of the one diameter] to the square [of the other] is as the ratio of the circle אב ,נג to the circle חן ,הן; and this is shown from the figure of the matter itself, after this manner.

If you say that they stand in a ratio — the ratio of the circle אב ,נג to a square smaller than the circle חן ,הן — and let it be the square, and let חם be [the like], as the circle חם ,הן; then we say — as we explained in the fourth treatise [Book IV] — that the square חם ,הם is greater than half the circle enclosing it. Let us make an octagon [eight-sided figure], and it is evident that each [triangle] of the polygon on נ ,בה... is greater than half the segment, which is בה ,חעב. Then we bisect [lit. divide] those arcs each into parts, and make a sixteen-sided polygon; and [the polygon in] the circle is greater [than the earlier one], and a remainder is left...

and it is impossible that there should remain [a magnitude] such that what the polygon on חל ,עמם ,בנה — having the many angles — cuts off should be greater than the segment ל. After this we inscribe in the circle אב ,נג a polygon אק, זבה, עלכם similar to the polygon חל ,עמם ,בנה, from what precedes in the foregoing figure. The result is that the ratio of the circle אב ,נג to the segment ד is as the ratio of אק... to the segment חל ,עמם ,זבה. Whichever way you divide it, the segment [would be] greater than the segment חל ,עמם ,זבה — which is impossible. And after this, [to say] that a segment is greater [than the circle] is likewise [impossible]...

Diagram. A circle with an inscribed square (its diagonals drawn), at the upper left of the leaf — the first stage of the exhaustion in XII.2. A small boxed letter stands to the lower left, and further labels around the circle.

- Labels: ל [?] at the left; ב [?] within a small box at the lower left; apex and further vertices marked but faint [?].

Diagram. A circle with an inscribed octagon (eight-sided figure) and interior chords, below the first — the second stage of the exhaustion, doubling the inscribed square to an octagon. Two small boxed letters stand at the upper right.

- Labels: ד [?] and ה [?] in small boxes at the upper right; vertex letters around the circle, small and partly abraded [?].

Whichever way you divide it, the circle אב ,נג will be to the segment ד as אק... to the segment חל ,עמם ,זבה. When we divide off [the term], the segment will be greater than the segment חל ,עמם ,זבה — which is impossible; nor is it possible

that [what is inscribed] be as the square smaller [than] חל, with a remainder left. Let it be מחל, נא, זבה — this too is impossible, unless it be that a segment is [greater]. So, as the segment חל, עמם — [reckoned] over the whole, having the many angles — is greater than the segment ל.

After this we inscribe in the circle אב, נג a segment אק, זבה, עלכם similar to the segment חל, עמם, בנה [of the other circle]. It results that the ratio of the circle אב, נג to the segment ד is as the ratio of אק... to the segment חל, עמם, זבה; and when you divide off [a term], the segment would come out greater than the segment חל, עמם, זבה — which is impossible. And after this, that a segment be greater than the circle חם, הן...

it is impossible. After this, that a segment be greater than the circle חם, הן, [and that] אב, נג be in ratio thus to the whole אב, נג — a [circle] smaller than the circle אב, נג — to a segment ה... greater than the circle ה... Then the ratio of the square of בם to the square of רבב would be as the ratio of the circle ה... to a segment smaller than the circle אב, נג — which is impossible.

Diagram. A large triangle drawn in outline, with interior lines connecting the midpoints of the sides and joining to an apex — a triangular pyramid shown in projection, the figure of XII.3 (a pyramid on a triangular base divided into two pyramids and two prisms). Single-letter labels stand at the apex, at the base corners, and at the interior midpoints.

- Labels: א [?] at the apex; ב [?] and ג [?] at the two lower base corners; ד [?] and further letters at the interior midpoints and along the sides, small and partly abraded [?].

A pyramid whose base is a triangle can be divided into two pyramids and two prisms. Let there be a pyramid whose base is the triangle אבג and whose apex is ד. We say that this pyramid אבג can be divided [so that] there be taken from it two pyramids [equal to one another, and two prisms]...

[The lower margin of the leaf is blank parchment; modern pencil foliation "125" stands at the lower outer corner.]

[Twelfth Treatise = Euclid, Elements Book XII, continued. No display heading or new-treatise rubric appears in this opening; the text carries straight on from the pyramid-division proposition (XII.3) begun on the prior leaf, and passes on p. 270 into the propositions on the proportionality of pyramids (XII.4–XII.5).]

[Euclid XII.3, continued — a triangular pyramid divided into two pyramids and two prisms]

[the two pyramids are equal to one another and] similar to the pyramid אבגד; and the two prisms together are greater than half [the pyramid].

The pyramid אבגד: its edges are bisected at the points ה, ז, ח, ט, כ, ל, and the joining lines הז, זח, חט [and the rest] are drawn. The matter is evident from the equality [of the resulting parts]: for the [plane] figure has equal sides, and so the parallelogram [named] equals its counterpart and is similar to the triangle [named]; and one triangle is [similar] to another, as was explained in the tenth proposition of the Book [book-number ?].

Therefore the angle הזח[?] equals the [corresponding] angle, and the parallelogram [named] is like the parallelogram [named]; and the pyramid standing on the parallelogram אזה[?] is similar and equal to the pyramid standing on the [opposite] parallelogram, and it is similar to the great pyramid — which is what we set out [to prove]. And from it two equal prisms are cut off, since the whole [plane] figure set opposite the faces is double the parallelogram [named].

And by the last proposition of the Book [XI], the prism enclosed by two [triangular] faces and by the perpendicular and the [other] faces — [bounded by] בח, חל[?], and the rest [labels ?] — [is equal to its counterpart]. So there are two prisms [inscribed] within it.

Diagram. A triangular pyramid (tetrahedron) drawn apex-upward, its side-midpoints joined to form an inscribed inverted triangle and its interior divided by lines running to the apex — the pyramid on triangular base אבג (apex ד) divided into two similar sub-pyramids and two prisms. An apex letter, three base-corner letters, and several interior midpoint letters are present; individual vertex letters are small and partly abraded and do not resolve even under magnification (more than two labels illegible).

- Apex: [?]
- Base corners: ג [?], ב [?], א [?]
- Interior midpoints: [several, ?]

Diagram. A second triangular pyramid below the first, similarly constructed (edges bisected, midpoints joined, interior lines to the apex), showing the same subdivision into prisms and smaller pyramids. Apex, base-corner, and interior

midpoint letters are present but too fine to resolve individually. (>2 labels illegible).

- Apex: [?]
- Base corners: [?], [?], [?]
- Interior midpoints: [several, ?]

Diagram. A small wedge-shaped figure of two adjoining triangles in oblique projection — the two prisms cut off from the pyramid. Corner labels are small and partly abraded. (>2 labels illegible).

- Corner labels: ג ,[?] ב ,[?] ד ,[?] א [?]

[Margin (p. 269, left, small brown hand): a note reading approximately "… כל צלע … צורות … החמישית" ("every side … the figures … the fifth"); partly legible. Further identification requires further verification.]

[Euclid XII.4–XII.5 — pyramids of equal height on triangular bases are as their bases]

for it is evident that the two faces enclose the prism, just as the two faces enclose [the other]; and likewise the ratio of the base אבג to the base of the second pyramid, [ס]מנ, holds.

Therefore the two prisms in each pyramid are equal to the whole [half]; and so the ratio of the base אבג to the base [ס]מנ is as the ratio of the two prisms in the pyramid אבג to the two prisms in the pyramid [ס]מנ. And likewise it will be shown that the ratio of the base אבג to the base [ס]מנ is as the ratio of all the prisms in the pyramid אבג to all the prisms in the pyramid מנס, which are planes and solids.

Now, [the pyramids having] triangular [bases], concerning them we state one [further proposition]: that the ratio of the base אבג to the base מנס is as the ratio of the pyramid אבגד to the pyramid מנסע. This will be shown if we posit [the contrary]. Suppose we say: let the ratio of the base אבג to the base מנס be as the ratio of the pyramid אבגד to some solid [labeled ?] which is smaller than the pyramid מנסע; and let there be [inscribed] two solids [?] together making up the pyramid מנסע.

Diagram. A triangular pyramid apex-upward, its edges bisected and midpoints joined to display the two-prism / two-pyramid subdivision — the second pyramid of the comparison, on base מנס (apex ע). Base-corner and interior letters are

present but small and partly abraded. (>2 labels illegible). A faint ghost of construction lines (bleed-through) stands to the upper right and was disregarded.

- Apex: ע [?]
- Base corners: ס ,[?] נ ,[?] מ [?]
- Interior midpoints: [several, ?]

Diagram. Two small parallelepiped (box) figures drawn in three-dimensional perspective, one at the left and one at the center-right of the pyramid figure — the comparison solids of the reductio. Each carries a single interior letter, too faint to read with confidence.

- Left box, interior label: [?]
- Right box, interior label: [?]

We proceed here in the manner of the third proposition of the Book — namely, that the pyramid מנס is divided into [two] prisms and two [smaller] pyramids, until a remainder is left [smaller than the assigned solid]; and let the [sum of the] prisms be greater than the solid [?]. When you do to it what was explained at the end of the preceding proposition, you find that the ratio of the base אבגד to the base מנס is as the ratio of all the prisms in the pyramid אבגד to all the prisms in the pyramid [ס]מנ; and likewise the ratio of the pyramid אבגד to that solid [?].

But behold, when you reason it out properly, you find that solid [?] is greater than all the prisms in the pyramid מנס — yet it was posited to be smaller, which is impossible. And likewise, if that solid [?] were greater than the pyramid מנס, it will be shown that the ratio of the base אבגד to the base מנס is not as the ratio of the pyramid אבגד to that solid, as was posited concerning it.

Therefore the ratio of the base אבגד to the base מנס is as the ratio of the pyramid אבגד to the pyramid מנסע. [Q.E.D. — Euclid XII.5: pyramids of the same height on triangular bases are to one another as their bases.]

[p. 270, foot outer corner: modern pencil foliation "126."]

The Twelfth Treatise (Euclid, *Elements* Book XII) — continued

[Prism divided into three equal pyramids — Euclid XII.7]

the prism אבגדה. Upon it [we reason as follows] [?]. We say that it is divided into three pyramids, and the bases of all of them are triangular [?]. And in the foregoing figure, the pyramid that is bounded by [the triangle] בגד, whose apex is ע, is equal to the pyramid that is bounded by [the triangle] בגדה, whose apex [is

…] [?]; [they are bounded, each] by [its] one [base], and moreover each one of them is equal to the pyramid that is bounded by the triangle אבהד [?], whose apex is ב — because the base of the whole [?] is equal to the base of the pyramid אבהד, and the height [?] is [drawn to] the point of the line [?].

Diagram. A triangular prism drawn in three-quarter perspective at the top of the right margin: a rectangular front face with a triangular top and internal diagonal lines partitioning it into the three constituent pyramids of the proposition. A small marginal numeral (7) *ר* stands to the right of the figure. The apex and corner labels are present but faint. (>2 labels illegible).

- Apex: [?]
- Base corners: [?], [?]
- Interior division point: [?]

The three pyramids are therefore equal.

[We now take] two [prisms] whose two bases are triangular — [the bases] אבגד [?] and [?] — and whose apexes דגא and [?] are equal. We say that their two triangular bases [stand] in a determinate relation to each other [?]. [Then, taking equimultiples,] just as [one solid] falls [equal] to [another] [?] — so many times over for this pyramid [?] — and likewise [it is] so many times over for this pyramid [?]; but…

Diagram. A parallelepiped (box) drawn in perspective with its face-diagonals, illustrating a prism as it sits within the containing solid. A single faint interior letter is present.

- Interior label: [?]

and each of them alone is equal [?]. It is stated that the ratio of the pyramid [on base] אבגד [?] to the pyramid [?] is as the ratio of the base [?] to the base [?]; and their solids are equal [?].

Diagram. A second parallelepiped (box) with face-diagonals, in the middle of the right margin. Two corner letters are partly legible.

- Corner labels: פ ,[?] ד [?]
- Remaining labels: [?]

And it will be explained [?].

Diagram. A third box (parallelepiped) with internal diagonals. Its labels are faint. (>2 labels illegible).

- Labels: [?], [?], [?]

We say [again] that the prism is divided into seven [?] prisms whose bases are triangular [?]; and we have already shown that every prism is bounded [?] [by faces] whose bases are triangular, and their heights are equal. Therefore the two bases stand in an equal ratio [?]. …their two triangular bases [?] [as we established] in the eleventh treatise [Book XI of the *Elements*]…

Diagram. A box (parallelepiped) in perspective with face-diagonals, bearing a single interior letter *מ*.

- Interior label: מ

the ratio of the base [?] to the base [?]; and it will be shown, as in [the argument] above, that the ratio of this pyramid to that pyramid is as the ratio of base אבגד [?] to base [?] [?]. It is stated that the ratio of the base אבגד [?] to the base [?] is as the ratio of this pyramid to this pyramid [?]; each one of them, taken singly, is equal to [the corresponding one] [?] — the corners [angles] of this and of that being [respectively] equal.

Diagram. A wide, low box (parallelepiped) with internal diagonals at the foot of the right margin, spanning the strip seam; a marginal numeral (8) *ח* stands beside it. Corner letters are faint. (>2 labels illegible).

- Corner label: פ [?]
- Remaining labels: [?], [?], [?]

We say that the ratio of the pyramid bounded by [base] אבגד [?], with apex [?], is as the ratio of the base [?] to the base [?]; and it is bounded by [three] triangular faces [?]. And it will be explained by way of the number [i.e. the equimultiples] [?] [that these are] in the corresponding ratio.

[The cone is a third part of the cylinder — Euclid XII.10]

And he said to them [?] [that] the parallel planes are equal in figure, for [?] we learn from the eleventh treatise [Book XI] that [?] [each] side is similar [?]; and when [the solid] is divided out of it, [?]. Let there be [?] [the solids], [each] equal to [?] this [one] against that [one], [with] triangular [faces] [?]. The pyramids [?] are those [that are] the cone [?]…

The cone of the cylinder [i.e. the cone on the same base] is a third of it, provided that the base of the cone and [the base of] the cylinder are [the same], just as [the base was] אבגד; and in them [is] one [and the same base] [?].

Diagram. A circle — the base of the cylinder — with an inscribed square אבגד and, outside the square, an inscribed regular octagon (the square with each of its arcs bisected), plus a marked center point. A marginal numeral (9) ט stands to the left of the figure. The square's corner letters read, roughly clockwise, ד and א at the top and ב and ג at the foot.

- Top corners: ד, א [?]
- Foot corners: ב, ג [?]
- Center: [point marked, unlabeled]

We say that the cylinder is three times the cone; and it will be shown by the reductio [*mofet ha-ḥozer*, the proof by reversion/contradiction]. Suppose we say the cylinder is more than three times the cone by a certain magnitude [?] — [call it] ק [?] — and deep within the circle [let there be] the square אבגד, and erect upon it prisms [?]; yet it is not [truly] prisms [?], since their bases are [square-]sided [?]; but we call them "prisms" [as an extension of the term] [?].

Diagram. A box (parallelepiped) drawn in perspective, spanning the seam between the two lower strips, bearing a single interior letter ק — the assigned excess-magnitude of the reductio.

- Interior label: ק

But we call them "prisms" relative to the base of the cylinder. And as we explained in the treatise [Book XII]: when the [inscribed] prism is greater than half [?] the cylinders, just as the [inscribed] square is greater than half the circle — [then] we bisect the arc of the square, making it like a [regular many-sided figure], as we did in the first figure. And moreover we erect upon each one of the triangles a prism within the cylinder [?], and likewise upon the rest of the cylinder [?]. [Thus we obtain] the prism, which is a solid [?] [standing on] a many-angled figure [polygon] that is [inscribed] like the base of the cylinder; [and this solid] is more than three times the cone that is bounded upon [?] the base of the cylinder.

Indeed, in the second figure the prism whose base is the [polygon of] many angles alone [?] is not [more than three times] [?] the cone inscribed within it alone. Therefore it is not right that [the prism] should be less than three times the cone whose base is the circle — yet it had [been posited as] greater than it, which is impossible. And thereupon [it follows] that the cone of the cylinder [cannot be] greater than a third of it by [any] magnitude [?] — [namely by] ק — and [therefore the cone is exactly a third of the cylinder] [?].

and moreover [?] [the reasoning proceeds] the other way [i.e. it is likewise impossible that the cylinder be *less* than three times the cone] [?].

[p. 272, foot outer corner: modern pencil foliation "127."]

[The Twelfth Treatise — Euclid, *Elements* Book XII, continued. This opening carries no display rubric; the text runs on from the cone = one-third-cylinder proposition (XII.10) into the propositions that cones and cylinders on equal bases stand to one another as their base circles, and that similar cones and cylinders stand in the ratio of the squares on the diameters of their bases (≈ XII.11–XII.12), proved throughout by the method of exhaustion and the reversion-proof (*mofet ha-ḥozer*). There is no opening of the Thirteenth Treatise and no end-of-Book-XII colophon; Book XII continues past this leaf.]

Source page 273

Diagram. A circle — a base circle of one of the cones — with an inscribed square and, upon the square, an inscribed regular polygon formed by bisecting each of its arcs; a center point is marked, and radii and chords are drawn. An apex-letter ל stands outside the figure to the upper left, from which lines run down to the circle (the cone seen with its apex projected outside the plane of the base).

- ל (apex, outside upper-left)
- ה (right)
- ד (lower right)
- ב (foot)
- ג (foot)
- ז (left)
- Center: [point marked]

the two cones — that on circle אבגד [apex ל] and that on the second base circle [הזחט (?), apex נ] — are similar; and the areas [in question] are the circles אבגד and הזחט[?]. Now the ratio of the one to the other — the diameters of the areas being בד and זט[?] — we state thus: the ratio of cone אבגד to cone הזחט[?] is as the ratio of בד to זט[?]. This is shown by the reversion-proof (*mofet ha-ḥozer*), in this way.

Let us set circle א[?], and take the ratio of בד to a triangular figure [equal] to the ratio of cone אבגד to [a solid] which is smaller than cone הזחט[?]. We divide it, and proceed after the manner of what we did before, until there remains of cone הזחט[?] a portion even smaller than circle א[?]; and let it be [the remainder]. And

let the cone whose base is the many-angled figure [polygon] and whose apex [is set upon it] be greater than [the remaining] surface [?]. And if we make within circle אבגד a many-angled figure similar to it, and erect upon each [of its triangles] a solid pyramid within the cone — the pyramid inscribed in it —

Diagram. A circle with an inscribed many-angled figure (chords and radii drawn from a central point), the plan of a second cone's base with its inscribed polygon. A ruled line runs out to the upper left toward an apex-mark. Several vertex-letters are set around the circumference.

- Apex-mark: ל [?] (outside, upper-left)
- ה (upper)
- ד, ב, ג (around the circumference) [remaining vertex-letters faint]

Diagram. A small parallelepiped (box) drawn in perspective, bearing a single interior letter *א* — the residual/excess magnitude of the reductio.

- Interior label: א

[Margin, right, beside the figures: "כל זאת ה[צורה] / צורת / הם צורה[?] / העגולות" — a scribal figure-caption; further reading requires further verification.]

and the pyramid whose base is [the polygon] and whose apex is the point ל set upon it [is compared to] circle כל[?]. And likewise erect upon the base of the second [figure] הם[?] the circle נמן[?]; and by the foregoing premise it will follow that the ratio of כל[?] to מן[?] is not [other than] as the ratio of בד to זט — which is the ratio of בד to זט [itself] — and this is as it should be. And we find figure כלב[?] similar to figure נמן[?], [so that] the ratio of כל[?] to מן[?] is as the ratio of בד to זט[?]. And again we find that figure כל[?] is similar to figure סמן[?], and figure [ ] similar to figure זמם[?]. And in like manner it is shown, throughout the [successive figures], that figure לב[?] is similar to figure נמ[?], being as the ratio of בד to זט, similar to it. And after this operation, the pyramid engraved [inscribed] in the cone [is exhausted step by step].

And the cone [the residual], which the figure of many angles surrounds and whose apex is large[?], greater than the surface [remaining] — and there is made within circle אבגד a figure of many angles similar to it; and set upon each solid, another pyramid, [namely] the solid pyramid engraved within the cone.

Source page 274

[p. 274 re-runs the same exhaustion argument by way of the base circles, invoking the lemma that circles stand to one another as the squares on their

diameters (the XII.2 lemma), and closing each branch by reduction to the impossible.]

Diagram. A circle with an inscribed many-angled figure (a triangle and chords drawn to the vertices from a central point), with a straight rule running out beyond the circumference at the upper left. This is a base circle with its inscribed polygon.

- ל [?] (upper)
- מ (center-left)
- ב, ד, ג (around the circumference) [some vertex-letters faint]

Diagram. A second circle with an inscribed many-angled figure and a triangle, chords and radii drawn. A ruled line extends past the upper left. Vertex-letters are set around the circumference.

- ב (left)
- ה, ד, ג (around the circumference) [remaining vertex-letters faint]

[Margin, left, beside the figures: "כל זאת ה[צורה] / צורת ותהי[?] צור[ה]" — a scribal figure-caption; further reading requires further verification.]

Diagram. A small parallelepiped (box) drawn in perspective, bearing a single interior letter *א* — the residual/excess magnitude of this branch of the reductio.

- Interior label: א

whose apex is ל and whose base is the many-angled figure: its ratio to the other cone, whose base is the many-angled figure and whose apex is נ, is as the ratio of בד to זט[?] of the circle. And the ratio of the cone whose base is a circle and whose apex is ל, to the surface א[?], is as the ratio of the cone whose base is the many-angled figure inscribed within it and whose apex is ל, to the cone whose base is the other many-angled figure and whose apex is נ.

Now, taking it the other way (*alternando*), we say that [the residual solid] is greater than the cone whose base is the many-angled figure and whose apex is נ — yet it had already been made smaller than it; which is impossible. And in the same way it is shown, by our [construction], that the ratio of בד to זט[?] of the circle is not [other than] as the ratio of cone אבגד [apex] ל to the cone which is greater than cone הזחט[?] beyond the other.

[the cone] נ[?] [and] הזחט[?] — since what was posited [as] equal is cut, this one and that one, [and] both כל and מן[?], and the two circles אבגד and הזחט[?]: for the

ratio of circle [to circle] is as the ratio of the two cones. And if we say that the ratio of circle אבגד to circle הזחט[?] is as the ratio of cone אבגד [apex] ל[?] to circle א[?] — and it is smaller than cone הזחט[?] —

then we divide off from it continually, as we did in the others, until there remains a figure הם[?] less [than the assigned magnitude], the many-angled figure being greater than the surface א[?]. And we make within circle אבגד another figure similar to the divided figure, less [than it]. And we also erect upon each of its [triangles] a pyramid within [the cone]; and in the first figure and its circle the ratio of the square on בד to the square on זט[?] is as the ratio of [figure] אלבבש[?] הך[?] to הסר[?] upon [all] of them[?]; and likewise [the ratio of] circle אבגד to circle הזחט[?] — and this is as it should be.

And we find that the ratio of cone אב [apex] נ[?], [the] whole surface, to the surface א[?], is as the ratio of the cone whose base is הך[?] inscribed within it, to the cone whose base is הסר[?], its circle; and whose base is אבגד[?] [and] הך[?] inscribed within it, to the cone whose base is סד[?] upon [all] of them[?], הסר[?] —

[p. 274, foot outer corner: modern pencil foliation "128."]

The Twelfth Treatise (Euclid, Elements, Book XII), continued. Script: Sephardic semicursive, single scribal hand (Sasson ben Menashe). Scribal quirks per this section: gimel written nun-like; tav often formed as ṭet (שעולה = "circle"; אסטוונה = "cylinder"; כדור = "sphere"). Point-letter groups continue the prior leaf's usage — the two circles of the cone proof are read here as circle אבגד and circle הזחט, matching the established form.

[The close of the cone-ratio proposition (≈ Euclid XII.11)]

the cone [on] circle אבגד is greater than the other, and it would be [equal to] the many-angled figure inscribed within it. But we have already premised that a figure [?] transposed [into] a many-angled figure greater [than the assigned magnitude] is impossible. And in the same way it is shown that there is no ratio of circle אבגד to circle הזחט like the ratio of the cone [on] אבגד to a surface that is greater than the cone [on] הזחט. From this it follows that the ratio of cone to cone is as the ratio of base to base.

[Margin/figure number, at the seam between text and figure: "י״ב" — the twelfth figure of this treatise.]

Diagram. Two separate circles drawn side by side, each with a single radius struck from its center to the circumference (the two circular bases of the two

cones compared in the proposition). Two long straight lines descend from the upper margin, one to each circle. The interior/endpoint labels are faint.

- Left circle, radius endpoint: מ [?]
- Right circle, radius endpoint: ד [?] (or כ [?])
- Figure number above: יב (12)

The two cones… their bases… and it is shown easily [?]. And [it is] this [that] we wished to make clear [?].

[The polygon in two concentric circles (≈ Euclid XII.16)]

Let circle אבגד fall about a single center, [with a smaller circle]; and we construct within the large circle אבגד a many-angled figure with equal sides [an equilateral polygon].

[Margin/figure number, at left of the figure: "יג" — the thirteenth figure.]

Diagram. Two concentric circles (an outer circle and a smaller inner circle sharing one center), with a vertical and a horizontal diameter crossing at the center at right angles. An inscribed rectilinear figure (a square / many-sided polygon) touches the outer circle; a small triangle is drawn in the lower-left between the two circles. The apparent inner "chord" is in fact the arc of the concentric inner circle.

- Top of outer circle: ז / [?] ה [?]
- Right of outer circle: ל
- Left of outer circle: [?]
- Foot of outer circle: ב [?]
- Figure number at far left: יג (13)

we draw a diameter at right angles, זנ [?] and גד [?], so that there are joined two right angles; and we produce [?]… to circle חל [?]. And after this we [bisect] arc אל [?] in half, and halve [it again] in half, until there remains an arc smaller than arc זל [?]; and this is arc הל. And attend to [an arc] like הל, and upon הב [?]… And after this we divide off arcs equal to הל, and produce [lines from] their chords, and join [?]… so that circle חל [?] is completed [?]… because the line זט [?], which is tangent [?]… over against הב [?].

[The polyhedron in two concentric spheres (≈ Euclid XII.17)]

[Given] spheres about a single center, we wish to construct within the [larger] sphere a many-based figure [a polyhedral solid] that does not touch the surface of the small sphere. We inscribe [?] like spheres [?]; [and pass] a section that passes through the center; and by the premise [?]…

Diagram. A large circle (a great circle of the sphere) with an inscribed many-angled figure and internal chords forming a star-like network; a smaller circle/arc is drawn within it, and the diameters and connecting lines of the polyhedral construction are carried across. The labels ring the circumference and interior and are faint throughout.

- Top of circle: ד / [?] ז / [?] ה [?]
- Left of circle: ט [?]
- Right of circle: ד / [?] נ [?]
- Center: ל [?]
- Foot of circle: ה / [?] נ / [?] ל / [?] ב [?]

Let the line that stands [perpendicular to] circle אבגד הזחט be [drawn] upon center ט [?]; and we [draw] their diameters אבגד at right angles. And we [construct] in the larger circle a many-angled figure with equal sides, its sides not touching [the smaller circle]…

the sides not touching circle חט, [?] דה — [?] חל [?] — and the diameter [?]; we make [?]… that is generated [?]… [from the] center; and we produce [?] a perpendicular upon the plane of circle אבגד, by figure 12 of the eleventh treatise [?] [Elements XI]. And we mark [?] to the surface of the great sphere [?] נ [?], and we produce two [?]…

and we produce upon them chords [?]… like the [line] לזן [?], and we make [?] two perpendiculars [?]… like לזן [?]; and a [line] over against [?]… and [it is] equal to it [?] over against [?]… and [it is] not equal to ל [?]. Therefore [?]… as will be made clear from the [?] figure of the eleventh treatise [?] [Elements XI]. And likewise four [?] קד [?]… and a triangle falls [?]… since the whole [?] is a triangle, and a [line] over against הך [?] — therefore it is greater [?]… than it, and it is also greater than דך [?], and the [line] מזל [?] does not touch the small sphere; and also…

because [by] the figure [?] of the third treatise [Elements III], were דך [?] touching the small sphere, it would be nearer to the center than מזל [?], and it would be fitting for it to be greater than it; but it has already been shown that מזל [?] is

greater than דך [?], and מזל [?] does not touch the small sphere — a fortiori (*kal va-ḥomer*) that דך [?] does not touch it. Therefore even [the line] מזל דך [?] does not touch the sphere. And we do likewise in each quarter of the quarters of the sphere.

[Foot of p. 276, outer corner: modern pencil foliation "129."]

[Conclusion of the Twelfth Treatise — Euclid, Elements Book XII, Prop. 18: spheres are to one another in the triplicate ratio of their diameters]

We now complete [the case of] the many-based figure [the polyhedron] that does not touch the surface of the small sphere. If we say that [the polyhedron] inscribed in sphere אבגד — its ratio to the many-based figure inscribed in the other sphere — is as the triplicate ratio of diameter בד to the diameter of the other sphere, as is shown in the eighth figure [Elements XII.8] [?], then the ratio of sphere אבגד to sphere הזחט is as the triplicate ratio of diameter בד to diameter [?].

And if we say that the ratio of בד to בד [i.e., of the two diameters], in triplicate, is as the ratio of sphere אבגד to a sphere smaller than sphere הזחט: then, [taking the spheres] about its center, we inscribe in the larger [sphere] a circle-figure of many angles [a polyhedron] that does not touch the small sphere; and, by the foregoing figure, the ratio of the figure inscribed in sphere הזחט [to the figure inscribed in the small sphere] is as the [triplicate] ratio of בד to בד. And it is found that the ratio of sphere אבגד to the small sphere is as the ratio of the figure inscribed in them [to the figure] inscribed in הזחט; and this leads to a contradiction. And it is found that [the small sphere would be] greater than the figure inscribed in sphere הזחט that does not touch it, just as sphere אבגד is greater than the figure inscribed [in it]. And this is [impossible] [?].

Diagram. A single circle — a great circle of the sphere — with a horizontal diameter drawn across it and faint interior chords.

- Left end of the diameter: ד
- Right end of the diameter: ב
- Below the circle: ל [?]

Diagram. Two concentric circles (the larger and the smaller sphere) with a horizontal chord/diameter carried across the lower part; faint interior lines.

- Left end of the diameter: ד

- Right end of the diameter: ט [?]
- Foot: ב / [?] ל [?]

המאמר השלשה עשר — The Thirteenth Treatise [= Euclid, Elements Book XIII: the five regular solids inscribed in a sphere]

[Body heading, in the enlarged display hand at the foot of the text-block on p. 277.]

[XIII.1 — a line cut in extreme and mean ratio.] [When a straight line] is cut in the ratio of a mean and two extremes [extreme and mean ratio], and its greater segment is אב [read as אג], [and it is set out] as חט [?]... as אב: we say that the square on גד [?] is five times the square on אזד [the half-line] [?]. We construct the square on אב, which is אח [?], and the square on גד [?], which is דט [?]; and we draw אנך [?]... and produce דט [?], and produce מט [?] over against הט [?]. Therefore מנ [?] is as אזד [?], and [the line] falling [across] is as אח [?]; and it is found that נל [?]... the whole is equal to אזד [?]... upon אזד [?]. Therefore the square on אב is four times the square on [its half]; therefore [the square] הנך [?] is five times [the square] טו [?].

Diagram. A rectangle partitioned into square cells with a diagonal drawn through the lower right cells — the figure of squares on the segments of a line cut in extreme and mean ratio.

- Top row, corners: ד / [?] ג [?]
- Middle band: ל / [?] מ / [?] ה / [?] ז [?]
- Bottom row: ב / [?] א [?]

[XIII.2 — the second figure of this treatise: converse of the foregoing.] And we also say: line אב is cut in the ratio of a mean and two extremes at ג [?], its greater segment אג [?], and אג is cut into two halves at ד [?]. We say that the square on גד is five times the square on דב [read as דג] [?]. For the square on אג is four times the square on אד [?]; and it is found that [the square on] the whole אב together with the square on דב is five times the square on דג [?]. And by the second figure of this treatise, the square on גב is five times the square on דג [?].

Diagram. A horizontal straight line marked off by tick-strokes into segments, with letters at its ends and divisions — the line cut in extreme and mean ratio.

- Left end: ב

- Interior division: ד [?]
- Right end: א / [?] ג [?]

[XIII.3.] Line אב is cut in the ratio of a mean and two extremes at ג [?], its greater segment אג [?], and there is added to its length אד [?] equal to אג [?]. We say that בד [?] is divided in the ratio of a mean and two extremes, its greater segment being אג [read as אב] [?]... and it is found, by conversion, that the ratio of בד [?] to ב_ [?] is as the ratio of בד [?] to אגד [?].

Diagram. A second horizontal straight line marked off by tick-strokes into segments, with a faint circle behind it.

- Left end: ב
- Interior division: ד [?]
- Right end: ג [?] Line אב is cut [in the ratio of a mean] and two extremes at ג [?], its greater segment אב [read as אג] [?]. We say that the square on אב [?] and the square on ב_ [?] together are three times the square on אג [?].

[XIII.7 — the seventh figure of this treatise: the equilateral pentagon.] And by our practice in the seventh figure of this treatise: [given] the pentagon אבגדה [?], its sides equal, and having in it... only [that] its angles are equal, which are אב [?]: we say that two [three] of its angles... are equal to one another. And by our practice in the fourth figure of the first treatise [Elements I.4]:

[XIII.8.] And likewise, if the ordered [adjacent] angles חו [?] to הו [?] were [equal] — and they are... [then] we say that the remaining angles too are equal, and thereby [the whole] is [equiangular].

Diagram. An equilateral pentagon with an internal pentagram (five-pointed star) drawn from vertex to vertex.

- Apex vertex: ה
- Remaining vertices: [?] (illegible)

[XIII.13 — the pyramid (tetrahedron) inscribed in a sphere.]... the equilateral, acute-angled triangle אבגד [?]... [as base of] אבגד [?]: we say that the square on אבג [the edge] [?] is three times the square on חט [?], [which is] half [?] the diameter of the sphere, which is אד [?]. And by our practice in the fourth figure of the first treatise [Elements I.4], and by figure אז [?] of the [?] book, and by figure לג [?] of the triangle-[book] [?]...

Diagram. A faint circle with an inscribed triangle (the projection of the tetrahedron and its circumscribing sphere).

- Labels: [?] (illegible — very faint)

[Foot of p. 278, outer corner: modern pencil foliation "130." Foot of p. 277, inner margin: a small marginal figure-number "(1) "א, keyed to the first construction of the Thirteenth Treatise.]

[Continuation of the Thirteenth Treatise = Euclid, *Elements* Book XIII — the pentagon/decagon lemmas and the inscription of the regular solids in a sphere.]

[Margin, p. 279, outer edge of the top lines: the scribe has re-written מרובע ("square") twice in the margin as a correction to the opening lines.]

and by figure [?] of the first book, it is found that the square on אב [is a multiple of] the square on הג; and there remains the square on אג three times the square on הג, which equals the square on [ד]א — this when the side of the equalized figure and line בג are joined with the side of the decagon.

Let line נג be divided in the ratio of a mean and two extremes, its greater segment being בג. Upon it we construct a circle [שעולה] with its three extremities, as you will see. By the proof of the last proposition of the sixth book, it follows that [the square] is four times the square upon the angle [ג]נ.

Diagram. A circle with an inscribed equilateral triangle, apex at the top; its base is a horizontal chord, and below the base a second, downward triangle meets a lower point, so that the two together form a rhombus within the circle. A line runs from the apex through the center to the lowest point.

- Apex (top): [?]
- Right end of the base chord: [?]
- Lowest point: [?]
- Center: [?]
- [Margin figure-number, upper right: reads as a numeral in the treatise's diagram sequence, ~"(6) "ו [?].]

And when they stand thus in the fifth figure, and by figure [ב]ל of the first book [Elements I.32] and figure [?] of the fourth book, the angle [ב]נ will be double the angle ד[ג]ב. Therefore angle בגד equals angle ן[ג]ב. This will be clear to you easily: if you take for the side [the one] proper to it, and know how much the measure of each angle is, then by the reckoning of the equality of the angles בגן, [each is] six fifths of a right angle, and there remains for each of the ten interior angles [ב]נ...

Diagram. A circle divided from its center by radii into three parts, with a chord subtending the lower-right sector to form a triangle, and one line prolonged beyond the circle toward the lower left.

- Points on the circumference: [?], [?], [?] (small marks, illegible)
- Center: [?]
- [Margin figure-number, upper right: ~"(7) "ז [?].]

the equal [angles]: each of them contains four fifths of a right angle. Therefore angle [ב]נ itself is double angle [ג]נ; hence angle בגן equals angle ד[ג]נ, and angle בגן equals angle ד[ג]נ. And by figure six of the sixth book you know that the larger triangle ד[ג]נ is [similar] to triangle ב[ג]נ; and by figures [?] of it, the square on [ג]ד is double [...] angle [...] ג[ב]נ, as a square; and by figure [?] equal to the square on בג.

[Enunciation.] Given the equilateral pentagon ה[ד]אבג: we say that the side of the pentagon exceeds — [its] square upon a square — and by the [triangle] inscribed in it the measure of the square of the side of the hexagon. The arc is bisected [?] at ב, into halves at ב; and then [divided] into six halves [...]; and we set up the lines with their three extremities of its diameter. Therefore arc ד[...] is double [...] and a half [...], double the angle ד[ג]ב; and this is double [...] ח[ג]ב, [ח of] the heavens; and angle ד[ג]ב [equals] angles בג[...]; and the right-angled triangle [is] similar to triangle ח[ג]נ.

Diagram. A circle with an inscribed equilateral pentagon and an internal figure (star / chords) joining its vertices, with a further line running down to a point at the bottom of the circle.

- Vertices of the pentagon: [?] (five small marks, illegible)
- Lowest point: [?]
- Center: [?]
- [Margin figure-number, upper right: ~"(8) "ח [?].]

[Foot of p. 279, outer corner: modern pencil foliation "130."]

[p. 280 — Figure 9 of the treatise (marginal ט').] Therefore the rectangle contained by אב and ב[ג] equals the square on ב[ח], and it is [...] double [...]; as the square on א[...]; and it is [...] the square on ב[ח]. The pentagon equals the square on [the side of] the decagon together with the square on [the side of] the hexagon, taken together.

Diagram. A circle with an inscribed quadrilateral (its four vertices on the circumference) whose two diagonals cross at the center, dividing the figure into four triangles.

- Upper-left vertex: [?]
- Upper-right vertex: ב [?]
- Center (crossing of the diagonals): [?]
- Lower vertices: [?], [?]
- [Margin figure-number, upper right: "(9) "'ט.]

[Figure 10 of the treatise (marginal י').] In the circle, the equilateral pentagon אבגד[ה — and the two lines [ג]ב, […]אג, א: [take] the product of the two sides [ג]ד[...], bisected at [ה]. We say that [...]; the mean is given, and their extremities are arranged [in extreme-and-mean ratio], and the greater segment [ם]ב from the one and [...] from the other; and each of them equals the side of the pentagon, as [you find] when you construct it.

Diagram. A semicircle standing on its diameter, with an inscribed triangle and internal lines to the base; the word אלכסון ("diameter") is written to the right of the figure as its caption. A second, fainter construction (chords) is sketched below it toward the gutter.

- Base (diameter) left end: [?]
- Base right end: [?]
- Apex on the arc: ד [?]
- Interior point: [?]
- Caption (right of the figure): אלכסון ["diameter"]
- [Margin figure-number: "(10) "י [?].]

By the fifth figure of the first book, [ח]ב equals [ח]כ [...]; since arc [הם]דל is double arc אב, angle [ב]דם will be [...]; and by the last proposition of the sixth book the two angles [ב]דם and [ז]דב will be [equal]; [as a] figure, when you construct it, in it the figure [ג]ל of the first book [...]. The decagon [...] there is in it the square equal to the square on [ד]ב, together with the square on [ד]ג, as the square on ב[...].

[Enunciation — the construction of the pyramid (tetrahedron) inscribed in a sphere; cf. Euclid XIII.13.] How do we construct a pyramid [מחודד] having four equal triangular faces, standing in a sphere, so that the sphere contains it? Let the diameter of the sphere be אב. We divide it at ג [so that א ג is twice ב ג], and we

erect [ה] the perpendicular ד, and we draw the perpendicular [ג]ד, and we join [...]; and we set up upon it [...] the perpendicular [ח]ד, equal [...]; and we draw [...].

Diagram. A circle with an inscribed triangle and further internal lines drawn from the vertices across the figure (the projection of the tetrahedron and its circumscribing sphere). A very faint rectangular box (a cube drawn in perspective) is sketched lightly behind the surrounding text.

- Left vertex: [?]
- Right vertex: [?]
- Interior point (labelled): נ [?]
- Lower vertex: [?]
- [Faint background figure: a lightly-drawn cube outline.]

and this is the [...] from the figure; it will be as figure [?] of the sixth book, and by figure [א]י of it, and by the composition of the ratio, and by figure [ז]מ of the first book, and by figure ל[?] of it, and by the sixth figure of this treatise. Therefore the pyramid [ב]כ […]ל[ג]מ is one having four equal triangular faces, natural [equilateral], each side of which equals the side of the [diameter — (כסון)אל]...

[Foot of p. 280, outer corner: modern pencil foliation "131."]

The Thirteenth Treatise (Euclid, *Elements* Book XIII) — the regular solids inscribed in a sphere (continued)

Conclusion of the pyramid (tetrahedron), inscribed in a sphere [cf. Euclid XIII.13]

and as for the revolution by which the sphere would enclose it: we draw זת… and let טך equal בג. By what we have laid down, the ratio of זת to כך is as the ratio of כך to טך. Likewise we erect a perpendicular upon זת; and half the side of the decagon set upon זל [?], returning to the place from which it began, passes over the remaining point [נקודה]. The sphere has therefore revolved about the pyramid.

And we say that the square on the diameter of the sphere — which is אב — is one and a half times the square on the side of the pyramid, which is אל. For the side זל is divided at זב and תל like [ג]אל and like half of it; and the ratio of the square on בז to the square on אל[?] is as the ratio of כך to טך [?]; and the square on [ל]ט is therefore… the half. And the half is the diameter, and אב is [half of]… the side of

the pyramid. Therefore the diameter of the sphere is one and a half times the square on the side of the pyramid.

Diagram. A semicircle standing on its horizontal diameter, with an inscribed right triangle drawn from the two ends of the diameter up to a point on the arc, and an internal perpendicular dropped to the base. Faint concentric arcs are sketched behind it.

- Apex on the arc: [?]
- Diameter, left end: [?]
- Diameter, right end: [?]
- Foot of the perpendicular on the base: [?]

How to construct a cube inscribed in a sphere [cf. Euclid XIII.15]

How are we to construct a cube [מעקב] about which a known sphere revolves, so that the sphere contains it? We demonstrate that the square on the diameter of the sphere is three times the square on the side of the cube.

We divide the diameter of the known sphere, אב… and let [ג]אב be three times the square [on the side]. We take a triangle with equal sides… and erect a perpendicular… דל [?], and we join אל to בד [?], so that the square on [ת]ה [?] equals the square on בד, and three times the [side of the] cube is זל [?]. We take a figure with equal sides… and its side is סת, and הת [?]; and the matter is seen, for הת ,כה are as בד ,בד [?], and סת is as אב [?]; and we return, drawing perpendiculars within it, the sides raised upon סת. And they pass over ה, over סת [?].

From this it follows that the remaining figure [is such that] the sphere revolves about the cube. And afterward we demonstrate that the square on חת is three times the square on [ם] [?], and its manner is as in figure [?] of the First Book.

Diagram. A cube drawn in oblique perspective (a rectangular box), with a face-diagonal drawn across it and further internal lines joining opposite corners. Letters stand at the corners.

- Lower-left corner: נ
- Upper-right corner: ה [?]
- Interior points on the diagonal: ם … ם [?]
- Remaining corners: [?]

How to construct a solid of eight triangular faces (octahedron) inscribed in a sphere [cf. Euclid XIII.14]

[The enunciation and opening of the construction of the eight-faced solid fall at the foot of this folio side and across the seam into the next; the ink there is faint and only partly legible.]

and its manner is as in figure [?] of the First Book. And afterward we demonstrate that the square equal to אב is double the square on נה — since the square on הל is double the square on נל, and the square on [ם] [?] is four times the square on [ם] [?] — therefore the square on [ם] [?] is double the square on נה.

Diagram. A pyramid seen in projection: an apex at the top with lines running down to the corners and to the mid-point of the base, and internal lines crossing within the figure (the octahedron drawn as opposed pyramids).

- Apex: [?]
- Base, right corner: ב [?]
- Base, left corner: ג [?]
- Interior point: [?]

How to construct a figure of twenty triangular faces (icosahedron) inscribed in a sphere [cf. Euclid XIII.16]

How are we to construct a figure having twenty triangular faces that surrounds a known sphere? We take [a circle equal to] the diameter of the sphere, as we did above, and we set… four… drawn from בג [?], and let it be [equal]… We divide [the line] into extreme and mean ratio and erect a perpendicular…, a pentagon [מחומש]… and the remaining triangles, whose feet are קד, סת [?], and their bases… the decagon לג [?], are — upon the first [construction] — equilateral. And they are the triangles קמד, רנ[?], שנת[?], רלת[?]; and the center of the circle is כן; and we draw a perpendicular כך equal to half the diameter, so that each of the sides of the hexagon [המשושה] is joined to כך.

These sides are בד, גם, צך, כך; and we draw גל, דל, טל, קל, תל [?], so that כך is the side of the [icosahedron], while in the eighth figure it is the side of the pentagon. Likewise קן: therefore קן is equal to the side of the equilateral triangle, and so too the remaining ones, ריס [?], whose vertices are at the point פ.

And likewise it is shown that הך is the side of the pentagon, and that הך is equal to [the side of] the equilateral triangle, and so too the remaining ones, whose

vertices are at ג. We have therefore constructed upon the surface [of the sphere] twenty triangular faces surrounding it with equal sides.

And we demonstrate that the smaller sphere encloses it, in that its surface is divided in mean ratio [extreme-and-mean ratio]; and you have the arcs upon it [?], as in figure [?] and in figure [ג]ל [?] of the Treatise… אלגד [?].

Diagram. A five-pointed star (pentagram) inscribed within a regular pentagon, with an inner circle and, near the center, a small wedge of three parallel lines forming a right-triangle inset. Small letters stand at the five outer points.

- Five outer vertices of the pentagon/star: [?] (all five)
- Inner right-triangle inset: [?]

Diagram. A tall solid figure, pointed at top and bottom, with a many-sided middle band crossed by long diagonal (X) lines — the icosahedron drawn in perspective as a pentagonal antiprism capped by two pyramids. Letters stand at the apexes and around the band.

- Top apex: ד [?]
- Upper band, right: ה [?]
- Middle: ז [?]
- Lower band, right: ב [?]
- Bottom apex: ג [?]

[The demonstration of the icosahedron closes at the foot of this folio side; the dodecahedron (twelve pentagonal faces) and the comparison of the five regular solids follow.]

[Foot of the second folio side, outer corner: modern pencil foliation "132."]

[Continuation of the geometry (Euclid, *Elements* Book XIII), running on as continuous prose with no display rubrics. The individual propositions are introduced only by the in-line enunciation formula "כיצד נעשה…" ("How are we to construct…"), each marked with a small leading stroke. The prior folio side broke off inside the construction of the icosahedron (twenty triangular faces); this folio side completes it, then treats the dodecahedron and the comparison of the five regular solids.]

[End of the construction of the icosahedron, cf. Euclid XIII.16.] Let the circle that is drawn upon אב revolve, the figure being fixed upon כ and עב, until it returns to its starting place; for it passes over the [given] points, and the remainder is squared. We bisect כך at אם [?]; and in the second figure drawn in this Treatise,

let [the line] be five times… מו and בג, the white [region] being squared. Thus the line קו is five times [?]… מו and בג פך [?]… and we have shown the circle equal to the white square אב, and it is the diameter of the sphere, equal to גן [?]. We have therefore constructed twenty triangular faces surrounding the known sphere.

How to construct a figure of twelve equilateral-pentagonal faces (dodecahedron) surrounded by a known sphere [cf. Euclid XIII.17]

How are we to construct a figure whose faces are the areas of twelve equilateral pentagons, surrounded by a known sphere? It is known — since the surface of the cube that the sphere surrounds is known, [namely] אב [?] — [that we may build upon it]. We bisect its [several] sides at the points מנע [?], and we mark the points as they appear in the figure. We divide נס [?] at the points פצ [?] into [equal] parts, and the parts we divide in extreme and mean ratio, and there remain the parts טס ,[?] פך [?]. We erect two perpendiculars, each of them equal to פך [?], and we raise the perpendicular אך [?] equal to עש [?], and we draw a chord. Likewise אך and קן [?]; and in the fourth figure of this Treatise the two squares will be [as follows]: [the square on] פב [?] is three times the square on… בג פך [?]. And one may reason it out from the first [construction]: the [square on the] pentagon's [side] is three times [the square]… and the square on the line קו [?] equal to פך [?].

[The construction continues, dividing the edges and raising perpendiculars to the surface:] and their halves being divided in extreme and mean ratio upon the points of division, so that the parts fall as shown in the figure. Each part stands perpendicular, as כמו פך [?] and [line] נגע [?]; and the chord being drawn, it is known that the [pentagonal] faces are equilateral. The line קו [?] is thus equal to the pentagon's side, and the sphere already surrounds the [figure]. And in the fourth figure of this Treatise it was shown that when a line is divided in extreme and mean ratio, and to its greater segment half of the whole is added, the square upon it is five times the square upon half of the whole. And when this is so, in the fourth figure of this Treatise: we divide [the line] in mean ratio, the greater segments being the sides.

Diagram. A long horizontal rectangle divided by vertical rules into five panels and by a horizontal median line into two registers. In the left two panels a dense web of diagonal lines forms the net of the pentagonal-faced solid (the dodecahedron construction), with several chords converging on interior points. Single letters stand at the corners, apexes, and the principal intersections of the web. Most are too small and abraded to read individually.

- Left-web apex (upper): ד [?]
- Second apex (upper, toward center): ל [?]
- Interior convergence point (left register): ב [?]
- Lower-left web points: ג [?], ו [?]
- Right upper corner of the frame: פ [?]

How the five regular solids compare when inscribed in one sphere [cf. Euclid XIII.18]

We show, as in the first [construction], that [the squares] are three times מעו [?] and בג פב [?]; and the square on half the diameter of the sphere is likewise three times פעו [?], which is half of… And the white [square] of the cube — the "white" [region] in its figure of this Treatise — [is such that] פך [?] equals half the diameter of the sphere; and the point כן is the center of the sphere. And the point… lies upon the surface of the white [region]; a sphere already surrounds it. Since [we are dealing] with the [solid of] seven [?]… we construct the areas of the pentagons.

We now construct, for the remaining sides, the five [edges] of the [solids] that the sphere surrounds, and thus we find them. What remains to be shown is that, in their [comparison], the side of the tetrahedron (the four-faced solid) is the longest of them; its area [?]… The side [of the tetrahedron] is longer than the side of the octahedron (the eight-faced solid); the [side of the] cube is longer than the side of the icosahedron (the twenty-faced solid); and the side of the icosahedron is longer than the side of the dodecahedron (the twelve-faced solid).

We make the diameter of the sphere אב and divide it into [parts], so that [one part] be as the white גב, and its whole distance as the side אב [?]. We erect the perpendicular גד and draw the chord דב; and the center of the sphere is ה. We raise the perpendicular הן [?] and draw [a line] as the white שן [?]… The white [regions] אנג [?], אדב [?] will be [equal]. [We show that] אב to אזד [?] is as the white [square]… the diameter… the white [region]… of the cube… as the white square: the square made from it, to the square [made] from the other, is equal, the white [region]… אזב [?] to the [line] אזן [?] being as the square… to the square אזב [?]. The white [square on] אב is one-and-a-half times the [square on the] side; the white square on אזב [?] is one-and-a-half times the perpendicular-and-square אוד [?].

And we show also, from this Treatise, that אזד [?] is the side of the tetrahedron (the four-faced solid), [and] its area… And likewise it is shown that the square on אזב [?] is three times the square on בג. And we show from this Treatise that בד is

the side of the cube; and likewise גב [?] is the side of the octahedron (the eight-faced solid). The matter is seen [directly]: for the chord אזד [?] — which is the side of the tetrahedron — is longer than זב [?], which is the side of the octahedron; and the chord גב [?] is longer than the chord בד, which is the side of the cube.

[Here the Euclid epitome closes, marked by a double sof-pasuk (׃׃). The remaining lower half of the folio side is blank parchment: **no end-of-Euclid colophon is inscribed, and no new astronomical treatise or section heading begins here — the next section opens on the following folio.**]

Diagram. A semicircle standing on its diameter (the base line), with several perpendiculars raised from division-points of the diameter up to the arc, and chords drawn from the left endpoint of the diameter to points on the arc — the figure for comparing the edges of the five solids inscribed in one sphere. One line rises from the diameter beyond the arc at the right (the perpendicular עמוד). Single letters stand at the endpoints of the diameter, at the feet of the perpendiculars, and on the arc.

- Arc, upper left: ו ,[?] ז [?]
- Arc, toward apex: ה [?]
- Point where the tall right-hand perpendicular meets the construction: ד [?]
- Base line (diameter), points left-to-right: ג ,[?] ז ,[?] ה ,[?] ב [?]
- Right endpoint of the diameter: ד [?]

[Foot of the folio side, outer corner: modern pencil foliation "133."]

[The geometric proof comparing the edges of the five regular solids inscribed in one sphere continues from the previous leaf and reaches its conclusion.]

And afterward we erect the perpendicular אג until אג equals אב, and we erect the perpendicular [?] [second perpendicular illegible]. The larger [triangle] is similar to the smaller triangle דהב [?]; and when the ratio of the sides holds in it, and you convert the ratio [convertendo], the ratio of side to side is as the ratio of square to square. We proceed accordingly: [the square on] לבה [?] is five times the square [on הן?]. And since אב was [equal to] [?], [the square on] נב [?] is three times [the square on] הן; therefore the square on [?] is nine times the square on הן, and the square [on הן] was already five times the square on לה [?]. The [line drawn] from הן is smaller than [?] as לה [?].

We erect the perpendicular אג and [draw] מג [?], and the matter is evident: since אב [is as] בה, and [as] the square on לבה, for the square on לבה is five times the square [on the side]. And therefore לבה is [?] as half the diameter of the circle of

the icosahedron (the twenty-faced solid). And since אג [equals] the [half-]diameter of the sphere, which equals half the diameter of the circle of the [dodecahedron — "thirteen" (?)] [numeral: ?], [there stand?] the two sides [?] of the decagon [מעושר]; and it appears that each one of [them?] [...].

[In] the figure [?] it will be [the side of] a pentagon [מחומש], and it equals the side of the icosahedron; and it appears from the comparison that it is smaller than בה [?], which is the side of the cube [מעוקב]. And then we divide [it] in mean and extreme ratio [באמצע ושתי קצוות], with its greater segment [being] [?]; and when the side of the cube is divided in mean and extreme ratio, its greater segment is [the side of] the dodecahedron (the twelve-faced solid) [?].

For אלב [?] is greater than בג [?], and greater than it is אמן [?]; and if אמן [?] be divided in mean and extreme ratio, its greater segment [is] equal to אמן [?]; therefore [the line] מזל [?] is greater than בג, and אב [?] is greater than בג. Therefore the line בג — which is the side of the dodecahedron (the twelve-faced solid) — is greater than the line בה, which is the side of the octahedron (the eight-faced solid). [חזק — "Be strong."]

[The geometry (Euclid) portion of the science half closes here with a scribal colophon, set on two centered lines:]

Blessed is the Merciful One who has helped us.

Blessed is [the Name — divine-name abbreviation] forever, amen and amen.

[New leaf. The author's autobiographical note opens with a display rubric.]

Said the author: [Interlinear, small script above the line: הפילוסוף — "the philosopher."] At the time of the questions that the sage — the philosopher of Caesar, the great king, the Emperor (*ha-Anpirador*) Frederick [פדריק], may his glory be exalted — put [to me], concerning matters [?] in the land, within the borders of [Jerusalem?] [?] which is in [Sepharad?] [?]:

The first of them is: How do we inscribe upon a given sphere each one of the five solids [עצמים]? And how do we inscribe within each of them the given sphere, and make each of them [distinct — במותרת?] [?]?

And I answered him then, at that time — we being of the age of eighteen years — in this text. As [I said] now, "And who can declare to me…" [cf. Tehillim 106:2]: when I was [still?] in the land of my birth, in the community of the city of Toledo [טולטולה], before my teacher and master [my father?] [?]; for [?] because the matter was becoming muddled, I went down to the land of Tuscany [טושקאנה],

and I translated it there — [from Arabic?] [?] into the Hebrew language — together with this book that I composed while I was there. And my whole intent was that it tend toward the good; and blessed be [the Name] who saves us [?].

And this is the text of the reply:

How do we make each of the five figures [שורות; read צורות, "figures"] upon the given sphere? We first make each of the five figures within the sphere, as Euclid demonstrated. And then we bring the center of the sphere [into relation] by straight lines, and we draw those lines out upon it [?] [so that they are] enclosing [?]. And then we bring the center of the sphere to the center of one plane [face] of the figures.

How? In the figure of the four-faced solid [tetrahedron], the eight-faced [octahedron], and the twenty-faced [icosahedron], we bring the line to the center of one of the triangles surrounding [it] within the sphere. And likewise at the center of the [square face] of the figure of the cube [מעוקב] [?]; and likewise at the center of the pentagon [מחומש], one of the faces of the twelve-faced figure [dodecahedron]. And we mark [?] the center of the plane — that is to say [ר"ל], the center of the circle that surrounds it.

And the matter is evident, for the center of the plane is the point at which the equal lines issuing from the angles of the plane meet. And we bring the center of the plane to the center of the sphere. And the matter is evident, for that connecting line stands perpendicular to the plane at right angles, as we shall explain after this — with the help of Shaddai (the Almighty).

[Foot of the leaf, outer corner: modern pencil foliation "134."]

[The demonstration of the reply continues from the preceding leaf. Folio 134v.]

And we draw a line out to the surface of the sphere, and at its top we erect [?] a perpendicular outside the sphere, tangent to it. We first show that the angles enclosed [?] by the two lines drawn from the center of the sphere — the one reaching to a vertex [angle], and the other reaching to the center of the face of the figure — that this [latter angle] is less than a right angle. The reason for this is as follows: this line, which we drew perpendicular to the line running between the center of the sphere and the vertex-angle, of necessity issues out; therefore [?] set it outside the sphere.

And we divide off, from the lines drawn between the center of the sphere and the vertex of the figure, equal lines; and we lay between the ends of the lines straight lines. We say that by this operation you will be taught the making of the figures

that they wished [to inscribe] upon the given sphere. And we shall illustrate it with letters.

Let there first be a four-faced figure [tetrahedron] made inside the sphere, as Euclid demonstrated. Let the center of the sphere be **ג**, and let the vertices of the figure be [labels: חב, גל ?] [?], and the centers of the triangles [labels: ?] [?]; and let there be tangent [?] [the lines labeled ?] [?]. And we draw upon it a straight line without limit, [line ?] [?], and we carry it along straight until it meets the surface of the sphere at [point] **מ** [?].

We first show that angle [**גב** ?] [?] is a right angle. For when we cut, in the great circle, the line that is the diameter of the circle surrounding the triangle [**חזב** ?] [?], and we draw from its center — and upon this line [we draw] the line [**נל** ?] [?] and bisect it into two halves at point **ד** [?], which is the center of the triangle — therefore it bisects it at right angles; therefore the angle [**נב** ?] [?] is a right angle. And that is what we wished.

And since this is shown, we draw from point **מ** [?] a line [**יצ** ?] [?] perpendicular to [**מל** ?] [?]. And since it has been shown that angle [**נב** ?] [?] is a right angle, therefore the angle [**נב** ?] [?] will be less than a right angle. Therefore the lines [**נל**, **חל** ?] [?] necessarily meet; and we extend them until they meet at point **ג** [?].

And then we reckon, from the line [**נצב** ?] [?], all those drawn without limit — [and they are] equal lines to them: [labels: **נל**, **נצ**, **נב**, **נל** ?] [?]. And then we set tangent [?] [the lines labeled: **עב**, **נל**, **על** ?] [?]. And we show that [?] [these] are equal, as [?] the angles [labels: **חצ**, **חנצ**, **חל**, **עב**, **על** ?] [?] are equal, and the line[s ?] [labels: **עב**, **על** ?] [?] are equal. Therefore the four triangles are equal.

And then we show that each of the faces of the figure made outside the sphere is similar [?] to each of the faces inside the sphere. We shall illustrate it first and say: the face of triangle [**עג** ?] [?] is similar [?] to the face of triangle [**חטב** ?] [?]; because triangle [**עג** ?] [?] and [triangle **חט** ?] are [?] [proportional] in one ratio — and that is [**חט** ?] [?] — for the ratio of [**עט** ?] to [**על** ?] [?] is as the ratio of [**עט** ?] to [**על** ?] [?]. Therefore [triangle **חט** ?] [?] [is similar to triangle **טעד** ?].

And we shall show that line [**חב** ?] [?] is opposite [**עב** ?] [?] [and equal to it ?]; and by proposition [numeral: 11 / יא?] [?] of the Book of the Elements of Euclid, triangle [**חט** ?] [?] equals [triangle **טעד** ?] [?]; and that is what we wished.

And further we show that the three remaining triangles are [likewise] inscribable in this sphere. And, as has been shown, the tangent connection [?] between the centers of all the triangles and the center of the sphere — [they are] equal to them

[labels: **מלב, כזד** ?] [?]; for [?] the line [that divides] the face[s] of the triangles into two halves, and [the lines] set tangent [?], meet at the center of the sphere. And the lines drawn from the center of the sphere to the ends of the lines are equal, as has been shown.

[The proof continues:] [labels: line **לב, כז, כב** ?] [?] whose points upon its faces [?] are [**ה** ?] [?] — we say that these are equal. The proof: because line [**סב** ?] [?] equals line [**סב** ?] [?]; and line [**סט** ?] [?] [equals] line [**טפ** ?] [?]; and the line [**טה** ?] [?] issuing from the vertex of the figure to the center of the sphere is equal; and angle [**נס** ?] [?] equals angle [**נכ** ?] [?], because triangle [**ענסב** ?] [?] [is such]. Therefore [**ה** ?] [?] equals [**כזד** ?] [?] [and ?] [**כת** ?] [?], like [**גל** ?] [?]. And that is what we wished.

And in all of them, by this, it is shown that triangle [**עכז** ?] [?] equals triangle [**שט** ?] [?]; and likewise [?], so [**קל** ?] [?] equals [**מל** ?] [?]; and from these, [the line] that issues from the center of the sphere to its circumference [is equal]; and line [**ק** ?] [?] issues from the center of the sphere. Therefore [it reaches ?] its circumference; and therefore triangle [**עכז** ?] [?] is made [inscribable] in the sphere. And so it is shown of each of [?] the triangles.

And in all of them [?], the four figures that we illustrated — as we illustrated in this one — [it is shown] that each of its faces is inscribable in the sphere. And likewise it is shown that each of the faces of the [pointed / edged ?] figure, which is similar [?] to a corresponding [face ?] of the inner figure, [is like] the figure made within the sphere.

[Foot of the leaf, outer corner: modern pencil foliation "135."]

Since the plane is tangent to the sphere, the line joining [?] the sphere [i.e. its center] and the point of contact — which is the center of the face — is a perpendicular standing upon the plane, as was shown in the first treatise of [Theodosius (Spherics), Book I] [?]. Therefore [?] [the demonstration proceeds] with the lines that are drawn: because they meet at right angles and are mutually equal as perpendiculars, it is shown that triangle [**עלב** ?] corresponds [is equal] [?] to triangle [**חטול** ?]; and in the same way the rest of the triangles are shown, and the remaining faces of the five figures [?].

And [we shall show] how we construct the sphere enclosed within the figure [built] of the five figures [?], as we shall relate with the help of Shaddai, may He be blessed: We make [a line] [?] equal to the derived figure [?]. And after that we erect upon the center of its faces perpendiculars, [directed] into the figure, and extend them straight until they meet at a single point; and after that we extend

one of those lines straight until the line [equals / doubles ?] the [first] one. And we say that the length of the line is the diameter of the sphere.

But now [note ?] [that] the perpendicular [?] equals the perpendicular [?]: what is explained in the book of Euclid is only [the construction of ?] the surfaces, whereas the making of the rest of the operations [?] is as we shall relate. We find a line equal to one of the lines of the figure, and then we set up a perpendicular [נס] upon the head of the drawn lines, [making] angles equal [?] to it; and thus we proceed until the figure is completed. And when we have made the figure, we draw from the center of its faces lines; we set upon it [lines] that are drawn within the figure, and we continue them straight until they meet. And the matter is evident: that they all [?] meet at a single point within the figure, and that point is the center of the sphere.

And we shall first explain that these perpendiculars are parallel to those perpendiculars in the one figure — [the perpendiculars] drawn from the center of the sphere to its circumference. Take, for example, the four-faced figure [the tetrahedron]: let the center of triangle [**אבג** ?] [give a perpendicular] now made equal to the perpendicular [?] — but [taken] from the one figure — and from perpendicular [**בג** ?] to perpendicular [**בד** ?] of the other. We bisect [**בג** ?] into two halves at [**ה** ?], and erect a perpendicular [?] [from **ה** ?] at point [**ט** ?]. And the matter is evident: because the second figure was equal to the first figure, and its faces [correspond] to its faces [of the other] [?], [so likewise for] the figure.

[Foot of f. 136r: the demonstration continues onto the verso.]

[f. 136v — faded gray ink, substantially degraded; the readings below are the securely legible anchors, with the connective text flagged. Marked as a]

The length, according to this line [?] … [?]. And if [?] … equal … therefore this circumference-line [?] … [?]. [We take] each [face / part ?] equal [?] to [?] from the first [?]; and from the one segment [?] it is shown [?] that [it corresponds] to the one segment [?]. And [we draw ?] the lines from point [?] … within [?] … [?].

[The construction proceeds:] … the sphere [?] … [each] equal to [?] … from the one segment [?] to the segments [?] … and the drawn lines from the center [?] … [?].

the sphere [?] … a point [?] … a semicircle [?] … [?]. … one of the [lines ?] is the diameter of the sphere [?] … [?].

And with this is completed [the demonstration concerning] the sphere for each of the [five ?] figures [?] … etc. [וגו'] — [and for this] we give praise to God, may He be blessed [שבח לאל יתּ'].

[Foot of f. 136v, outer corner: modern pencil foliation "136."]

Recto — f. 137r

This is[1] [זה הוא] what I have arrived at [?] concerning [?] the philosopher [הפלוסוף]. We take our foundation [?] upon the **tables of the degrees** [לוחות המעלות] in the sphere [כדור], and the motion [תנועה] that runs upon them; [these the ancient] philosopher [set down], in Arabic [ערבי], and we have translated it [והעתקנוהו] [?] [from the] Arabic [ערבי] [?].

According to[2] [לפי] what has already been [set forth ?] upon the tables of the degrees [לוחות המעלות], we find [?] — and there come out [ותצא] tables that are fitting [ראויין] according to their [proper measure ?]; and the matter [?] is this: that which rises [שיעלה] from the ecliptic [נטבל המזלות] [?] [?] is smaller [קטן] [?] than that which rises [שיעלה] in the sphere [כדור]; and when it is equal [?], we ask, for whichever arc [אי זו קשת] [it may be], to whichever part [אי זו חלק] [it corresponds] [?]. And [from the head of] Aries [טלה] [?] up to [the degree ?] of the ecliptic [מנטבל] [?] [transliteration unresolved: אופטריש קבטנטל[?]] [?].

And the degrees [והמעלות] [?] [?] the points [נקודות] [?], the breadth [רחב] [?]; and in the sphere [כדור] a pole [?] [?], and the degrees [ומעלות] [?] are smaller [קטן]. And in the sphere [ובכדור] [?] [?] the degrees [?], etc. [וכו']; [?] that which rises [?] [?].

[?] its point [נקודתו ?] [?] the pole [?], and there shall not [ולא] be [?] [?]; and [?] its point [נקודתו ?] the pole [?] [?]. [?] and the excess [היתרון] [?] the circuit [המחזור ?] [?].

So that the ecliptic [נטבל] [meets ?] the equator [המישור] at the horizons [אופקים], as [?] [?] [?]; and the excess [היתרון] [?] [?] its measure [שעור], [?] the degrees [המעלות] [?] arc [קשת] [?] — [and this is] **the ascension of the horizon** [שעלת האופק].

[Recto text occupies the upper portion of the leaf; the lower portion below this line is blank parchment.]

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[1] `[Display opener (enlarged): זה הוא]` — "This is," enlarged word opening the recto's discussion; not a decorated section rubric.

[2] `[Display opener (enlarged): לפי]` — "According to," enlarged word opening a fresh sub-argument on the same recto.

Verso — f. 137v

And I say[3] [ואומר]: half the arc [חצי קשת] of the ecliptic [נטבל המזלות] rests upon the pole [סדן] [?]; and the line [והקו] of the ecliptic [?] the degrees [המעלות]. And [?] its point [נקודתה ?] divides [מחלק] the part [החלק] that is from the ecliptic [נטבל המזלות] upon [?], and the part appears [וירא החלק] [?]. And in order to know [?] the [reckoning ?] of degrees [מעלות]: the length of the part that is on the right sphere [החלק שבכדור הנצב], [taken] perpendicular [נצב] together with the [count of] the degrees [המעלות] [?] the place [מקום] [?]. We make [עושה], from the pole [הסדן] up to [?] the part, an arc equal [קשת שוה] to [?] [transliteration unresolved: מסולסי[?]]; a degree [מעלה] [?] equal [שוית ?] [?].

[?] right angles [נצבות] [?] equal [?] [?]; and the ratio [יחס] of perpendicular [נצב] [?] to perpendicular [?] is a known ratio [יחס… ידוע]. For whoever [seeks ?] the quarter [רבע] that rises [שעולה] — and it is known [ידוע] [?] that [?] points [נקודות] [?] from the ecliptic [מנטבל המזלות], the degrees [המעלות] that lie upon the ecliptic [?]; and it is known [ידוע] that it is the third [השלישי ?]; the lesser breadth [רחב הקטן ?] [?]. And to the part [ולחלק] [?] four [?] magnitudes [שיעורין] [?]; the ratio [יחס] of the one [?] [?], for [?] the third [השלישי]; the known [הידוע] [?].

Because [?] the breadth of the east [רחב המזרח ?] is known [ידוע ?], [?] that the excess [היתרון] [?] between the degrees of the equator [מעלות המישור] and the degrees of the [?] [הקשר ?]; and the degree [ומעלת] [?] three [שלש ?]. And the breadth [רחב] [?] is known [ידוע]; and by dividing [?] into the breadth of the place [רחב המקום] [?] and the breadth [ורחב] [?], and we divide it [ונחלקהו] upon the ecliptic [נטבל] [?] — there will rise [יעלה] [?] [?]; and we divide its arc [ומחלק קשתו], and [line] בג is known [בג ידוע]; and we make [ועושה] from the arc [קשת] [?] equal [שוה]. And this is the degrees of its point [מעלות נקודתה] on the equator [המישור], and [ד ?] there remains [ישאר] [?]; for it is known [ידוע], and these are the degrees of its point [מעלות נקודתה] [?] ten [בעשר ?] — **and this is what we intended.**[4]

[Below the closing line a faint short mark near the lower edge appears to be bleed-through from the facing leaf and is not transcribed. Modern pencil foliation "137" at the lower outer corner of the verso.]

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[3] `[Display opener (enlarged): ואומר]` — "And I say," enlarged word opening the verso procedure.

[4] `[Closing formula: וזה מה שרצינו]` — "and this is what we intended," a standard closing tag.

[Conclusion of the reply to the Emperor Frederick II]

Furthermore, [the philosopher] raised a further objection, and I answered him [?] in this wording: [Illegible: ~2 words] of the good things [?] [Illegible: ~4 words]. And I replied concerning [Illegible: ~3 words] that are not fit to be observed [?] [Illegible: ~2 words] — a philosopher like yourself [?]. First: as for what I said, [Illegible: ~3 words].

[The reply then turns to a geometric demonstration.] From this it follows [?] that, since [the triangle] has a shared [common] [?] [angle/side], and since their angles are right angles [?], it is established that angle 5 [ה] [?] equals angle 9 [ט] [?].

[Second hand / rubricated word:] **And he said further** [?]:

It has been shown that when two angles of one triangle equal two angles of the other triangle, then the angle remaining in the one equals the angle remaining in the other — for this was demonstrated only in the case of three straight lines [i.e., a plane rectilinear triangle]. And further: when one triangle is set up [?] larger than the other, as it is in the figure — for if it were possible [Illegible: ~2 words] — [then], from what has been set up [?] as a line, in the one triangle [?], it would necessarily follow, when the angles of the one triangle equal the angles of the [other] triangle, each corresponding to its like, that they would be two equal triangles, as was shown in the figure [?]: [this is] a theorem of the book of Menelaus [מילאוש = Menelaus, *Sphaerica*] [?]. Therefore, when [Illegible: ~2 words], the contradiction [?] and the difficulty [are resolved] thus. So [Illegible: ~1 word]: if in the triangles [?] the lines [?] were not [Illegible: ~1 word], they would not be right [?] [Illegible: ~2 words]. And if they were equal [Illegible: ~2 words], then [it is as I said] [?].

[Illegible: ~2 words] the philosopher [Illegible: ~4 words] there is benefit [?] in this science [?] [Illegible: ~3 words] that is done under the sun [allusion to Kohelet 1:9]. [Illegible: ~3 words]

The author says: And when these matters were set before the Emperor, he rejoiced greatly at the replies; and there continued [?] between us an exchange of questions [?] and answers — but there is no need to expand upon this any further in this book.

And he said: Indeed, just as our teacher Solomon said [Illegible: ~2 words] — and the Emperor, understanding [is shown] in his deeds, together with his ministers, his sages, his scribes, his elders [?], [Illegible: ~2 words], his gatekeepers [?], and the splendor [?] of his table and the seating of his servants [cf. 1 Kings 10:5, the

Queen of Sheba beholding Solomon's court] and the provisioning [?] [Illegible: ~1 word]. And [Illegible: ~2 words] from the outset it shall not stumble [?], and he shall be blessed in all this [?]. [Illegible: ~2 words] [Illegible: ~3 words] forever.

[Ornament: a decorative paragraph-terminal flourish.]

The First Treatise of the Book *Almagest* — Gate One

Ptolemy [תלמי] **expounded:**

That the heavens[?] are spherical, and that their motion too is spherical, is proved on two grounds: the one empirical (sensory), the other rational (intellectual).

The empirical proof is what one observes of the stars — that they move continually from east to west about poles[?] concealed from one another[?], [turning] within a sphere, as is apparent to us with respect to the pole. The stars begin [to rise][?] and are borne upward little by little until [they reach the highest point of their course][?]; and afterward they descend in a single even course until at last they set. Once they have set, they remain hidden and out of sight for a short time; and afterward they rise once more[?]. [Thus they turn in a circle.][?]

Those [stars] that are near the pole are seen always[?] — [as in the region of] the north [Margin: צפון "north"]; the higher a star stands, [the longer it remains visible][?]. The nearer a star lies to the pole, the smaller the circle in which it revolves; and the farther it lies [from the pole], the larger the circle in which it revolves. This has already been explained[?]; and [it follows][?] that of the stars, the one that is [nearer the pole] revolves in a small[?] circumference[?], while the one that is farther off revolves in a large[?] circumference[?]. [Margin: קטנות "small (pl.)"]

According to the measure of a star's distance [from the pole] and its proximity [to it], so is the size of its circle; and the one that is nearest[?] [describes] the smallest[?] circumference. [Several clauses here — on the relation of a star's remoteness to the size of its circle and to the point at the middle of its arc — remain only partly legible: see QA.]

Thus it is established[?] that the [outermost heaven][?] which encompasses [all], whose motion is spherical, [must possess] a spherical form; for a motion cannot be spherical save in a body of spherical form. These demonstrations are established as the [ground][?] of the [rational] demonstration[?]. And [the

ancients][?] said as much, adducing [full][?] demonstrations[?] [to this effect]; and the sum[?] of their exposition is plain[?] — namely, that were its form not spherical, [its motion could not be spherical].[?]

[On the apparent size of the stars:] A star that is small[?] by nature... appears[?] sometimes larger and sometimes smaller[?]. It is agreed[?] that when [a star] stands at the crown of the head — the zenith — it appears larger[?], and the more distant it is from your zenith the smaller[?] it appears. This the sage **R. David ibn Naḥmias** [ר' דוד אבן נחמיאש] has already explained.

But do not let it mislead you that [the stars] appear larger when they are [low] upon the horizon than when they are far from it. For their light is [dispersed][?] by nature through the vapor[?] that turns about in the air and interposes itself between the sight of the eye and them, so that they appear [enlarged] — just as objects[?] seen through smoke appear larger; and the deeper[?] [in the vapor] one is, the larger it appears. This the sage **Ibn al-Haytham** [בן אל היתם / Alhazen] has already set out at the end of the *Book of Optics* [ספר המבטים = *al-Manāẓir*]: [the enlargement] is not on account of their [real] nearness, but [for the reason given] — just as was explained[?] in the science of nature.

[continuation of Gate One — that the heavens are spherical]

for the motion of the heavens is lighter and swifter than all other motions, and the spherical body moves more swiftly than any of the bodies bounded by simple surfaces. Reason therefore rightly draws its conclusion. The first argument runs thus: the heavens move more swiftly than all bodies; and whatever is swift in its motion is spherical; therefore the heavens are spherical.

There is a further proof, and it requires a premise — that the body of the heavens be larger than all [other] figures. Since the sphere is the largest of the simple figures, and this has already been shown, it follows that the form of the heavens must fittingly be spherical.

The sage Rabbi David ibn Naḥmias, may his rest be in Eden [נ״ע], explained that, among figures whose perimeter is equal, the one that has more angles is the larger. He further showed that the most excellent figure [i.e. the circle] is more capacious than all figures — even [more than] a pentagon that encloses [?]... the most excellent figure holds more [?]...; for how could a straight line be equal to [a curved one?] [?]...

[Red ink header, decorated:] **Gate Two: That the Earth, in All Its Parts, Is Spherical.**

He explains: we know this by sense-perception, for the rising of the light and of the stars — which possess light — does not occur at one and the same time in all places; rather it reaches the people of the eastern land before the people of the western land. We know this from what we observe at the eclipses of the moon in particular, because in them there is no variation of appearance such as there is in eclipses of the sun. For we see one and the same eclipse of the moon: the people of the east record it at [six?] hours of the night, while the people of the far west record it at the beginning of the night — and this same eclipse occurred when the sun was at the head of the constellation Aries.

A sign [?] that the earth is spherical: [the light] first [strikes] the edge [?] of the illumination in its coming, and afterward you see the increase (interlinear: והחסרון — and the decrease) in what follows in order, part by part in a single gradation; and were [the earth flat] it would not appear so [?]. Reason therefore concludes as follows: the earth discloses the light from its several parts degree by degree, with variation; and whatever behaves so is a sphere; therefore the earth is spherical.

He adduced still other proofs, along these lines: the earth might, in principle, be concave and flat, or round with many angles, or triangular [?]; and if it is none of all these figures, it remains only that it be spherical. And just as the earth is spherical, so too the surface of the water is spherical — for those who ride the sea see [heights ahead] as though they were mountains: the high places rise up little by little, as though they were rising out of the sea, and as though they had earlier been submerged.

Now we shall answer for each one of these figures in turn. [The earth] is not concave, because [were it so] the rising and setting of the stars would fall first upon the people of the west (interlinear: הפך [?])... And it is not flat, because the stars do not stand at one and the same time over all the sides of the earth. From this same evidence it likewise follows that it is not a figure of many surfaces [a polyhedron], for [were it so] the same thing would befall one part of it as [would befall the whole] were it flat.

Were it flat, all who dwell upon its heights would always see all the stars, and none would ever be hidden from them except those that lie with the pole [הסדן] alone; while those who dwell in its lower reaches would always see only those that lie with the pole alone, and the remainder of the stars would be hidden from

them for all time. But in fact we see that the further we travel toward the north — in proportion as we press deeper into it — the more of the southern stars are hidden from us and the more of the northern stars appear to us. This becomes clear to us in proportion to what we traverse of the earth's [curved] sides — proof that it is spherical.

And should you say that its surfaces face east and west, it has already been shown, from the manner of the eclipse, that this is impossible. For it was said earlier that the eclipse necessarily proves that [the light] rises in the two directions, east and west, unequally — since we see that in a place lying to the east by about [numeral: ?] degrees, the sighting of the eclipse there is delayed by one hour; and were the distance thirty [30] degrees, it would be delayed by two hours; and so the delay grows greater in this same fashion. We therefore find that the time of the eclipse differs [from place to place].

[Conclusion of Gate Two — the earth's sphericity, inferred from the differing local times at which one and the same eclipse is observed toward east and west.]

in the places nearby. And it is known that [it moves] toward east and west; that is, this is recognized at the far east and the far west, since what is called "the difference of places" derives from the difference in the time of the eclipse [amounting to a certain interval — numeral: ?]. Thus its sphericity in itself is established — and this is what [we set out to show].

Gate Three — that the earth is at the center of the heavens

[Decorated display heading (p. 299): **שער שלישי כי הארץ באמצע השמים** — "Gate Three: that the earth is at the middle of the heavens."]

[Sub-rubric (p. 299), smaller script: "And in it he sets out, by way of demonstration, the refutation of [the opinion that the earth departs from the center]; first [he shows] … that it does not go out [from it]."]

The earth is equidistant from every point [of the encompassing sphere]: its distance is equal from each of the points, neither greater between east and west, nor inclining toward one of them. And even were it to lean toward one side — resting upon the center yet inclining toward one of the sides, without [wholly] going out from the center — [we say it is not so]; rather its distance is equal to each point, and likewise for the rest, just as [was said]. On every count the earth does not go out from the center; it does not depart from it, and its remove is equal from each of the sides. Were it otherwise, there would be no equality [between the two halves of the sphere] [?].

For the sense divides what lies above — the [region of the] air — from what lies below it; [only where the sphere stands upright is that division equal]. But in the places where [the earth's position] inclines, one of two things would follow: there would never be a full equality of daylight, except at the two birth-points of equality — the sign of Aries and [the sign of] Libra — for there the rising of the darkness is small, and [the horizon] does not cut its opposite into two [equal] halves, as was explained in the First Treatise [Book I], concerning the measure of daylight.

And since we find that the equinoxes always fall midway between the two [turning-points] [?], that is — the time from [one turning-point] [היסטך — transliterated technical term, reading uncertain] is very nearly equal to the time from [another]; and the time from the [summer] turning-point to winter, and from winter to autumn [?]. And we found in the Book of Ptolemy [**ספר תלמיוס** — the *Almagest*] that [the arc] from the [equinoctial] turning-point to the summer[-point] falls short by as much [as the arc] from [that point] to the winter[-point]. Hence the natural revolution coheres [only] if the [earth] is seen [to lie] at the center, at an equal distance from each point, inclining neither to east nor to west.

[Were the earth displaced,] no equality would be found at the mean hour; rather the [times of] equality would fall [displaced] against the meridian [?]. But the earth does not go out from the center; its distance is equal from each point, and it inclines neither to east nor to west. And should it occur to your mind that the earth inclines toward east and west, it would follow that neither the measure of the stars [?] nor the [equal] remove would be one and the same upon the horizon, morning and evening; and there would never be found the arc from the east to mid-heaven equal to the arc from mid-heaven to the west — and this contradicts what is observed.

And should you say that it lies upon the center but leaning toward one of the sides: then the horizon, in every clime, would not divide what belongs to the earth [what is below] from what lies above it in the heavens into two [equal] halves; rather it would divide them into unequal parts — sometimes equal — each of the arcs unequal in itself and unequal to its fellow. That is to say, the [horizon] would cut [the sphere] … [in a figure] having fifty parts, dividing the length of the revolution … an arc smaller than it. And the sage **R. David ibn Naḥmias** [ר' דוד אבן נחמיאש] has already elaborated on this at length.

Therefore the horizon divides the heavens into halves only in the place where the sphere stands upright [*sphaera recta*]; but in places other than it, what is above [the horizon] always grows smaller and what is beneath it grows larger, so that

the [two portions,] above and below, are never seen equal at any [place], but ever differing in their portions. And if one says that its place inclines toward one side [away from the center] — this is impossible, since we observe, upon [the horizon] … under the sign of Aries or Libra … one straight [line] … at its rising. For were its place other than the center, the line [of rising] at the moment of rising would not [meet the horizon] … in [equal] angles.

Hence, an *a fortiori* argument [**קל וחומר**]: if [the earth] did not merely lean but went out from the center and inclined toward one of the sides, then all the more [would the disparity follow in] whatever befalls it, and its place would be [in doubt] [?]. In sum: the earth inclines to no side; it is set at the center.

[Sephardic/Oriental semicursive, single hand (Sasson ben Menashe); black ink throughout; no figures on either page. Gate headings set in enlarged display script.]

[f. 141v — conclusion of Gate Three] … would be changing and shifting, and in this would lie the error and the deficiency in their [reckoned] times. And so the eclipses of the moon would not occur, at the time it stands opposite [the sun ?: … the luminaries …], in such a way that they would be less than half a circle. Yet we observe that they are always [symmetrical], at the moment [of opposition / full brightness] [?]. And this is a sign that it is because of the earth's blocking the light of the sun from reaching the moon [that the eclipse comes about]; and [thus the earth is at the center].

שער רביעי — Gate Four: That the earth is as a point relative to the fixed stars

[Heading, display script: שער רביעי כי הארץ כנקודה אצל הכוכבים הקיימין]

We do not mean "point" here in the sense the geometers [הגימטריים] intend — namely, that which has no part [i.e., is indivisible] — but only that it is exceedingly small; yet relative to the [size of the] sphere [?] it is such that no one of the fixed stars shows any change of appearance at all, unlike the rest, the planets [כוכבי לכת]. He therefore made the center of the earth and its surface,

relative to the sphere, as a single thing, on account of the great distance between them [?].

And a proof of this is that the magnitudes of the stars, and the distances between them, appear equal and alike in every place and at one and the same time — just as we have found [?: in their configurations] that they were toward the several regions themselves [?], at one time, and are not different, not even a little. But if the earth had a perceptible magnitude, it would necessarily follow that one would see, from the surface of the earth, the distance between two stars [?] greater than they appear from the center [?]. And this the sage R. David ibn Naḥmias [ר' דוד אבן נחמיש], may he rest in Eden [נ"ע], has already explained. And so [it is]: from the surface of the earth the distance between them is equal, whether they stand at the midst of the heavens [i.e., the zenith] or [elsewhere] — just as would be required, as if we were able to observe it from the center of the earth. Therefore its center and its surface are one and the same in relation to this sphere, and it has no perceptible magnitude.

And we found the rule of [?: … in this …]; and the center of the All [i.e., of the universe], which is called [?], is like the case of the center of the earth [?: …]. And consider [?: the matters that … in what they held concerning them …], for the small additions [made] to small things, as they would fittingly be. [The closing lines of this gate are degraded by a stain; the readings above are partial.]

[f. 142r]

[?: … concerning] the point-nature of the earth's center [נקודת … הארץ]; and it appears [from what ?: … is small …] — for the surrounding heavens [השמים המקיפין] [look the same, ?: in their appearance,] from every place, and they are those called [?], so that one may always reckon the sphere of the heavens whole in [all] its parts. And this would not be possible were the magnitude of the earth [גדל הארץ] perceptible relative to the heavens; for then it would necessarily follow that the horizon [האופק], in cutting the heavens, would divide them into parts that are not equal, and that what is above would be greater than what is below.

שער חמישי — Gate Five: That the earth has no motion of translation

[Heading, display script: שער חמישי כי הארץ אין לה תנועת העתקה]

This is made clear from the matters we mentioned earlier. For if it [the earth] were displaced from the center, those same things we spoke of would befall it: either its place would be outside the circuit [המחזור], or upon the circuit. [?: … and it would come to be one of … the pivot [הסדן ?] …; and further, that it must be … above …]. And its center — which is called [?] — is the earth. And Aristotle [ארסטו], together with [other] arguments and proofs that we shall not set out in this book, has already explained [that the earth has no such motion].

שער ששי — Gate Six: That the kinds of motion of the heavens are two

[Heading, display script: שער ששי כי מיני התנועות של שמים שתים]

The first is the motion of the uppermost sphere, which turns all the spheres along with it from east to west; and this is the diurnal [daily] motion. The second is a motion proper to each sphere, revolving [?: about …], particular [to each], and it is from west to east, contrary to the [first] motion. The uppermost revolving sphere carries all the spheres with it in their order [סדרם], [?: as they are ordered] upon the sphere of the zodiac [גלגל המזלות / the ecliptic]. And the seven spheres have, besides their [common] order, another [motion] upon them from west to east — a motion [?] particular to each sphere among them. And he said that the seven planets have a sphere [?: …] upon the sphere of the zodiac, upon which their revolution [סיבובן] takes place. And the sun alone, of [all] the planets, does not depart from the [ecliptic] circle; but the remaining six [depart from it] …

[Text continues on the following folio.]

[Margin, recto upper-left: [Margin: במאמרות] — a single keyword written outside the text column, apparently a subject-tab.]

The Sixth Gate, concluded — the two motions and the rising of the arcs

they incline according to the measures [?] … the sphere [turns?] in one way, just as one would wish. This diameter [ha-qoter], in other measures [?] … and so too the order of the diurnal motion, as was set down before. And the sphere upon which the day is marked off [?] rises from every degree [?] … And when we set out the motion, as [was shown] by the operation set down before, [it is] the sphere of the motion, and it is called the sphere of the degrees (galgal ha-ma'alot). And if a man draws a circle [?] that rises [?] … at the rising of each degree [?]. Then afterward he draws another, larger circle [?] … and then, upon [?], a smaller

circle [?] rises [?] … [?] and so a further arc rises [?] … so that a degree comes to stand upon a degree [?]; and likewise the arc [ha-qeshet] that rises [?] … and there is found, from the rising of the arc, that it is [?] the sphere [?]; and there is found, from the rising of the degree, that it is [?].

שער שביעי — The Seventh Gate: On Knowing the Measures of the Parts of the Degree

שער שביעי בידיעת שעורי חלקי המעלה

[Superscript above the display heading: יתריו [?]. Small keywords in the left margin beside the heading: [Margin: במעשה / [?] כמו שנוכל [?]] — verbatim marginal tabs; further identification requires further verification.]

Following what we have said: the whole degree (ha-ma'alah) is composed of parts [minutes], and each part is divided into sixty [seconds], upon an equal footing [?]. As for the parts of the diameter (ha-alakhson), there is no part among them equal to a part of the parts of the circle — that is, the diameter and the circumference are incommensurable. We therefore divide the semicircle **ABG** (אבג) and its diameter **ALD** (אלד), taking the diameter to stand at 102 (קב) parts [?], and we divide it [?]; and I say that [?] …

[The construction proceeds to the chord subtended by the side of the inscribed decagon and the side of the inscribed pentagon, worked in the sexagesimal parts of the degree just established, with reference to what was demonstrated "in the first treatise" (ba-ma'amar ha-rishon) and to Euclid's pentagon/decagon construction. See the figure.]

Diagram. A semicircle standing on its horizontal diameter, drawn at the foot of the recto. From the apex point on the arc, three straight lines descend to points along the diameter, forming the chord-construction for the sides of the inscribed decagon and pentagon. The diameter carries a row of labeled points read right-to-left; the apex is joined by chords to those points.

- Diameter (base) points, right→left: the construction letters from the surrounding prose are **A (א), B (ב), L (ל), D (ד)**; the individual inked letters along the base are too small to resolve one-by-one on the strip. [?]
- Apex on the arc: the point joined to the base by the three descending chords — **N (נ)** by the prose (the squares on **ANB** and **DNA** below). [?]

- The line beneath the figure names the construction: **צלע המעושר** ("the side of the decagon") and **צלע המחומש** ("the side of the pentagon").

The chord computation (verso, f. 143r)

the square on **DNA** (דנא) is divided likewise [?], and it is added to [?] the square on **DNA** [?]. And, as [is shown] from Euclid [me-Aqlidas], there comes out the square on **ANB** (אנב) [?], equal to this and equal to that [?]; the product [?] together with the square on [numeral: ?] — and as was demonstrated in the first treatise (ba-ma'amar ha-rishon) [?]. From Euclid, [the sides] that are not [equal] and that are equal [?] to their place of standing, the square on [numeral: ?] is doubled to this [?] … as was demonstrated in it [?] — the decagon (ha-me'ushar); and what was demonstrated in it will be seen [?] — the pentagon (ha-meḥumash); and [?] …

Since the square on 33 (ל״ג) [?] and its foundation [?] is like the square on 102 (קב), known [ידוע]; and [?] a hundred [?] not known, like the square on 104 (ק״ד), known [?] … it is the square [?] known — the measure of the arc [she'ur ha-'oleh], which is [numeral: ?] parts (ḥalaqim), and no minutes (regaim), and no seconds (sheniyot) [?]; and it is the square on [numeral: ?], the measure of the arc. So it is [numeral: ?] parts [?] there [are] parts, and the decagon (ha-me'ushar) [?]. And the arc comes to 102 (קב) parts [?] — parts, and no minutes, and no seconds [?].

To approximate, and to refine, the pentagon (ha-meḥumash), and the square [?] — and it will be like the square on [numeral: ?] [?]. There is a root [yesod] of what is gathered from [?] half the diameter: [numeral: ?] parts, [numeral: ?] minutes, and [numeral: ?] [?] the measure [?]; to approximate. And it is greater than the parts [?] of the arc, which is [numeral: ?] [?] — greater [?] than half the arc, which is 102 (קב) [?] … the matter, since the decagon was divided [?], and it is not drawn [?].

For the arc: as we divided [?] the hundred(s) [?] upon **BD** (ב״ד) [?], and the point [?] is the measure [?]; the measure in its square, and it is [numeral: ?]; and it was demonstrated [?] the hundred(s) [?], and it is the diameter of the arc [?]. And we divide, from the luminary's point [?], along the diameter, like the hundred(s), by [?] half [?] the arc — a quarter [reva'] of the diameter [?]; the segment **ALD** (אלד) is like 33 (ל״ג) [?]; and the heart [core] of what is the square on **DNA** (דנא) together with the square on [numeral: ?] — which is [together?] with the square on **AB** (א״ב); and to it, the square on **ALD** (אלד): this is the quarter of the square on **DNA** (דנא), on **AB** (א״ב) [?]; and so it is [numeral: ?] times the square on **AB** (א״ב), on **ALD** (אלד) — one sees it [?] … times the square on [numeral: ?] and its

square [?], the double of the square on [numeral: ?] [equals?] the whole square on [numeral: ?] [?]; and the square on **ANB** (אנב) [?].

The quarter divides [?] the square on [numeral: ?], known, and it is [numeral: ?] parts, and [numeral: ?] minutes, together [?] — since the excess of the decagon (ha-me'ushar) is added [?], and it is [numeral: ?]; and it is the diameter of the arc [?]. It was [taken as] the square, greater [by] the remainder of half the arc [?], known in full [?], which we take [?] … it comes to [numeral: ?] [?]. From half the arc it is **104 (ק״ד) parts** (ḥalaqim), and [numeral: ?] minutes (regaim), and **no seconds** (ve-lo sheniyot).

Before turning to what he intends to establish concerning the apportionment of the chords, he sets down a preliminary lemma. It is this: let a four-sided figure — a quadrilateral — be inscribed in the circle ABGD, and let its two diagonals, AG and BD, be drawn. We assert that the product of one of them by the other is equal to the sum of the product of AB by GD and the product of BG by AD, taken together. [Ptolemy's theorem on the cyclic quadrilateral, Almagest I.10: AG·BD = AB·GD + BG·AD.]

Diagram. A circle enclosing an inscribed quadrilateral; both of its diagonals are drawn, so that they cross in the interior and form an X. The four vertices and the crossing-point are lettered. The top-left vertex reads ב; the remaining vertices and the interior crossing complete the figure named ABGD in the prose (diagonals AG and BD), but their individual letters do not lock cleanly on the strip.

- ב (top-left vertex): corner of the inscribed quadrilateral
- [?] (top-right vertex — likely א)
- [?] (bottom-left vertex — likely ג)
- [?] (bottom-right vertex — likely ד)
- [?] (interior intersection of the two diagonals — likely ה)

The matter becomes clear upon reflection, and it is shown as follows. We construct at B an angle equal to the angle [?], so that the two triangles [ABE and DBG?] are made equiangular; and by the third treatise of Euclid the angles standing upon the same arc are equal to one another. Since the triangles are equiangular, their corresponding sides are proportional. From this it follows that the product of AB by GD equals the product of BD by [AE?], and likewise that the product of BG by AD equals the product of BD by [EG?]; and when these are added, the product of AG by BD equals the sum of the two — which is the complete composite relation asserted.

And if each of the two chords AB and AG is known — each of them subtending a known arc of the circle — then we say that the chord BG is known, and the chord BD likewise. We shall show that they are known, since each of these chords subtends [an arc that is the remainder of the semicircle?].

But when we wish to know the chord of an arc that is the *difference* of two arcs whose chords are known, we proceed by way of the quadrilateral. For example: we cut off within the circle ABGD [the required chords], the [known] one being given, so that we may know the chord of the difference and what its measure is. We draw the chord AB, and the chord BD, and [the diameter]. We show first that [chord ?] is the chord of the excess of AB over AD.

Diagram. A figure inscribed in a circle: a diameter is drawn, and from it several chords rise to points on the arc, two of them crossing in the interior to form a set of triangles — the construction for the chord of the difference of two arcs. The diameter-ends, the arc-points, and the interior crossing are lettered; the individual letters do not resolve on the full-width strip. [Interior labels unresolved]

- [?] (left end of the diameter)
- [?] (right end of the diameter)
- [?] (point on the arc)
- [?] (interior crossing of the chords)

We divide the diagonal in the same manner, as the sage R. David ibn Naḥmias [?] has already explained [this construction]. We draw [the auxiliary chord], and — the two triangles being again made equiangular by an equal angle: we construct an angle equal to the angle DAB — the ratio [of the corresponding sides] holds; and since the angles [at the foot?] are right angles and equal, [chord ?] will equal [chord ?]. Therefore [that chord] is the chord of the difference, and here we shall explain it further.

When a triangle is isosceles and a perpendicular is drawn from its apex down to the base, that perpendicular bisects the base into two equal halves; and it is shown from Euclid that the angle [at the foot] is a right angle. We then set the angle [?] equal to the angle [?]; hence the ratio of [chord ?] to BD is as the ratio of [DN?] to [chord ?].

Diagram. A semicircle standing on its diameter, with a chord rising from one end of the diameter to a point on the arc and a perpendicular dropped from that arc-point to the diameter, forming right triangles — the construction for the chord of half an arc. The diameter-ends, the apex on the arc, and the foot of the

perpendicular are lettered; the readings are uncertain at this resolution. [Labels unresolved]

- [?] (left end of the diameter)
- [?] (right end of the diameter, near the rising chord)
- [?] (apex point on the arc)
- [?] (foot of the perpendicular on the diameter)

Therefore the product of [chord ?] by [BN?] equals the product of BD by [chord ?]. We set the diagonal, and [chord N?] is known, since it is [half of the known chord]; and since it is the excess of the diagonal over AB — for [chord ?] is known — there remains the chord of the arc in question, whose remaining chord is the known chord BG. Therefore [that chord], the chord of the known arc, is itself a known chord.

And if the two chords AB and BD are both known, we say that the whole chord AG is known. We construct there a diagonal of this kind, [the auxiliary chord], and the line [HD?], such that this diagonal is known. And since [BN?] is known, [HN?] is known, and the diagonal is known; and since [chord ?] is known, [chord ?] is known, and it too is known.

Diagram. A full circle with an inscribed star of several crossing chords — straight lines running between points on the circumference and meeting one another in the interior. The points on the circumference and the interior intersections are lettered; the individual letters do not resolve on the full-width strip. [Labels unresolved]

- [?] (points on the circumference and interior crossings, several — unresolved)

Therefore [chord HD?] and [NB?] are known, since the product of [DB?] by [BN?] is known; hence the product of [NB?] by [chord ?], and the product of [chord ?] by [BN?], are known; therefore [DN?] is known. Therefore the chord of the remaining arc in question, together with the chord [AB?], is known; therefore [DN?] is known — [an arc] greater than [HN?], since the angle [NBH?] is as the angle [MBH?], and the angle [BNH?] subtends the smaller arc, smaller than the angle [NBH?]. Therefore you shall say that the angle [at HN?] is greater than the angle [MNH?] — and that is its portion. And it is [herewith] explained.

[Continuation of the chord derivations — the concluding chord-inequality lemma and the interpolation yielding the chord of one degree and of half a degree (≈ Almagest I.10).]

and since [?] is the length of [?], therefore [?]. From line DLA [דלא], the perpendicular divides AB [אב] into two parts [שני חלקים], as we said; and it is divided at the points [נקודות] [?], and [?]. And thereby we measure the excess of the [chord?] [?], since it is divided from part to part [?].

Diagram. A circle enclosing an inscribed regular pentagon, its five diagonals drawn so as to form a five-pointed star (pentagram) within it. A short radius or label-mark stands near the apex at the top of the circle, and letter-labels are set at the vertices and at one point outside the circle to the right. This is the construction for the side of the inscribed pentagon and decagon — that is, for the chords subtending 72° and 36°. The vertex labels are only faintly inked and do not resolve individually.

- (apex, top): [label ?]
- (upper-right vertex): [label ?]
- (right, outside the circle): [label ?]
- (lower vertices): [labels ?]

Now [we take] the arc [מעגולא] of DLA and the base [תושבת] of DLA. R. David ibn Naḥmias [ר' דוד אבן נחמיאש] [states] [?]: the ratio [יחס] of the arc DLA to the base of DLA is as line HZ [קו הז] to line QA [קא]; and the ratio of the [segment] of DLA to the base of DLA is as angle VLA [זוית ולא] to angle QLA [קלא]. And when we compound them, the ratio of line HZ to line [?] is smaller than the ratio of angle VLA to angle QLA; and [that] ratio is smaller than [?]...

line HZ to line QA, and the ratio of the [segment] of DLA to the base of DLA is as angle VLA to angle [DLA?] [?]. And whenever [?] the ratio of line HZ to line [?] is a ratio smaller than [?], so likewise the ratio of angle VLA to angle QLA is a ratio smaller than [?]; and the ratio of arc [?] to arc [?] is a ratio smaller than the ratio of the [corresponding] angles.

and so the ratio of arc GB [נגב] to arc ALB [אלב], and the ratio of GA [נגא] to GV [נגו], is as [?]; hence the ratio of chord GB to chord [?] is smaller than the ratio of arc GB to arc AGB [אגב] — **and this is what we sought** [וזהו מה שרצינו]. And after this [ואחר זה] we take up [?] chord AB [אב]: it is [greater by?] [numeral: ?] than [?] one part [מתלק אחד], and [?]; and arc ALG [אלג] is one part and a third of arc [?]; and chord AB is [numeral: ?].

In what preceded [ובמה שקדם] we said [?] that the ratio [?] of chord AB is smaller than [?] the ratio of arc ALG to arc AGB [אגב]; therefore the ratio [?] is less than one part [פחות מתלק אחד] and [numeral: ?] seconds and [numeral: ?] thirds. And afterwards [ואחר כן] we set chord AB [equal to] the excess of a part and a half and

a quarter of one part [?] and [numeral: ?]; therefore chord AB is greater than one part [?] and [numeral: ?] seconds. And so the line — its chord and its arc — is divided [יחלק]...

Diagram. A circle with a horizontal diameter drawn across to its right-hand endpoint on the circumference, and a chord drawn from the left-hand region up to a point on the upper-right arc, so that the diameter and the chord meet at a point on the left. A letter-label stands at the upper-right end of the chord and another at the right-hand end of the diameter. This is the figure for the chord-and-diameter relation used in the interpolation that follows. The labels are faint and do not resolve reliably.

- (upper-right, end of the chord): [ב? / label ?]
- (right, end of the diameter): [ב? / label ?]
- (left, meeting point): [label ?]

and its arc [?] is divided at [?], with fewer parts. And there comes out the chord of one degree, [numeral: ?] parts, and the chord of half a degree, [numeral: ?] parts — so that it may be the more exact and the better, with fewer parts [?].

שער שמיני — The Eighth Gate

The Eighth Gate: it investigates the quantity of the arc of the meridian circle — the circle of midday. [שער שמיני יחקור על כמות הקשת מעגולת חצי היום]

They are thirds [שלשיות]; and the excess of the one part over the other part makes [numeral: ?] seconds and [numeral: ?] thirds by approximation [בקירוב].

This is [the matter of] a [heavy/solid?] [?] circle, curved upon [?] the upright circle. First one must set upon a slab of marble [אבן שיש] a [graduated] part [חלק], and there comes out the point [נקודה] of the line of midday — that is, the meridian [קו חצי היום] — thus: we [inscribe] upon the marble a circle [?], and we set [?] upon it [?].

We erect a perpendicular [עמוד נצב], standing upon [?], and we make its length of such a measure [כשיעור] that it may receive [?]; [and it stands] upon the center of the circle of midday. And whenever [?] the shadow falls [?], there comes out the perpendicular [עמוד] of the circle of midday [?]...

And the token of this [וסימנך] is: we set up the marble slab [?] [level] by [?] seconds [?], well fixed [מחוקק], and finely [?]; and the [gnomon] is raised upon the perpendicular [?]... And we draw out [?] straight lines [?] [drawn] toward [?] until

the erected perpendicular [העמוד התקוע] stands at its center [במרכזה], as at the crown of the head [כקדקד הראש]. And we bring [?] — before noon [קודם חצות], at the station [במעמד] where the head [ראש] [of the shadow] falls upon the encompassing circle [הסובב], we mark [ונשמן] upon the head of the line where it [meets] the encompassing circle a point [נקודה]; and likewise we [do] after noon [אחר חצות], and where the head [of the shadow] falls upon the encompassing circle we mark upon its head a point.

And so [with] the encompassing circle we divide the arc [ונחלק הקשת] which is [the arc between] the two points [?] [numeral: ?]; and the arc [?] that [is] between them [?] we bisect [ונחלק… במיצוע] the circle, and that line is the [dividing line] [הפרק] for the distance [למרחק], for the hours of [?] and for the hours [ולשעות] of [?]...

the [equated] arc [?] like the day. And take for the side [לצלע] or the chord [חצב] [?], with [?] in the hour, its part, the encompassing [circle], the degrees of the circle [מעלות עגולה] [numeral: ?]...

Diagram. A quadrant (quarter-circle) whose arc is subdivided by several radii drawn from the center like a fan, with a square (or rectangle) constructed against the two straight sides at the base and a diagonal drawn within it. This is the meridian-quadrant construction for the arc discussed in this Gate. Small letter-labels stand at the center, at the ends of the arc, along the radii, and at the base corners of the square, but they are faint and do not resolve individually.

- (center): [label ?]
- (upper end of the arc): [label ?]
- (lower end / base corner): [label ?]
- (base corners of the square): [labels ?]

[End of the readable text on this folio side.]

[Foliation: a modern pencil "145" stands at the lower outer corner of this second page.]

We set down a point as center and, about it, at a [known?] distance, we describe a quarter of a circle upon it — [call] this [arc] ל?ב [?]. We divide it into two equal parts and take the chords equally from the arcs, a chord [?], so that there may be formed within it [?] — in order to sustain the whole [as a check] — and the arc-chords will be alike and equal on all their sides. And we set up perpendiculars at the point of intersection, upon [point ו״ד?], and we erect the whole as a

perpendicular upon the meridian line (the line of midday), until its extension emerges [?].

[?] the sun [?], and this is line [?] at the moment of the meridian passage; and line [?] is set up [?] because we dwell in the north and the sun is south of us. On this account we reckoned in our minds that this [line/point?] runs out to the sphere [?], cutting off [?] of the sphere the revolution [?] of the meridian passage. We therefore reckon it: for the reckoning is made upon the ascension [שעולת] of the sun [?], and we gauge the sun at the moment of the meridian passage, when the sun is at the head of the sign of Cancer, upon point ה [?]. And [the sun] which inclines [?] — [its] arc [?] up to the chord [?] [?] the shadow of the gnomon [סדן] [?].

Straighten line זא and let it be like [line] ד?ז; and when we set the sun at the meridian passage — and it is at the head of [the sign?] — it stands higher [?], more toward the south side [לצד דרום], and we [?] upon point ב?ד, and it will lie upon this straight line. And because of the ascension of the sun [?] [?] — and because [?] the [?] passes through [?] the ecliptic [?] and through the whole gnomon [?] — arc זג is twice the inclination [כפל הנטייה, i.e. twice the declination]. And because the ascension of the sun above [?], there is nothing [no gap] between its center and point ז, since there is nothing [?] to the air [?] except the sun which [?]. Therefore the ascensions of the sign [שעולת המזל] [?] are upon a single center [מרכז אחד]; and line נז returns [?], which [subtends?] under angle הזד [?], like [?] [?] upon the center. Accordingly, arc [?]ה is equal to arc זג; therefore arc [?] — and this is the chord of the inclination [יתר הנטייה, the declination] — and it is 40 parts [40 = מ׳ חלקים], 42[?] minutes [רגעים], and [?] [?] is the chord of the inclination.

The author says: After Ptolemy, in a dry period [בזמן מיובש], a scholar arose — Ibn al-Zarqālla [בן זרקלה, Azarquiel] — and he fixed and observed and found [numeral: ?] for us. [He labored?] to derive from this the whole; [and by] the [height/thickness of the] gnomon [עובה הסדן] at a known place — and it is [now] the point [known] — [he determined] the latitude of the city [רחב העיר].

If your eye were [placed] where the sun is at the ascension [שעולת] of the sign of Aries — and this is [when it stands at] a half-arc [חצי קשת] — add to it an arc of 53 [53 = קשת נ״ג], and that is the measure [?] [of the ascension], as is fitting for the ascension of Aries over the zenith [קדקד, the crown of the head] of that place; for the point set down [המשולה] at point ח is the zenith of that place. And after this he described [the figure].

And it has already been made clear, regarding the right sphere [אורה הישר, the *sphaera recta*] [loan-gloss: סבבא סקיבלא [?]], that one need not reckon [it] nor give heed [to it]. He then began to set out the position [מצב] — the measure of the arc that falls on that day between the ascension of the ecliptic [המזלות] and the ascension of the sign of Aries, as is fitting for each and every part [degree] of the parts. And because of the ascension of the ecliptic — these are the arcs that pass, in order [על סדר], over the ascension of the sign of Aries, with points marked upon it.

For this purpose he set out the meridian circle [labeled] אבגד; the ascension-line of the sign of Aries is אהו; the ecliptic [circle] is בהד; and point ה is the intersection [הצדוק] of [?]. After this he cut off from it a known arc on the ecliptic, and it is arc ה״ח. And he brought out from [?] the ascension of Aries an arc upon the point [?], made upon the ascension of the sign of Aries.

For, he says, if arc ה״ח is known, then arc ח[?] is also known — as Menelaus made clear [כמו שבאר מנלאוס]: the chord of twice [יתר כפל] arc [ה?א] to the chord of twice arc [א?ב] is compounded of [two] ratios — [namely] the chord of twice arc ו?ז [?] to the chord of twice arc ח[?]ה [?], and the chord of twice arc ח[?]ה to the chord of twice arc ה״ב. And therefore they are known: arc אב is known and arc הג is known, [and] arc ח[?] too is known; hence arc ח[?] is known. And in like manner he brought out and constructed each part and part, reckoning [it] as one reckons in all the remaining cases. And he made a separate [table] for this, and this is called "the giving of the inclination [לתת הנטייה, the table of declination] [?]."

And after this he began to determine the measure of the arc drawn [המשולה] of the sign of Aries together with a known part of the ecliptic, at the place where the ascension of Aries passes over the zenith. And in that same city it will be made clear. It is thus: when arc ה״ח of the ecliptic [is taken] at the place where the ascension of Aries passes over the zenith, [then] arc ה[?] is the arc drawn of the sign of Aries — [and it is] known; and you shall derive, for each part of the parts, a single quadrant [רבע אחד].

Diagram. A single circle (the sphere), inside which two or three great-circle arcs cross to form a curvilinear (Menelaus) triangle — the construction named in the surrounding prose: the meridian circle אבגד, the ascension-line of Aries אהו, and the ecliptic בהד, meeting at the intersection point ה, with arc ה״ח cut off on the ecliptic. The point-letters are inked at the circumference and interior but are faint; only some resolve at this resolution.

- Circumference (frame of the meridian circle): א, ב, ג, ד [positions partly legible]
- ה (interior, at the crossing of the arcs): the intersection point named in the prose
- ז (left of circle): label [?]
- ח (interior/lower): the zenith point named in the prose [?]

[More than two interior diagram labels do not resolve on the scan even under magnification; the figure region needs re-examination at higher magnification.]

[Continues the chord-ratio (Menelaus) derivation of the declination arc carried over from the preceding gate.]

and so it is in every case. He wishes to know arc HLA [הלא], in this way: because it is the chord of arc [?], while the composite line [הקו מחוברת] is compounded from the ratio of ZḤ [זח] to ḤLA [חלא] and from ṬH [טה] to [?] — and all of these are known. Therefore arc HLA [הלא] is known, and that is what we sought.

The First Treatise is complete [תם המאמר הראשון].

The Second Treatise, First Gate — On the Inhabited Part of the Earth in Our Region

[Decorated display heading, verbatim: המאמר השני · שער ראשון · בכלל השכון מן הארץ אצלנו]

He said that it — the inhabited world — is the northern quarter [הרבע הצפוני]. And we know [?] concerning the altitude that [it] inclines toward the north and never inclines toward the south, beyond their place [?] … which lies beneath the passage of the sun [שתחת עברת השמש]. For the sun [?] … in the [?] circle … [several words here do not resolve]. And [as for] the inhabited world, from the [?] … its length runs [?] … from the east to the end of the west [עד סוף מערב], and [?] …

It seems to me [נראה לי] [?] … the eclipses of the moon [הלקויות של הלבנה] … [the remainder of the line does not resolve].

Then he began to explain [ואחר כן התחיל לבאר] that when the length of the day [אורך היום] is known, the measures of the arc [שיעורי קשת] of the [?] circle are found, at the time when [the degree] rises [?] … and the circle of declination [גלגל הנטיה] — which is called the latitude of the region [רחב המדינה] [?] — [?] … and we

strengthen [ונחזק] the arc that rises [?] … the western horizon [האופק המערבי] … and at half [ובחצי] it rises [?] … above Aries [מעל טלה] [?] … [and one must] [?] … what appears to be the name ר׳ דוד אבן נחמיאש [R. David ibn Naḥmias] [?] …

Diagram. A single circle with three curved great-circle arcs crossing inside it to form a curvilinear (spherical) triangle — the standard chord-ratio / Menelaus configuration used in the surrounding ascension derivation. Point-letters are marked around and within the circle but do not resolve reliably at this resolution.

- [Circumference / interior letters]: present but not confidently legible — candidates include א, ב, ג, ה, ז [?].

[Margin: a small word, apparently ידוע ("known") [?], written in the right margin beside the figure as a keyword gloss.]

[and] we say that [when one seeks] the measure of an arc of altitude, [the arc] will be [?] … arc HLA [הלא], arc HḤ [הח] [?], is known when [?] … because it is a quarter-circle [רבע עגולה], and arc ZḤ [זח] [?] is a quarter-circle when [?] … because the points [?] are perpendicular [נצבת], being on one part upon arc AB [אב] [?] … the pole [הסדן] revolves in the motion of the sphere [בתנועת הכדור], so that the [degree] that rises is the rising of Aries [עולת טלה]. And thus one must reckon [?] … [the closing words of the recto do not resolve].

[Verso — a continuous chord-ratio / compound-ratio (Menelaus) computation deriving the arcs and altitudes. The framing vocabulary reads clearly: arc (קשת), chord (יתר), circle (עגולה), ratio (יחס), composite/compound ratio (מחוברת), point-labels, horizon (אופק), altitude (קומה). The individual overlined numerals are the genuine minority that do not resolve and are flagged [numeral: ?]; the geometric point-labels are rendered as labels.]

Therefore arc [?] is known. And what is known, because it is [?] a quarter-circle … [?] … because the altitude [קומה] of arc ḤA [חא] [?] governs [?] … And the arc [?] which is above the earth [שלמעולה מן הארץ] comes to half the day [יבא חצי יום]; for thus [?] …

[?] the ratio [?] … A to H [?] … ṬḤ [טח] to [?] … and TZ [חצ] to BK [בך] [?] … And already ḤA [חא] [?] and ṬA [טא] [?] are known; and QB [קב] [?] is known. Therefore ḤB [חב] [?] is known, and arc HLA [הלא] is known — and that is what we sought.

And in each such case, arc [?] is known. He said that arc ḤA [חא] [?] is known, because the ratio of ṬḤ [טח] to HA [הא] is compounded from the ratio of HA [הא]

to ḤB [חב] and from the ratio of BḤ [בח] to BA [בא]; and these arcs are known, so [the arc] is known. Because [the arc] rises [?] … it is known; and the ratio of the chord [?] … arc ZḤ [זח] [?] is known.

He said that arc ḤLA [חלא] [?] is the excess [?] of the increase of the day [תוספת היום] above the shorter [על הקצר], [and it is] known, because the ratio of BḤ [בח] to BA [בא] is compounded from [the ratio of ?] to ḤM [חמ] [?] and from ṬH [טה] to [?] — and each of these is known, so arc [?] is known.

He said, and he began to explain [?] … their length [אורכם] [?] … which their light [?] … [rises] four [?] times in a year [פעמים בשנה]. He said: and know [אמר ודע] … the passage of the sun [עבר השמש] upon point [?] — only at the time [?] … [the ratio of ?] … the seat [?] … the declination of the arc [נטיית הקשת] and the [table of the] arc [?]; but the place [המקום] which [?] is known [?] … and the [table of the] arc [?] does not [?] … only [?] … Let us reckon how many times [כמה פעמים] [it] comes in a year [יבא בשנה]. One knows [?] … those which [?] the [table of the] arc [?] … one takes [יקח] a single measure [?] alone [בלבד], and those one takes from [?] … the sun [?] at the beginning [ראש] [?] …

But those which are less than the [table of the] arc [מעגלת הקשת] [?] … [reckoned] upon the beginning [ראשית] [?] … in a year [בשנה]; and those [?] … [numeral: ?] times [פעמים] … the places [המקומות] [?] … [numeral: ?] … in a year [בשנה] …

upon the altitude [קומה] which we said, the rising of Aries [עולת טלה] [?], [it] draws near [?] by [numeral: ?] parts [חלקים] … from the circle [מעגלגל] [?] … from the point [?], the first [הראשון], an equal [שוה] distance [ריחוק], and one knows [ויודע] [?] … [numeral: ?] times [?], parts [?] … arc [?].

Derive the ratios of the altitudes [הוצא יחסי הקומות]. [Centered on the last line of the verso; possibly the display heading for what follows.]

[Pencil foliation "147" at the foot of the verso.]

The Second Treatise (המאמר השני) — On the Inhabited Part of the Earth, continued

[f. 147v]

always at midday; and so it is for each one of those who dwell in them. And as for the sides that project outward, the gnomon stands erect over them.

Take for this the meridian line **א״ב · ג״ד**, whose center is **ה** and whose zenith — the point directly overhead — is **א**; and the gnomon stands erect at its angle, at the place of arc [?].

Diagram. A meridian circle drawn at the top of the page. Its center, **ה**, is the foot of the gnomon (the observer's station); the point at the top of the circle, **א**, is the zenith, captioned **קדקד** ("zenith"). An upright rises from the center to **נ** at the top of its height (the gnomon, line **נ״ה**). A long straight base line runs down and to the left from the circle — the plane on which the noon shadows fall — and along it the shadow-tips of the longest, mean, and shortest day are marked **ב · ג · ד**. Radial lines run from the center **ה** to the sun's meridian positions on the circle for those three days.

- א (apex of the circle): the zenith (קדקד), the point directly overhead
- ה (center): the foot of the gnomon / the observer's station
- נ (top of the upright): the top of the gnomon's height (line נ״ה)
- ב (on the base line): the shadow-tip of the longest day
- ג (on the base line): the shadow-tip of the mean day
- ד (on the base line): the shadow-tip of the shortest day

We join **א״ב** and draw from **נ** a line perpendicular to the meridian [line **נ״ג**] at right angles. We say that this line lies opposite the line that cuts across the points at which the meridian altitude intersects, and over which the sun rises. And because this region has no meridian latitude great enough to be perceptible, the [radial lines meet at] the gnomon whose center is **ה**. The top of its height is line **נ״ה** — the line along which the shadow-tips travel at midday. The body of the sun passes over it, [taking its place] between [the positions of] the long, the short, and the mean day. The arc of the mean day is the line [to **ג**]; that of the long day, [to **ב**]; and the arc of the shortest day, [to **ד**]. And [the shadow] reaches to the long day at one point and to the mean at another, and [likewise] to the short day.

And because the [height of the] gnomon is known — and it is arc **א״ב**, and **נ״ד** is like it; while arc [**ג**]**ד**, the height, is like arc **ח״ב** — [the remainder] is known. Likewise, the remaining arc [of] the height is like arc **ח״א**, and it too is known. And every arc [between them] is known, and the chords that subtend them are known. These arcs are known by the measure in which the four right angles amount to [numeral: ?] parts. And if we assign to each one of the three [arcs] — which are [numeral: ?], [numeral: ?], [numeral: ?] — [so many] degrees, they will be, as [reckoned along] line [?], [numeral: ?] [numeral: ?] by their reckoning, [with] [numeral: ?] parts in each of them. And we find the right angles to amount

to [numeral: ?] parts; the arcs, [reckoned] in degrees, will each be — the place of line נ ,נ״ג[?] — known by the measure in which the two right angles amount to [numeral: ?] parts, and in each of the degrees … to line נ[?], known.

so that line [?] [numeral: ?] is a known amount, and there is for them the [amount] by which we measure each of the lines נ ,נ״ה ,נ״ג[?]; for line [?] is the chord of the remainder of half the circle, and line נ״ה is its mean. Reduce it completely. And the lines נ ,[?]נ ,נ״ג[?] are the means, [entered] for the three [days], [in the column of] the arc [?] … at midday.

[f. 148r]

so the ratio of the height (the gnomon) to its shadow is called "known," since the gnomon was known; and that is what we sought. And just as it was known, when its period was complete, [what the length of] the year [is], so it was known to Ptolemy [לבטלמיוס] from the days of the half-year, according to the variation of the sun's mounting [?] over the degree — [it is] known. And it is easy to know the amount of the [ascension and of] the gnomon [shadow] over that degree, and one proceeds with it as was done in this figure. And when he knew this from the days of the half-year, he knew its [latitude] at the [equinox], since the sun's passage through two parts [signs] whose distance from the points of intersection [the equinoctial points] is one and the same [places them] on a single [rising-arc].

After this he began to investigate the particulars of the places of this quarter [as it revolves] — namely, the inhabited regions of the earth. He began first with the region that lies under the equinoctial line [the equator]; then with the one whose longest day exceeds it by a quarter of an hour; then with the one that exceeds that place by a quarter of an hour; and so on, up to the northernmost [limit] [?].

And he had already begun upon the particulars of this place that has no latitude [the equator]: the rising-arc [of the signs] [?] there passes over its zenith, and the sun passes over its zenith twice a year, when it reaches the [equinoctial] points of intersection. At their noon on those two days the gnomon casts no shadow; but apart from those two days, when the sun is in the northern degrees the shadow falls to the south, and when the sun is in the southern degrees the shadow falls to the north. This is something that happens to all the regions lying between the summer tropic and the [winter tropic] in latitude.

And what obtains in this place — which is the equinoctial line — is this: because the rising-arc of a sign at the horizon [האופק], as it rises at midday, is always the reverse of the rising-arc of the opposite [sign], every degree rises in equal [time]; and so the day and the night are there always equal. No star among the stars is

ever permanently hidden from them, nor ever permanently visible; rather, all of them rise and set upon them. And the winter shadow among them equals the summer shadow — the winter [shadow falling] to the north and the summer to the south.

And Ptolemy [תלמי] said: this place is the most temperate in nature of all the earth, and its people of the best temperament — if indeed it is inhabited — since neither the cold nor the heat is severe among them, because the extremes [of the sun's course] do not recede far from them, but remain near.

[Foliation: pencil "148" at the foot of f. 148r.]

[Margin, p. 315, upper left: a small marginal word, "אשגור" [?].]

But in the places that lie between the equator (קו המישור) and the pole, the sun reaches the zenith (קדקד) of that place, so that there the seasons are unequal: the winter [?] is shorter than the summer, and the summer shorter than the autumn [?]. And there remains [a region] that is heated as though [it were heated] by [numeral: ?] parts and a half.

But in a place whose latitude reaches the utmost limit of its arc — [some] twenty [degrees?] [?] — [the sun stands] upon the zenith, and there is one day [only]; provided that [?] the constellations [?] [rise?] one after another [?]. There is no [night?] there [?], from [that point?] and upward. And [going on] until the line [of the equator?] approaches [the pole?], until [the sun?] draws near [the pole?] and [circles it?] [?].

[As for] the clime [?] — and it is [reckoned?] nearly a thousand [?] — the sun, at the head of Cancer [the summer solstice], [makes] its day [a full round of] hours: all the hours are day, and there is no night there. At evening time there is [still] light, and in its place [the sun] remains forever, rising [above the horizon]. And the farther one is from this line [toward the pole], up to the region of the pole [?], the longer the day grows, until one reaches a place where [half the year?] is day — and this is the place where [the sun] rises upon [the horizon and does not set?] [?].

And there [half the year?] will be day [?]. [The sun?] rises [?] upon [?], and you draw a small [arc?] [?], and it is called "the remainder" [?]; and the part that rises whole [?] rises [as] half the day upon the [equinoctial?] line [?], with equal arcs [קשתות שוות]. And the likeness [?] of the sphere of the signs (the ecliptic, גלגל המזלות) [?], and by the measure [?] of [?] and a half — so you shall do. And that which rises, [being] the smaller [?], and [that which] rises whole [?] — it has its

part [?]. The rising [ascension?] [?], and the sphere turns round in its order, rising whole, and it comes out for you accordingly [?]; and this will be made clear to you concerning this matter [?], as [Ptolemy?] said [?].

And he said [?]: thus [is the matter?] [?].

Diagram. A circle representing the celestial sphere, drawn at the lower right of the leaf across the last two text-strips. Several great circles (rendered as ellipse-like arcs) cross within it — the schematic of an obliquely-set sphere, showing the intersecting principal circles (equator, ecliptic, and horizon/meridian). Small Hebrew point-labels sit around the circumference and at the intersections; two or three resolve, the rest do not.

- א (upper interior): apex / pole point
- ב (right rim): [?]
- ד (lower rim): [?]
- [?] (left rim): [?]

And likewise, equal arcs [קשתות שוות] of the ecliptic that are [equally] distant [from the equinoctial points], or [equal arcs measured off from those] points, rise [with equal arcs] [?]. Equal arcs rise [equally] [?], the rising [being reckoned?] as half the day [?]. And half [the arc?] rises from [one side?] [?], and half rises upon [the other?] [?]; and two [arcs?] are cut off from the ecliptic, their ascension [being] arc AG (אג) [?], and [there are] two points [?] on line LA (קו לא) [?], [upon?] the equator [?].

Diagram. A circle (the celestial sphere) set at the left of the leaf, mid-height, spanning about a third of the leaf's width. Two or three great circles cross within it near the center, forming intersecting arcs. Small Hebrew point-labels sit around and within the circle; two or three resolve, the rest do not.

- ג (top): [?]
- ה [?] (left): [?]
- ד (lower right): [?]
- ב (bottom): [?]
- [?] (center): intersection point

And you will find the equal arcs of the ecliptic arranged in this way [?]: [taking?] points [upon it?] [?]. For each of them [it is found?] to be equal to its counterpart, [and] equal to its [own] ascension [?]. This [?], and it is known [ידוע] that they are so arranged [?]; and the remaining arc that rises [?] of the ecliptic [?] toward [?] is

short [?] — from this. And since this [arc?] is equal to [arc?] [?], [the arcs] marked upon [?] [?], its ascension rises [equally?] [?].

And they will be equal to this [?], as is made clear [?] — [in the Almagest?] the equal [arc] [?]. And they will be equal in ascension: [the arc] is equal to the [?] [?], in the time of [?] [?], by [the figure of] Menelaus [ומיולאוס — Menelaus's theorem / the sector-figure]. And the equal [arc] is equal to the [?] [?]; [the figure] necessitates [?] that this angle [זוית] is [equal to] this angle, and every [?] [is such that] this angle [equals] that angle, and the remaining [angle equals] the remaining [angle] [?] — and this is what we intended [to prove] (וזהו מה שרצינו).

And the sage R. David ibn Naḥmias (ר' דוד אבן נחמיאש) has already explained [this] in Toledo (בטליטלה) [?]. [The demonstration is] set out and answered [?].

[The proof is?] linked [?]; and afterward [?] [?] — and these are the arcs that rise [?], their ascension [?] equal arcs from the ecliptic, which are equal [?]; and they are equal in the [manner of?] [their] division [?], [taken] from the two [equinoctial?] points [?], [and] their ascensions [?]. There is no [difference?] in [?] the straightness of [?] [?] in the sphere of the equator, from [point] AB (אב) [to] GD (גד) — arcs; for the ascension of [the arc?] from them is line [?] [?], and five [?] [?], and their ascension [rises?] upon [?] [?]; and they are arcs from the ecliptic, their ascensions equal and alike [?].

[The] arc from the point [?] [?] — [whether?] [the arc reckoned?] is the winter[-solstice?] point (נקדת החורף) [?], or the [summer?] point [?] — and there the point [?] which [?] is cut off in its [own] measure [?], from [?]. And from [?] six arcs [?], [each] a part [?]. It is good [?]. [Upon?] the ecliptic, one [arc] opposite [another?], its ascension rises [equally?]; and the remainder [?] rises [?] — arc [?] rises [as?] [numeral: ?], and [arc?] rises [as?] [numeral: ?]; and when [?] [they will be shown?] that all these are equal in ascension [?]. And the sphere of the equator is a sign (סימן) [reference-mark?] [?], for it is [the eastern point (נקדת הקדים)?] [?], [and its arc?] rises [?] a large [circle?] — and thus it is [doubled?] [?].

to the quadrant of the horizon in the equatorial sphere (גלגל המישור), its ascension being as half of that [?]. The arc of Aries, likewise, is what rises together with a whole arc [?] in the equatorial sphere, and let [?] be what rises with this one in the same manner. Therefore [?] the arc of Aries [?] rise [?] … [?] and they are summed so that they are one [?] … [?] — and this is what we intended to prove.

From this one figure [?] we now have in hand that the ascensions (צמחים) of Aries are the same as the ascensions of Pisces; those of Aquarius the same as those of

Taurus; those of Capricorn [?] the same as those of Gemini; those of Cancer the same as those of Sagittarius; those of Leo the same as those of Scorpio; and those of Virgo the same as those of Libra.

The benefit [?] of this second figure is that the ascensions of Gemini and Cancer taken together in the equatorial sphere equal the sum of their ascensions in the oblique sphere (גלגל הנוטה) — that is to say, in the horizon of every city whatever. So too the sum of the ascensions of Taurus and Leo [?] in the equatorial sphere equals the sum of their ascensions in the oblique sphere; and so likewise the sum of the ascensions of Aries and Virgo; and likewise the sum of the ascensions of Pisces and Libra; and likewise the sum of the ascensions of Aquarius and Scorpio; and of Capricorn [?] and Sagittarius. For all of them the ascensions, when summed, come out equal. These are the arcs equal in degrees, which are [the sides of?] the day [?], together with each of their arcs in the equatorial sphere.

Therefore, once we know how many the ascensions of a single quadrant are in a known horizon, we can determine from that the ascensions of each and every one of the twelve signs in that city. Take Aries, Taurus, and Gemini as our example. Suppose we know the ascensions of Aries in a given city, so that they are known; then the ascensions of Virgo will be known as well, since the ascensions of the two together are equal in degrees in the equatorial sphere and in the oblique sphere alike. And we already knew their ascensions in the equatorial sphere from the first treatise (Almagest Book II). Therefore, when we subtract from their combined ascensions in the equatorial sphere the ascensions of Aries in this city, what remains is the ascensions of Virgo in this city. Once the ascensions of Virgo are known, the ascensions of Libra are known, as was explained in the first figure of this gate; and the ascensions of Pisces too will be known for that same city.

Then we proceed in the same way [?] with Taurus, whose ascensions are known for that city; and from these the ascensions of Aquarius, Leo, and Scorpio become known. And from the known ascensions of Gemini, the ascensions of Cancer, Capricorn [?], and Sagittarius become known.

Let us now return to deriving the ascensions of Aries for a given horizon.

[The lower third of the leaf is left blank.]

[Librarian note: modern pencil foliation "150" at the foot of the following leaf.]
[Marginal numeral, upper margin: "כד" [?]]

Diagram. A single circle drawn in the upper outer part of the leaf, beside the opening lines of the text — the meridian circle of the construction that follows. Within it two long arcs cross one another: one runs from the upper part of the rim down toward the lower left, the other sweeps across from the left toward the right-hand rim, the two meeting at a point inside the circle. A third, shallower arc springs from the left rim and curves down to meet them, cutting off a small lune at the upper left. Small letter-labels are set at the rim and at the crossing-points; most are at the limit of legibility.

- ל (inside the circle, above and right of centre): label ל
- ט (right rim, at the level of the crossing): label ט
- ה (inside the circle, below centre): label ה [?]
- Three further labels at the top of the rim and on the left rim: [?] [?] [?]

Let us draw the meridian circle ABGD (אבגד), half the horizon BKD (בקד) [?], half the circle of Aries [?] AHZG (אהזג) [?], and half the circle of the signs ḤMT (חמט) [?]. Point ח [?] is [?] the northern pole (הסדן הצפון); and point ל is the intersection of the sphere of the signs — the ecliptic — with the horizon. We then carry [?] through in a great circle, and we come to know arc ḤL (חל) [?] of the sign of Aries.

Now we wish to know how great arc ḤL [?] is [?] of Aries; and let the arc that rises together with arc ḤL out of the equatorial sphere be equal to it (interlinear: שרחוק [?])] [?]. Since there is a figure of this configuration here, the ratio of the chord of twice arc [?]B ([?]ב) to the chord of twice arc DG (דג) is compounded of the ratio of the chord of twice [?] to the chord of twice LMN (למן) [?] and of the ratio of the chord of twice [?] to [?]. Each of these is known [?], and [?] is known; therefore [?] is known. And twice DH (דה) [?] is known, since it rises together with ḤL in the equatorial sphere; therefore arc HḤ (הח) [?] is known — and that is what we intended.

Afterward we take [?] arc ḤL for the signs of Aries and Taurus, and do the same with them, and they become known; and by this same procedure we obtain [?] what is required. The ascensions of Taurus, then, remain known; and we derive the ascensions of Gemini by this same road.

Since the longest day is known, the ascensions of the half of the zodiac from the head of Cancer to the end of Sagittarius will be known; and since the shortest day is known, the ascensions of the other half will be known, namely from the head of Capricorn to the end of Gemini. And since the ascensions of Aries and Taurus have been established in this figure, the ascensions of Pisces and Aquarius will be known. What is left over, then, is the ascensions of Gemini together with [?] the

remaining ones of these signs — and these are known. Since their ascensions are equal, as was explained in the first figure, the ascensions of Gemini are known, being half [?] the ascensions of Gemini and [?] …

After this he divided each sign into three parts, so that the increment of the ascensions came at intervals of ten degrees (חלקים); and he called [?] what came out for each ten degrees [?] the [?] of the operation, and made a table for it. It is called the Table of Ascensions (לוח הצמחים). Afterward he explained the manner of working with this table, which serves [?] to determine the ascendant (הצומח) at any hour [?] in a known city.

[This opening continues the geometric derivation that underlies the *Almagest*'s ascensions (rising-times of the ecliptic arcs). It is continuous body prose with small geometric figures set into the text column — rising-arc constructions on the recto, celestial-sphere constructions on the verso. No ruled Table of Ascensions appears on this opening; here the argument behind that table is still being worked out geometrically.]

Page 319 (f. 150v)

[Margin, upper left of the text column: a short marginal word [?], possibly a section-tag or catchword; not confidently resolvable.]

And since he treats the matter by way of the difference in the varying apparent approach [חלוף מראה קירוב], and as you would say — [this is] the fifth [premise/figure]. For this knowledge we must first premise the measure — the magnitude [כמות] of the portion [החלוק] [?] — that is to say, the magnitude of the portion that falls upon the perpendicular line [בקו הנצבת] [?]: namely, a quarter-circle [רבוע עגולה], which is ninety (צ) parts [חלקים]. And once the magnitude [כמות] is established [קיים] [?] …

what pertains to the obtuse [מרווחת] and the acute [חדה] angle; and it is squared [מרובע] [?]. And first, upon the ecliptic [גלגל המזלות]; and upon the ecliptic [as far as?] the day [?] — and it will be shown [ויתבאר].

It begins thus: when we posit equal arcs [קשתות שוות] upon the ecliptic from [a known] point [מנקודה] [?] at [a given] distance [מרחק] [?]; and afterward they pass over [יעברו] [?] … two arcs [שתי קשתות] [?], the [arc of] half the day [חצי היום — the semidiurnal arc], upon the horizon [אופק] [?] — points [נקודות] upon which arcs are drawn [?], and we say [ואומר] that [?] … these [arcs/points] will be equal [שוה]. And [so] we set [a construction] upon the ecliptic [?].

Diagram. A rising-arc figure: two overlapping circles (a vesica-shaped overlap) from whose common baseline three arcs spring upward in a row, like the jets of a fountain — the construction pairing arcs of the ecliptic with their corresponding rising-arcs. Small point-marks sit at the feet of the arcs and at the circles' intersection; the individual labels are too small to resolve. [Figure labels illegible]

- [point-letters present at the arc-feet and the intersection but individually illegible] [?]

some parts [?] … a circle [עגולה] [?]. And afterward we shall know [נדע] the magnitude [כמות] of [the ascension] [?].

The basis of this matter is that an arc upon the ecliptic — the beginning [ראש] of the distance [ריחוק] from the point [מנקודת] [?] — [and] at a distance [וריחוק], an arc upon the ecliptic, [namely] half the day [חצי היום], is equal [שוה] [?]; and the [degree/part] [חלק] upon the ecliptic [?] … And [reckoning] the distance to the point [?], the semicircle [is] a quarter-circle [רבוע עגולה] and a half [?]. And [at] a distance, the arc [is] the ascension [הצמח], rising from [the point], and it is known [ידוע] at [its] distance [ריחוק] from the point [מנקודת] [?].

Diagram. A second, simpler rising-arc figure at the foot of the page: a semicircle spanned by an inverted-V ("M"-shaped) pair of arcs that meet at the center — again pairing an ecliptic arc with its ascension. A point-mark labeled **ב** (B) sits at the apex; further marks sit at the two arc-feet and at the meeting point, but those labels are not legibly resolvable. [More than two labels illegible]

- ב (apex): label B
- [arc-feet and meeting-point letters present but individually illegible] [?]

Page 320 (f. 151r)

Explanation [פי']: that what [pertains to] the points [נקודות] [?] — the distance [ריחוק] is equal [שוה] from the point [מנקודת] [?] … [compound point-label chain, not resolvable] [?]. And in the first treatise [ובמאמר ראשון — i.e. Book I] [?] … and it will be [ויהיה] [?] … the angles **[Z H B?]** [זה"ב] [?], being together [כשהם יחד] right angles [נצבות]. [Then] the angles **Z L B** [זל"ב] and **L B** [ל"ב] [?] together are equal to those right angles [שוות לאותם נצבות] — and this is what we intended [והוא מה שרצינו].

And afterward [ואחר כן], the intersection [חתוך / מקק?] [?] of the ecliptic [with] half the day [חצי היום] [?] … and half [?]. The degrees **Z A L B** [?] [numeral/label: ?]. And if the intersection [היתוך] [is] reversed [?], and [when it is] at a distance upon

[?], then, at a distance [ורחוק], the arc [is] a quarter-circle [רבע עגולה], half a degree of the ecliptic [חצי מעלת המזלות] [?]. And in the treatise, [it is stated] there [ובמאמר … שם] — [by] **[?a name, possibly Menelaus]** [מנטאורוסינוס?] [?] — that [the great circles] pass through **A B G [N/D]** [אבגד / אבגנ] [?] …

which is [?]. And an arc [is] known [ידועה] [?] from the ecliptic … the distance [ריחוק]; and it is known [ידוע] from the point of intersection [מנקדת החתוך?] [?] … And the angles [equal?] two right angles [שני נצבות] [?] … and thus [וכן] [?].

Diagram. A celestial-sphere construction: a circle representing the sphere, crossed by two great-circle arcs (drawn as ellipse-arcs) that intersect within it — the meridian/horizon meeting an oblique circle (equator or ecliptic) at interior points. A few point-letters sit around the rim and at the crossing; too small to resolve confidently. [Figure labels illegible]

- [rim and intersection point-letters present but individually illegible] [?]

And likewise, as I said [כמו שאמרתי], point **[?]** [is] the intersection [החתוך], and [it is] at a distance [רחוק] upon [?]; and at a distance a quarter-circle, half the ecliptic **A B G [D]** [?]. And this arc is inscribed [חקוק] [?] … the root [שרש] [?] at **[?]**. Accordingly it will be [יהיה] [?].

Diagram. A second sphere figure of the same family: a circle crossed by a great-circle arc cutting obliquely across it and a second arc, meeting toward the lower part of the circle — the oblique-sphere / ecliptic-on-horizon construction. Point-marks at the rim and at the crossing; labels not legibly resolvable. [Figure labels illegible]

- [rim and crossing point-letters present but individually illegible] [?]

the ascension [שעולת] of half the day [חצי היום] [is] inscribed [חקוק] [?] … And [as far as] point **[?]** [is] the ascension [שעולת] [?]. And if the points of intersection [נקודות החתוך] [are] reversed [הפוך] [?] … the ascension of half the day, [as much as] point **[?]**; and its ascension [שעולתו] [is] known [ידועה] [?]. And the arc which the circle of the ecliptic [makes] with the horizon [קשת שהעגולה … עם האופק] [?] … in the measure [בשעור] wherein the arc is [at] a right angle [קנצבת] [?] … the parts [חלקים] **[compound value]** [numeral: ?] …

the parts [חלקים] [?] — [these being] what remains [מה שנשאר] of the arc, the angles being right angles [זויות נצבות] [?] … And the ascension [שעולת] [?] — [as much as] point **[?]** … And another arc [ואחר?] [?], the ascension [שעולת] [?], for it [?] fifteen [15 = ט"ו]; therefore they are [?] … in the measure of **A B** [אב] [?]. And half the arc [וחצי הקשת] [?], the line [קו] [at] a right angle [נצבת] [?] parts [חלקים].

Diagram. A third, more elaborate sphere figure at the foot of the page: a circle divided by two (or more) crossing great-circle arcs into curved segments — an oblique-sphere construction of horizon, meridian, equator, and ecliptic. Several point-letters are marked around the circumference and at the interior crossings; individually they are not legibly resolvable at this resolution, though the top mark reads plausibly as **ב** (B). A faint offset figure (show-through from the facing folio) is visible below and is disregarded. [More than two labels illegible]

- [multiple rim and interior point-letters present but individually illegible] [?]

[Librarian note: modern pencil "151" in the lower-right margin of p. 320.]

He next inquires concerning the pole ג. At the remove of the rising quadrant [רבוע השעולה] — the ascension of half, that is, half of the whole — we are able to determine the magnitude of angle כב״צ [?], that is, arc [ם]כ [?]. For since point ג is the pole of the ascension of half the whole, arc בח [?] will be the rising quadrant. And because the figure has this configuration, the ratio of the chord of the doubled arc [subtended] by ב is compounded of the ratio of the chord of double בז [?] to [the chord of double] אזח [?], and of the ratio of [the chord of double] טה to הה [?]. The one term is known, because it subtends the erected arc — arc בז [?], the base [המושבת]; and the other is known, because it is the remainder of the rising quadrant. And by it one finds the remainder of the rising quadrant, and [likewise] the remaining part of the rising quadrant. Therefore this magnitude is known — which is the rising quadrant that lies before you in all of this. This is known, and it is what we intended.

In the first figure of this Gate it is shown that the angle at the head of Virgo equals the angle at the head of Scorpio. Hence, if you know the degree of Virgo, with point ב at its head, arc [?] will be 101 parts [ק״א חלק]; and the angle at the head of Scorpio will be the same. And since the distance of the head of Scorpio and the head of [Aquarius?] [ראש דנ״ס — reading uncertain; דלי, Aquarius, is the likeliest sign] from the point of intersection [נקודת ההיתוך] was one and the same distance, and so too [for] Virgo —

Accordingly, in the second figure you will find from this that the angle at the head of [Aquarius?] [ראש דנ״ס — reading uncertain] together with the angle at the head of Scorpio make right angles; and if the angle at the head of Scorpio is 101 parts, the remaining part of the angle at the head of [Aquarius?] [?] [is the complement], and likewise the angle at the head of Taurus [ראש שור]. And if we set arc [ב]ז [?] at two degrees, with point ב at the head of [Leo?] [ראש אריה —

reading uncertain], the angle כה״ה [?] will be 101½ parts [ק״א חלק וחצי]; and likewise the angle at the head of [Sagittarius?] [?]. And the whole [sum] of the triangle of the arcs — the head of Gemini [ראש התאומים], the head of [Aquarius] [ראש הדלי], and the head of Aries [ראש טלה] — the remainder being right angles, is [numeral: ?] and a half. Thus we have already come to know the angle at the head of [?] for every sign. The angle at the head of Aries and the head of Libra we know from the fourth figure; the angle at the head of Cancer [ראש סרטן] and the head of Capricorn [ראש גדי] from the third figure; and the remaining zodiacal angles in this fifth figure. And it leaves you [to derive] the first and the second.

After this he treats [the matter] by another method, by which the remaining angles between the ecliptic [נתלת המזלות] and the horizon-circle [גלגל האופק] are likewise made known. He lays down the meridian [שעולת חצי היום, the ascension-circle of midday] [אב[ג] [?], the rising [circle] of Aries [אה[ן] [?], and the horizon [בה[ד] [?] — these being the sections of the ecliptic — [and shows them] equal; and [shows] that they are the points of the winter [solstice].

Diagram. A circle representing the sphere, crossed internally by several radiating great-circle arcs (the ecliptic, the horizon, and the meridian) that intersect within it and divide the circumference into sectors; point-marks are set around the rim. A three-line note is written inside the upper part of the circle (approx. "וזו הזוית / שם נצבת / כי יבואר" [?] — "and this angle is there a right angle, as will be explained"). An external caption ("צורה מצוירת" [?], "the figure as drawn") stands below. More than two labels are uncertain

Diagram. A circle (sphere) with two or three great-circle arcs crossing near its center, dividing it into sectors; point-marks (single Hebrew letters) are placed around the circumference and near the intersections. An external caption to the left ("וזו… מצוירת" [?], "and this [is how it is] drawn"). More than two labels are uncertain

Diagram. A further circle (sphere) at the foot of the page with two intersecting great-circle arcs and point-marks set around and within it; an adjacent external caption. This and the preceding figure belong to the group of construction-figures for the ascension theorem. More than two labels are uncertain

We find them all equal. We say that every angle החם [?] equals angle דל[ב] [?], because they belong to the same triangle — the two triangles being alike; so that angle דלב [?] equals angle החם [?]. And you may reckon this in the way that the sage R. David ibn Naḥmias [ר׳ דוד אבן נחמיאש] set it forth in the first figure of the Gate of Ascensions [שער הצמחים]. And afterward he says that the arc of their

angles, together with the two collecting points [שתי הנקודות המקבצות] — the eastern with the western — are equal to two right angles. He calls "eastern angle" the [angle] produced by the eastern dividing-section [חתכת המזרחית], and "western angle" the angle produced by the western dividing-section [חתכת המערבית]; and as he explains at [point] ט [?] —

[He treats] the eastern angle. He lays down the rising [dividing-]circle אב״ג [?] and the ecliptic [ג]אה [?], erected upon the two points א and ז [?], one of them eastern and the other western; and he shows that there the angles דאה ,[ב]ז [?] are equal to two right angles. And this is proven, because angle דאה [ב]ז [?] equals angle [ב]ז [?], and [likewise] since they are right angles. And as was shown in the figure preceding this one, [it holds] —

Diagram. Two overlapping circles — a larger circle and a smaller one intersecting it — representing two great circles (the rising circle and the ecliptic, or the ecliptic and the horizon) that meet at two intersection points; point-marks (single Hebrew letters) are set at the top of the upper circle, at the two intersections, and at the foot. More than two labels are uncertain

— that the arcs whose distance [from the intersection] is equal are themselves equal. And it is shown that in this figure the eastern angle, together with the western angle opposite it, are both equal to two right angles. Therefore, if you take the rising [circle] and divide it into four equal parts at four points — two upon the two intersection-points [חיתוכין] and two upon the two poles [הקטבין] — then reckon, from one intersection-point, two equal arcs; and we set on either side of the intersection a small arc equal to it. It will readily be shown to you that, for any two points whose distance from one intersection is the same equal distance, the eastern angle for the one together with the western angle for the other are both equal to two right angles. And just as the eastern angle runs from the head of Aries [ראש טלה] up to the head of Libra [ראש מאזנים], so from these [same relations] we can know the eastern angle that runs from Libra up to Aries.

[Conclusion of the Second Treatise — the rising-times of the signs and the angles of the ecliptic]

This is known through the first motion: from [?], and likewise from the standing [erect position] of the angles — which are two parts together, as has been explained regarding them. And from this [?]. And we say thus: given a known arc [length], a line, [point] L [?], and a known latitude [רוחב], the measures of the required [angle] are set out [?].

In it were found [?]. And we say thus: [?] — these are small measures, the right [erect] angles; and the [?]. And we say this: [when] the [rising] arc [?], the measure of the angles that the ecliptic makes toward the beginning [head] of the eastern [rising] sign [?] — the receiving [rising sign] [?], that is to say, [the angle at] the beginning of the sign that rises up above [the horizon?] [?]. And one must [determine] these — the measures of the required line — according to [the arc of] the ecliptic [that is at] the meridian [חצי היום] [?].

The sun, being upon the ecliptic at its rising, at the place of its rising [מקום צמיחתו], [gives] the beginning of the [rising] sign; and this is known from the Table of Ascensions [לוח הצמחים]. And afterward [we treat] the remaining [ascensions] set out on the ecliptic [?] toward the zenith [הקדקד].

The rising-point is a fixed place [?], for the zenith [הקדקד] [?] [?] the horizon [האופק]. And because we have set down the arcs and the measures of [?], and for each sign [there is a value] as [?], there is a difference [שינוי] also in the angles, which we [reckoned] beforehand [?]; and there is yet another difference [?]. [As for] the arcs and the [rising-]times [?], the day [?] — because the measure of the arcs is such that the ascension of the zenith [מעלת הקדקד] and the remaining rising-times, together with the ascension of the zenith relative to the [part] on the ecliptic at midday [בחצי היום], are equal on both sides [?] to a single arc, [that of] the meridian [ראש חצי היום]. But it changes according to the arc [?]; and the measure of the arcs and the rising-times before midday is as their measure after midday, [differing only] in the measure of the length of the [seasonal] hours [שיעור אורך השעורים]; and [likewise] the rising-times of the half-signs, which [meet] with [?] [?], and the angles of the one half [?].

And one makes use of the arcs and the rising-times in [the place] where [?] appears — namely, that you first know the measure of the distance of that part which is above the circle of the meridian [מעגלת חצי היום], toward the east (and this is before midday), or toward the west, after midday. And you take the part that is at mid-heaven [בחצי השמים], and the rising part [החלק הצומח] [?], [and thereby] the time [?]. And since [we have set forth] all this [?], we have recounted it. And we [add] this alone [?]. And he said that one may also, for [reckoning] all the arcs and rising-times, make use of four columns [ארבעה טורים], as was written in the first column [בטור הראשון], whereby the [seasonal] hours will be made known.

[The lower third of the page is blank parchment.]

[Concluding lines of the Second Treatise:] And we say: [the measure of] the arc that comes from the zenith [קדקד ראש] to the beginning [head] [?] is thereby completed. And with the remaining angles [?], [it is set down] in the measures of the remaining rising-times [returns], and [?] the ascension [?] the zenith, and on the ecliptic [?] — in the third column [כטור השלישי] it was written [?]. The remaining arcs [?] east, from the sphere [?]; and we say [it is] approximately [close] [?] — [thus] the standing of the setting angles [נצב הזויות המעריבות]. [A small word closing the treatise follows; possibly "concluded" (תם/חתם) [?].]

הַמַּאֲמָר הַשְּׁלִישִׁי — בִּתְנוּעַת הַשֶּׁמֶשׁ

The Third Treatise — On the Motion of the Sun

שַׁעַר רִאשׁוֹן — First Gate: On knowing the measure of the length of the year and the number of its days [שער ראשון בידיעת שיעור אורך השנה ומספר ימיה]

The truest [most reliable] way to determine [choose] in this matter [?]: from all that it is granted [permitted] to set down, that [we may] establish [?], a close approximation [קירוב] is obtained by it — namely, when the sun comes to a star among the fixed stars [כוכב מכוכבי הצבא], until it returns together with it a second time. For, since the star has a motion [?] over against it [?], and in general [?], the light of the sun rises [?], and its being seen together with the star [?] — this is not [?] a fitting matter [?]; because the [mean] motion of the sun is greater [more] than that of the star [?], [and] this is [?].

[?] at Alexandria [אלכסנדריה?] [?], and the day that [?]; [?] the day [?], and it is profane [ordinary] [?] — the sun [?] from the [?] a line [?]. [On the day] that is completed [?], the light of the sun [rises] from the point of [?] [?], as we have shown [demonstrated]; and there remains for you [ונשאר לך] [?] that [?], a line [קו] [?]. And likewise the number of the days [מספר הימים], and the hours [והשעות], and the moments [והרגעים] which [are taken] from [?], until the completion [תאות] of the year — and this is the measure [line] of the length of the year [וזהו קו אורך השנה].

And it has [?] been found in this, that is to say, that the length of the year [אורך השנה] is three hundred sixty-five [שס״ה = 365] days and a quarter [ורביע], together with a small further amount [?]. [?] one of the wise [?] [?], and [?] the sun [?]. Another [?] beyond this — the star that [?] [?], and for the sake of [?] the

length of the year [אורך השנה] [?]; [and] the matter is [?] according to the truth of the matter [?], and further [?].

[Foot of page, pencil foliation: 153]

[Book III — On the Motion of the Sun (המאמר השלישי), continued. Sephardic semicursive, single column, scribe Sasson ben Menashe.]

[f. 153v (right page of the opening)]

He found the length of the year to be 365 days, 14 regaim [the first sexagesimal fraction of the day, i.e. "minutes"], and 48 seconds — that is, according to the reckoning in which the day is taken as 60 regaim. But according to the reckoning in which a day is 24 hours, each hour being 60 regaim, the length of the year, in Ptolemy's view, is 365 days, 5 hours, and [numeral: ? regaim — candidate = נ"ה 55].

When one divides the 365 parts — which are the degrees of the sphere — over these days, hours, and regaim, there comes out the motion of the sun in a single day: 59 regaim [arc-minutes], 8 seconds, [numeral: ? thirds], [numeral: ? fourths], [numeral: ? fifths], approximately. This is what is called the mean motion of the sun for one day. And when we take a twenty-fourth part of this, the mean motion of the sun in a single hour is 2 regaim, 27 seconds, [numeral: ? thirds], [numeral: ? fourths]. For this reason the sun's motion in one hour is so called.

Now the sun has another motion, one that is not uniform, besides this mean motion. Ptolemy set out to investigate it — its cause and how it comes about — and he examined first the cause of this variation, which is common to all seven planets. He supposed in his mind that the cause of this variation is one of two things, or both together. The first is a sphere whose center is displaced from the center of the world [the eccentric]. The second is an epicycle sphere — meaning a sphere whose center revolves upon another sphere.

The matter is clear: whether we suppose that the cause of the motions of the planets is that they revolve upon the circumference of an eccentric sphere, or upon the circumference of an epicycle sphere, either is possible. The meaning of "variation of motion" is that the planet traverses equal arcs in unequal times. For example: the sun travels from the point of the head of Aries [the vernal point] to the head of Cancer in about 94½ days [?], and from the head of Cancer to the head of Libra in about 92½ days [?]. So you see that the arcs are equal while the days are not — and this shows that the sun has another motion besides the mean one we spoke of.

Since it is not fitting for the planets to have any motion but uniform motion — as is explained in natural science — and yet we do observe variation in their motion, there must be a cause for this. The masters of this science therefore supposed that the cause is that the planet revolves upon the circumference of an eccentric sphere, or upon the circumference of an epicycle sphere.

[f. 154r (left page of the opening); pencil foliation "154" at foot]

אמר המחבר [Said the author] — These revolutions, whether the eccentric ones or the epicyclic ones of the epicycle sphere, are engraved within the globe of that planet itself. For within the globe itself another globe is hollowed out. The center of the great globe is the center of the world, but the center of the small globe hollowed out within it is a different center, not the center of the world. Likewise, within the great globe itself another globe is hollowed out — a small globe set in a different manner. It is not one that rolls within the whole of the great globe and surrounds the great globe on all its sides, like the one just mentioned, but in another way: it is hollowed out within the body of the great globe, at one place of it — a small globe whose center lies upon a point [within the great globe]. This small globe is the one called the epicycle sphere.

[The following is a labeled geometric construction keyed to the diagram below. The recurring point-labels A, B, G, D (אב״ג ד), H (ה), Z (ז), Ḥ (ח), T (ט), and M (מ) are read from the prose; several interior arc-values and a few subordinate labels are at the limit of what the scan will yield under magnification and are flagged for re-examination.]

So that the matter may be made clear to you: let the great globe be taken, and let the circle bored out from it be the circle אב״ג ד [A-B-G-D]; let the point [label: ?] be [set], and let their center be ד [D][?], which is the center of the world; and there is hollowed out [a circle] whose center is ה [H]. And if you divide the globe אב״ג ד into two halves at point [label: ?], and [draw lines] from the center at a distance of [numeral: ?], they will meet at [point label: ?] — and this is what is called the epicycle sphere.

So then we make the globe אב״ג ד; and there is hollowed out within it, on one side only, the globe ה״ז ח״ט [H-Z-Ḥ-T] in [its] motion [and its] [labels/values: ?]. And if you divide the globe ה״ז ח״ט into two halves at point מ [M], and divide the globe אב״ג ד into two halves at point [label: ?]... [the construction continues into the following folio].

Diagram. A figure of concentric circles set into the lower-left of the text block, illustrating the eccentric/epicycle construction described above: a large outer circle, a middle circle within it, and a small circle at the center marked with a central point. Faint compass arcs and inscribed straight lines forming a star/polygon pattern are visible within the circles. The point-labels belonging to the figure are not legibly resolvable on the figure itself at this resolution (the labels A/B/G/D, H/Z/Ḥ/T, M are recovered from the surrounding prose, not read off the drawing). [The figure's own labels remain unread and need re-examination at higher magnification.] …its [mean] position. He [Ptolemy] adopted this arrangement because, given the anomaly [השינוי] of its motion, the position of the star may be taken to lie either on the eccentric sphere [גלגל יוצא מרכז] or on the epicycle sphere [גלגל הקפה]. Let us set the eccentric sphere as the circle ABGD [אבגד], with its center at H [ה]; and let the center of the degrees — that is, the center of the world — be W [ו]. We draw the line [joining the two centers and extend it] to the far distance [המרחק הרחוק — the apogee] and to the point of the near distance [המרחק הקרוב — the perigee].

Now as [the body] moves along [the arc] ABG [uniformly about the center H], the [apparent] motion [seen from W] varies from [uniform motion] [?]. And angle DHG [דהג] is equal to angle [?], as was demonstrated in the first book of Euclid [Elements I]. Therefore angle AHB [אהב] is greater than angle DHG; and accordingly arc [?] is greater than arc [?] [that is, the difference of the two arcs is the anomaly of the motion]. [The following clause repeating the construction from the apogee to the perigee, with its specific arc- and point-labels, is a dense semicursive string I cannot resolve into reliable labels at this resolution — see QA.][?]

Diagram. The eccentric construction. A large outer circle (the concentric of the ecliptic, whose center is the center of the world) contains, offset toward the upper part, a smaller circle (the eccentric); nested near the top is a small bull's-eye of two or three concentric rings around a central mark (the body of the sun on the eccentric, drawn with a solar glyph at its center).

- [Interior, near the inner circle]: ו [?] (W)
- [remaining interior labels do not resolve: ?]

Diagram. A single circle carrying a diameter drawn from a labeled point at the top down through the center, with two chords struck from a point on the lower-left rim, and short tick-hatching marking a graduated arc along the lower-right circumference (the arc on which the equation is measured).

- [Top, upper end of the diameter]: ה [?] (H)
- [remaining rim/vertex labels do not resolve: ?]

Diagram. A circle with an inscribed triangle / crossing chords forming an X near the center, and tick-hatching along an arc of the right-hand circumference (again a graduated arc measuring the angular difference).

- [remaining vertex labels do not resolve: ?]

Diagram. The equivalence figure: a large circle (the deferent / concentric) with a smaller circle (the epicycle) overlapping it at the upper left, a diameter drawn across the large circle, and a line joining the small circle to the center. This is the standard construction showing that a body carried on an epicycle riding a concentric is geometrically equivalent to a body on an eccentric circle.

- [Upper part of the large circle]: ה [?] (H)
- [Small overlapping circle, left]: ב [?] (B)
- Lower rim: ד [?] (D)
- [remaining labels do not resolve: ?]

[Verso. The upper margin carries a small ink letter ג at the top; the lower-right corner bears the pencil foliation "155".]

[Margin, top of verso: ג — a single letter (possible quire/leaf signature); not a running header.]

And when the center of the epicycle sphere [מרכז גלגל הקפה] traverses an arc [?] equal to arc [?], then an anomaly [שינוי] appears to the observer, and its one motion is added to [the mean motion of] the star (interlinear: הכוכב — "the star"). When the center of the epicycle sphere is found at [point] B [ב], and the position of [the star] on the epicycle is [?], then — because the star indicates the [same] portion [?] — [the two motions coincide]. [A stretch here setting the star's arc on the epicycle against the arc of the eccentric, with several specific arc- and point-labels, is below my reliable-decode threshold in this semicursive at the supplied resolution and is flagged rather than reconstructed.][?]

The center of the epicycle sphere then adds arc AB [אב] alone, which is equal [in appearance] to arc [?]; and so it appears as though [the body] had been added [?] … [and this] arc [?] corresponds to arc [?] as before. And because the motion [at the apogee] appears the smaller [יראה קטן], whereas [near the perigee it appears the greater] [?] — [the argument runs] that the motion of the star on the epicycle sphere [corresponds] to what [is observed] on the [eccentric] sphere: [namely,]

from [point] G [ג] to [point] B [ב] [is as] from [point] A [א] to [point] G [ג] [?]. [Two further clauses tracing the correspondence of the two motions arc-for-arc are not reliably legible and are flagged.][?]

The conclusion of the argument is legible: for the principle of the one of them is like its principle in the other [כי סוד האחד מהן כסודו בחברו]. He means by this that whatever appears in each of the two foundations [היסודות — the two hypotheses] is equal, the one to the other: that is, the anomaly, whether it arises from the epicycle sphere or from the eccentric sphere, is one and the same. Afterward he chooses for the sun the eccentric sphere, and not the epicycle. And he said this concerning the ratio between the two centers [יחס שבין שני המרכזין], which is like the line [?] in the first figure [בצורה הראשונה].

He further sought to determine at which degree of the ecliptic band of the zodiac point A — which is the apogee [the point of greatest distance] — would fall. He derived this from knowing the lengths of the two seasons, the spring [Heb. החום, "the warm season," i.e. the quarter from the vernal equinox] and the summer; and by this he completed his determination [להבנת...(?)], for he found the length of the spring to be 94½ days and the length of the summer to be 92½ days.

He then inscribed the circle of the zodiac ABGD about center H, setting its two diameters to intersect at right angles and extending them out to the four points — the solstitial and equinoctial points — which are A, B, G, D: point A the spring [the warm season], and the others marking the summer [הקיץ], the autumn [הסתו], and the winter [החורף]. [The exact pairing of letters B, G, D with summer, autumn, and winter is not fully resolvable on the page; only A is read with confidence.]

Since the quarter of the spring — which is the sun's motion along arc AB — is the longest of all the remaining quadrants, and since it is already known that the motion at the apogee is the slowest [most gradual], it necessarily follows that the point of the apogee, which is the highest point [נקודת הגובה], lies between the two points A and B, and that the center of the eccentric sphere lies between the two [diameters].

Diagram. A large outer circle (the zodiac) with a smaller circle set within it and displaced toward the top (the eccentric). Two diameters cross at right angles through the figure; the horizontal diameter is carried out to the right, beyond the outer circle, to a marked point. A center is marked at the intersection, with a second center-point nearby (the center of the eccentric). A short chord/line is drawn across the upper-right of the figure. The letters are small; only the

extended right-hand point is fully legible. The construction corresponds to the zodiac circle ABGD about center H described in the surrounding text.

- Right end of the horizontal diameter, carried outside the outer circle: א (point A) — legible
- Top end of the vertical diameter: ב [?]
- Left end of the horizontal diameter: ג [?]
- Bottom end of the vertical diameter: ד [?]
- Intersection of the diameters (world-center): ה (H)
- Second center-point near H (center of the eccentric): ז [?]

He then set down point Z, and drew line HZ [(ז)קו ה] through the two centers, and [point Ḥ(?)] the [good/mean(?)] point; and he cut [the figure] upon center Z. At whatever distance arose, of [numeral: ?] [the ascension(?)], he carried it across; [and he drew] through point Z line NS parallel to line AB; and this line is [?]. And he drew [line ?] and set up [a perpendicular(?)], so that arc [TN(?)] is [numeral: ?] and a half [days(?)]; and the whole of arc [BTB(?)] is [numeral: ?] and a half; therefore the mean motion [along arc BTB(?)] is [numeral: ?] and a half, and [numeral: ?] parts and [numeral: ?] moments; and the motion along [BTB(?)] is [numeral: ?].

Therefore the whole of arc [TLB(?)] is [numeral: ?] parts [candidate: קמד = 144] and [numeral: ?] moments [candidate: נו = 50], and there remains for each one of them arc [TN(?)] equal to [numeral: ?] parts [candidate: שן] and [numeral: ?] moments. Then he cut [the figure], and we know the perpendicular ʻZH [עזה], which is equal to line HD. And since arc [ʻB / PB(?)] is known, and arc [ʻGB(?)] is known, and [the arc] is known [ידועה] — because it is a quarter of the ascension — therefore arc [PB(?)] is known; the measure of [the perpendicular(?)] is known; this line, which is equal to it, is known; and it was already known [that HD is known]; therefore this diameter is known.

[Verso — the derivation continues.] It comes out in the computation as two and a half parts approximately [the eccentricity], which is one part out of [numeral: ? — candidate כד = 24] of half the diameter of the eccentric sphere [i.e. of its radius]. Next he determines the magnitude of arc ḤB in this way. He first derived by computation that this line is one part and two moments, and that this [other] line is two and a half parts approximately; therefore, when they are combined, this will be [numeral: ?], as the longitude, which is [numeral: ?] — so many parts. From this [comes] the right angle that arose; and since it stands upon

[numeral: ?], this is its diameter; therefore the arc whose ascension is this will be a number of parts.

And so this right angle is [known(?)]; and since it is upon the center of the ascension ABG[?], therefore arc HB [הב(?)] is likewise [numeral: ?] parts. We reckon that upon it the right angle [subtends] [numeral: ?] parts; and arc AB is as [numeral: ?]; and upon [the right angle] of [numeral: ?] parts, arc HA is [numeral: ?] parts and a half. And since point B is the head of Cancer [ראש סרטן] — that is [פירוש] — point HA becomes the point of [numeral: ?] parts and a half from the boundaries [מתחומים].

Next he derived the length of the winter quarter, which is arc [numeral: ?], and of the autumn [הסתו], which is arc [numeral: ?], in this way; for [the sum of the two together] is arc [numeral: ?]. Arc [numeral: ?] is [numeral: ?] parts, and arc [numeral: ?] is [numeral: ?] parts and [numeral: ?] moments, and arc D is [numeral: ?]; therefore arc [D-L-G(?)] is [numeral: ?] parts [candidate: לו = 36] and [numeral: ?] moments; and the sun [moves]...

In the mean motion, [in the arc reckoned in days] [numeral: ?] and [numeral: ?], which is the time of the winter. And the remainder [is] the arc of [numeral: ?] that the sun traverses in [numeral: ?] days and [numeral: ?] moments approximately. Therefore, in full: for arc AB, which in degrees is 90 parts [= צ 90], from the head of Aries [ראש טלה] to the head of Cancer [ראש סרטן], the sun traverses it in [numeral: ?] days and a half; and 90(?) parts from the head of Cancer [סרטן] to the head of Libra [ראש מאזנים], in [numeral: ?] days and a half; and 90(?) parts from Libra [מאזנים] to the head of Capricorn [ראש גדי(?)], in [numeral: ?] days and [numeral: ?]; and [90(?)] from Capricorn to the head of Aries [ראש טלה], in [numeral: ?] days and [numeral: ?].

You will find that the mean motion exceeds the [apparent] motion from the start of [numeral: ?] by [numeral: ?] parts, [numeral: ?] moments, and [numeral: ?] seconds [שניות]. The time of the mean motion is [numeral: ?] days and a half, which is [numeral: ?]; and it adds in the summer quarter one part and [numeral: ?] moments, [numeral: ?] seconds; but in the winter quarter the [apparent(?)] motion exceeds the mean by [numeral: ?] parts, [numeral: ?] moments, [numeral: ?] seconds; and it adds, in the autumn quarter [רבע הסתו], [numeral: ?].

[Pencil foliation "156" is written in the lower margin of this page.]

Therefore, if we divide [the zodiac] from both sides of point A and take the remaining arcs from the sphere of the zodiac — these being arcs — each of them

will be a quarter-circle. After that we divide the eccentric sphere and set the distance between the two centers at [numeral: ?] parts and a half. It has already been shown by construction that the arc of the eccentric which its diameter subtends exceeds [the corresponding zodiac arc] by more than one degree; and we now wish to know how great [the equation] is.

Point G [ג] is the center of the eccentric, and point D [ד] is the center of the [sphere of the] degrees, and your angle [there] is a right angle. It is therefore close [to demonstration] that the arc has in it more than [numeral: ?] parts. We wish to know how much it will be — for the matter is straightforward, since this line which lies between the two centers is known, and likewise [the other lines are known].

Take half the diameter; the line HA [הא] is known, and its angle is a right angle, and so the parts of line KB [קב] are known. And if we set upon [it] a quarter-circle, by the reckoning in which [the hypotenuse's] angle is a right angle, its side will be 30 parts and the arc upon it 30 parts; and this is the greater angle. By the reckoning in which the diagonal-angle is a right angle, [it is numeral: ?] parts; but by the reckoning in which the angle is [numeral: ?] parts, the greater [comes to numeral: ?] parts and [numeral: ?] seconds. And this is the arc ABD [אבד] of the eccentric, and it adds to the arc of the corresponding part [of the zodiac] a whole degree — that is, [numeral: ?] parts and [numeral: ?] seconds. On this account the arc of each single [zodiac] part is increased; and from there each one of them adds an arc of [numeral: ?] parts and [numeral: ?] seconds. This is the line of difference between the [true and the mean], each one [numeral: ?] parts and a half. And when it stands at [numeral: ?] parts upon it, the mean operation will be [complete?], because it is greater than the difference by [numeral: ?] parts. And so it continues.

Diagram. Two concentric circles — the outer being the sphere of the zodiac, the inner (drawn offset toward the upper portion) the eccentric sphere. A horizontal diameter is drawn across the full width, and a vertical radius drops from the center to the lowest point. Within the offset inner circle a slanted radius runs from the center toward the upper right, illustrating the eccentric and the position of its center relative to the center of the zodiac.

- א (center): center of the [sphere of the] zodiac
- ב (left end of horizontal diameter)
- ג (right end of horizontal diameter)
- ד (foot of the vertical radius, lowest point)

- Upper terminus of the slanted inner radius: [?]

And likewise, when there is in it [numeral: ?] parts and a half, the differing (anomalistic) motion will be [numeral: ?]. After what we have said — being [numeral: ?] parts and [numeral: ?] seconds — then, when we divide from the eccentric sphere an arc and wish to know how much of the equation combines with it from the sphere of the zodiac, so that we may know the difference between them:

We divide the zodiac sphere ABG [אבג], with its center D [ד]; and the eccentric is [drawn] about center [ג/ה?]; and the broken diameter between them is ABH [אבה]. And at the [point of] equation, from the point [of apogee] — which is E [ה] — there is a known arc of the eccentric, and it is [numeral: ?]. And Ptolemy [תלמי] gave for it its sides up to [numeral: ?]. Then we draw from that point [the line] EA [הא] — this line — for the arc ABH [אבה] of the degrees is thus known. Again we draw the perpendicular DB [דב], which is known; and since the arc HB [הב] is known, the angle KTB [קטב] is known, and the angle KBD [כבד] opposite to it is known.

Diagram. Two concentric circles (the zodiac circle ABG with its center, and the eccentric) with a horizontal diameter and a vertical radius to the lowest point. A slanted chord runs from near the center toward the upper left, meeting the circles at lettered points; radial lines form the equation triangle described in the adjacent prose (center D, apogee point E, and the perpendicular DB).

- ט (near the center)
- ד (foot of the vertical radius, lowest point)
- ה (top)
- Right end of horizontal diameter: ג [?]
- Upper-left terminus of the slanted chord: [?]

And if we mark upon [it] a quarter-circle at the vertex of the right angle, upon which the diameter DA [דא] rises — and it is known, since it is what lies between the two centers — there remains [an arc that is] known. Therefore the whole of KBD [כבד] will be known; and if we set [it] known, then KB [כב] is known. And if we mark upon [it] KBD [כבד] at the vertex of the right angle upon which the diameter DB [דב] rises, the angle KBD will be known; and there remains what the outer angle adds over the inner angle EDB [עדב], and the angle ALDN [אלדן?] will be known. Therefore the arc of that [portion] of the degrees is known — and this is what we sought.

And in the same way we can derive each and every part of the parts of the degrees, whenever the arc that combines with it from the eccentric sphere is known. And Ptolemy [תלמי] has already composed a table for this. The procedure with it is as follows: with what you have, you write down the amount of the mean (interlinear: motion) motion, after you have subtracted from it the motion of the apogee — for the starting point is reckoned from the point of the far distance [the apogee]. And if the number is less than [numeral: ?], [reckoned from the point] that rose [as the argument], the equation will be [additive?]; and it is [numeral: ?]. If it is more, then one must subtract from it the amount of that angle.

Diagram. A single circle with a vertical diameter from top to bottom; in the lower half an inscribed triangle is drawn, its apex toward the center and its base a chord low in the circle. Short words are written beside the arcs, distinguishing the eccentric arc from the zodiac (degree) arc.

- ה (top of the vertical diameter)
- ד (foot of the vertical diameter, lowest point)
- Arc-caption (upper): יוצא [= "eccentric"]
- Arc-caption (lower): מעלות / המזלות [= "the degrees" / "the zodiac"]
- Base-chord endpoints and mid-vertex: [?]

[Foliation: pencil "157" at the lower outer corner of page 2 (verso).]

Midrash ha-Ḥokhmah — Astronomy (Almagest paraphrase)

The Third Treatise (the Sun), conclusion — and the Fourth Treatise (the Moon), opening

[f. 157v]

and this is the equation, as it is written in the table; and the true position emerges, which is angle H-[Z?]. And if the number found for it were more than half a degree — and it is arc A-[B?] [?] — then it approaches in the reverse manner: for the apparent angle, which is angle B-Z-D, together with two right angles is greater than the mean [angle], which is angle H-M [and label ?] together with two right angles, [being] greater than it by the measure of angle [label: ?].

On the inequality of the days together with their nights. A day together with its night is twenty-four hours [כ״ד], which is the revolution of the sphere from

one point until it returns to that same point; and that is three hundred sixty degrees [ש״ס] only. This would be so, however, only if the sun were fixed and not moving. But since the sun does move, one must take that motion into account, and reckon in the amount of that motion as well. A day together with its night is therefore more than twenty-four hours by the measure of that motion, for over the course of a [solar] day the sphere revolves more than three hundred sixty degrees, by the amount of the sun's motion in a day.

And since the sun's motion is not equal on every day, as we have explained, there arises here too a certain difference of this kind, corresponding to that same variation of the motion. There is, moreover, a further inequality affecting the passage of a day and its night, and it arises from the rising arcs of the degrees [the ascensions]. For although the arcs of the ecliptic are equal, the [signs] of the zodiac do not rise [uniformly], nor do they stand at [equal ascensions] in the halves of the days; [and so] there arise arcs of ascension [unequal to] the equal degrees [of the ecliptic]. Hence this increment to the day is produced from this cause as well; and still more of what may be observed [is] that this increment [is reckoned] by way of the [tables of] ascensions [המעבירים]. [Several clauses here carry degree- and minute-values that will not lock at this resolution: the ascension-values of the signs in the right sphere amount to [numeral: ?] degrees, differing by [numeral: ?] and again by [numeral: ?] among the [oblique] signs, and the [remaining] values fall nearer to one of the two equinoctial points [נקודות השיווי], the ascension-values of the signs amounting to more than [numeral: ?] by [numeral: ? — "three degrees and a half"?], so that the difference between one ascension-value and the next is close to [numeral: ?].]

Accordingly, the zodiacal signs assigned to the *addition* [of the equation of time] are those in which the two [effects] combine as an excess — the sun's equation together with the excess measured by the degrees of the rising arcs — and they add together, running from the head of [Aries?] to the middle of Aquarius [חצי דלי]; while the remaining [signs] are assigned to *subtraction* [גרעון].

[f. 158r]

[the total]. From the sun's equation, [numeral: ? — reads ~50] minutes and two-thirds of a minute; and from the equation of the seasons [חילוף העתים], four [ד] minutes and two-thirds of a minute. The total, on combining the two of them, is [numeral: ?] minutes and a third — and this is [about] half a degree — and one part per [numeral: ?] in an hour.

Now some have differed in their opinions on this, one from another; but this is so small a quantity that one need not take account of it for the sun, nor — in reckoning its conjunction [molad] — for the rest of the planets: in these there is no perceptible error [חטא מורגש]. In the case of the moon, however, because of the swiftness of its motion, it does reach us: in a single hour the error is [numeral: ?] and close to [numeral: ?] fifths of one part.

The procedure. When we wish to reduce the unequal [apparent] days to equal [mean] days, we first take the sun's mean motion and its true [motion] at that appointed time, and we determine the true motion in the right sphere [בכדור הנצב]; then we take the difference — the difference between those [ascension-]limits [הקצוות] and the mean motion. Of whatever results we take one part in [numeral: ?] of it, and what results we call the "operative portion" [חלק מעשה]. If the ascensions [הצמחים] are more than the mean motion, we add it to the [apparent] days; and if they are less, we subtract it from the days, just as we did [before]. What results after the addition and the subtraction is the equal [mean] days. And reckon the beginning of the days from midday — because the difference between the divisions of the ecliptic and what rises or sets of them varies, and so it varies according to the variation of the divisions [of the ecliptic]; and in every place [reckoning] is [taken] at the ascension of midday, which in every nation does not change, so that this difference does not alter it.

המאמר הרביעי בתנועת הירח — The Fourth Treatise: On the Motion of the Moon

שער ראשון באי זו הבטה יאות לחפש בעבור הירח — First Gate: On which kind of observation is proper for investigating the Moon

[Margin, in a smaller running hand beside the heading:] and he chose for himself the eclipses of the moon [only] [?].

the eclipses of the moon only, because these are not affected by a change of appearance [שינוי מראה, i.e. parallax]. The clarification of the matter is this: because the earth has a perceptible size relative to the sphere of the moon, the line drawn from the center of the universe and the line drawn from the surface [משטח] of the earth will not be one and the same — and this only when the moon is not directly over the crown of our head [קדקד ראשנו, the zenith].

[Text breaks off here; the discussion of lunar parallax and the choice of eclipse observations continues on the following folio.]

It was for this reason that they took care, on account of this parallax (*shinnui mar'eh*, the "change of appearance"), in the matter of the eclipses of the sun. For a solar eclipse comes about when [the moon passes] between it [the observer] and the sun [?], and its apparent position differs [from its true position] [?]; and therefore it does not occur in every place at one and the same time. Its eclipse does not appear the same in every place, and so it is not proper for us to measure the motion of the moon from it.

The eclipse of the moon, by contrast — since it occurs when the moon stands between us and the sun [i.e. opposite the sun] — is a matter common [to all] and the same in every place. The eclipse is found [to be of the same magnitude] [?] and equal in every place; indeed [observers] saw it at this same time [?]. There is no difference [in the position] of the moon except with respect to longitude (*ha-orekh*). But the moon [yields its true motion] [?] in every place [?], [reckoned by the] longitude [?]. And since the [observation of the] solar eclipse is not exact — because the place of the moon is not the same [for every observer] [?] — [and since] one cannot proceed with it as one does [with the lunar eclipse] [?], there is not enough in it [to fix] the motion of the moon [?]; the position of the moon [in a solar eclipse] cannot be [reliably] recognized [?].

[Ptolemy therefore derived the moon's motion] from [the demonstration afforded by] the lunar eclipse [?]. And since the moon's motion appears [variable] — moving through so many degrees in its overall motion, swift [at one place] and small in its diminution [slow at another] [?]. For the moon comes at one midnight, and he sees it together with a certain star [name: ?], and [notes it] beside that star [?]; and afterwards it comes, at the end of [several] nights, [to stand] together with another star; and in a further month it comes [again] into position at midnight [?], as [it had stood] with the first [star] [?]. And at its coming, at the end of [several] nights, he did not see it beside [the same star] — beside the first star [?] — [but had advanced past it] [?]. So too he did not see it beside that star with which it had stood in the first month; rather the moon [had moved] further [?].

And he did likewise in a third month; and from the discrepancy [?] of the moon's motion [he reckoned that] the very arc that lies between one star and another is to be taken as [the measure of the moon's] motion [?]. He computed by this its motion, and saw that when it returns to a known point of its epicycle (*galgal ha-haqqafah*), the center does not return, within the epicycle, to that same point of the sphere of the zodiac (*galgal ha-mazzalot*, the ecliptic). For when it returns to a known point —

— that point always keeps its station, continually, facing one point of the sphere of the zodiac. Had the sun done likewise in the epicycle, then in the same way the center would have returned, within the epicycle, to that same point of the sphere of the zodiac. This, therefore, is a proof that the center of the epicycle does not revolve upon its own track within the sphere of the zodiac, but upon another circle, as will be explained. Nor is there any need to explain [here] that the moon itself travels upon its track in the epicycle and does not [merely] return within the sphere of the zodiac itself. For thus it appears: the longitude traverses, in equal days, arcs that are not equal — just as [is the case] with the sun, which we found [to advance unevenly] together with a star, [now more, now less] [?], as we said.

And from this it became evident to him that the moon has two motions; and he was not to remain in doubt, nor to content himself with one alone, as they [others] had said. The one is the motion that appears according to longitude alone. And afterwards it became evident to him that it has a motion in latitude, since the star [i.e. the moon] sometimes inclines to the north of the sphere of the zodiac, sometimes to its south, and sometimes has no latitude at all but travels upon the sphere of the zodiac [the ecliptic] itself. Therefore it has two motions: one in longitude and one in latitude.

And now, to know the total of each of these motions — that is, how, in the passing of time, each of them completes [its cycle] — [Ptolemy] set the degrees in the sphere [?]. This is not to be seen except through the sequence of the moon's eclipses: [taking eclipses] such that the time from the first to the second equals the time from the third to the fourth, and the arc of motion that the moon [traversed] from the one eclipse to the second equals the arc that the moon [traversed] from the third to the fourth. And further, the good observer noted precisely, and knew, that at the very point where the moon stood in its epicycle [at the first eclipse], at that same [point] it stood [at the second] [?]; [and at the point where it stood in its epicycle at the third], there it stood at the fourth eclipse. And further he noted precisely that its place in its epicycle at the first and second [eclipses] was [not] in the [same] position it had at the third and fourth, [reckoned] to the nearest [reference] [?]. And because the mean [interval] [?] of time, or [the interval] between [?] the eclipses [?], necessarily requires it, it follows that between them there must be a renewal of whole months, of one [integral] number [?]; and therefore it is proper that between them there be whole [cycles] [?].

[Text continues on the following folio.]

and they are equal in respect of their center within the epicycle and within the sphere of the zodiac; and the nodes, too — taken to correspond to the complete cycles — are likewise equal. This is how they found the matter to be.

They divided the days of the one interval among those two intervals by the number of anomaly-cycles, and the length of a single cycle emerged. When you then divide the parts of the sphere by the number of days of that cycle, there emerges how far the moon travels within the epicycle in a single day. In the same way, divide the days of that interval lying between the two eclipses by the number of months contained in it, and the mean [synodic] month emerges. When you reckon that interval together with the sun's mean motion for one day, the sum yields the amount the sun has traversed in its mean motion during the mean month, until the moon overtakes it. Then, when you add to it the parts of the circle in one revolution — namely 360 [ש"ס] — the whole sum is the moon's travel during the mean month. And when you divide that by the number of days of the mean month, there emerges how far the moon's mean motion carries it in a single day.

We shall now explain the nature of this. He said that the ancients adduced the intervals between the four eclipses in the manner we have described — namely, that the interval from the first to the second be equal to the interval from the third to the fourth, and that within that span whole months and whole cycles be completed. He meant that the measure of the "month" is reckoned from one conjunction to the next [or from one node to the next [?]]. As for the meaning of "whole cycles": it is the travel of the epicycle's center along the ecliptic [נתלת המזלות], which carries the moon — from its being together with a [fixed] star until it returns to that same star — round again; and likewise a [whole] return within that same span, from one node to the next [?].

And they found it to be [numeral: 126,007(?) — the thousands-figure ו⟨?⟩ק does not fully resolve] … days; and Hipparchus [אברכם = Hipparchus [?]], after further observation, found it to be [numeral: 126,007(?)] and seven days and one equal [equinoctial] hour. He found that this span comprises [numeral: 4,267(?) — ד' אלפים ורס"ז] months, and that it contains, of the returns of the epicycle's center, [numeral: 4,573(?) — ג⟨ע⟩ו מאות וה' אלפים ד'] returns. And in order to simplify the procedure, Ptolemy [בטלמיוס] took [Margin, page 2, upper (darker ink): "השוות" [?] — perhaps "the equalized/mean [motions]"] the numbers — whether those of the ancients or those of Hipparchus — and reduced the count to two, taking a [numeral: 47th(?) — מ"ז] part of each of them; and there was gathered, from the

number of months, [numeral: ~267(?)] months, while the returns of the epicycle's center are double [כפ"ל] the [anomaly] returns.

And when Hipparchus [אברכם] divided those days by the [numeral: 4,267(?)] months that they had found within this span — that is, from one conjunction to the next, or from one node to the next — there emerged as the portion of a single month: 29 days [כ"ט יום], 31 minutes [ל"א דקים], 50 seconds [נ' שניות], 8 thirds [ח' שלישיות], and 20 fourths [כ' רביעיות]. This is on the reckoning that a day contains 60 minutes [ס' דקים]; but on the reckoning that it contains 24 hours [כ"ד שעה], each hour holding 60 minutes [ס' רגעים], the lunar month comes to 29 days [כ"ט יום], 12 hours [י"ב שעות], 44 minutes [מ"ד רגעים], and 3⅓ seconds [ג' ושלישׁ].

And if we compute the sun's mean motion during the aforementioned lunar month and add to it 360 parts [ש"ס חלקים], the whole sum is the moon's mean motion for one month. When we then take from it the portion of a single day, it comes to 13 degrees [י"ג חלקים], 10 minutes [י' דקים], 34 seconds [ל"ד שניות], 58 thirds [נ"ח שלישיות], and [numeral: ⟨33⟩ fourths(?) — the fourth place does not fully resolve].

The determination of the portion of a single day of the varying [anomalistic] motion, taken by itself, is as follows. Since within these months there are completed [numeral: 4,573(?) — the return-count does not fully resolve] returns of anomaly, the motion in each cycle being [numeral: ?] parts, we are to multiply the number of cycles by these parts; what results we divide by the days of this month, and the quotient is the portion of a single day. And when he refined the calculation further, he found a small addition, about [numeral: 12(?) — י"ב] fourths.

Its motion in latitude [ברוחב] they derived in the following way. When the two eclipses of the moon were separated by as long a span as one could manage, and the eclipses were equal in the magnitude of eclipse [שיעור הלקות] and this equality persisted, and the moon was in both of them at one and the same point of its [inclined] circle, and the eclipse was on one and the same side [whether north or south [?]], and at one and the same node — whether at the head [ascending node] or at the tail [descending node] — then, in such a concurrence, both conditions require that the moon's distance from the node at the onset of its eclipse be equal to its distance at the end from that very same node, and that it be seen on the same side. In that case, that span comprises whole returns for the moon's travel in latitude, and likewise for the travel of the epicycle's center.

When you divide that period by the number of revolutions in latitude, you obtain the moon's mean motion in latitude. In this period there were five thousand four hundred and [numeral: ?] months, and among the revolutions of the latitude-motion there were five thousand [numeral: ? hundred] and [numeral: ?] revolutions. When you convert all these revolutions into parts [degrees], then divide what accumulates over all these months and assign to each day its share of it, the moon's daily motion in latitude comes to 13 parts, 13 [minutes], [numeral: ? — the remaining sexagesimal places sit below the legibility floor].

The meaning of the motion in latitude is this: it is the motion of the center of the epicycle sphere upon the [node?] of the inclined sphere. In Ptolemy's correction he added to the computation about ten fourths. The latitude-motion exceeds the longitude-motion — the smaller [of the two] being the motion of the zodiac; so when we subtract the longitude-motion from the latitude-motion, there remain [ז 30 = or 3 = ג: literal glyph ambiguous] regaim and about 11 seconds.

When the ancients assembled [their observations], they saw that the inclined sphere shifts together with the sphere of the zodiac; this we found from the displacement of the eclipses. They observed one [eclipse] in a single sign, and afterward observed another in a different sign by itself; and in this way it became known to them that there are no fixed points there, but shifting ones, and that their displacement is by the known measure that lies between longitude and latitude, as we said.

Now he explains the ratio of the radius of the carrying sphere — which is the inclined one — to the radius of the epicycle sphere. Thus let us picture, in the figure, the moon risen above the center of the sphere of the zodiac and lying in the plane of the sphere of the zodiac; and what has risen is inclined upon it by the measure of the moon's position in latitude and its distance. And its center, likewise, [is the] center [of...] by the measure of the excess of the moon's motion in latitude over its motion in longitude.

And we picture the epicycle sphere revolving upon the ascending node, the inclined one — it too [moving] in the regular order of the course of the zodiac, all of it from west to east; and the motion of the [epicycle] center upon the node is the measure of the motion in latitude. For this we need to take the eclipses of the moon. He marked for it the ascending [point] of the epicycle sphere, and marked upon it the positions of the moon at the eclipses; and afterward he drew, with lines, the ascending [points] and the center of the zodiac.

[recto foot; continues on the verso]

And between the length of the nodes [there lies a distance] like the radius of the epicycle sphere, by the measure in which the diameter of the inclined sphere is 60 parts; and it came out to him that it is 5 parts and [numeral: ?] regaim, approximately. Afterward he marked for this [the circle?], which is for the moon's mean [simple] motion.

He explained the mean motion: it is [the case] when the center of the epicycle sphere is upon the far point of the carrying sphere; for the moon has no [variation?] except from its motion in the epicycle sphere alone. And this thing cannot be except at [the moment of] conjunction [?] alone — [numeral: ?] — when the center of the epicycle sphere is upon the far point of the carrying sphere. And it is likewise possible, at that same time, for the moon to be at the ascending point of the epicycle sphere; and if it has no motion of the sphere's variation, then its mean place in longitude is [also] its mean place. And it is possible that it not lie upon the [circumference?]; and if it shifts [?], then he drew [?].

[Then, near the figure:] thus we set up the carrying sphere [?], and the far distance-point [is] A [?], and the distance was like [?] the epicycle sphere upon the point [?], and the center of the zodiac [is H?]. And we draw the diameter [K-D-L?].

Diagram. A geometric figure of the simple lunar model, drawn in the lower-left of the verso. A large circle (the carrying / deferent sphere) has a smaller circle set at its apex, overlapping it (the epicycle sphere); a vertical straight line — the diameter / apsidal line — runs from the apex down through the centers of both circles, and a roughly horizontal line crosses near the top. The large circle is captioned to its left, and its point-letters are faint.

- (large circle, label to the left): גלגל הנושא — "the carrying sphere" [the deferent]
- (apex of the small circle, on the vertical line): [?]
- (center, on the vertical line): [?]

[Diagram marked as a: two point-labels flagged `[?]`; recommend a higher-magnification re-render of the figure's interior letters.]

Ptolemy marked, in the first figure, [?]; and it is equal to [?] the arc KL and the chord [?] — [Menelaus?] — that is, like the excess arc, not [reckoned] from the sphere of the zodiac. And the way in which he derived this [was] between two centers, which is the line KH. And afterward [he drew?], and we set up [?], and [we join?] to [?] and the center. Line [K?] is known, and angle KHL is known; and because [K?] is known and its half is known — since it is half the chord

subtending twice the arc KL — therefore [?] is known; and [numeral: ?] [parts?] which is [?]. By the measure in which [?] is known, [it is] [numeral: ?] parts; and [?] is also known, by [its] known measure; and the whole arc will be known by [its] known measure.

[Pencil foliation "161" at the foot of the verso.]

[f. 161v, continuing the first (simple) lunar model and its equation-table from the previous folio.]

there likewise results a known part; and where everything in it is fixed, the part in it will be known and the arc that results will be known, when the recurring problem in it is such that — as the resultant part yields parts — so too the angle of the part is known. The operation with this table is like the operation with the arc-table (לוח הקשת), and the cause of the addition and subtraction (התוספת והגרעון) in it is as in the arc-table.

The Fifth Treatise (המאמר החמישי)

This treatise will discuss the procedure for constructing an instrument by which a star may be observed — and likewise the stars, how far each of them is; and [the elongation] between it and the sun; and one observes the moon with it at the chosen instant (עת הקיצוץ הנבחר), so that in every case one may know how great the distance is between the sun [and the moon].

This instrument is the one called בעל הטבעות [the ringed instrument — the armillary]. One sights the position of the moon with this instrument when it stands at the mid-heaven (בחצי שמי הרום [the midst of the heavens]), so that it may have no parallax (שינוי מראה) in longitude, but rather its apparent position (מקומו הנראה) is its true position (מקומו האמת).

Now the position of the moon found at the time of its quadrature (רבוע) to the sun, when compared [with it], is not the same as what comes out in the present reckoning of the moon [i.e. by the first model]; for [in that model] there is no [additional] displacement of the center of the epicycle sphere (גלגל ההקפה) — at quadrature — onto the point of the near-distance (המרחק הקרוב) of the deferent (הנושא), whereas at conjunction and opposition (הקבוץ והנכח) it stands upon the point of the far-distance (המרחק הרחוק) from it.

Therefore the epicycle sphere (גלגל הקפתה) completes a full revolution, and the epicycle revolves twice in a [lunar] month. The center of the deferent sphere (גלגל הנושא) oscillates about the center of the zodiac (מרכז המזלות), against [the motion

of] the zodiac, by the measure of what the whole mean distance adds — that is, the [distance of the] center of the epicycle from the mean sun, reckoned upon its mean motion in latitude (ברוחב).

Consequently, the point of the far-distance from the deferent oscillates against the motion of the zodiac, from east to west; and the center of its epicycle oscillates toward the direction of the motion [of the stars, likewise] from east to west [?]; and the two motions combine, so that [twice a month] the point of the far-distance of the eccentric (היוצא) coincides with the point of the epicycle-center at the near point [of the deferent], at the time of quadrature.

An illustration of the matter: [consider] the zodiac sphere … and the motion is then such that their two centers are one, which is a single point; and it is set at the two points **א** and **ב**, which are the poles of the axis (קטרי הראש [the two ends of the axis]); and it oscillates against [the motion of the zodiac] … and the eccentric sphere (גלגל היוצא) [has] center **ג** [?], and its center is like **ג** [?]; and the point of the far-distance from it is **ז**.

[f. 162r. Modern pencil foliation "162" at the lower gutter margin.]

He will now explain the matter: that that same point [is displaced] in the moon [?] — that the epicycle sphere is [inclined] to the deferent sphere [?], [there being] a small point[-distance] lying between the center of the zodiac sphere and the point of the near-distance from it. And by inspection [it appears] that the distance of this hidden point at present — namely, its distance from the center of the zodiac sphere —

Diagram. At the left of the text-block a large circle represents the deferent / zodiacal circle, drawn with a vertical diameter carrying a point-letter at its top and one at its foot. At its upper-left a small circle — the epicycle — is drawn with a fan of radial lines converging on its center; two long straight lines run from the epicycle down into the large circle, representing the mean and the true (apparent) directions toward the moon, the angle between them being the "angle of difference" (זוית החילוף) derived in the proof below. Three short labels are written in a vertical stack along the interior radius, naming the deferent sphere and the zodiac sphere (the third, lowest label is not securely legible).

- Vertical-diameter apex (top of large circle): **ה** [?]
- Foot of the vertical diameter: **ד** [?]
- Epicycle (upper-left small circle) apex: **א** [?]
- On/near the epicycle: **ג** ,[?] **ב** [?]

- Interior radial label (upper): גלגל הנושא [the deferent sphere]
- Interior radial label (middle): גלגל המזלות [the zodiac sphere]
- Interior radial label (lower): [?illegible]

[More than two labels are uncertain]

— is approximately like the distance of the center of the zodiac sphere from the center of the deferent sphere; and it amounts to [numeral: ?] parts. Thus this point, which is computed alone [?], lies toward the side of the near-distance.

In knowing the true position of the moon according to its motion [?], [proceed to] the demonstration: Set the deferent sphere [as the circle] **אבן** about center **ד**, its [other] center being **ה** [?]; and the point that stands opposite the epicycle sphere is **ג**; and [there is] the point of the far-distance and [the point of] the near-distance; and the place of the moon on its epicycle sphere is **ח**. Draw the line **הבמ** [?] [and the lines] **במ**, **הה** [?], and construct arc **אב** of the deferent, which is known, it being the mean [elongation] — the double [elongation] mean between the two luminaries; and likewise construct arc **מ[?]**, which is known, it being the distance of the moon [along] its epicycle sphere as it is set.

And now, in order to know: because of arc **אב** — that is, the angle **אדב** — and because of the amount of arc **מ[?]**, which is [reflected in] arc **מ[?]** — that is, the angle **מדב** — [we obtain] also the amount of the angle **בהד** [?], and this is the angle of difference (זוית החילוף) between the mean motion (המהלך האמצעי) and the true.

We say: since the angle **אדב** was known, and the line **דה** between the two centers is known, and the line **דב** — which is half the diameter (חצי האלכסון [i.e. a radius]) — is known, therefore the line **בה** will be known. And because line **הב** [?] is also known, as we said before, the remaining angle **בה[ד]** of the right-angled triangle is known; therefore the line **נב** [?] is known.

And the remaining angles of triangle **הבד** are known; therefore the angle **הב[ד]** [?] is known. Likewise the angle **מדב**, which lies opposite it, is known; therefore arc **מ[?]** is known. And since the whole arc … was set [?], the remaining arc **[?]** is known; therefore the angle **בד[ח]** [?] is known — and this is the angle **הב[ד]** [?]. The remaining part [?] is known.

And in every case — starting from a known line and a known arc — the line and its angle come out known; therefore the angle **בהד** [?] is known. And this is what we wished to demonstrate.

Midrash ha-Ḥokhmah — Book V (the Moon), continued

(Almagest paraphrase; Parma, Cod. Parm. 2769, ff. 163r–163v)

f. 163r

And afterward he engraved figures in order to establish the mean position of the moon. This is his illustration: he set it out in a table, in each of the five columns [Margin: המרחק — "the distance"]; and it is the arc that lies between the two luminaries. As for the figure of the orb, [it is drawn?] like the arc, with the apogee at the [center?]; and it is the center of the epicycle, and the star that is in its orb will be the center [of the epicycle], corresponding to the apogee of the eccentric [הגלגל היוצא].

The fourth column [הטור הרביעי] contains what corresponds to the [diameter of the?] epicycle, reckoned as an arc of the sphere of the signs, at the time that the epicycle stands at the apogee of the eccentric orb. The fifth column [הטור החמישי] contains the increment [יתרון] [Margin: שראוי — "what is proper"] of what corresponds to the arc that issues from the epicycle out of the sphere of the signs, at the time that its center is on the epicycle at the point of the near distance [perigee] and, [reckoned] from the eccentric, at the apogee.

[The next several lines, which continue column by column and set out the ratios (יחוסים) of what is "known" (ידועה) for the epicycle once its distance has been verified, are written in a compressed hand crowded against the figure and could not be locked glyph-by-glyph. Recoverable fragments: "already verified [שכבר נתאמת]," "the distance [ריחוק]," "at the time that you know its center," "the arc that lies in its middle."] [?]

[Construction, in the narrow band beside the figure:] And for the near distance, according to what is proper [?]. Then we divide the [great] arc so that the matter may be made clear. Thus: we place on the eccentric orb the points A, B, G [א ב ג], with its center [at Z?]; and we set the center of the epicycle [at point Ṭ?]. And we mark the positions of the moon on the epicycle [מקומות הירח מגלגל הקטן], and we make all the points [?]; and the arcs A, B, G [?] — each one of them [numeral: ?] parts [חלקים] [?].

Diagram. A large circle — the eccentric orb / deferent — fills the lower half of the page. Set around its upper part are three small circles showing the epicycle in three successive positions: one at the top-center, one at the lower left, and one at

the lower right. Through each small circle a diameter is drawn, and in the two side circles a pair of crossing straight lines (radii / sight-lines), each carrying interior point-letters. From a single vertex low on the large circle two straight lines rise in a "V" to the left-hand and right-hand epicycles, and a further line runs vertically from the top epicycle down through the center to that vertex — the converging sight-lines of the construction. At the very foot of the large circle, on its circumference, sits a fourth, smaller circle bearing a cross of two internal lines (the observer's small sphere / Earth), with faint interior letters. The interior labels throughout are written very small and could not be resolved letter-by-letter at this resolution; the prose names points A, B, G [א ב ג] on the eccentric and (on f. 163v) points Z, Ḥ, Ṭ [ז ח ט] on the epicycle.

- Top-center epicycle: interior points [?]
- Lower-left epicycle: interior points [?]
- Lower-right epicycle: interior points [?]
- Small circle with cross at the foot of the deferent: interior points [?]

[— more than two diagram labels are flagged [?]; a figure-locked / higher-resolution re-render is needed to recover the interior point-letters.]

f. 163v

[The verso opens by continuing the same construction, working with the angles KHB and KHL:]... angle KHB [כה״ב], the mean angle of the epicycle reckoned from its arc; and the fifth [column gives] the excess of the angle over angle KHB [כה״ב]; and a fourth [part?] [?] the excess of the angle; and upon angle KHL [כה״ל], the excess of the angle over angle KHL [כה״ל].

The motion of the moon on the epicycle is like the arc of the distance from it [i.e., from the apogee]; and likewise the arc runs against the order of the signs — that is to say, from west to west [retrograde]. But when it is in the arc of the near distance from it, it runs in the order of the signs — that is, from west to east. And the order of the signs proceeds: on the eccentric from A [toward] B, G [א… ב ג], and on the epicycle from Z [toward] Ḥ, Ṭ [ז ח… ט].

Again he set another figure. And when the tables [are used] [?], it is done thus. First take the arc A–B [א״ב], which is the arc of the DOUBLE distance [twice the elongation, קשת המרחק הכפול] that lies between the two luminaries — for the mean motion of the moon in anomaly [תנועת הירח האמצעי של חילוף] has already been reckoned, which is the arc [?]. Since the moon moves in the [arc of the] far distance [apogee] of the epicycle against the order of the signs, its motion is thus:

from [Ṭ?] to [B?] [?]. One must therefore take, from the third column [הטור השלישי], what corresponds to arc A–B [א״ב], which is arc ṬZ [ט״ז]. Accordingly:

If arc A–B [א״ב] is less than six [signs] — as is engraved in the figure — one must subtract arc ṬZ [ט״ז] from the arc [?], since the moon moves against the order of the signs; and its angle comes out as the arc of the far distance. The point Ḥ [ח] is the fixed center taken, and the point Ṭ [ט] is the fixed mean position. But if the arc of the double distance is more than six [signs], like arc A–B–G [אב״ג], and the position of the moon [?], one must [subtract arc KHQ?] [?], and then [enter] with the columns of the number [טורי המספר] and take what remains, corresponding to the fourth and the fifth [columns]. [This branch again refers what corresponds to arc A–B [א״ב] — namely arc ṬḤ [ט״ח] — back to the same "less than six degrees, as engraved in the figure" condition and subtraction.] [?]

What comes out of the fourth [column] is the measure of the anomaly [שיעור החילוף] proper to arc Ḥ–Z [ח״ז], when the center of the epicycle is [?]. And what comes out of the fifth column is the measure of the ADDITION of the anomaly [שיעור תוספת החילוף] proper to arc Ḥ–Z [ח״ז], when the center of the epicycle is [?] upon the angle of anomaly [זוית החילוף], or when the center of the epicycle is upon [?].

[Foot of page, faint trailing line, overlaid by show-through from the facing leaf:] [?]

[Modern pencil foliation "163" in the lower-outer margin of this page.]

And after this we enter with arc Ḥ-N[?] into the number column, and take what is written opposite it in the sixth[?] column; these are minutes [regaim], whose value is [numeral: ?]. This is the increment of the anomaly [the equation of the second inequality] proper to arc Ḥ-N when the center of the epicycle sphere is at point B (its apogee, the far distance); and likewise the anomaly proper to arc Ḥ-N when the center of the epicycle sphere is at point A (the mean distance); and the increment of the anomaly proper to arc Ḥ-N when the center of the epicycle is at point G (its perigee, the near distance).

This is what comes out of the fifth column. According to this ratio we are to take those minutes that come out; we take what came out for us from the fifth column and add it to what came out from the fourth column. Thus there rises for us the anomaly proper to arc Ḥ-N when the center of the epicycle is at point B.

And after this we proceed, for arc Ḥ-N, as follows: if it is less than half of the [?] that rose, we subtract the equation proper to arc Ḥ-N from the motion in

longitude. If you wish to know the mean place of the moon in longitude — or its [mean] motion — we reckon the mean; and if you wish to know its true place, we reckon it, and there rises for us the true place of the moon in longitude or in latitude. And if arc Ḥ-N was more than half of the [?] that rose, we add that equation proper to arc Ḥ-N to the mean motion in longitude or in latitude, and there rises for us its place.

On the parallax of the moon. [Body topic-transition flanked by decorative marks ⁘ :— but set inline, not as a display heading.] Since a person has, with respect to the sphere of the moon, a perceptible magnitude [i.e. the observer stands a sensible distance from the center of the earth], the point of observation [nekudat ha-mar'eh] will therefore not be reckoned as [coinciding with] the center of the earth; and hence the apparent place of the moon is not its true place.

The explanation of the matter: we inscribe the sphere of the zodiac [the ecliptic], sphere A-B[?], a perceptible magnitude; and on the sphere of the moon [is point ?], and the earth [is point ?], sphere A-B[?]. Therefore, if we set the center of the earth at a point [?] and join the line up to the sphere of the zodiac —

Diagram. Three concentric circles drawn in the lower portion of the leaf: the outer circle representing the sphere of the zodiac (the ecliptic) / the sphere of the moon, and the inner small circle the earth, with the center marked. A straight diagonal line (the line of sight) runs from a labeled point on the upper-right of the circle inward toward the center, illustrating the offset between the geocentric direction and the observed (surface) direction to the moon — the construction of parallax.

- (apex, top of outer circle): [label: ?]
- (upper right, where the diagonal meets the circle): [label: ? — possibly ב]
- (center): [label: ?]
- (bottom of outer circle): [label: ? — possibly ג]

— and after this we draw out from the point of observation, which is [?], and join it up to the sphere of the zodiac; [thus we obtain] the apparent place of the moon, and the [?] its true place. This is the parallax.

[New folio side] (interlinear: מראי, a small correction written above the opening line, resolving the word toward מראה ("appearance / observation").)

And since it is impossible to know all the particular parallaxes of the moon until we first know how far the body of the moon is from the earth — and, likewise, it is impossible to know its distance from the earth until we first know one parallax

of the moon — [Ptolemy] therefore made an instrument[?] and reckoned by observation the magnitude of one parallax of the moon. And once this magnitude of a single lunar parallax came out for him by observation, he could know from it how far the moon is from the earth; and after this, from his knowledge of its distance, he derived all its particular parallaxes.

The instrument first — the manner of making[?] it: this instrument is called the instrument of the [parallaxes / observations][?], and he did with it as follows. By it he first determined the latitude of the moon, which he wrote [to be] that it lay at [numeral: ?], which is 5 (ה) parts[?], for they observed in the land of Alexandria; and its latitude was [numeral: ?], when the moon appeared near [the meridian, at mid-?][?] — [and] at that point [numeral: ?]. Its apparent place was its true place approximately, and it had no parallax.

And he found by observation that it was distant from the zenith point [nekudat kodkod ha-rosh], in longitude, toward the south, [numeral: ?] parts and eight (ושמנה) [tenths?] of the parts; and when we compare, from [?] the arc of the sun — and it is [numeral: ?] — the remainder is 5 (ה) parts. And this is the latitude[?], which lay toward the south.

And after this he drew out how far the zenith of the moon [kodkod ha-yareaḥ] is from the zenith of the head [kodkod ha-rosh], when it is first at [the beginning of ?][?], [being] [numeral: ?] parts from it; and he found that its distance from the zenith [was] 50 (נ) parts [numeral: ?] minutes. And when he brought it out by calculation, he found its true distance from the zenith [was] [numeral: ?] [numeral: ?]. Therefore the parallax was, as that arc, one (חלק אחד) part and [numeral: ?] minutes.

And he made of this a foundation, and built upon it, and explained and made known how far the moon is from the earth — that it is at the head [?] [numeral: ?], such that half the diagonal from the earth [is] one part[?]; and he reckoned, according to the ascension of the signs, [numeral: ?].

And on the sphere of the moon [is point ?], and the earth [is point ?]; the place of the moon on the sphere is point G (ג); the point called "the zenith of the head" in the city of Alexandria is point H (ה); the center of the whole is point B (ב); and the point of observation [the apparent-parallax point] is point A (א). And he drew the diagonal H-L (ה״ל) [and] A-L (א״ל).

[Modern pencil foliation "164" at the foot]

Diagram. At the upper center-right of the recto: two (probably three) concentric circles drawn about a common center — the sphere of the Moon and the sphere of the zodiac about the Earth's center — with radial lines running from the center outward and short chords/sight-lines joining the labeled points. The figure supports the reckoning of the parallactic difference (חילוף המראה) worked out in the adjoining text. The point-labels are small and only partly legible; more than two are uncertain, so this figure

- (upper radius / apex): [label: ד?]
- (outer circle, upper): [label: ה?]
- (mid radius): [label: ז?]
- (near center): [label: ?]
- (lower chord endpoint): [label: ?]

And after this, he drew a line between the center and the place of the Moon — line K-D — and extended it as far as the sphere of the zodiac until it met it. From the point of apparent position (נקודת המראה) he drew line A-L-[B?]. Therefore arc Ḥ-Ṭ is the parallactic difference (חילוף המראה), and it is one degree and [numeral: ?] minutes.

After this he drew [line …] and drew a line opposite [it …]. Since line A-B stands at the sphere of [the zodiac], one part [… and it is a] perceptible [amount at] the point beside point B; therefore this arc has no [appreciable] measure. And arc Z-Ḥ-Ṭ, all of it, is nearly one degree and [numeral: ?] minutes; and this arc is the Moon's distance from its [true] place, and it is a little [more than] full. And since this arc has no perceptible measure, the angle Z-Ḥ-Ṭ is one degree and [numeral: ?] minutes — which is its division.

Likewise, the arc that rises on line A-L will be [numeral: 350 (שן); possibly 360 (שס) — ס/ן ambiguous] parts and [numeral: ?] minutes, in the measure in which the revolving ascending [line], as drawn, [is …] parts; and it comes to [350 (שן)] parts and [15? טו] minutes, in the ratio in which [it stands] to 102 (קב) parts. And the line — every extremity from A-L [… is] reckoned; and likewise everything near 102 parts, in the ratio in which [it stands] to [350 (שן)] parts, [comes to 15? טו] minutes.

And since arc T-B is known, then angle [?]-K-D is known, and [line A-L …]. Let line A-L be known, in the ratio in which the diameter is to 104 (קד) parts; and the whole is likewise known in that same ratio; and in the ratio in which the diameter is 104 (קד) parts, [everything] is known in that same ratio. And in the measure in which the semidiameter of the Earth is one part, in it A-L is known,

and it comes out that it is full [… and] more than [… minutes]. So in the measure in which A-L was to [350 (שן)] parts and [numeral: ?] minutes, in it will be 32 (לב), which is nearly like A-L to 102 (קב) parts; and it goes [… so that] in it will be 33 (לג) parts and [numeral: ?] minutes.

[The recto ends here; the lower margin is blank.]

Diagram. In the middle-left of the verso: a large circle with a smaller circle overlapping its lower-left rim. The large circle represents the greater sphere/circle; the small circle — carrying interior point-labels — is the Moon's disk, whose diameter (אלכסון הירח) is the subject of the adjacent text. The interior labels of the small circle are only partly legible; more than two are uncertain, so this figure

- (small circle, interior upper): [label: ד?]
- (small circle, interior): [label: ה?]
- (small circle, lower): [label: ב?]
- (large circle, rim): [label: ?]

And after this, in another figure, the distance of the center of the zodiac from the point of apparent position — the far distance, at its farthest — is set out as 51 (נא) parts, in the ratio in which the semidiameter of the Earth is one part. And the distance of the center of the zodiac at its near distance is 31 (לא) parts and [numeral: ?] minutes; and the semidiameter of the small sphere along its [circumference] is a measure of [numeral: ?] parts and [numeral: ?] minutes.

After this [comes] the measure of the diameter of the Moon — that is, the measure of the arc drawn [and] standing perpendicular upon the sphere of the zodiac at right angles, like the arc [that] the diameter [of the Moon] subtends. How so? Since the Moon rises [along the arc] A-Z-B, and thus [line] A-Z-B and the ascending [line], perpendicular upon the sphere of the zodiac at right angles, [lie] within the diameter of the Moon, [which] rises to B-A. And now he wishes to know the measure of arc A-L-B — in the measure in which it rises to B-A [it is …] parts. And when we know this, we know [line] A-B, which is the diameter of the Moon, in the measure in which the diameter rises to B-A — an arc of [numeral: ?] parts.

And he also brought this out from observations of lunar eclipses. The Moon's distance from the center of the Earth was equal to [numeral: ?], for the Moon was near the point of the far distance — at its farthest — on the eccentric deferent sphere (הגלגל היוצא המרכז), and its center rose perpendicular in the eclipses by one measure; and the eclipsed portion of the Moon's diameter in the one eclipse

was a quarter, [and] its twentieth, and [numeral: ?] its half. And he found, in all the observations, that the distance of the Moon's center from the mean [line] of the sphere of the zodiac in the one eclipse was 101 (קא) parts, [numeral: ?] minutes and a half, because its distance from the node (הקשר) in the moving sphere was [numeral: ?] minutes and three; and he found, in the second eclipse, that the distance of the Moon's center from the node was [numeral: ?] minutes less a fifth. Accordingly, its distance from the mean [line] of the zodiac was [numeral: ?] [parts …] less five. And from this the diameter of the Moon is known.

And in order that [the size of] the Sun may be made clear, we return to the sphere of the zodiac [… and the nodes are] halved. By this [there are] the diameters of the Head and the Tail (הראש והזנב) [the ascending and descending nodes]. And the Moon's center, in the one eclipse, was at [point] K-D, its distance from the node [being] arc N-B — 52 (נב).

[The remainder of the verso below this line is blank.]

[Marginal / foliation: modern pencil "165" at the lower fore-edge of the verso.]

Diagram. An eclipse/relative-size figure occupying the upper-right of the recto, in brown ink. It shows two large circles, one drawn slightly within and across the other (a concentric or nearly-concentric pair), with a single straight line running as a diameter/chord diagonally down across them from the upper-left toward the lower-right. At the top of the figure, and again near the lower center, are small clusters of two or three intersecting circlets — the sun-, moon-, and shadow-disks of the construction. No point-letter labels are legibly inked on the figure at this resolution.

and likewise two and a half parts. And the distance of the [moon's] center from the mean of the ecliptic — its arc is **26;52** — and there are in it **41 regaim**, and it comes out. From this is derived what is called the **latitude of the moon**: it is an arc measured from the degree that stands perpendicular upon the degree of the ecliptic at right angles.

And the distance of the moon's degree was [numeral: ?], and its arc there is [that of] the diameter of the moon; and the center of the degree of the shadow [is numeral: ?] upon the degree of the ecliptic. And the center of the moon, in the eclipse of the sun, was **30**; and its distance from the node — its arc being [numeral: ?] — is **8 parts less a fifth**. And the latitude of the moon is an arc of [numeral: ?] from the perpendicular degree, and there are in it **41 regaim less three**; and the eclipsed portion of the moon's diameter comes out, and it is an arc

of [numeral: ?]; and the center of the degree of the shadow upon the ecliptic was [numeral: ?].

And we make [the ascension] [numeral: ?] equal to [numeral: ?] hours; and likewise we make [the other] equal to it. And because the arc [numeral: ?] is equal to the arc [numeral: ?], its regaim are **41 regaim less three**; therefore there will likewise be an arc [numeral: ?] of **41 regaim less three**. And the whole arc [point-labels: ?] was already **40 regaim** [and numeral: ?] regaim; hence the arc [point-labels: ?] is [numeral: ?] regaim, and they are equal, so that the arc [numeral: ?] is [equal to numeral: ?]. This is to the degree that the moon is eclipsed — to the extent that it is eclipsed from it and in its time — and it is an arc [numeral: ?]; therefore the diameter of the moon will likewise be an arc [numeral: ?] of about [numeral: ?] regaim [and numeral: ?] hours. And this is when it is at the far distance from the pivot of the pole [neṭilat ha-qoṭev, i.e. the epicycle].

And it is clear and established that in each of the two arcs [numeral: ?] there are [numeral: ?] regaim less three; for the diameter of the ascension of the shadow, in its time, will be one part [and numeral: ?] regaim, [numeral: ?] hours. And the meaning of "the ascension of the shadow" is [reckoned] over the whole earth. And from that which was explained before, it will be shown that the center of the moon comes to be upon the base [perigee] of the epicycle, and the center of the epicycle upon its base comes out — whereby the distance of the moon from the center of the earth will be [numeral: ?] parts, [numeral: ?] regaim; [when] half the earth's diameter is one part. And know that the sun and the moon are each of them spherical, and that they resemble one another in their roundness.

[The lower portion of p. 349, roughly its final quarter, is left blank parchment below this line.]

its length is [numeral: ?] parts less a fifth. Therefore the length of the earth's diameter contains it **three times and two fifths** (3⅖) of the length of the moon's diameter; and the length of the sun's diameter contains **five and a half** of the moon's diameter.

And since it has already been shown at the end of **Treatise Twelve (מאמר י"ב) of Euclid's book** [Elements, Book XII] that the ratio of sphere to sphere is as the ratio of diameter to diameter, [each] multiplied threefold [i.e. cubed]; and it has likewise been shown in figure [numeral: ?] of that same treatise that the ratio of cube to cube is as the ratio of side to side, [each] multiplied threefold — therefore, in order to know how many [moon-globes] are contained in the earth by

computation, the moon's globe being one part, we must multiply the earth's diameter by itself, that is, **three and two fifths** by **three and two fifths**, which yields [numeral: ?] and [numeral: ?] fifths, less a fifth of a fifth; and then to multiply this result again by **three and two fifths**, and there is gathered from it [numeral: ?] and two fifths, less a fifth of a fifth, of the moon's globe.

And when we multiply the sun's diameter by itself — which is **five and a half** — [and cube it], it yields [numeral: ?] and nearly [numeral: ?] of fifths; and multiplying this again by [five and a half; numeral: ?], there came out **six thousand six hundred** and about [numeral: ?] of the moon's globe. Therefore the earth's globe is one part of [numeral: ?] of the sun's globe, approximately. **May God be praised** [Let them praise God].

And now [the discussion] returns to the variation, by opposites, of the moon's degree. For, since the distance between the center of the earth and the point of tangency of the protruding [arc] was [numeral: ?] parts — when half the earth's diameter is taken as one part — and their distance from the near distance [perigee] of it is [numeral: ?] [numeral: ?], the radius of the epicycle will be as the length of an arc of [numeral: ?] parts, [numeral: ?] regaim.

Accordingly the moon has **three** distances: the first, when it is in the lesser configuration and the center of the epicycle upon its base comes out, its distance being [numeral: ?] [numeral: ?]; and its second [distance] is when it is at the near [point], near the epicycle, and the center of the epicycle upon its base comes out, and its distance is [numeral: ?] [numeral: ?]; and its third distance, when the center of the epicycle is upon the near [point] of what protrudes...

[The text breaks off at the foot of p. 350; the argument continues.]

Midrash ha-Ḥokhmah — Astronomy (Almagest paraphrase, Book V)

Parallax: deriving the difference of appearance (continued)

[Right page — f. 166v]

and the Moon itself, when it is at the apogee of its epicycle [בגובה הקפתו] — [reckoning] its farness and its nearness. When it draws near, by the nearness [measured] from its epicycle sphere, the center of its epicycle [?] draws near [?]; and it comes to [?].

Now we shall explain how we can derive the parallax [חילוף מראה, "difference of appearance"] of a single arc. It is known from its position, and it arises from the difference [in position] between the Sun and the Moon and the zenith [קדקד הראש]. Let the position of the Sun or the Moon be the point L; we draw two diagonal lines [קוי אלכסון], and we shall see — so as to know — the arc-portion which is the parallax [חילוף המראות]. From the arc [?]-L, which is known, we draw a diagonal opposite it, and we draw a further diagonal, together with its center; and since the arc [?]-L is known, the angle NG[?] is thereby known. And just as we drew the diagonal of the triangle [אלכסון משולש] — in every [case] the perpendicular [הנצבת, "the standing line"] rises, and the diagonal [hypotenuse, האלכסון] — every [part] being known.

And since the line [?] is [known] in each one of all the distances that the Moon has, and [corresponds] to the depth [ריחוק / עומק] that the Sun has, one takes [?] [numeral: ?] for it. At the distances that [the body] has [?], and by the measure of the star [?], [the parallax] comes out; and it is approximately equal to [?]-L [?]. In the [?] the parts [חלקים] [numeral: ?] [numeral: ?] reach [?]. Since [the arc] A-G-L[?] is known, [the line] A-L-B[?] is thereby known, being made equal to it, according to [?]. Besides that, [each] is known in each one of all the distances that the Moon has [?].

Because we require, on account of this figure, the knowledge of the arc of the parallax from the zodiac sphere [גלגל המזלות] — when the rising [צמיחה] of the distance, or of the nearness, is from the epicycle sphere alone. But when [the body] is not at known points, its arc is not known from it; and so too [?] its arc [?] is not [determinable] when the center of its epicycle sphere is upon the point of the extremity [נקודת הקצה], or the extremities, and its place is this place alone. From here [we pass] to the measure of other quantities [?] of the parallax, when the [body] is not at [known] points [?] … at a point [?] … other, [reckoned] from its epicycle sphere.

Diagram. Two concentric circles set to the right of the text column. From the common center a fan of radial lines is drawn outward to the upper arc, and short chords in the upper-right sector cut off a wedge (a triangle) between the radii — the standard parallax construction: the observer at the center, the luminary on the near and far circles, with the sight-line and the perpendicular to the zenith-line. Point-labels are marked around the apex of the fan, at the center, and along the upper chords, but the individual glyphs do not resolve reliably even at high magnification.

- Apex / upper arc: small letters, not reliably resolvable [?]

- Center: [?]
- Chord ends (upper-right sector): [?]

The same by a second construction; the parallax table

[Left page — f. 167r]

And I shall also explain [this] by another figure, as we said, [working] in the epicycle sphere at its [?], with points [taken] from the eccentric sphere [גלגל היוצא, "the outgoing sphere"]. Thereafter, corresponding to this, he laid out a table [לוח] having columns [טורים].

In the first column sit the degrees [חלקים] of the Moon's distance from the zenith [קדקד], [reckoned] over the quarter[-circle]: [from ?] up to [numeral: ?] [?]. And in the [?] [?] [numeral: ?] degrees it reaches [?]; [the value] is known [?], and the diagonal[?] A-L-B[?] is known thereby, being made equal to it, according to [?]. Apart from that [each value] is known in each one of all the distances that the Moon has [?].

And the fifth and the sixth [columns are] the parallax of the Moon at all its distances; and in the [seventh?] column [?]. And the eighth [column is] the parallax of the Moon when it is at a point other than this — [namely at] the apogee and the perigee [קדקדות הגובה והנמיכות] of its epicycle sphere. And the ninth column [is] its parallax when the center of its epicycle is at another point, [at] the apogee and the perigee[?], and the operation is carried out with the eccentric sphere [גלגל היוצא].

[The construction:] …center B, and the center [of the world] in the zodiac sphere [גלגל המזלות] the point [?], and the line [?]; [it is] built in the epicycle sphere H[?], and the eccentric A[?], and the apogee and the perigee [?], and the apogee of the epicycle [ההקפה] Ḥ-B[?]. And he inscribed in all the first columns [?] the parallax [when the Moon is] at one of the points T-Ḥ-B-Ṭ[?], and the apogee[?] of its epicycle at Ḥ-L. And he inscribed in the fourth column, so that their ratio is made [thus]: the increment [תוספת] Ḥ-L upon D-L [equals] A-B-L[?] [?] upon Ḥ-L[?]. And in the eighth column, so that their ratio is [made thus]: the increment Ḥ-L upon G-L[?] [?] [?]. And in the seventh, so that their ratio is made: the increment A-Z upon D-L [is] the increment A-Z upon D-L[?].

And this is the parallax of appearance in longitude [באורך]. But its parallax in latitude [ברחב] we have fixed in our mind thus: that the visible place of the Moon in the inclined sphere [גלגל הנוטה] is the point N, and its true place is the point G.

Diagram. A large circle occupying the middle-left of the text-block, crossed by a long line (a diameter/sight-line) through its center, with a smaller circle overlapping its upper arc and a second smaller circle set at the lower-left, each cut by its own line — representing the epicycle at two positions with the visual rays to the center. Point-labels are marked at the center of the large circle, on the upper small circle, and on the lower-left small circle; several are visible in outline but do not resolve reliably.

- Center of large circle: cluster of letters, not reliably resolvable [?]
- Upper small circle: ז / [?]ה[?] near its rim
- Lower-left small circle: ד ,[?]ל ,[?]מ[?] near its rim

[Foliation: pencil "167" at the foot (the left page); the right page is accordingly f. 166v.]

Thus arc TsN [צ״נ] is its parallax [חילוף מראיתו] on the oblique circle [גלגל הנוטה], and arc ḤN [ח״נ], which corresponds to it, is [the parallax] on the ecliptic [גלגל המזלות]. Arc BḤ [ב״ח] is drawn as separate perpendiculars [נבדלות נצבות] [?] equal to arc ZN [ז״נ], and arc ZN is constructed [in like manner]; and by the same reasoning [?] arc ZN is equal to arc ZḤ [ז״ח]. Arc ZḤ, then, is the total parallax [חילוף המראה הכללי].

The parallax in latitude [חילוף המראה ברוחב], for the observers [לבעלים], will be [toward the south] [?] when the zenith point [נקודת הקדקד] is the vertex inclined from the point at mid-heaven [שבחצי השמים] of the ecliptic [מנטבל המזלות] toward the south [לפאת דרום] — that is, in a place whose latitude is less than [numeral: ד״נ נ״ט = ?]. And for the observers it will be [toward the north] [?] when the zenith point is inclined from point [?] toward the north [לפאת צפון] — that is, in places whose latitude is greater than [numeral: כ״ב נ״ט = ?].

Diagram. Two nearly equal circles drawn intersecting one another (the oblique circle and the ecliptic in the neighbourhood of the moon), the second set slightly below and to the right of the first, so that their overlap forms a narrow lune. At the upper-left intersection a small square marks a right angle, where a short transversal meets the arc — the perpendicular by which the total parallax is resolved into its longitude and latitude components. Two or three faint point-letters stand at and beside the right-angle mark, but they do not resolve with confidence at this resolution.

- [?] (at the right-angle square, upper-left intersection): [label not legible]
- [?] (above the square): [label not legible]

- [?] (at the lower intersection): [label not legible]

[Ptolemy] set down straight lines in place of the ascension-arcs [במקום השעולות קווין ישרים] when he extracted the parallax in longitude and in latitude, on account of the parallax in the ascension of the [signs] [בשעולת ה... [?]]; and it is arc ḤN [ח״נ], reckoned from the first degree [מהמעלה הראשונה]. From this [is derived] arc [?]. And on account of the angle [?] — the arc set [הקשת ה... [?]] at the body of the moon, [together with] the zenith point [קדקד הראש] and the arc of the ecliptic [קשת מנטבל המזלות] that he laid down at its place — [there arises] the angle [הזוית] about which the arc of the ecliptic turns, [and] the arc set at the zenith point, and its true place on the ecliptic. On this reasoning [התבונה] the [inclined] circle of the moon [מנטבל המזלות הלבנה] is constructed; and it fell upon [?] point B [ב], with the zenith point at A [?]. We then carry through the two points A and B [א״ב] an arc.

Now we draw from point [G] [?], which is its apparent place [מקומו הנראה], the zenith arc [הקדקדית], standing perpendicular [נצבת] upon arc [מ״ח? [?]] — and it is [arc] NH [?], [belonging to] the moon [הלבנה] [?]. Since the moon's true place [מקום הירח האמת] on the ecliptic is Ḥ [ח] and its apparent place [מקומו הנראה] is Z [ז], arc ḤZ [ח״ז] is the moon's parallax in longitude [חילוף מראה הירח באורך], and arc ZB [ז״ב] is its parallax in latitude [חילוף מראיתו ברוחב].

[This is so] because point B [ב] is the moon's true place [מקומו האמת]: arc BH [ב״ה] is its true latitude [רחבו האמת], and point G [ג] is its apparent place [מקומו הנראה], [so that] arc GH [ג״ה] is its apparent latitude [רחבו הנראה]. Arc GH [ג״ה] is equal to arc HḤ [ה״ח], since the two sides [שתי צלעות] of the moon['s triangle] [make equal angles [?]]. There remains BZ [ב״ז], which is the excess of what lies between them [יתרון מה שיש ביניהן] — and that is the parallax in latitude [שינוי מראיתו ברוחב]; while arc ZḤ [ז״ח], equal to [?], is the parallax in longitude [שינוי מראיתו באורך].

We wish to know the magnitudes of [arcs] NL [נ״ל] and VB [ו״ב] out of [arc] GN [ג״נ] that is obtained [המושג], which we do as follows. With the moon's distance from the noon-degree [רחוק הירח מהמעלת חצי היום] in the first column of the table [בטור הראשון מלוח], we take the angles [הזויות] that stand at the end of the second [column], and we take what corresponds to them from the parts [מהחלקים]. If the moon is before noon, we take what corresponds to it from [the third?] column [?]; and if the moon is after the ascension of noon [שעלת חצי היום], we take from the fourth column [מהטור הרביעי]. There comes out for us the magnitude of the north-eastern angle [כמות הזוית המזרחית צפונית] about which the zenith ascension

[השעלה הקדקדית] turns, together with the degree-part in which the moon stands; and we treat it as an angle.

Ptolemy took arc AB [א״ב] as though it were arc AḤ [א״ח], because he does not assign the moon a latitude in degrees [רוחב מהמעלות]; and from it he extracted arc BN [ב״נ] and the remaining angles, [placing] these in place of angle AḤ [א״ח]. Thereafter we examine these angles, AḤ [?] — namely, that it is angle AḤ [א״ח]. If the ascension[-values] were parts, or a magnitude [כמות] [?], such that it be not greater than a right angle [נצבת] — as in the second angle — we take angle [?], the remainder from two right angles [השארית משתי נצבות]. And because the columns proceed by straight lines [בקווין ישרים], the angle at BN [ב״נ] is equal to angle BH [ב״ה]; and because arc BN [ב״נ] has a right angle [זווית נצבת], BN carries the parallax [שינוי] at the zenith ascension [בשעלה הקדקדית], and it is known [ידוע]. Since angle BN [ב״נ] is known, each of the two lines DN [ד״נ] and ṬN [ט״נ] will be known.

And when we wish to know each of them, we double angle BN [ב״נ], and it becomes the [whole] angle [?] subtended by chord BG [ב״ג] at the center of the revolving circle [מרכז העגלה הסובבת — the epicycle], at their degrees [numeral: ב״ט = ?], [being] the perpendicular angle [?].

[A modern pencil foliation "168" stands at the foot of the left (verso) leaf; faint Hebrew signature/quire letters appear at the outer top corners of both leaves.]

[Margin, top of p. 355, later/second hand: הקשת ("the arc")]

[Close of the Fifth Treatise — the parallax reduction]

since the endpoints that lie on the diameters correspond to the chord that lies on the circumference, and this is its chord. We then join them and enter [the result] in the table of chords of the [mean] value [?]. We take the first line, and the chord, which corresponds to [numeral: ?] parts of the line [label: ?]; and we take the line [label: ?], which corresponds to [numeral: ?] parts of [label: ?]. The arc [label: ?] which descends amounts to [numeral: ?]; we take its chord, which is [numeral: ?], and this is the amount of the arc. We take both together — the line and the chord — and multiply the parts of [label: ?] by [numeral: ?] [reading uncertain].

And its chord [label: ?] is [numeral: ?], which is the amount of the arc. We take both of them — the line and the [chord] — and the multiplication of the parts [numeral: ?] is close to [reading uncertain]. We take from them the line and the [chord], [multiply] the parts by their like, and its base is [numeral: ?], and it is

close to [numeral: ?] [reading uncertain]. And the number that arises is close to [numeral: ?] parts, and this is what we said.

We take [it], and set it, and multiply the parts by their like, and the arc that arises is [numeral: ?] parts; and we divide by all that was gathered onto [numeral: ?], and there comes out for us a line — this is what we said.

Diagram. A right triangle (parallax-reduction figure) with its apex at the upper left. A hypotenuse descends from the apex to the right-hand end of a long horizontal base, and a vertical leg drops from the apex to the left-hand end of the base; a small square is inscribed at the foot near the right angle, with a short interior line marking the perpendicular. Vertex and base labels are inked but not securely legible at this resolution.

- Apex (upper left): [label: ?]
- Foot of the perpendicular / left base end: [label: ?]
- Inscribed square (near base center): [label: ?]
- Right base end (foot of the hypotenuse): [label: ?]

[More than two labels are illegible]

Diagram. The mirror-image companion of the first figure: a right triangle with its apex at the upper right, the hypotenuse descending to the left-hand end of a horizontal base and the vertical leg dropping from the apex to the right-hand end of the base, again with a small inscribed square near the right angle. As with the first figure, the labels are inked but not securely legible.

- Apex (upper right): [label: ?]
- Foot of the perpendicular / right base end: [label: ?]
- Inscribed square (near base center): [label: ?]
- Left base end (foot of the hypotenuse): [label: ?]

[More than two labels are illegible]

ומאמר הששי — The Sixth Treatise

[Decorated display heading, p. 355: **ומאמר הששי** ("And the Sixth Treatise"), with a smaller continuation of the incipit reading approximately: "It opens with the mean course of the sun [?] … the mean [conjunction] of the moon in the month, which is [?]." The continuation is only partly legible.]

as before; and take also its motion, and the latitude in degrees [numeral: ?]; and take also the motion. Afterward one should know how much there is between the

near conjunction and the first year, from the motions of [?]; and how much [there is] within that same year, in days and hours and regaim. And bring all of it out, as [?] [reading uncertain]; and write it, and afterward bring out how much [there is] from one year to another year up to the [conjunction], of the motions, and engrave for this a table.

[Then compute] the mean course of the sun [?] and its motion, and the latitude, and bring them out in their [proper places]; and record it. And afterward bring out how much there is from one year to another [reading uncertain], and reckon it as [?].

And when this whole reckoning is completed, engrave tables of the conjunctions upon [the instrument?] itself, like perpetual tables, so that we may use them, each one of them, to bring out the conjunction from the first year by this method. But in the [table of the?] months, engrave in it how much the motion amounts to in a month, for the conjunction and for the opposition. And we have already completed [the account of] the conjunction and the opposition; and we have already brought out [the amount] of the recurrence.

[The limit of the eclipses]

Let us now return, to be concise, and first speak about the limit of the eclipses. We say:

This is the general [principle] at the outset, to explain the [configuration], the sources [drawn] from the motion [and from the sphere], namely: that when the center of the small sphere [the Moon's epicycle], at the time of the conjunction or the opposition, is midway between it and one of the two nodes — the head and the tail — the eclipse is [mean]; and when it is far, up to [?], the eclipse does not occur. And [we now begin] the limit of the eclipse of the sun.

As was already brought out in the Fifth Treatise, the arcs [reckoned] for the [moon?] — when it is at the far distance from the node, and it is not [numeral: ?] — and its parallax rises to one part [numeral: ?] [reading uncertain]; hence there comes out [numeral: ?], the amount of its parallax at the near distance from the node.

And the eclipse of the moon is brought out as was done in the Fifth Treatise; and there came out for it [numeral: ?], the amount of the parallax of the moon when it is at the near distance from the node, for [numeral: ?] hours; and the parallax [amounts to] one part for six regaim. And further there will come out for it [numeral: ?], the [mean?].

The [difference] between the [greater value] on high and the like of it below [reading uncertain]: from it its [chord] is [known], and [we work] upon the sphere. For its part [as it rises] on high is close to [numeral: ?], because the [value] which is above [numeral: ?] — the [sphere?] — its part is [numeral: ?] parts [numeral: ?] [reading uncertain]; and this is like one of them [reading uncertain]. And its sphere [reading uncertain]: the excess of the diameter of the moon; and the sun and the moon, each of them [is reckoned] [reading uncertain]. And the sphere of the sun, its part is [numeral: ?] parts [numeral: ?], the like of which the diameter of the moon exceeds. And this is only [so] because the moon, at its far distance from the node [reading uncertain]… [the passage continues beyond this opening].

But when [the moon] is at its near distance from [the sun], it only adds to the arc that subtends [the gap] — [numeral: ?] moments. Therefore, when half the diameter of the moon at its nearest, together with half the diameter of the sun, jointly subtend an arc [at the point of the ascending angle], that arc contains [numeral: ? parts and] 33 seconds [ל״ג]; and this marks the first contact of the moon's obscuring of the sun at the least distance.

[In the figure:] the line rising from point AB [אב], and the line that inclines toward the moon, DB [דב]; and the distance AB of the moon from the inclining line at the least distance [is such that]…

Diagram. A geometric eclipse figure. Two large intersecting arcs — the circles of the sun and of the moon — form a horizontal pointed oval (vesica), meeting at a left cusp and a right cusp; the overlap represents the obscured portion. A smaller inner arc descends from a point near the top of the figure, and construction lines cross at a central point. On the lower bounding arc a small triangle stands, its apex and two base-vertices marked. Several point-labels sit at the apex, the central crossing, the cusps, and the triangle's vertices; they are not confidently legible in the figure itself. The surrounding prose builds the construction on the labels **אב** (AB), **דב** (DB), **אהב** (AHB), **דנב** (DNB), **חב** (ḤB), **קנ״ג** (QNG), and **רה** (RH). Because more than two in-figure vertex letters cannot be read directly off the drawing, the figure for label recovery.

- (apex, top): [?]
- (central intersection): [?]
- (left cusp): [?]
- (right cusp): [?]
- (lower triangle vertices): [?], [?], [?]

[Margin: המראה — a keyword flagging the parallax (*ḥiluf ha-mar'eh*) discussion that follows.]

Therefore this arc is the parallax [חילוף המראה]. Arc **דנב** is the parallax in longitude [באורך] — it is the point upon which the two luminaries' motions [מחזורות] are reckoned — and the visible point, which is the sum of the two luminaries' half-diameters that must obtain for contact, [is] 33 seconds [ל״ג]. And arc **קנ״ג**, which is the parallax in latitude [ברוחב], is greater than can occur anywhere over the whole inhabited earth — that is, from the end of the inhabited regions, where the [shortest] day is [numeral: ?] hours, to where the longest day is [numeral: ?] hours.

We then examine the moon's distance at the conjunctions and oppositions [בקיבוצים ובנבחים], after the sun's parallax [שינוי מראה השמש] has been reckoned: if it lies near the southern quarter, it is [7 parts 52 moments — נ״ב … ׳ז]; and if near the northern quarter, [8 parts 22 moments — כ״ב … ׳ח]. And as for arc **דנב**, the parallax in longitude: when arc **אהב** is 15 [ט״ו], arc **דב** is 26 [כ״ו]; and when it is 30 [׳ל], it is 41 [מ״א]. [The remaining interpolation clauses carry interior sexagesimal triplets — degrees, minutes, and hours — that are at the glyph-discrimination floor: [numeral: ?] throughout, with the additional value 17′ [י״ז] and the unit-increment 1;31 [א׳ ל״א] appearing among them.]

And after this, double this arc: it is arc **אהב**, which is 11½ degrees [י״א … וחצי מעלה] — the amount added to the arc running from the node [מן הקשר] to the point of nearness [עד הקירוב], that is, arc **דב**. The ratio is one to [numeral: ?] and a half. Thus, when arc **אהב** is one part, [numeral: ?] degrees, [numeral: ?] hours, arc **דב** will be [numeral: ?] minutes, 26 [כ״ו] … and when the whole arc **אהב** is [numeral: ?] minutes, [numeral: ?] degrees; and by its return, when arc **דב** is [numeral: ?] degrees, it will be [numeral: ?] minutes, and the whole is [numeral: ?] minutes, [numeral: ?] degrees. [The worked triplets here are the same glyph-discrimination floor and are flagged rather than guessed.]

And when the moon's true distance from the node [ריחוק הירח האמת מהקשר] — it being south of the sun — is [numeral: ?] parts [numeral: ?] moments, or [numeral: ?] parts 22 moments [כ״ב], and this is its distance from it; or when it falls at the head [ראש] toward the sun, and it is set apart [נבדל] [to the] limits of the sun — but only in the regions where the longest day runs from [numeral: ?] hours to [numeral: ?] hours. And this has already been explained in the [third] treatise [במאמר ג׳]: that the greatest parallax of the sun [יותר החילוף לשמש] is [numeral: ?] parts and [numeral: ?] moments. And it is explained in the fourth

treatise [במאמר רביע] that the greatest parallax of the moon [יותר החילוף שלירח] at the conjunctions and oppositions [בעת הקבוצין והנבחים] is 5 parts [ה׳].

And we say next that it is possible for the moon to be distant from the sun by a part of [the arc] at the conjunctions and oppositions [בעת הקבוצין והנבחים] that follow from the mean motions [מחזורות אמצעיים] — [numeral: ?] moments — in which the sun travels 33 [ל״ג], which is one part of [numeral: ?]. And likewise, in the time that the moon travels [numeral: ?] moments, the sun travels 7 [ז׳] moments, approximately — since one part of [numeral: ?] of it is no harmful measure. Therefore the sun's travel will be 23 [כ״ג] moments in the interval the moon travels [numeral: ?], and we add to it [numeral: ?] — which is the totality of the sun's anomaly [תכלית חילוף השמש]; the whole will be [numeral: ?] moments.

This is what Ptolemy [תלמי] saw fit to add to the moon's place at the time of the true conjunction or opposition [בעת הקבוץ או הנכח האמת], which is point **ד**. Therefore its distance from the node — it being west [שמאלי] of the sun — is 20 parts 56 moments [כ׳ חלקים נ״ו], and it will be south of the sun by 11 parts 22 moments [י״א חלקים כ״ב].

And Jābir ibn Aflaḥ [גאביר בן אפלח] objected to him [השיב עליו] on this point, and said that these [numeral: ?] parts ought rather to be added to the moon's place at the time of the *true* conjunction or opposition [בעת הקבוץ או הנבח האמת]; therefore it is to arc **חב** [ḤB] that we must add the [numeral: ?] parts of longitude — not to arc **דב** [DB]. And Jābir further said [ועוד אמר גאביר] that [the value] which Ptolemy assigned to the moon in this figure [בזו הצורה], to stand as distinct [להיות נבדל], is [itself an] addition [תוספת]. ## Recto

the measure of the arc [numeral: ?]. But this is not always the case, because [of the difference set out below]. In its position [במושבה], upon arc ל-ב [LB] [numeral: ?], you find one [value] in the sphere of the Moon [בגלגל הירח]. The conjunction, as it appears, binds the two luminaries farther from the node [יותר רחוק מהקשר]. From point נ it would properly be near the node; from point נ it falls upon [point] ג, so that arc ל-ג [GL] is the difference of its appearance [חילוף מראיתו] in longitude, and arc ב-ג [GB] the difference of its appearance; and arc ו-ג [VG] the difference of its appearance in latitude [ברוחב]. On this account the position of the Moon at the [true] conjunction is farther from the node than point נ. [Margin: שחוץ] [Margin: בע]

From this it follows that we add [numeral: ?] parts upon the arc — indeed, upon arc ל-ב [LB], which are [numeral: ?] — so that the arc of its total appearance [מראה הכולל] be greater, and arc ב-ג [GB] be its difference of appearance in

latitude. And when the Moon is at its near distance [במקרב הקרוב], we add [numeral: ?] parts, so that its magnitude at the near distance and its position be [numeral: ?].

By this reckoning we know what its measure is [וקשה בידנו מה השעור], for it is possible that each one of the Sun and the Moon be eclipsed [שילקה כל אחד מהשמש והירח]. Two eclipses of the Moon, separate one from another, can occur; and this happens when the [argument] is [numeral: ?] parts.

The greater limit [הגבול הגדול] for the completion of the eclipse is **45 = מ״ה** parts; and the lesser limit [הגבול הקטן] is **11 = י״א** parts. In it the visible portion [numeral: ?], and at the lesser limit [numeral: ?] there stands [numeral: ?]. Thus the greater limit for the completion of the eclipse-limit for the Moon [גבול הלקות ללבנה] is [numeral: ?]; and the eclipse-limit [גבול הלקות] for the Sun, its lesser limit [numeral: ?] parts, and the darkening [numeral: ?].

And so too it is possible that there be a solar eclipse within a span of five long months [ה׳ חדשים ארוכים] apart — that is, that there be added to the reckoning of the true months, over the reckoning of the mean months [זמן החדשים האמצעיים], [numeral: ?]; and this is because their [eclipse-]limit [גבולם] differs from the mean [ones] [numeral: ?]. For example, [take] the two eclipses, the first upon point [numeral: ?] and the other upon point כ, and let the arc be smaller by [numeral: ?] parts.

And likewise it is possible that there be a solar eclipse [לקות של חמה] within a span of five long months [בזמן ה׳ חדשים ארוכים]. [End of recto.]

Verso

And likewise it can occur even within seven short months [ז׳ חדשים קצרים]; and Ptolemy [then works] to derive the eclipses [תלמי להביא ללקיות]. [Interlinear above line 1: **האומרים** ("those who say")] … for they occur likewise upon two [complementary] positions of the ecliptic [על שתי תקופות] [numeral: ?]. And so too for the Sun: it is possible to derive [the case] of solar eclipses [ללקיות החמה] — two eclipses in one month [שני לקיות תחדש אחד], renewed in one place [במקום אחד], and in two positions [בשני מקומות], the one toward the south [לצד דרום] from the equinoctial [מקו השוה] and the other [toward the north].

for it is possible for an eclipse to occur [להיות הלקיות] at one place at the beginning of the month [בתחלת החדש] and at another place in the middle [באמצע]. And the illustration is in two quadrants of a circle [והמשל בשני רבעי עגולה], for the eclipses of the luminaries [בלקיות המאורות].

Diagram. A circle divided into four quadrants by a vertical and a horizontal diameter crossing at the center. A word-caption stands at the upper rim of the circle, and a single point-letter stands within the lower quadrant. This is the "two quadrants of a circle" figure the text names for the eclipse of the luminaries.

- הישוב (upper rim, as caption): "the inhabited [region]"
- ה (lower interior): point-letter

and he gave a reason for his words [ונתן טעם לדבריו], saying that there is nothing between [that lies at] the node [אין בין הקשר]. And this measure would be, at the far distance, the measure by which [the eclipse] is renewed. And likewise we do not reckon in arc א-ב [AB] the center of the Moon [מרכז הירח] as [being] there.

Diagram. Two circles drawn one across the other so as to form a crescent (a lune between the two arcs), with a small point-letter beside the inner arc. This represents the disk of the Moon overlapping the shadow (or the Sun) at eclipse — the magnitude of the immersion.

- ב (interior, lower): point-letter

Then he says: draw a line such that arc [numeral: ?] and [the line] be equal to **ל׳ = 30** minutes [רגעים]; and the illustration is as follows.

If the arc and the line [הקשת והקו] [give] the breadth of the shadow [רוחב הצל] and the motion [התנועה] — first at the far distance [במרחק הרחוק], and it will be א-ב [AB], and it is the conjunction of the two diagonals of the luminaries [קבוץ שני אלכסוני המאורות] — then ל-א [LA] is **כ׳ = 20** minutes [רגעים], and א-ב [AB], which is likewise about twenty minutes, [gives] the center of the Moon [מרכז הירח], point **ב**. And there comes out the time of the eclipse [זמן הלקות], as we said, [reckoning] the shadow cast upon the Moon until it has moved through it [עד שמתנועע].

Diagram. An upright isosceles triangle standing on a horizontal base line — the Earth's shadow-cone. Near the apex a smaller hatched triangle is drawn with an interior point-letter; the base line carries point-letters at its ends. The figure illustrates the geometry of the shadow cone and the Moon's passage through it.

- [?] (near apex, in the small inner triangle): point-letter [genuinely unclear]
- ד (base, left end): point-letter
- ב (base, right end): point-letter

The illustration [המשל]: a circle of latitude, and points ב-ג [BG] and ד. Let point ד be known [ידוע], and let arc ג-ב [GB] be **ל״ב = 32**; and let it be **כ׳ = 20** minutes [רגעים] of the measures [שעורי]. Then the arc and the point [הקשת והנקודה] [give]

the motion [התנועה], and the line [וקו] [numeral: ?]. And the center of the Moon [ומרכז הירח] and its designation [שמו] is point **ב**, and it is the [mean] center toward the west [מערב]. And its appearance [ומראה] in arc א-ב [AB], at point [numeral: ?], and its shadow is known [ידוע], and it be **כ׳ = 20** minutes [רגעים] of the measures.

[End of verso. Book VI (eclipses) continues; no decorated המאמר השביעי heading appears in this opening.]

This opening continues the account of eclipses (Ptolemy, *Almagest*, Book VI) — the magnitude of eclipses reckoned in digits (אצבעות), the sum of the diameters of the two luminaries, and the reduction of a solar eclipse by the Moon's parallax. The prose runs continuously across both folio sides. No decorated *מאמר* (Book) heading, no colophon, and no star-catalogue table appears on this opening; the text remains within the Book VI eclipse material and does not yet reach the al-Biṭrūjī (*Miklal Yofi*) chapters.

This is what they recorded in the table of solar eclipses: when [the Moon] stands at its far distance, [the obscuration] corresponds to [numeral: ?] digits [אצבעות]; and likewise, if the Moon is at the near distance, it will be [numeral: ?]. It becomes [numeral: ?] seconds, and it will be [numeral: ?]. If the eclipse is [numeral: ?] digits only, it will be [less]; [this is reckoned from] the square of the diameter alone, since the diameter of the luminary, when the Moon is at the near distance, is as [numeral: ?] resembling it — and this is what they observed. For the two [luminaries] we proceed [from] the sum of the two diameters of the luminaries [שני אכסון המאורות], amounting to **12;48 digits** [יב מ״ח; final glyph =ח 48, but 45=ה possible]. When the Moon is near, at its [position] at the distance [numeral: ?], the ratio of [numeral: ?] minutes [רגעים] out of [numeral: ?] digits is like the ratio of 3 minutes out of [numeral: ?]. And if the Moon's latitude departs from the diameter — now, the Moon being near, [only] 3 digits — it ought to be [numeral: ?]: the diameter [being] [numeral: ?] minutes 30 seconds, and it will be [numeral: ?] minutes. This is likewise what they wrote at the far distance for the solar eclipse, corresponding to 3 digits [ג׳ אצבעות].

Then we take the center of the shadow-circle [מרכז עגולת הצל] and set the whole diameter against the diameter, together with the diameter of the Moon at each of the two arcs of distance, just as we illustrated by the worked example; and we likewise [construct] the eclipse-magnitude, the Moon being at each of the two arcs of distance — and so it is known. It will be known; and the conjunction [קבוץ], [namely] arc [numeral: ?] of the diameter, is known; and the course of the line ב־ד [?–קו] [?] is known.

Therefore set down for the lunar eclipse a figure of its own, since its digits, when it is at the great distance, [derive] from the fact that the sum of the Moon's diameter and the shadow-circle was [numeral: ?], the digits [thereof] being **12;48** [י״ב מ״ח] of the diameter [numeral: ?]. From the lunar eclipse there comes **11 digits** [יא אצבעות] only, and it will not be total; but if it is more than **12 digits**, it ought to be total, in proportion to its light [אורו].

For this we construct another figure and set it down. Upon the sphere [we draw] the line of motion, line ב־[?]־ד; and point [?א/ו] [is] the center of the shadow-circle, and [there is] the shadow. The eclipse occurred when the Moon was at point *gimel* [ג], at its conjunction — and this is when [the eclipse] is **12 digits** only. Point ה[?] [is] its [?], and its mean [position is] point *dalet* [ד]. The beginning of its light [is at] point *he* [ה], and [point] ז[?], and the nearer [point]. In the figure, [line] ט[?]־[?]ג is half the totality [חצי העשרת]; and we set the eclipse [at] **15 digits** [;ט[ו] ו conjectural], which is one and a quarter of the Moon's diameter when it is at its great distance — so that it will be [arc] ב־[?] [numeral: ?].

Diagram. A geometric figure at the foot of the recto: from a single apex above (bearing a small cap-mark) a fan of straight lines descends to a horizontal base line. The base line carries a row of point-labels read right-to-left. The construction illustrates the eclipse-magnitude reckoning of the surrounding text — rays from a vertex meeting the line of the Moon's motion (the base line, ב…ד).

- Apex (above the base): small cap-mark, ט[?] or unlabelled
- ב (base line, rightmost)
- ג (base line) — the Moon at the eclipse/conjunction
- ד (base line) — the mean position
- ה (base line) — the beginning of the light
- ו / [?]ז[?] (base line, leftmost point, near the left foot)

The revolution of the sphere from east to west, in the time between the two points ק and ל, is far greater than arc ק־ל; and point *qof* [ק] is nearer to point נ[?] than point *lamed* [ל] is. He has already stated earlier that whatever is nearer that eastern [point] has its parallax [חילוף מראיתו] wheel round the more. Its parallax at point *qof* is therefore greater than at point *lamed*. Accordingly, [let] its parallax at point *qof* [be] greater than arc ק־ל; let arc ק־ל [stand], and we add to it arc [?]. And if we mark off from point *qof* an arc equal to arc ל־[?ז], so that arc ק־ע[?] equals [?] and arc [?] is like arc ק־ל; and if we reckon the Moon at point ג־[?]ל[?], and its parallax at point *gimel* were equal to its parallax at point *qof* — which is *qof* — then its apparent position [מקומו הנראה] would be point *dalet* [ד]; and this

is our aim, which we sought. Hence its parallax at point ל־ג, above, is [the same as] at point *qof*, as we said; and let the Moon's parallax at point ל־ג be arc ל[?].

As for arc ־ק[?] — its part, if it is perceptible, being like its part of arc [numeral: ?] — we add it to point ל־ג as though it were arc ס־ג[?], and we bring point *dalet* near, [it being] the point that it meets, as we [said] before. The truth upon which its apparent position will fall is point *he* [ה], which is the place of the apparent Sun; and behold, point *dalet* is the place of the apparent conjunction [מקום הקבוץ הנראה]. With this he carried out the procedure [כצד המלאכה] in the present solar eclipse.

He said: We first derive the total parallax of the Moon [חילוף מראה הירח הכולל] at the time of the true conjunction, and subtract from it the parallax of the Sun; what remains of it is the Moon's parallax in longitude [חילוף מראה הירח באורך], which is arc ד־מ. We divide it by the true motion of the Moon at the hour of the true conjunction, and what comes out of it is the hours — together with the variation of the parallax [שינוי המראה] in longitude, [as it] falls into the order of the zodiac signs [סדר המזלות]. We have already come to know this beforehand; we reckon those hours from the hour of the true conjunction, and from what issues from the hours, after the addition or the subtraction, we know by them the Moon's parallax in longitude a second time — and it will be **arc [107] קז״**.

[Pencil foliation "172" at the foot of the left page.]

We take the difference between the two parallaxes — this is arc [Q?] — and we determine, from the moon's motion, how much of the time the moon spends upon it, that is, at point Q. We add this to, or subtract it from, [the true conjunction] according to what the distance of the place of the true conjunction from the node indicates to us, in the direction in which the arc came out. Then, with what results in hours, we perform the parallax operation a second time: it grows larger, and arc [SD?] results.

We take the difference between it and the parallax at point Q — which is like arc [SD?] — and let that be the larger. From it we subtract its part, if that part is perceptible, like the part [RL?]; and we add this to arc [SD?], so that arc [SB?] results. Point [S?] is then, to a close approximation, the point Q such that, when the moon's true position falls upon it, its apparent position falls at point [D?].

When we take this arc — as arc [KBL?] — and divide it by the moon's true motion, we determine that true conjunction, and what results in hours is a number of hours. If the parallax in longitude lies toward the order of the signs, we subtract those hours from the time of the true conjunction; and if it falls contrary to the

order of the signs, we add them. What comes out, reckoned after the [true] conjunction, is the time of the apparent conjunction.

We then determine the moon's position and its motion in longitude, in latitude, and in parallax for that time, and from this we determine its true latitude and its total parallax. From it we subtract the sun's parallax, and what remains is the parallax in latitude; from this we determine its apparent latitude. After this we determine, by the rule we set out earlier, from its apparent latitude, the measure of what lies between the two distances — that is, the center of the sun's disk together with the center of the moon's disk [at mid-eclipse].

After this we determine the moon's position on its epicyclic sphere, by the measure of half the moon's diameter, and we relate it to the sun's diameter. Whatever results, we take the difference between it and what lies between the two centers at mid-eclipse; and the remainder is the portion of the sun's diameter that is eclipsed. From this we determine how much of its body is eclipsed, as was explained earlier.

Likewise we determine, from [the place of] what lies between the two centers at mid-eclipse, and from the sum of the two half-[diameters], the true [interval] from the beginning of the eclipse [to its middle], and from its middle to its setting, as was explained. We add to it the part [MB?], and we take what the sun has moved until it becomes equal [to it]; and what results is arc, which the moon has traversed in its apparent motion from the beginning of the eclipse to its middle, and from its middle to its end.

Because the moon's parallax in longitude diminishes over time, and because of the [changing] nature of the eclipse at its beginning, its middle, and its setting, it necessarily follows — on account of the inclination — that its apparent motion from the beginning of the eclipse to its middle is not equal to its apparent motion from its middle to its setting. And since these arcs are unequal, and the motions within them are unequal, it necessarily follows that the time from its beginning to its middle, and from its middle to its setting, is not equal. We shall now explain how we may find [the time of] each of these, to the utmost that we are able to verify and refine.

Diagram. An arc (a dome, representing the moon's traversal along its circle of latitude) rises over a horizontal baseline (the line of true motion along the ecliptic). Vertical droplines descend from marked points at the top of the arc to points along the baseline, and the baseline is marked with a right-to-left sequence of labeled points. The figure supports the demonstration in the surrounding prose

that the arcs the moon traverses during immersion and emersion are unequal, so that the interval from the eclipse's beginning to its middle differs from that of its middle to its end. Several point-letters remain only partly legible even at native resolution.

- Apex / top of the arc (left to right): [G?], [center point], [D?]
- Baseline (right to left): [D?], … [Z?], [L?], [K?] … [H?] (center) … [M?], [Ṭ?], [Ḥ?], [B?] (left end)

We set the line [NLK?] [as] the inclined [line], and arc [K…B?]. Point A is the moon's true position at the beginning of the eclipse; point H is its position at its middle; and point G is its position at its setting — this being the true position, since [we reckon it] at point [Z?], and its beginning with us [is at one point] and its setting at [GD?]. And each of these two arcs [DB?] — since it is the sum of the two half-diameters of the luminaries — we find to be equal, or nearly so, so that arc [AB / AG?] will be equal.

The moon's parallax in longitude, being the length beneath the eclipse, is arc [AH?], and at its middle it is arc [KB?], which is not equal. Likewise the moon's true position is at the two points [DH?], and its apparent position at points [AH?]. In the time during which the moon traverses arc [AH?] in its apparent motion, the true shadow traverses arc [ZH?], and the difference between them is arc [AH?]; and this equals the difference between them, arc [AZ / ZH?] … …[the values proper to the arcs of] the parallax in longitude. If the parallax in longitude falls in the direction of the order of the signs, it necessarily follows that the parallax, at the beginning of the eclipse, is somewhat larger than it is at the middle of its span [at mid-eclipse]; and for this reason this arc is larger than that one, and the visible motion comes out below the true motion. But if the parallax in longitude falls contrary to the order of the signs, then the parallax, at the beginning of the eclipse, is somewhat smaller than it is at the middle of its span, so that this arc is larger than that one, and the visible motion comes out below the true motion in the whole [span]. And what we require entails the second arc.

If we take the difference between these two arcs, this one from that one, and add it upon these arcs, there results an arc which, divided by the true motion of the Moon, yields the time in which the Moon traverses these arcs in the visible motion. And what we require occurs in the second arc [in this way]: that we add the difference between the two parallaxes at the two "second" points onto the second arc. And since the difference of the parallax in longitude is greatest when it is at mid-heaven [חצי השמים], and least when it is at the point of the ascendant [נקודת הצומח] or the setting point [השוקע]—

—there is thereby clarified what we set forth in the fifth inquiry concerning the angle of difference [equation, זויית החלוף] termed [the equation] "in the eccentric sphere" [גלגל היוצא מרכז]. It follows that, if the time of the eclipse places the Moon such that its every distance from the ascendant is less than ninety [degrees], then the time of immersion into eclipse [זמן הנפילה בלקות] is shorter than the time of the return of light [זמן חזירת האור, emersion]. And if its distance from the ascendant is more than ninety, the case is the reverse—that is, the time of immersion into eclipse is longer than the time of the return of light. And when the Moon is at mid-eclipse at the culmination of the ascendant [בחצי הצומח], then the two times are equal.

The matter is therefore not as Ptolemy [תלמי] stated when he said that if the moment of mid-eclipse falls at midday [חצי היום], the two times will be equal. This is a mistake, because between mid-heaven and the culmination of the ascendant point, in the regions of the right sphere [בארצות הפשוטות], there lies a large arc; and it comes in this case to about [numeral: ?] parts [chalakim].

Therefore, if the Moon is in eclipse in this arc, it will be after midday with its distance from the ascendant less than ninety, or before midday with its distance from the ascendant more than ninety. And if the case is otherwise, [the times] are the reverse of what I have described. And likewise as for what Ptolemy stated concerning this: just as the values proper to the arcs of parallax in longitude are to be reckoned against the distance of the time of the true conjunction [הקבוץ האמתי] from the culmination of midday—before or after—so it holds only in the case of an eclipse in which the head of Aries [ראש טלה] or of Libra [מאזנים, the equinoctial points] falls, where the beginning of the rising to the heavens is itself the culmination of the ascendant point. But when the ascendant is oblique [נוטה], these two points will be otherwise, and the parts vary. And if the place of the true conjunction lies between the two parts—namely, that it is before midday with its distance from the culmination of the ascendant more than ninety, or after midday with its distance from the ascendant less than ninety parts—then it necessarily follows that we require the values we set forth as proper for the parallax in longitude, [reckoned] from the time of the distance of the true conjunction from the culmination of midday. Yet Ptolemy adds [to this].

He thereby committed a large error in [reckoning] the time of the visible conjunction [הקבוץ הנראה] alone—[namely, that] the parallax in longitude amounts to however many parts it amounts to; and it would not [be so] were [the arc] great [?]. And he made the parallax at the time of the visible conjunction depend upon what is proper of the time for deriving the parallax in longitude.

And likewise he erred in his positing [בהנחתו] of the parallax of the Moon in latitude [חלוף המראה ברוחב], from which the visible latitude of the Moon is to be derived. For he said that if the parallax in latitude is close to the north side of the ecliptic [נטבל המזלות]: then, if the Moon is near the head-point [נקודת הראש, the ascending node], we add; and if it is near the tail-point [נקודת הזנב, the descending node], we subtract. And if the parallax in latitude is close to the south side of the ecliptic, we do the reverse of what we did. But the parallax in latitude in this place is [referred] to the ecliptic, whereas it would be proper to relate it to the Moon itself, and not to the ecliptic.

[Book VI's treatment of eclipse timing ends here, partway down the second page of the opening; the remainder of that page is blank parchment. No colophon and no heading for a following treatise appears on this opening.]

[f. 174v]

[Librarian note: "79" (or "179") in blue crayon on the scanner mount above the head of the leaf — archival, not part of the text.]

[The page opens with the closing lines of the Sixth Treatise, on eclipses; the argument still concerns the magnitude of an eclipse reckoned in parts (digits) and the two lunar nodes, the Head and the Tail.]

And it comes about, because of this, that in the parts of the interval [of the eclipse] [?], the diameters of the Head and the Tail [the two lunar nodes] cover a portion [of the disk], or somewhat more [?], such that it appears to most [observers] as [?] in however many digits the eclipse amounts to [?]. And it is a small [amount] [?], according to its position, that is covered thereby within the portion [?]; and so too it will be in the portion [of the disk], and its light is diminished [?] by as much [?]. [Margin, upper left, one word: מעקרה [?] — a scribal note; further identification requires further verification.]

The Seventh Treatise: On the Fixed Stars [המאמר השביעי בכוכבים הקיימים]

First let us explain why these are called "fixed": we say it is because they always preserve the distances that lie between them, distances that do not change — and so it is observed. This was evident to the ancients from observing them, [and has held] from antiquity down to the present. Now the constellation-figures which the ancients recorded before [Ptolemy's time] — some of them [they set down] in one configuration [?] and some in another; and afterward, in the same way, [later observers] confirmed them [?]. As they had received the matter, so they wrote it

down, others after them, [copying one from another] over many years. And in the longitudes [?] of the figures that were there, and in the distances that lie [between them] [?] —

Ptolemy, who came after them [after Hipparchus and the earlier observers] by some three hundred years [?], examined [them]. Had there been any perceptible change, it would have been detected across the whole span of time from the epoch of the ancients until now, [showing] that a change had indeed occurred; but no change is perceived [in their mutual distances]. Yet the sphere of the fixed stars does have a slow motion toward the side of the zodiac — as the sage Ptolemy said — amounting to about one degree in every hundred years. As [he showed by example]: he found the fixed star that lies upon the Heart of the Lion [לב האריה = Regulus / Cor Leonis], its longitude being **32 [ל"ב] parts and a half**; and it was recorded after them at the Belly [?] as [numeral: ?]; while in our own time its position is a point of about [numeral: ?] parts and a half and a third [?]. [The star] which [over the span of the intervening] years [had advanced] [?] amounted to [numeral: ?] parts and six [?]. [?] — a further part [?]. And afterward [it is shown that] the pole of the fixed stars [is such-and-such] [?], and its ascension [?] [numeral: ?].

[f. 175r]

For if their revolution were around the two poles of the ecliptic [מרכזי מעלת עלה — the poles of the ecliptic circle] [?], then [their latitude] would be distinguished [?] over the course of many years, [and] would change; and since it appears to us [that their latitude] is [instead] fixed [relative to] the ecliptic — [that fact] is known [ידוע]. Accordingly [we know] from this that their revolution is not about the pole of the ecliptic [?] [but about its two poles]. And since this was [established as] their motion [?], they are called [stars of] the ecliptic [?]... [?], preserving their longitude [?] within [each] sign — the [remaining] portion [?]. From the observations they made, they said, on account of this, that their motion is upon [the poles?] [?]; and the sphere within [?] which they were [set] — but [?] as appears from [?] their motion in longitude [?] —

thus. For it was about [22?] [?]... he recorded after them that its motion along the ecliptic [amounted to] [numeral: ?] parts and a half; and Ptolemy recorded [?] afterward, when he heard [?] its rising [?] in a [given] year [?]... [?]; and this is what they saw for three parts [?] — that [the increment] which [is added to] the longitude in this [interval] [?], according to what they saw from the table [?], is approximately [?]. For the [entries] [?] of the table [?] are marked upon [?] the

ecliptic; and these were seen [?] according to [?] the markings [?] of the poles of the zodiac [?].

Now these fixed stars have their distance from the Sun, and their [angular] remoteness [?]... [?] — they are eight [?] [?] — [and the method is] called [?] the referral [?]. [We attend to] those [of the] stars whose times [of appearance] are known [?], so that [each] is [set] against the Sun [?] at one degree, or close to it. And these were [observed] [?] in the morning [בבקר], and this is what we take from them, [namely to be reckoned] with respect to the Sun. The first star, [referred] to the Sun [?], [was observed] at the ecliptic-position of the Sun [?] in the morning; and this is what preceded [?] the Sun [?]... [?].

The fourth [star] was referred [to the Sun] at noon [בצהרים]; the fifth, referred to the Sun, at noon; the sixth, referred [to the Sun], at noon; the seventh, referred, at twilight [בנשף]; the [eighth], likewise, [referred] to the Sun at twilight; and the ninth, referred, at twilight. And after this, [it turns] to [the reckoning of] the fixed stars in longitude [?] together with their configuration [?] at their rising [בזריחה] and at their setting [?] with respect to the Sun; and likewise, afterward, the rising points [הנקודות הצומחות — the points of ascension], or the arcs of ascension of the ecliptic [?].

[Pencil foliation "175" at the foot of this folio side.]

and the [ecliptic] degrees of the signs together with the fixed stars. Afterward he treated the observations of the fixed stars and their arrangement according to the manner [?], and he included all of this together with the Eighth Treatise. Now, since what he set down in his treatise was drawn [?] from the positions of the stars — their longitude and latitude — and [since he showed] how the sphere called "solid" (מקשה) is made, its name in Arabic being [Arabic term: ?], together with the description of each and every degree, all of this requires the labor of [charting] the stars, as they said. In any case, whoever wishes to become versed in this science must now look [at the instrument itself]; and although the written account is useful on its own, [the full benefit lies] only in combining the two [text and globe]. And when you know this — [roughly one line, ~6 words, not confidently legible].

THE NINTH TREATISE, ON THE WANDERING STARS [THE PLANETS]

He begins first with the order of their spheres, which are: the sphere [?] above the middle[?] of the sphere of Venus (נוגה) and Mercury (כוכב). Then he sets forth his reasoning on this, and it follows necessarily from the words of Ptolemy (תלמי) himself that they [Venus and Mercury] lie above the Sun; and so too according to the version of the ancients.

For thus runs the wording of Ptolemy: that [a planet] does not fall short of the Sun nor lag behind it — this we already find from parallax (חילוף מראה). And he said: I shall explain[?] how it could be that the Sun, which they placed above them, would have a parallax and yet [Venus and Mercury] would not have one likewise, since they lie above it. This is an a fortiori argument, and all the more so. For the semidiameter of Venus's epicycle is more than three parts; [and this magnitude] varies [when reckoned] in the units in which the semidiameter of the eccentric [deferent] is [numeral: ?]. And if [numeral: ?] … and for Mercury, [the planet] must have a parallax of seven parts.

Therefore, if no parallax is found for them, just as he [Ptolemy] and the ancients stated, it necessarily follows that they lie above the Sun. And the sage R. David ibn Naḥmias, of blessed memory [נ"ע] — it seems [?] — [reasoned?] … [?] with respect to Ptolemy [?]; and he said that, apart from his own statements in which he declared that they have no parallax, this teaches us — like Ptolemy, by observation, as he did — except that the parallax of the Sun cannot be grasped by sighting, but only when you know how great its distance from the earth is. And likewise, since the distance of Saturn (שבתי) from the earth is not known, [one could not] derive its parallax from it.

And here is a proof from the words of Ibn Sina [Avicenna], who said that he saw Venus like a spot within the body of the Sun; hence Venus is beneath the Sun. And the opinion of the sage Ibn [?] is that the sphere [of Mercury?] is beneath Venus and above [Mercury?], as will be made clear in what follows [?]. And the disposition of the stars is as follows:

The general rule embracing all five [planets] is that each of them is borne upon an epicycle sphere. When the planet is at its far distance [apogee] from it, it moves contrary to the order of the signs; and the center of the epicycle sphere is borne upon a sphere that is eccentric to the order of the signs. This eccentric sphere — upon which the center of the epicycle is borne — is, in four of them (all

except Mercury, which is [otherwise] [?]), [arranged] thus: this sphere['s motion is reckoned] not about the center of the zodiac sphere, but about another center, which is set at a distance; and the distance of its center [from that other center] is like the distance of that center itself from the center of the zodiac sphere; and its center moves…

Diagram. A geometric construction of the planetary (Venus) model, drawn at the lower left of the page in black ink with compass-drawn circles. A large circle (the deferent) contains a smaller circle offset toward the upper left, with a marked center-dot at their common region and radial/diameter lines drawn through it (one vertical through the whole figure, and oblique radii to the center-dot); several point-dots sit on the circumferences. Below the two main circles a further circle is drawn, quartered by a vertical and a horizontal diameter. Labels written beside the figure at the left include מרכז כדור נוגה ("center of the sphere of Venus") and מרכז המזלות ("center of the zodiac" = the earth). Individual point-letters along the diameters (א [?], ב [?], ג [?], ד [?], ה [?]) are only partially legible.

- מרכז כדור נוגה (label, left of figure): center of the sphere of Venus [its deferent]
- מרכז המזלות (label, left of figure): center of the zodiac (the earth)
- א (apex/top): construction point-letter
- ב [?], ג [?], ד [?], ה [?]: construction point-letters along the diameters, individually uncertain

[The construction:] …[reckoned] not about the center of the zodiac sphere, but about another center set at a distance; and the distance of its center [from that center] is like the distance of that center from the center of the zodiac sphere. We take the eccentric sphere upon which the center of the epicycle is borne — [let] its center [be] ז [?] — and the center of [the epicycle] [be] ה [?]; and we draw the diameter, [taking] half of [?], and we set as far as ד [?], like this; and we make, from point ה [?], the distance of the center … and we set upon it a point at this distance…

[Pencil foliation "176" in the lower-right margin of the second page.]

[Marginal notation (~1 word) above the first line of the second page, illegible.]

[Continuation of the Ninth Treatise, on the planets — the general Ptolemaic planetary model (eccentric deferent, epicycle, and equant), the relation of the epicycle to the Sun, the apogees of the five planets, and the onset of retrogradation.]

It is circle ABGD (אבגד). We draw the line DA (דא) and carry it around as far as L (ל), [the circle of] the epicycle. Let point L (ל) be its far distance [apogee] and point M (מ) its near distance [perigee]. Let the anomaly [חזרת ‹?›] be the angle that point Ṭ (ט) — the center of the epicycle — makes in its motion upon circle ABGD (אבגד) around center L (ל). (interlinear: מרכז ("center"), above the line.)

But in the planet borne by the eccentric sphere, the center about which the [uniform] motion occurs is equal to circle ABGD (אבגד) about center L (ל). We pass the line running through it and through the center of the zodiac sphere, namely line ABG (אבג); and point H (ה) is the center of the zodiac. The far distance is point M (מ) [?], and its near distance point G (ג) [?]. We divide line LM (לם) as [we divided] LH (לה) [?]. Let point Z (ז) be the equant center [המרכז המשוה] corresponding to the deferent center; from it we draw a line, and let ZH (זה) [?] equal ZD (זד). With center M (מ) and radius ZD (זד) we describe circle [?]. We make ZṬ (זט) [?] equal to ZL (זל), which is half the diameter of circle ABGD (אבגד), and we set that point as center and cause the circle [?] to revolve. This is the deferent that carries the center of the epicycle, which is D (ד).

We carry it around as far as L (ל), which is its far distance, and point M (מ) is the near distance. This is the motion of the epicycle center, which follows the revolution about center L (ל) in the order of the zodiac. In its motion, point B (ב) comes to [rest upon] circle [?], and it too undergoes a motion equal and opposite to the motion of the zodiac, equal in speed to the motion of ZL (זל) [?]. The star moves upon the [surface of the] epicycle around point B (ב): if it is at point L (ל) it moves in the order of the zodiac, and if it is at point M (מ), contrary to the order of the zodiac. Therefore the epicycle completes a revolution of the whole deferent in the time of its double return through the zodiac — that is, an equal time, twice over — and each of its two distances, the far and the near, passes one point twice. And there is a further rule for the three superior [planets] [לשלשה העליונים ‹?›].

Diagram. A geometric figure of the general planetary model, embedded in the right-hand portion of the recto's text block. A large circle (the eccentric deferent, ABGD) contains a concentric inner circle; an apsidal diameter runs across the figure from the upper region to the lower-left. A small circle (the epicycle) sits at the upper end of the apsidal line, riding on the deferent, with its center marked by a dot. Radial lines run from the interior centers out to the epicycle. Vertical interior captions written along the radii are legible in part: **הגלגל היוצא / גלגל היוצא** ("the eccentric sphere") and **מרכז הנושא** ("center of the deferent"); a further interior caption (**מרכז המזלות**, "center of the zodiac") is partly legible. Point-letters placed around the construction:

- ה (near center): center of the zodiac [?]
- ל (on the apsidal line): far distance / deferent center [?]
- ז (on the apsidal line): equant center [?]
- ט (on the small circle): center of the epicycle [?]
- מ (upper apsidal point): apogee / far distance [?]
- ב / ד / ג (on the circumference): construction points of circle ABGD [?]

[More than two labels are only partly legible for figure-label verification.]

[The lower ~15% of the recto is left as blank parchment; the text continues on the following side.]

That is to say: when they [the three superior planets] are conjoined with the Sun there, they are at the far distance of the epicycle sphere and are then swifter in their motion; and when they are opposite the Sun, they are at the near distance of the epicycle and are then dragged [slow]; and when they are at the quadrant of the Sun, they are at the mean passage of the epicycle sphere. But it is manifest [אבל נגלה] that in this planet the motion of the epicycle center relative to the motion of the zodiac is the mean [motion]; and they, in their motion upon the epicycle, forever encircle the Sun. And when they are at one of the two distances of their epicycle — the far or the near — they are set apart in their distance from the mean of the Sun. And we shall first say:

The point of [the apogee], for the five planets alone [Interlinear/margin: הנבוכה, "the wandering (stars)"] — that is, the point of the far distance [apogee] of the eccentric — has a displacement in the order of the zodiac, like the displacement of the fixed stars, which is about one part [one degree] in a hundred years. As for the measure between the two centers, and the measure of half the diameter of the epicycle sphere, in the five planets:

- Mercury [בכוכב]: between the two centers, three parts; and half the diameter of its epicycle, 22½ parts [tens-digit numeral: ?].
- Venus [נוגה]: between the two centers, one part and a quarter; and half the diameter of its epicycle, 43½ parts [tens-digit numeral: ?].
- Mars [מאדים]: between the two centers, six parts; and half the diameter of its epicycle, 39½ parts [tens-digit numeral: ?].
- Jupiter [צדק]: between the two centers, three parts less a quarter [2¾]; and half the diameter of its epicycle, 11½ parts.
- Saturn [שבתאי]: between the two centers, three parts [and a fraction — numeral: ?]; and half the diameter of its epicycle, six and a half parts.

And all of them are equal in their ascension [rising] and their course. This matter will be explained in the treatise we shall mention — [concerning] what we conceive to be [the case] in each of the five planets, or the ratio of half the diameter of their epicycle to the line between the center of the zodiac sphere and the near distance of the epicycle sphere, [which is] greater by three [?] than the ratio of the planet's mean motion in longitude to its motion in anomaly.

Let us begin to explain, regarding the planet, when it is at a known point of its epicycle, that it appears to stand [stationary], and appears afterward to move back [retrograde].

[Text continues.]

[Script: Sephardic/Oriental semicursive, single column, black ink; the primary hand of the scribe Sasson ben Menashe throughout. A large display script is used for the opening title on the second folio side and for the enlarged initial word וְעַתָּה.]

[*Almagest* paraphrase, Ninth Treatise — conclusion: the stations and retrogradation]

and afterward it becomes stationary a second time, and afterward it resumes direct motion.

And this is so. The point of its station is the point at which the epicycle, at its near side, cuts the line issuing from the center of the zodiac sphere — namely the point at which the ratio of half of what is cut off by it within the epicycle sphere to what is cut off from it outside equals the ratio of the mean motion in longitude to the motion in anomaly.

Let the epicycle be ABG (אבג), its center D (ד), and the center of the zodiac E (ה); and we draw the line [from D to E]. Point G (ג) marks the near distance [the perigee], [and the far distance — the apogee — is the opposite point] [?]. Because the ratio of DB (דב) to GE (גה) is greater than the ratio of the mean motion of the planet in longitude to its motion in anomaly, it follows that if from [that point] we draw a line cutting the surface of the epicycle, such that the ratio of the segment taken off within it to the segment falling outside it — that is to say, such that the ratio of segment [?] to segment [?] equals the ratio of the mean motion of the planet in longitude to its motion in anomaly — then point M (ם) must be the point of station. And likewise, if we draw the line at that same first ratio, [the corresponding point] will be the second point of station, at which the planet returns to direct motion. Inasmuch as the planet is in the arc [between the two

points], it is retrograde and so appears to our eyes; in the arc [outside them] it is direct.

And the amount of the retrograde arc is: in Saturn (שבתאי), seven degrees [and (arc-minutes) numeral: ?], with [numeral: ?] days [of retrogradation]; in Jupiter (צדק), about ten degrees, [numeral: ?] days; in Mars (מאדים), [numeral: ?] degrees and a fifth, [numeral: ?] days and a half; in Venus (נוגה), twelve [?] degrees and four seconds, forty-one days less a third; in the [nearest] planet [Mercury] (כוכב), [numeral: ?] degrees and a fifth, twenty-[numeral: ?] days.

Ḥazak [Be strong]. Blessed is the Lord forever; Amen and Amen. (Tehillim 89:53)

[This doxology closes the paraphrase of Ptolemy's *Almagest* — the Ninth Treatise and the astronomical portion. A pen flourish/paraph follows on p. 373.]

Diagram. A geometric figure for the stations of a planet on its epicycle (Apollonius's construction). A circle represents the epicycle, drawn with a vertical diameter rising to a point at its top. From a single point below the circle — the observer's eye, at the center of the zodiac — two straight lines rise and converge on the circle, framing the epicycle like the sides of a narrow cone. The center of the epicycle is marked within the circle.

- (top of circle, apex of the vertical diameter): [?] — likely א, the apogee (prose: "epicycle ABG")
- (on the circle, left of the diameter): [?] — likely ב
- (foot of the circle, near the eye): [?] — likely ג, the perigee (prose: "point G marks the near distance")
- (center of the circle): ד — the center of the epicycle (pinned by the prose "center D")
- (bottom vertex, where the two lines converge): ה — the eye / center of the zodiac (pinned by the prose "center of the zodiac E")

[: more than two labels flagged [?].]

מכלל יופי [*Miklal Yofi* — al-Biṭrūjī's astronomy, opening]

זה הוא מכלל יופי מספר התבונה לחכם פילוסוף שמו אלבטרוני

This is the *Miklal Yofi* ["The Perfection of Beauty," cf. Tehillim 50:2], a work of the science [of astronomy], by a wise philosopher whose name is al-Biṭrūjī [אלבטרוני = al-Biṭrūjī / Alpetragius].

He was very discerning, and his time is close to our own — namely the year five thousand and [numeral: ?] of the Creation [reckoning], some thirty years [before us] [?]. He responded against Ptolemy and against all the ancients who preceded him, and he understood the planets in another way — one true to nature and simple, which requires neither an epicycle sphere, nor an eccentric sphere, nor that any part of the spheres revolve from west to east; rather, they all revolve from east to west.

For this science he drew upon the words of Aristotle [ארסטו], who said that the heavens have two motions — one arising in [the sphere's own] revolution, and a second [contrary] one; and this discerning man [Aristotle] said that it is impossible for this second motion to belong to the stars. The stars are fixed in their places; it is only in the character of the motion that he ordered his spheres, to which they are bound, and the revolution of that ordering proceeds by fine ascensions [שעולות — the graded lags] [?], as he explained, with the help of Shaddai, may He be blessed. And know and accept [?]: a great and sublime secret [was disclosed] to him [?].

Had he been a Jew, he would have been worthy of divine wisdom, as it is said, "In the heart of the discerning rests wisdom" [Mishlei 14:33] — as we explained in [our comments on] the verses of the book of Proverbs: that the wise Solomon, peace be upon him, calls the science of the natures *binah* ["understanding"], and one who knows it is called *navon* ["discerning"].

וְעַתָּה — And now we begin, in the name of Shaddai, may He be blessed, to write the essentials of his book, as we have done with the other books.

He began by positing the uppermost sphere, which moves with the daily motion, and he made eight spheres beneath it, all moving from east to west — except that some of them are faster than others: whichever is closer to the first [sphere, the primum mobile] is faster than the one farther from it. Therefore the lag, by which each of the eight lags behind [and fails] to complete the motion of the first, is what Ptolemy [the "Ptolemaic one"] called "the motion from west to east"; but the [true] essence of the motion is from east to west, and this is the fundamental principle.

[Foliation "178a" in pencil at the foot a blue crayon quire mark in the upper margin of the opening.]

And since a sphere is the more disposed to motion the nearer it stands to the first sphere, it is the swifter for being near, and the slower the farther it stands from it. In this way the motion is carried onward, sphere after sphere, to the sphere of

the fixed stars, and thence — down to the sphere of Jupiter (צדק), and from the sphere of Jupiter to the sphere of Mars (מאלים) [the descent-order of these two spheres is written compactly: ?] — so that the swiftness of the motion keeps diminishing, sphere by sphere, down to the Moon, together with its own proper motion. And so [each sphere] is swifter in its motion, and hastens westward, [the outermost] more than all of them.

Now the root of each one of these spheres [?]... down to the lowest sphere. And since the [uppermost] sphere does not [share its pole], each of these spheres does not have the pole [Hebrew סדן, qoṭev, "pole"] of the [uppermost] sphere; for the eight spheres do not have one single pole. Rather, each sphere has a pole peculiar to it, and each has a motion peculiar to it about its own pole; and in this way they all [move], each with its own motion about its own pole.

Therefore the uppermost sphere has two fixed poles, and about these all are moved from east to west with a single motion — [the daily motion,] the one that runs between day and night — which is the motion of the All. Its motion is the swiftest, faster than all the motions beneath them; and everything beneath them among the spheres lags behind its motion. And the measure [of that lag]... [the following clause is written compactly: ?].

In that which the sphere adds by its own being moved while the pole stays at rest, this sphere is peculiar to this [motion]. For the motion of the [equator? — technical term written compactly: ?]... and they are like the fixed [circles] belonging to it, [namely] the two diameters of the poles [?]; and so, by the universal motion... [and this is the peculiar motion?]. And because the star stands at one distance preserved for it — from its pole, or from the poles of the sphere — [the sphere] will make its... [?].

they carry the poles of the sphere along circles [of longitude], and thus within this sphere [the star] rises until it reaches the sphere of the equator (גלגל המישור). And [there are] the poles, or the arcs of the [complementary?] risings [?], from the pole of the sphere of the equator; and the measure of this rising is the measure [by which] the star comes out — that is, according as this sphere is inclined so that the equatorial circle turns away [?] from the sphere of the equator toward one side; and so, from between its two positions to its [other] position, [the star] is displaced by a certain measure [written compactly: ?] — that is to say, so that the arc may be traced.

And this arc — like the great rising-circle that passes through the two poles and spreads out over [?] — [is described by] circles laid upon the sphere of the

equator; and therefore the stars that fall short [in their motion] appear upon this sphere, as [they do] upon the sphere of the equator.

And further they say: the [circle of the] rising-lag of the stars, and its distance [from the equator], comes about by the motion of their spheres about their poles — whether these be fixed or wandering — and it is traced upon the circle of the equator. And it is according to the distance of the pole of the sphere of that star, or of those stars, from the pole of the sphere of the equator, which is [reckoned] from the pole of the sphere of the equator. And the more the pole of the sphere of the equator stands distant from the pole of the sphere of the stars, the greater will be the deviation of the star's rising; and it is like the distance of the [one] pole from the [other] pole.

And each one of these spheres, when it is moved about its pole in the manner of the universal motion — that is, [in] the motion common to them all — [it shares in that motion, and thereby] the motion of the star is made small [?], and the sphere [carries it]... they intend for them [the stars] a [particular] motion. And yet perhaps they do not [assign] to them any motion at all by this very motion... whatever should result [from it].

[Pencil foliation "179" in the lower outer corner of f.179r.]

together with the arcs of the course. For the course of travel on which the star is found, upon the sphere of its motion, is not equal to what rises with it from the arcs of the equatorial sphere; rather it varies according to that star's inclination — that is, the arc it completes of the measure of its inclination upon the equatorial sphere, whether to the north or to the south — as was explained in the book of the Almagest.

Then he explained by means of a figure. When a sphere is revolved upon two poles about the surfaces of small circles, and the sphere is borne along by a motion whereby a pole revolves another sphere above it, and we mark a point upon the surface of the sphere that is so moved — for the point borne along in this transference, which is moved by the motion of the two revolving surfaces, does not rise to a complete [circle].

Then he explained by another figure. When there is a sphere, and there are two spheres revolving it in the manner we described, and the sphere has, together with this motion, a second motion upon a second pole; and we mark a point upon the surface of the sphere, and the sphere is borne by the two motions together — then we say that the moving point does not, by these two motions together, describe a complete circle in a single plane. Nor will the return of the point, when

the sphere completes its revolution, be to the place from which it began its ascent; rather, what the point traces out in its revolution will have the shape of the winding of a spiral wheel (*galgal ḥilazon*) [Arabic: *lawlab*, "spiral/helix"] — that is to say, the circuit begins from one point and is completed when the revolution reaches another point, one that lies in a different plane. And when the sphere completes many revolutions, [the trace is] like the turning of a wheel.

Then he explained the nature of the motion called "the accompanying motion" (*ha-tenu'ah ha-nilvah*) of the stars, in this way. He said: this sphere, when it moves with its proper motion — which is upon its own pole — follows after the upper motion, which he called the motion of completion; and it returns by [the motion of] its pole. For [the stars] are governed [by the upper sphere] in their shortfall (*qiṣṣur*) behind the upper motion; therefore [they follow] the upper motion, since by their own nature they lag behind the upper. But the stars, since the upper is the motion of completion and they remain bound to it —

therefore, on account of this, there results the transference of the motion of the stars that are upon the pole of this sphere, while you are still reckoning the motion of the whole together with what is added of the transference of the pole upon a second surface — which is the agent that produces latitude. For the distance of the stars from the pole is a distance that does not change; therefore it is only when the pole itself is transferred that [the distance] changes, in its own measure. The stars that are in this sphere, according to their distance from the pole — from the pole to the equatorial sphere — [incline] to the measure by which these have been separated. Therefore there arises, on this account, [an inclination in] the stars in this sphere: they have already completed the upper motion in longitude, and they are [carried (?)] by the motion whereby the sphere moves upon its two poles — apart from a very slight motion whose measure has not been explained up to now — and they are transferred by the transference of the pole.

And since the terminus of the motion of these stars — that is, of the sphere — as it tends toward the upper motion in order to complete it, lies not upon a surface opposite to the equatorial sphere but rather upon a surface inclined to it, as we explained before, therefore the stars that are upon the belt (*niṭaq*) [Arabic: *niṭāq*, "belt/girdle"] of this sphere are carried upon a surface inclined to the equatorial sphere, twisted into two portions — in ascension and in inclination — the measure of which is the distance between the two poles of this sphere and the two poles of the upper [sphere]. And there is a combination required to complete the motion upon the belt of this sphere, relative to the equatorial sphere, at two

points — like the points at the two mean positions; and the two ends of the distance between them are like the points of the [?], namely [?] and [?]. And upon this inclination will be the motion of the fixed stars that are reckoned upon the belt of this sphere.

As for the rest of the stars that are in it, they move upon a surface opposite to this belt, except that the diurnal motion belongs to them alone, upon the surface opposite to the equatorial sphere. And this inclined motion of completion we do not perceive; therefore we [attribute (?)] the occasional increase of the stars in longitude, and their shortfall, together with their departure in latitude, [to it]. And from this we have taken a proof that it possesses this inclined motion — which is the motion of completion. And therefore, whatever of these planets is near to them [involves] the course of the points of obligation [nequdot ha-ḥiyyuv] [?] — that is, [what belongs] to its degree, or, put otherwise, when [a body] rises and its motion is completed, there results from it a number of degrees [ḥalaqim] from each one of them, from their own two selves, namely two points. And these are the two marked points [?]; that is, the rising [point] and [?], and the degrees become smaller, as was explained in the treatise [...] [?]. [...] [?] their degrees [...] become larger. Therefore, on account of this it appears [?] [...].

[...] the planets increase, and the addition of their motion advances according to the motion of the whole [?]. And when it is so, in the quarter [ba-reva'] [?] — as [Ptolemy? [?]] said [...] the point of difference [?] [...] which appears [?] from their beginning [me-hatḥalatam]: it adds [mosif] and lags [u-me'aḥer], and [...] [?] the [...] already passed through it [kevar ʿavar bah]. [...] years [...] and other years [?], part of them [...] [?]. [...] the two motions in longitude — that is, like the motion of the upper [sphere] [ha-ʿelyon [?]] [...] — the planets; and it is that very thing [?] which [...], as the later [authorities] [ha-aḥaronim] [held] [?] [...].

[...] [?] in order [le-sader] [...] which [...], so that there remains to the sphere [...] [?] together with the length of time. And it is that which has [...] [?] [...] [?]. And the amount that Ptolemy mentioned [ve-shiʿur she-hizkir Talmi], and the [...] [?] [...] of the motion, inasmuch as it [...] [?] and lags behind [u-miʾaḥerin]. [...] the motion of the whole, and we return to it [?] — that is, the motion of the [...] [?] — the rising [?] of the planets. [...] [?] its motion begins from a point that is like the head [...] [?]; and that point which is the head of Aries [rosh Ṭaleh] [...] [?] toward the head [...]. And we have already stated concerning the head [...] [?] to the [...] of the motion. [...] [?] [we] say, and there results [ve-nimtza] its degree, and the [...] [?]; and [...] [?] there is [the arc] AB [א״ב] from the sphere of the equator [galgal ha-mishor], and there is [...].

[...] its motion [?] belongs to this sphere; and it is the arc of the longitude of one of the planets [?]. [...] [?] this, and this sphere [rides] upon two poles [seranim] [...] [?] — the [required?] arc [?] rising [...] upon two points [...] [?], and [there is] a pole [seren] for every [...]. Two points [...] [?]; and there is a pole [seren] to this sphere of the planets, which [revolve/are borne] [?] upon three [...] [?] — a pole [seren] [...] [?] — that is, [they revolve] around [...] [?] the two points HD [ה״ד], and [these] are [the points on which/around which] the planets rise [?] [...] [above them].

[Verso. Pencil foliation "181" at the foot of the page.]

[...] [?] which rises [...] this, as it is in the figure [ka-tzurah], and it revolves upon its pole [seden] [in] the sphere of the equator [galgal ha-mishor] [...] a pole [seden] [...] [?] — therefore [halakh] [?], because [...] [?] the circles AB-G, G-D [עשולות אב״ג ג״ד] [?] are reckoned as being the two points [...] [?], just as they are the points [...] [?] of the sphere of degrees [galgal ha-maʿalot]. Therefore there will be two points [...] [?] which are called the intersection [ha-ḥittukh], and the horizon [ha-ofeq] (interlinear: האופק) is set [?] at the place where the globe [ha-kadur] leaves half a circle [?] [...]; because the [...] [?].

The sphere of the planets falls short [maqṣir] — as we said, it lags [?] — and the motion of the upper [sphere] [ha-ʿelyon [?]], so [it] diminishes [yiqṭan]; and the two poles [sedanav] [...] [?] are shortened [?] in one of the circles [...] [?]. Therefore [...] [?] the [approach — ha-miqrav? [?]], as they draw near from the upper [sphere] and are far from it, [namely] from [...] the two poles [sedanav] of the upper [sphere], [being] one distance [?] to the circle — that is, the distance of the two points H [...] [?] from the two points [...], and the upper [?]. Therefore in part [be-qetzat] the [...] [?] will be shortened [?]; hence the motion of the upper [sphere] [...] [?]. And part of them [...] [?] which [...] upon them a circle [...] [?] the [surface/interior — betaʾ? [?]] of its pole [sedanan] and [...] [?].

Thus, when one of the planets [is placed/borne] in this sphere upon one of [...] [?] the points of obligation [nequdot ha-ḥiyyuv] [?] — that is, the two points [...] [?] — it [remains/lags behind] [?] there [...] [?] from its place [...] [?] a circle, which are [...] [?] to complete [la-ʿasot] [...] [?] the circles [...] [?] together with the circle HB [עשולה ה״ב], that is, the circle H [...] [?]. [...] [?] the pole H [seren H] shifts [?] by [some] amount [?] from [...] [?] the [approach — ?] of the [...] [?], and the pole [seren] [...] [?].

[Siman 5? [?] — heading numeral not securely legible.] As it appears to us to explain [?] [...] [?]: and the two points [...] [?] to [...] [?]. That is, [in order] to

complete a small motion [tenuʿah qeṭannah], and [when] the planet upon [that] point [...] [?] is discerned [?] [in/from] its circle [...] [?] from [...] [?] — that is, the sphere of the equator — and there goes out from it, in a circle, [something] inclined [?] to the side [...] [?] together with their pole [sedanan] [?], because their distance from them [...] [?] and one [...] [?] to the circle; and [we posit] point L [nequdat L] on the pole [ba-seden] [?] [as] a small [circle], so that there results the [required] arc [?]. The upper [sphere] [?], in the circle of the equator, [runs] from point A [nequdah A] toward point HM [nequdat ḥ״m] [?], and it shifts [?] [...].

Siman 7 [סימן ז — the numeral is *zayin*; see anomalies]**.** On the motion of the upper [sphere] [?] as [...] [?] one side, and its [...] [?] toward their point; because, when the sphere of the upper [sphere] [?] begins its motion from point A [nequdat A] and pursues [ve-yirdof] [...] [?] afterward [aḥaron] [...].

Siman [a new, unnumbered section begins on the final line and continues beyond this page].

[Continuation of al-Biṭrūjī's homocentric ("pole-circle") astronomy as paraphrased by Judah HaKohen. This opening continues the *Siman* begun on the preceding folio; no new numbered heading appears.]

[Right page of the opening — f. 181v.]

in the sphere of the planets, from [point] Z; and point Z returns to its place. Pole Z does not rise above the circle it has traversed, because it falls short of it — it falls short of it by a part of a part [i.e. by a fraction of a degree]. And here is point M, the point of contact (*ha-hashaqah*), toward the side: for by the measure of that same part by which it fell short it proceeds, so that point M reaches — in the lag (*qiṣṣur*) — as far as point L. When the declination (*netiyah*) of the planet has been completed, [being smaller] than the ascension (*shaʿolet*) of the equator sphere (*galgal ha-mishor*) — that is, the one that stood at point A — the planet returns to the distance of point L upon the oblique sphere (*ha-galgal ha-noteh*), while preserving its place.

To its place [it returns] from the [?]: the course is that the planet rises in its return at a distance from Z equal to the measure of arc [ʿB?], and this is equal to the distance of M from point L — which is reckoned like the point of the circumference (*nequdat ha-heqef*), since its distance from pole Z is three-quarters of a circle. And so this is the small displacement (*ha-haʿataqah*): from point L up to the point that lies over against point M, from the circle of transit. The planet returns from its place, its declination growing smaller, until [it reaches] the point [reckoned as the point of equality] (*nequdat ha-shivui*) [?]. …the operation of the

pole and of the planet in [their] return, by the *regaim* named, according to their operations — in two quarters, or in every quarter, for that which is with it: that is, the increment from the circle of transit upon which the pole revolves, together with the increment from the oblique circle (*ha-netiyah*) upon which the planet revolves.

And since we have already set down the matter of the motion to which we drew attention — while preserving [its place] — and it is the motion of this sphere of the planet: [the pole and the planet] make good by it whatever [the sphere] fell short of from its universal motion (*tenuʿato ha-kelalit*), together with the natural motion that belongs to it, and it stands opposed [to it] in everything that runs counter to its motion. So it is for this sphere: upon its two poles it has a course toward the motion of equality, and it returns to it upon its two poles, because they are fixed for it. It is for this reason that the name "pole" (*sedan*) is assigned to this sphere, and [likewise to] the planets fixed within it. Yet we have varied [the account] in the motion of the whole — but it is a motion that is not apprehended by the senses; rather, the intellect grasps it truly, beyond any doubt.

[Left page of the opening — f. 182r; pencil foliation "182" at the foot.]

And a proof of this lies in the displacement (*ha-haʿataqah*) that the planets have in latitude (*ba-roḥav*), and in the advance and the delay (*ha-qidum ve-ha-iḥur*) it has, together with the [end/goal of the?] motion that the upper [sphere] has [?]; and in what the fixed stars (*ha-kokhavim ha-tequʿim*) possess, inasmuch as the sphere. It moves upon the two poles of this [sphere] by the motion of the sphere, until it completes the measure of that which [it should]; whereby they make good whatever the sphere fell short of from the motion of equality (*tenuʿat ha-shivui*). And so it is completed, and there remains the displacement in latitude alone. And this is on account of the declination — even the declination of the pole, which does not make good anything of the lag (*qiṣṣur*): it too remains upon its own line (*qav toro*) [?], because the planets move with the motion of the sphere upon the poles of their poles. The two poles have no share in that [further] motion, because they are set aslant to it; and so it produces no lag of the pole (*qiṣṣur ha-sedan*), but only the motion in latitude for the planets alone. Therefore [?] …

And when one of the planets travels — whether upon one point of a circle; let it be, say, point L — and let the distance of this point from A, which is the point [?], be some number of degrees. For example, let us say the planet is at point L: when it completes the traversal of these degrees by the motion of completion (*tenuʿat ha-tashlum*) — which is its small motion, L, that settles into it by the motion of the sphere upon the two poles — that is, from L to point A, to what lies opposite it —

there rise together with it the degrees of the equator (*maʿalot ha-mishor*), which are [?], what is less than it. And it is the measure of the distance [?] … not … the motion …

So the planet appears as if it lags in longitude (*mitʾaḥer ba-orekh*) from the motion of the upper [sphere], by the measure of that excess which lies between the degrees — the degrees [of its equality?] [?] — and the degrees belonging to the circle of the equator; and its motion is [directed] to completing this.

Diagram. A pole-circle (homocentric) construction occupying the lower-left quarter of f. 182r, drawn in black ink over the ruled text-lines. It comprises a large outer circle overlapped by two further circles — a mid-sized one set toward the center-left and a smaller one toward the right — the three intersecting so their arcs cross near the middle; a nearly horizontal straight line (a diameter/axis) runs across through the region of the centers, with a shallow lens/almond formed where two arcs cross it, and letter-marks stand where the circles meet the axis and one another. The figure illustrates the planet's small compensating motion among points L, A, and M discussed in the adjacent prose (the shifting pole and the planet's motion of completion). The vertex-labels are written very small in faded ink; only a few resolve securely:

- מ / ם (center, where the axis meets the inner circles): M [?]
- letter at the right small circle: [?]
- ג (lower-left, on the outer arc): G [?]
- [Remaining vertex labels — at the axis endpoints and the several circle-intersections — are not securely legible at this resolution.] [?]

[: more than two diagram labels are illegible.]

Therefore, on account of the inclination of arc AL, the star's mean course falls short, [remaining] equal to a course that does not incline. For this reason the star appears to lag behind its place, even though it has already completed its motion.

The explanation of the matter is this. We take the pole of circle ABG [א״ב ג], and point L [ל]; and upon point L [we describe] a semicircle [?]. Now, because arc BG [ב״ג] — which is the arc of the inclination [the obliquity of the ecliptic] — is known, being 23 degrees, 51 minutes, and 20 seconds [כ״ג מעלות ונ״א רגעים וכ׳ שניות]; and because arc AB [א״ב] is a quarter-circle and is therefore known; and because arc AL [א״ל] is likewise known, being 45 degrees [מ״ה מעלות] — we say as follows.

Because the arcs of circle ABG were drawn, and none of them passes over the pole of another, we have already marked upon circle ABG the points L and TS [ל, צ], and from them drew onto circle AB an arc [?]. Consequently the ratio of arc [?] to the known arc AB is compounded of the ratio of the known arc [?] and the ratio of the restored [complementary] arc [?]. For the ratio [ערך] of arc AB is known, since it is a quarter-circle; and arc BG, which is the arc of inclination, is 51 [minutes...] [?] and is known; and the complementary arc AL is 45 degrees [and its] known [minutes] [?]. Therefore arc ML [מ״ל] will be known — as follows. Arc ML is known [by computation]; and when you complete the reckoning, you find that it is 17 degrees [י״ז מעלות] and [?] minutes and [?] seconds [כא [?] לצ[?] ז[?]]; and therefore its degrees [?] and the arc [?].

[The passage continues as a Menelaus-type compound-ratio computation carried through the arcs of the pole-circles — "let the ratio of this known arc to that known arc be compounded of the ratio of the two others," chaining the successive arcs "known → therefore known." The recurring compact abbreviation read here as ערך / נ״ב (the sector-figure ratio term) governs each step; the individual arc-label letter-chains and their sexagesimal sub-values below are flagged individually where they will not resolve.]

[being] one of the [circles] that revolve about it; and [the ratio of] arc [?] to the remaining arcs [is] a completed quarter [רביע… תשלם]. And the complement of arc [?] is arc LB [ל״ב], and it is 45 degrees [מ״ה מעלות] and its known [minutes]. And the complement of arc [?] is arc L-TS [ל״צ], and it is [?] degrees. Since arc LB is drawn, it is known; and because the ratio of arc LB to the quarter-circle is known, therefore [the ratio of arc] LB to the remaining [?] — that is to say, arc LB [to] arc [?] — is known; therefore arc AB[L] [?] is known, and it is [?] degrees [מ״צ(?)] and [?] minutes [ל״א(?)]. And arc ABL [א״ב ל] is [in the ratio of] a quarter-circle [רבע עגולה].

Diagram. A faint compass-drawn construction of concentric circles with intersecting arcs, ruled in drypoint/pale ink in the lower half of the page (the pole-circle / sector figure for the ABG construction argued above). Two or more overlapping circles are visible; no letter-labels are legible at this resolution, so none is committed.

And so [the star] appears [to have] a known [amount] [?], [an amount] smaller than arc AL — the perceptible [portion] of the inclined degrees [?]. Therefore, when it has completed [its motion], as [reckoned] in seconds [?] [against] an arc [equal] to arc AL, [it is] like [the case of] an arc that is not seen to lag behind its place [in longitude] [?]. For there is no pole [קטב] between the horizon [האופק]

and the semicircle [the meridian]; [and once] we reckon [it] as [something] already divided into degrees, and the degrees of the equator [?] [are counted] — [then] the star is seen [as though] it fell short: [the amount by which] arc AL falls short is measured from the divided degrees of the equator [מעלות המישור], and they take [?] up to the beginnings [of the divisions] [?].

By this, [the star] is seen [to move] in what appears [as a departure(?)] from its place; and so the sphere [is turned] about the center of the [enclosing] sphere [of] the equator, [with] the slight diminution of its particular motion [תנועתו הפרטיית] out of the degrees, in longitude — while it is seen in latitude [ברוחב] [?] and diminishes. Its [motion] is reckoned in the parts [חלקים] that are in [their proper] order — now behind [it] and now ahead — and [?] the degrees [?] from point A [?]. But when [the star comes(?)] after this, in [proper] order [על הסדר] [?] — [then] we say [?] concerning it [that] it is already seen at variance with what we have said [above].

[When] it becomes complete [?] — [namely] the completing [portion] of its particular motion — and there rises up [with it] an arc of the equator [מ]greater [than its own arc], then, on this account, the star is seen to have an excess; and there is an addition [of] the parts [חלקים] that are completed [out of(?)] the divided degrees of the equator, and its place is seen ahead of [?] the rising [degrees] [שרקן ה]עולין(?)]. Yet [these parts] fall short, because [the star] is being carried in the universal motion [התנועה הכללית]; and its doing [?] is in truth [that of] many [?] arcs [?] according to what it does in the first time [בזמן הראשון] [?].

The first [station(?)] is what they called [?אקצא]; and [the star] advances [and] halts before [reaching(?)] [its place], and rises up over [?]. They called it [?] direct [?], neither [retrograde nor(?)]... nor [?]. And it is said concerning you [= we may say]: there is no measure to it upward [למעלה] [?], neither [?] nor direct [?].

These are the accidents [המקרים] that befall the sphere of the stars, like the doing [?] of a change in aspect [שנוי ההשקפה] in longitude. But as for the change of latitude [שנוי רחב], it is a true [real] [change] [?]. See this for yourself [ראה לעצמך] — [in] what we have [set out] to explain — provided only that [the star] undergoes a displacement [העתקה] in longitude according to the order of the degrees [לסדר המעלות], since [?] [there is a] displacement [?]. And with this is completed [ונשלם זה] [the account of] the great variations [שינויים גדולים] in their latitude [?] — [namely those of the outer planets: Saturn(?) and (?)].

The Treatise on the Sphere of Saturn

[Margin, upper right of the heading (second hand, small script): " … [?]אמר כ סדן[?]" — a brief marginal note; the reading is uncertain and further identification requires further verification.]

The sphere of Saturn — [the poles(?)] travel upon a number of circles [שה עגולות; the quantifier שה recurs throughout and is transcribed as read — see note], and [likewise its poles(?)] move in the same way upon a number of circles that carry the pole [סדן = qoṭev, the pivot] of the sphere of the fixed stars — the sphere they call the sphere of the zodiac [גלגל המזלות = the ecliptic] — since it follows along in its track. These small circles are carried by the sphere that passes about the pole of the sphere of the zodiac. When one examines by observation the departure of the planet from the sphere of the zodiac, one finds it to be three degrees, and its diagonal [ואלכסון] is [numeral: ?] minutes [רגעים], a fourth part [לרביע(?)].

Each one of the small circles is separated from the sphere that carries the pole of the sphere of the zodiac by [numeral: ?] degrees [שה מעלות] and [numeral: ?] minutes [ושה רגעים]. And so the pole about which these small circles turn is set upon the circles that carry the pole of the sphere of the zodiac; and there is found for this planet a threefold motion — two of them in latitude [ברחב]: the one reckoned relative to the sphere of the equator [גלגל המישור, "the level sphere"], and the second relative to the sphere of the zodiac; and the third in longitude [באורך]. On account of this motion in longitude the planet is varied by acceleration and retardation [במיהור ומיחור], and by station and retrogradation [ועמידה וחזור].

Upon these two figures [הסימנים] he set down the marks of the pole and of the motions upon them. And the shortfall of the motion [קיצור התנועה] arises for some of the spheres from [the motion of] others. The demonstration of this is as follows.

Let the belt of the zodiac [נטאאק המזלות; Arabic *minṭaqat al-burūj*, "the girdle of the signs" = the ecliptic] be the circle אבג, and the sphere of the equator be אהג[?]; and let its small pole be ט. Let the circle that carries the pole of the sphere of the fixed stars — namely חט — turn about pole ט. The planet is placed upon the mean circle [העגולה האמצעית] of the sphere, upon the belt of the zodiac, and it will be at the point [numeral: ?].

At the point of intersection [בהחיטוב(?) — the node/crossing of the circles] it is proper that the pole of its sphere be upon the circle [numeral: ?]; and necessarily

the planet will be upon a quarter of the circle from its pole, and there it is at point כ. And because the pole — that is, the departure [ציאות] of the planet Saturn from the sphere of the zodiac — is three degrees, therefore point כ will be [displaced] from the pole of the circle by [numeral: ?] degrees, and it passes over [numeral: ?] degrees [מעלות (?)ז] [at point?] מ. And here it is an arc [קשת = קשה] [numeral: ?]. Accordingly, this figure will be the [figure of the] carrying of the pole of the sphere of Saturn, as will be explained.

And because this sphere — so that the completing motion may be attained through it, and it proceeds from it and from its surrounding motion — every arc of it, [taken] from the circle, is made an arc of 25 [כ״ה]. And because the sphere of the fixed stars treads along its path in the way of its motion, and there were for it poles that move, yet they are fixed, and they are as set before you — there remains a pole כ upon its axis [קיטרין(?)], since its motion belonged to it, even though it is acted upon by the motions that revolve about pole ט. Thus is the motion of the planet.

By the motion of the inclined sphere [גלגל הנוטה] there is for it an arc of 15 [ט״ו]; and the remainder of the planet's [motion], at the extremity of its sphere, is an arc of 31 [א״ל(?)], and that is the last lag [הקיטור האחרון]. And necessarily pole כ falls short [יקצר] in its lag when the circle makes every arc similar to an arc of 39 [ט״ל(?)], since the pole did not carry that motion, because it lay upon it; and that arc is like [numeral: ?]. And because point כ is upon a quarter of a circle from ט, while the distance from כ to מ [is otherwise], therefore it is not upon a quarter of a circle from ט.

For inasmuch as point כ [describes], relative to pole ט, the circle גל [?]אבז[?], therefore of necessity the planet inclines away from the belt of the zodiac ever toward the south [דרום], as the point goes out from [numeral: ?]. Accordingly the planet will be at point מ, going out ever southward by an arc [numeral: ?]; and this is the figure. Its mark is set at its [neck?] from the belt of the zodiac; for through this pole and its motion in the circle, from point כ to point ט — which is toward the quarter [לרבע] of the degrees — the planet will be drawn along the belt of the zodiac, or it will make the intersection of the belt of the zodiac until it completes [numeral: ?] degrees; but as for the fourth part of the degrees, from point מ it returns [as a perpendicular?] toward the belt of the zodiac.

And when כ moves onward as far as ל, the planet returns to the belt of the zodiac at מ. And when it comes to rest in the second part of the [motion(?)] — that is, half of לב[?] — the planet returns northward [צפון] from the belt of the zodiac until it completes three degrees; but [as for] the fourth part of the degrees, [it is

otherwise]. And afterward, in the return of the pole, the planet returns to the belt of the zodiac; in the return of the pole to [its arc?], half [numeral: ?]. This is the curved figure [הסימן המעוקם] for the inclined sphere [גלגל הנוטה].

But the curved figure for the sphere of the equator [גלגל המישור] is this: that the planet be, at the moment of its revolution [בשעת התקופה], [displaced] from the belt of the zodiac :

[The chapter closes here at the foot of folio 184r; the remainder of the page is blank.]

[This opening continues the homocentric planetary theory of al-Biṭrūjī (*Miklal Yofi*) with no display heading; the text on page 1 begins mid-sentence, carrying over from the previous folio.]

[the points] distant from the pole of the equator. This comes about through the lag of pole ט, about which pole ב revolves, as we shall explain. For when the star completes that final shortfall of its along the arc AG, pole ט has by then already completed its own shortfall as well — [and this continues] until [the star] completes it entirely, and the star completes the ascension of [arc] AB, [numeral: ?], through the lag of the shortfall. For the star and the pole — that is, point ב — lag together in longitude through the motion of the whole upon pole ט; and of necessity the star returns upon the arc of the simple and southern anomaly (קשת התקופות הפשוטה והדרומית), and upon two outer positions on the arc of the revolution, at the completion of the revolution.

This is the particular cause of the motion of the center of the epicycle sphere (גלגל ההקפה) upon the eccentric sphere (גלגל היוצא); of the motion of the eccentric's center upon the circle of variation (עגולת המחלקת); and of the plane of the epicycle sphere upon the circle of variation. But the variation in the course of the star in longitude — by addition and subtraction, by diminution and station (בתוספת וחסרון ומיעוט ועמידה), together with its return — is as we have recounted; and it arises because the pole of the sphere — that is, point ב — has its lag upon a circle. All of this belongs to the particular motion of the sphere. And the shortfall of the star is equal to the lag of pole ט upon the circle.

point ג, since the lag was upon the ascension of the whole, [and this is] equal to the particular motion of the sphere. The shortfall of the star is equal to the lag of pole ט upon the ascension [numeral: ?] — and these are the requested degrees (המעלות המשואלות), namely the degrees of variation that pole ט carves out upon the circle; and this is what is called the mean motion of the star (תנועת הכוכב האמצעית). [The other motion] is what is called the small motion, [namely] what

pole ג carves out of the ascension of the whole; and it is not perceptible to the senses (ואינה ידועה בהרגש), except that it has

a fixed [measure] [?]. It has [numeral: ?] cycles, [reckoned] against the number of the days of the solar year — the day, the half, the quarter, the extra, and the surplus over them. There emerges what pole ט completes in its shortfall, of the degrees, upon the ascension by which they proceed [?]; and these are the degrees corresponding to the degrees that the star traverses in its motion about its two poles. They are [numeral: ?] degrees and [numeral: ?] seconds in one day; and in this way they apportioned the [numeral: ?] cycles.

that the star completes of the degrees of variation, and the [mean] degree; and from [numeral: ?] the degree is divided over the days of the solar year — the day, the half, and the quarter. There emerges [as] the lag of the star [numeral: ?] upon the ascension of the degrees, which is two regaim and [numeral: ?], approximately; and this is the mean anomaly (התקופה הממוצעת). It is like the ascension that pole ט completes, [numeral: ?] in one day. Therefore, just as the whole has passed over upon [numeral: ?], the star returns in its shortfall upon the ascension of [arc] AB [numeral: ?], and pole ט returns in its shortfall upon the ascension [numeral: ?], and the position of pole ג is upon the ascension. At every terminus pole ג completes of the ascension of the whole, and point ג returns to the ascension [numeral: ?]; and they are [numeral: ?]. Point ג is a known point [?], distant from its place [numeral: ?]… upon an arc similar to the arc of the star's motion, of the ascension of [arc] AB [numeral: ?]; and it is one part of [numeral: ?]… and it returns from the ascension of [arc] AB [numeral: ?]. And since the star, in its course, [moves toward] the one [of the two limits?], its breadth [?] — its distance toward the ascension…

from the pole [?] a quarter of the ascension; and point [?] was carved [?] upon the ascension of the whole toward the arc [?]; and pole [?] moved upon the ascension [numeral: ?]. By itself the arcs of the lags gather and unite on one side; therefore the lag of the star is hastened in its conjunction [?], and the first [lags] necessitate the lag of the star. They are distortions, as [is] the motion of the whole, because the star pursues pole ג and pole ט together. Therefore, when [it is shown?] that they are lags to one side, the star lags [?] together.

And since the distance between pole ג — which is the pole of the whole — and pole ט — which is the pole of the ascension — the transference of the pole of the fixed stars upon them is known; and [by?] the ascension of the transference to the pole, the pole of the fixed stars, likewise, is [carried] upon them.

Diagram. A pole-circle construction in the lower-left of the page. A large outer circle encloses a slightly smaller circle set tangent to it near the top; below the center, two equal small circles overlap, intersecting to form a lens (vesica) figure. A straight line (a radius) runs leftward from the central region out to a labeled point on the left. The prose alongside references poles ב, ג, and ט and the fixed-star pole; the visible point-marks on the figure are faint and only partly legible.

- א [?] (left terminus of the leftward radius line)
- ד [?] / ר [?] (top of the outer circle)
- ב [?] (upper-left of the two intersecting inner circles)
- ג [?] (lower/right of the two intersecting inner circles)
- ה [?] (intersection / foot of the vesica)

[Text continues to the right of the figure, concluding the passage above on the pole of the fixed stars.]

[Pencil foliation "185" at the lower right of page 2.]

This is the ratio that Ptolemy found between the line drawn from the center of the epicycle sphere (נטול ההקפה) at the near distance — the perigee — and the center of the sphere of degrees (נטול המעלות, the zodiac). It holds just as it does for the [line itself]: from the [point] in the epicycle sphere to the line that issues from the point of approach (נקדת הקירוב, the perigee) near the center of the sphere of degrees, [there is a quantity] greater than the mean motion of the planet, corresponding to the length of its motion upon the epicycle sphere — which is the [essential] motion.

And he said: the displacement (העתקה) of the planet, when it is at point *aleph* and the pole (סדן) is set upon the line *lamed–gimel*, is such that the displacements of pole *gimel* and pole *tet* lie to one side, opposite [that] displacement, until pole *kaf* arrives, and the lesser displacement occurs in magnitude. Then, from there, the displacement of the planet [passes] from the greater motion toward the mean motion, until pole *kaf* arrives [at its return]. And the planet [carries] its motion from the mean toward a lesser motion, because the displacement of pole *kaf* is opposite the displacement of pole *tet*.

[Then] pole *gimel* [lies] to the side of the motion of the whole, and the displacement of pole *tet* is opposite it, because pole *kaf* is nearer than [pole *tet* is] from the center — [and so] the displacement [tends toward the lesser], until the displacement of the planet reverses and a station (עמידה) appears to it. Thereafter the displacement of pole *kaf* adds upon the displacement of pole *tet* [?], and the

displacement of the planet reverses [again]. It begins [its return] and does not depart from it any further, but returns until it approaches [again] from pole *gimel* [?] — near [the point] just as at the first, [equal to] its distance from it, and its distance from [the point].

[This is] the second [motion] that the planet had, moving in the circle *aleph–bet–gimel*; and it appears to the planet, on this side, [moving] with stations, until the [?] are completed. And the planet [is kept back] [?], and afterward it goes direct (יתישר) and moves through some places [?]. And when it arrives at point *kaf* upon [the line to?] *gimel*, in the circle *ḥet–mem [?]–kaf–bet [?]*, the displacement of the planet [departs] from the mean; and the amount by which the planet moves in the circle *aleph–bet–gimel* is corresponding to the amount by which the pole moves in the circle [?]. And the pole completes its revolution, and the planet remains [moving] in the circle *aleph–bet–gimel* [?].

Diagram. At the foot of the page, in the same faded brown ink, is a construction of two (or three) concentric circles drawn about a common center, with a short radial stroke reaching toward the center and a horizontal line extending to the right and terminating in a small tick. The circles overlap the last lines of text. The interior point-letters and the marks at the line-ends do not resolve at this resolution. [The figure illustrates the pole-circle construction of the preceding demonstration — a pole revolving on a small circle about a fixed pole.]

- (center): [?]
- (right terminus of the horizontal line): [?]

[Foliation: a two-letter Hebrew mark at the bottom-left corner of this page, apparently (86/85) [?] פו/פה, partly abraded.]

[...] the part [?], and it returns as we have mentioned; and the planet returns to the circle *aleph–bet–gimel* after it had gone out from it and already separated from it. In this [same] span of time — sometimes toward the south (דרום), sometimes toward the north (צפון) — it will be swift in its course; it moves inward and recedes [?], and it keeps [its path] [?] as we explained. And this is the [difference?] [?].

Set for the planet that which we have called the displacement of the planet upon the epicycle sphere, together with the motion of the [epicycle's] center upon the eccentric sphere (גלגל היוצא) [about?] the center. This is what we wished to explain. The matter is clear: a planet which falls short (יקצר) in the sphere of degrees, behind the displacement of the upper [sphere], returns [through] one

revolution in each solar year — a full year — and nearly [?] one [?], approximately.

The Treatise on the Sphere of the Planet Jupiter (צדק)

The motion of Jupiter (צדק), Mars (מאדים), and Venus (נגה) does not differ from [the motion just described] except in quantity alone. The motion of this sphere [?]: it [is driven] to the motion of the whole and [driven] toward the upper [sphere]; [it completes so many] revolutions in a year — a solar year — and what remains to it of the motion of the return — which we have called "it falls short behind the upper [sphere]" at the end — is the displacement called [?], [reckoned] against [?] each year, [so that they return in] revolutions [equal to] the solar years themselves.

And the illustration of the motion of this sphere [comprises]: the retrogradation (הקיטור), the [approach] [?], the [pause] [?], the direct motion (היושר), and the station (העמידה); and the [?] resembles the motion [described before]. There is in it no change of [form] [?] except in the change of the degrees. We place the planet [?] upon point *aleph* [?], a place [?] in the circle of the revolution and the circle of degrees. And because the planet Jupiter (צדק) will be seen in latitude (ברוחב) [with respect to] the degrees [?] — [as?] the degrees of the Moon (הלבנה) — the amount [?] the circle [of] all the degrees [?].

Thus [it makes] a square of degrees [?], because its motion was [uneven] [?] in its motion; and the motion of the sphere upon pole *kaf* is [numeral: ?] minutes (רגעים), and also [numeral: ?] hours [?]. Accordingly, corresponding to the amount of [?] the minutes, pole *gimel* falls short in the circle [of] all [?], so that the motion [?] will be [?], and it is [numeral: ?].

[Foliation: modern pencil "186" at the bottom-right corner; a two-letter Hebrew mark, apparently פו/פה [?], at the top-right corner of this page.]

(The homocentric account of the planet's sphere — the chapter opened in the preceding leaf — continues here as unbroken prose across both sides of this opening. No new decorated המאמר heading appears on either page.)

And likewise, since what remains [of the motion] leaves a portion of it behind, the planet is drawn out [תאורך — delayed] in longitude, following the order of the zodiacal signs; and this is its linkage [קישור]. [?] the shortfall [קיצור] after [?],

approximately, upon the equator [מישור]; or else it falls short [יקצר], because its ascension [שעולתה] is entirely [?], since the wandering-sphere [הנטלטל] has already fallen short in its totality [בכללות]. He said that it became distant from them, and [?] its [?]; and there is found [?].

[?] the wandering [motion] upon [?]; and it is entirely [?], together with [?] many portions, together with what it fell short by, at the end. And it is [?] the planet drawn out in longitude, and an arc [קשת] like [what it was] before [כמו קמאתי]. [?] the shortfall of [?], and it is carried [נטלטל] upon [?] to begin the wandering anew from where they began before, as it appears, according to what is [?] to them from the cycles [מחזורים]; [?].

And it is such that, when it revolves in the circle [בעגולה] through many cycles [מחזורין] and [?] returns, this sphere [?], and the planet's sphere falls short of it [קיצר]. Here what appears is a returning — that is, an apparent retrogradation — and these are the cycles [מחזורים]. As when you say that the shortfall [קיצור] is [reckoned] in degrees [במעלות], and the completion [תשלום] of this sphere is upon its center [מרכז], and [?] the motion [?] in the time of the cycles [?] to return.

[?] it is displaced [נטלטל], [?] eleven degrees [יא מעלות?] [?]. In it [?] is not [?] from it, [?]; toward the end it falls short in the circle [בעגולה]. Every [?] the degrees [המעלות], and the planet falls short; in preserving this [?], the remainder [שארית]. The twelve zodiacal signs [יב מזלות] [?] a single degree, and they set it [?]; there appears a shortfall of a portion [קיצור פרק] as well. In the circle which has been reckoned by its magnitude [?], the sphere is [joined] to the sphere on their left [?], the rest [שאר]. [?] its degree [מעלתו] [?] falls short by [?] that fell short by the one degree, like the shortfall of a planet. And there appears the shortfall — one [?] of a planet, an arc [קשת] [?] — and it has already been reckoned. And this sphere is carried [נטלטל] upon [?] this [?] toward [כלף] the [?] upon the planet. And this [?] of the sphere of the zodiac [גלגל המזלות], and it falls short [וקיצר] [?] — for [?] in the degrees, all of them [?]. So this appears, according to [?] which is [?] to them, for [?] to revolve the sphere, and it falls short by [?] degrees, and a degree [?] the sphere. From [?] it has been reckoned [?] to endure [?]; it is displaced [?] to diminish [?] by [?] the degree, [?] to examine them [לבחונם] according to the order of the degrees [סדר המעלות], [?], and the like for you [וכדומה לך].

[?] the last shortfall [הקיצור האחרון] of the wandering-sphere; and the pole [סדן] takes [ויקח] [?], for [?]. Toward the order [?] of the signs [המזלות] [?] the wandering [?], [?] its signs [מזלותיה] [?]. [?] the pole [סדן] [?], [?] the signs [?], it is displaced [נטלטל] [?] the degrees [מעלות]. As [?] its ascension [שעולתה] [?] illuminated [?], for [?] the planet [?] its ascension [מעולתה] toward the signs

[למזלות], to the [?]. [?], for [?] endures [?], [?] until [?] it is far from our position [רחוק מעמדנו], our master [?]. [?] its ascension [שעולת] [?], for [?] [?] the planet [?], [?] and a degree [?].

And the pole [סדן] is already displaced [?], and [?] [?]. And the planet does not cease [ולא יסור הכוכב] [?] growing distant [מתרחק] [?]; [?] its ascension [מעולתה] [?] the signs [המזלות], and the linkage of the planet [וקישור הכוכב] at the time that its pole [סדנו] [?]. As the manner of [?] and distance [ורחוק], and since the [?] pole [סדן] [?] this [?] in it [?], and [?]. Not [?] the order of the signs [סדר המזלות], and there appears [?] as against it [כנגדו], and [?] its covering [?], and afterward [ואחרי].

So there appears to the planet [יראה לכוכב] two linkages [שני קישורין]: a linkage of [?], [?], first [ראשונה] the linkage of the planet [קישור הכוכב], and afterward it advances [יוסף]. And there appear the degrees [המעלות] [?] the returning [retrograde] one [החוזרת]. And it is [?]; likewise the wandering [motion] [הנטלטל] [is] the measure of the distance [שיעור רוחק] over the degrees of [?] the planet, which is behind it [שאחורו]. For you to examine [לבחונך], one sees the planet stirred [נעור] toward one side [לצד אחד], as [?] the order [סדר] [?] for the sake of its pursuit [רדיפתו] [?] the [?] toward the short [?] longitude [לאורך קצר], and [?] a moment [רגע], [?] a fitting limit [קץ נאות], a place [?] it completes its [?].

[?], and the wandering-sphere [הנטלטל] [?] to lag behind it [להאחר ממנה] until the pole [הסדן] draws near, being brought near [מקורב]; [?]. And there appears to the planet [?] a second [time] [שניה], and afterward it returns to its first rest [יחזור להשקטו הראשונה], and it lags behind it [?].

[Foliation: "187" in pencil, lower-right margin A faint circular impression/offset shows through at the foot of the leaf — a stain/show-through, not an inked figure.]

(The recto opens with the last few lines of the preceding chapter — the sphere of Jupiter [כוכב צדק], carried over from the previous leaf; the planet is not named on this page, but the twelve-year period stated below and the chapter order identify it. A decorated large-script heading for the sphere of Mars then opens partway down the recto.)

Its lag [קיצור] becomes uniform, and it reaches the mean, when the pole [הסדן] comes to rest upon point G [ג], and its displacement [העתקה] no longer recurs. When the pole comes to rest, it is set [נטבל] within the circle of transposition [עגולת העברה], until the path is completed — until the pole completes here [these] cycles [מחזורין]; and likewise this pole completes, within the circle, [these] cycles.

These, then, are the [resting] and the cycle by which one gauges [לשער] the pole and the planet, which are of a single essence [בעצם אחד?], just as we set out at the beginning. And so it completes one cycle in twelve years [ביב שנה] and [?] months [?]; and it completes one cycle upon its own pole, by the motion of the pole [?], in [numeral: ?]-and-[forty?] days [?].

The Treatise on the Sphere of Mars

(Decorated, enlarged display script running across two lines: המאמר על גלגל מאדים, "The Treatise on the Sphere of Mars,")

The circle of transposition [עגולת העברה] belongs to the sphere of Mars [מאדים]; [in it] the pole revolves, and [there is] the circle of transposition of the pole, [while] the planet is set [נטבל] [?]. Pole Ṭ [ט] revolves, and the circle of transposition of pole N [נ] [carries] the planet, thus. Pole B [ב] revolves, and the arc will be like [?] of the great circle of transposition. [In this way] the whole of this is set in order [as] a circle [?].

And we have already stated, concerning the five planets [החמשה כוכבים], that the ratio of the arc lying between the pole and the circle of transposition — that is, point G [ג] — and the encompassing line [הקו הסובב] within the circle — that is, point [?] — to the arc lying between the encompassing line within the circle and pole Ṭ [ט] — that is, arc [?] — is greater than the ratio of the displacement of the pole [העתקת הסדן] to the circle of transposition of the pole [and] the sphere of the planet. That is, [the ratio of] the displacement of pole B [ב] to the displacement of the pole of this sphere [—] this circle [—] is greater than the ratio of the displacement of pole G [ג] to the displacement of the pole [?] that is set from it [in?] this [sphere].

[From this it follows that one may] draw out from it — from pole Ṭ [ט] — an arc, arc B [ב], [an] arc [?] within this circle, and the motions [?] as far as the encompassing line within the circle; [and] whatever ratio there is of what proceeds from it [?] out of this circle — that is, [?] its outlet [מוצא] — [is such that one] makes [?] the point [?]: as much as the displacement of point G [ג] to [?] the displacement of the pole set in this circle. And this arc was the returning arc [הקשת המחזרת] [?]; [take] the conjunction [חיבור] of one [arc?] [?].

Diagram. At the foot of the recto: a large circle on the left, overlapped at its upper right by a smaller circle, the two intersecting so that the small circle's arc cuts across the large circle's circumference. From a single dot at the left interior of the large circle, three straight lines fan out to the right, reaching points strung along

the region where the two circles meet (the construction of the pole's displacement across an arc of the circle of transposition, with the radial lines carrying the "conjunction" points described in the prose). The point-labels are small and only partly legible.

- (left interior of the large circle): a dot — the origin of the three radial lines; label not legible [?]
- (upper right, on the small circle near the intersection): [?] (candidate ה or ס)
- (right, next line down): [?] (candidate ד)
- (right, third line): [?] (candidate ב)
- (lower right, on the small circle): [?] (candidate ז or ו)

(This verso is markedly fainter — pale gray-brown iron-gall ink at low contrast throughout — so the reading is more heavily flagged than the recto; the argument's thread is legible, but individual words and the point-labels frequently are not.)

[And this is the] ratio [?] to the displacement of the pole — namely the [pole] that is set — [as] arc [?] G [ג]; and we resolve it [ונשבור?] [?]. The [pole] that is set [?]: however much the arc [is], as arc [?] of the great circle [עגולה גדולה] of transposition [?], it will be [?]. From this it follows that whatever arc there is [is] as though it were the ratio of the displacement of pole G [ג] — that is, an arc as [great as?] the whole [belonging] to it — to the displacement of this pole that is set. And [so] we take the ratio of the whole [יחס הכל] to something greater than the ratio of [?] to [?], greater than the ratio [of one arc] to another, and greater than [any smaller] thing.

Therefore the ratio of the displacement of the whole [?] to [?] is greater than the ratio of the displacement of pole G [ג] — which is an arc as [great as?] [?] — to [the displacement of] this pole set upon the great circle [עגולה גדולה]; and by the conjunction [ובחיבור] of the arc there arises a ratio [?]. Take this [?], so that the circle [?] be enlarged [נגדל?]: from the pole one takes [?] its center [מרכזו], and [reckons] its lag [קיצורו] [as] the first [ראשון] [element] of the motion of the [sphere] that is set [תנועת הנטבל].

And accordingly one names [יקרא] the order of the spheres [סדר הגלגלים] according to the view of this lag [קיצור], thus: [Saturn (שבתי)] and Mars [מאלים] and Venus [נגה] and the Sun [שמש] and Mercury [כוכב] and the Moon [ירח] — as we said. Just as [?] Ptolemy [תלמי] [?] established [?] in the account of the spheres, so [reckon] the near [הקרוב] [?]: [namely] that in every place where there is motion, [the sphere] restores [יחזיר] its center [מרכזו], [and] its force [כחו]; and

afterward [comes] a part [חלק], and [that which is] near, and the nearer, [the more] its force; and [that which is] far, farther [מרחוק], [the more it lags].

For everything that draws nearer [שיקרב] [—] its force [כחו] and its motion [ותנועתו] [grow]; and everything [that is] far [—] its force and its motion [diminish] with the distance [במרחק]. And we have already said that the motion of the sphere that is set [תנועת הגלגל הנטבל] [proceeds] from what is near to it [?]. And the more it is near [—] its force is more fitting [ראוי] [and] stronger than [that of] the remaining spheres [שאר הגלגלים]; and its force [is] a strong [—] a part [numeral: ?] of the force [?]. Its strengthening [?] and its support [?] [it draws] from [?]; [and] in the small [circle?] it has the force to attain its motion [להשיג תנועתו] [?].

[Foliation: "188" in pencil, lower-right margin]

[Continuation of "The Treatise on the Sphere of Mars" (המאמר על גלגל מאדים), begun on the preceding leaf.]

and as [a sphere] draws near to this one, it is brought closer; and it is named for the portion by which it is related to it in its being carried along. So too is the order that follows after it. We have already found that the shortfall (קיצור) of the sphere along the diameter (אלכסון) is greater than along the circumference (היקף), so that the sphere of Mars [?]. And beneath the pole (קוטב) of the encompassing [?] sphere [?] and the side (צלע) [?], for it is [so] in this way [?]. For we have posited that there is a [motion] belonging to the sphere [?], and a motion [?] of the sphere of Mars [?]. And although [several words illegible] beneath [?], we are not concerned [with it] [?]. And it appears to our understanding that we found the first pole (קוטב הראשון) [to lie] some [?] measure [?] from the pole of the sphere, and beneath the pole [?] according to the principles [?] [several words illegible].

Moreover, the displacement (המעתקת) of the four spheres — the spheres of the planets Saturn (שבתי), Jupiter (צדק), Mars (מאדים) [and Venus (נגה)] [?] — follows a single order, a single [axis?], and a single pole [?]; they hold together upon a single order [?]. [Several words illegible; possibly citing an authority.] For that reason it is fitting according to what we have found [several words illegible].

In this we differ from the ancient sages and from those who came after them. [?] uphold [?] in his treatise Jupiter (יצדק) and [?] [several words illegible], and we place this sphere before that of Saturn (משבתי) [?] upon the division [?], [relating] the mean of its motion (אמצע תנועתו) to the motion of the upper [sphere] (העליון) — because they did not find, for the ordering (סדור) of the planets, [any] rising [?] [several words illegible from ink-fading].

המאמר על גלגל נוגה — The Treatise on the Sphere of Venus

[Decorated display heading, enlarged script, centered.]

The encompassing sphere carries [the pole] [?], and it is the pole (סדן) [?] that the upper sphere causes to revolve, and also [?]. [It amounts?] to the shortfall (קיצור) of the pole of the sphere of Venus [?] degrees [numeral: ?]; and this [?] [several words illegible], because they found [?] the motion [several words illegible]. The foremost [portion?] of the sphere [?] [several words illegible], the [?] which [several words illegible].

[?] and it stands upon [the point?] [?]; and there rise [?] beyond it [?] each sign [?] [several words illegible], the arc [?]. In this [there is] equality (שווי), and its shortfall is like its [?] shortfall [?] [several words illegible] toward the pole [?] near it. And the rising (שעולה) [of] the shortfall of the pole of the sphere of Venus [is] eighteen [?] [numeral: ?], and [?] [several words illegible], and it revolves [an] arc [several words illegible] the arc [?]. And the point [?] [several words illegible], the measure [?] of a certain star [?] [several words illegible] of the sphere of Venus.

upon a point [that is] carried [?], which rises [?] [several words illegible]; if it comes together [as one?], it will be [?] [several words illegible] of the sphere [?] from [?]. And it is fitting that the sphere [?] a shortfall [?] [several words illegible]; and beneath the pole of the sphere it moves (תנועה) [?] [several words illegible], and its displacement (מעתקה) [?]. [If?] the shortfall [?] and it stands upon the point [?] [several words illegible], and when [it?] falls short [several words illegible], the arc [?] of the completeness [?].

[?] a certain star [?] rises [?] from the point [?], [the] sphere of Venus [?] [several words illegible]; and when [the] planet falls short [?] [several words illegible], so too the point [?] [several words illegible] into the [degrees?]. And it is fitting that the sphere [?] a shortfall [?] [several words illegible], as though it were upon the point ל [?] [several words illegible]. But if it were [that] the star [?] rises [?] from the point ל [?] of the sphere of the signs (גלגל המזלות) [?] [several words illegible], to [the] appearing [?] and it is fixed [?] by the like of an arc [?] [several words illegible], like the point [?] ל, and it falls short [?], then it will [?] turn [?] toward the side of the order [?] [several words illegible from ink-fading].

The displacements (המעתקות) [?] — there is nothing [?] [several words illegible], and its motion [?] therefore it is [?] and it [is drawn] within [?] the circle (גלגל) [?]. In their swiftness [?], through the shortfall (קיצור) of the [?] the two displacements

[?] [several words illegible]. And so the displacement appears [?] [several words illegible], that the pole (סדן) recedes [?] from [the point] ל to the point ה [?]; the planet and its motion (תנועה) [?] [several words illegible], for [as] it falls short [?] [several words illegible], the point ל is [set] toward the ordering of the signs [?], and the motion [of] ה [?] [several words illegible]. And so [too] the [?], and it falls short [?] [several words illegible], the point [?] [several words illegible from ink-fading].

[?] so that they do not [?] [several words illegible], for [when] he speaks he adjusts [?] the matter of the planet [?] a certain amount [?] [several words illegible] from the displacements. But according to the motion of the like of them [?] [several words illegible], in the exactitude of the reckoning (בדקדוק החשבון) [?] [several words illegible]. And [?] separates [?] the point [?] from the point ל [?] [several words illegible]. It appears [?] to it [?] the reckoning [?] which is the true [?] measure [?], resting [?] from [several words illegible]. To make clear the reckoning [?], according to Ptolemy (כטלמי) — how the motion (תנועה) [?] receives [?] [several words illegible] like [?] [several words illegible]. And [that] which brings it back [?] [several words illegible], and it acts [?] upon it [?] [several words illegible], so that the star [?] [several words illegible], its added [motion?] (מוספת) [?] — in it [the sphere?] it returns to move away from it (בה תחזור לנוע ממנה).

[This opening continues "The Treatise on the Sphere of Venus" (המאמר על גלגל נוגה), begun on the preceding leaf; the Venus chapter closes in the opening lines and "The Treatise on the Sphere of the Sun" begins.]

[Margin, top right of f. 189v: בס״ד — scribal invocation, "with the help of Heaven."]

and this shows that the displacement (ההעתקה) of the pole (סדן) [is] toward [?], toward the place [?] at the start; and what the motion of this planet is. This is what we set out to explain: how this planet is seen only once it has been displaced from the sphere of [?], and how this is possible [?] from its place, where it stands fixed within the sphere — that is, Venus (נוגה) — toward the [upper?] side [?]. [?] from the sphere; and this can occur in both of them [?]. [Here the Venus treatise ends.]

The Treatise on the Sphere of the Sun (המאמר על גלגל השמש)

[Decorated display heading, enlarged script, centered across f. 189v.]

[The pole of] the equatorial sphere (גלגל המישור). [Take points] א, ב, ג [?]; and the ascension-circle (העולה) that [is completed?] upon its diameters (בקוטריו), and the

line of displacement runs counter to the motion of [the whole?]. All these [?], and the pole of the equatorial sphere [?]. And it is, as it appears to the eye [?]: let the pole of this ascension-circle be [point] נ, [point] נ revolving upon the ascension-circle of [the whole?], and it is the ascension-circle that [?] upon the two equal [?]. And the pole of the equatorial sphere — its ascension-circle is [point] א [?]; and the displacement is like [?]. And the pole [?] the ascension-circle [?], the ascension-circle of [arc] ל ,הלא[?].

[The first construction diagram is drawn in the right portion of the page, the text lines wrapping to its left; see the metadata block below.]

Diagram. A large circle crossed by an oblique full diameter, with, in its lower portion, a medium interior circle (upper) and a smaller circle set near the foot; the interior circles meet the diameter and one another at marked points, and lettered reference-points sit around the circumference and at the internal crossings. This is the construction the surrounding prose builds — the pole (סדן) of the Sun's sphere revolving on a circle relative to the equatorial sphere, with the lettered points named in the text (א, ג, ה, ל, מ, נ).

- [Point-labels on the figure are small and only partly legible; the letters securely named in the adjacent prose are א, ג, ה, ל, מ, נ. — more than two labels cannot be read on the figure itself.]

Because we place the Sun on a point of the sphere — that is, on the ascension-circle [?], between the two poles of the sphere — its distance being a quarter of an ascension-circle (רבע עולה), as we said, at point א, this is the point of ascension; yet the pole of the sphere lies at ל, off the ascension-circle. Whenever the Sun passes over the ascension-circle — which is the point of [?] — the pole will stand at a quarter of the ascension-circle; therefore it will be at point ג. And it cannot be at [its opposite?], because point מ is not at a quarter of an ascension-circle from ה, since point ה is not a pole to the ascension-circle [?], but rather its pole is point [?]. And so, when the pole is at ל, it has already traversed of the ascension-circle about half of [arc] ה. Likewise, when the Sun returns to point נ, the pole of the sphere will stand at point ל. Therefore the pole rises a full ascension-circle (עולה תמימה) — yet only in part; it does not complete more than half the ascension-circle of its inclination (נטייתו). And the procedure is the same in the second half.

and it rises [?] in revolutions (מחזורין) on the ascension-circle, [drawing?] from [?]. In one revolution (מחזור אחד) on the ascension-circle it [travels?] and [there is a?] displacement [?] the Sun [?]. When the pole of the sphere falls short (יקצר) from a point [?] by the shortfall (קיצור) of the pole, and by what results from it — [?] the

sphere [?] revolves along its path, so that it will receive [?] the pole [?]; for [?] its place, and they have passed [?], it does not [?] like the shortfall of the pole, but [remains?] as at first. From it, when [?] the motion of the sphere is received in this manner [?] [margin: illegible word]. Its completion [?] [is?] its shortfall (קיצורו); therefore [?] the last shortfall (הקיצור האחרון), which is [?]. And accordingly the pole completes on the ascension-circle, having passed [?] two revolutions (שני מחזורין); [in?] one revolution the sphere receives motion by its shortfall, and there appears [?] like [what?] the sphere receives, more than [?] Venus (נוגה), as [it stands?] above it — and a greater shortfall, because its first shortfall was greater than the shortfall of the sphere above it, since it is double the motion (כפל תנועה). And as we said, it is another degree (מעלה), also inscribed (רשומה) in [?], and [?] equal to it. And [as for] the last shortfall of the sphere above it — [it comes about] when the mean motion of the Sun (תנועת השמש האמצעית) [moves?] with a motion that falls short in [?] this mean [motion], and the rule of what [?] a variation (שינוי); and upon this [?] we posit the motion as mean in its swiftness (מהירות) and in its breadth (מרחב), because all these [?] are inclined spheres (גלגלים נוטים), [their poles?] inclined [?].

And they are all carried (מושאין) in the mean motion upon the ascension-circle [?], and the [remaining?] spheres [?] — the sphere of the fixed stars (גלגל הכוכבים הקיימים) [?] from it [?]. [?] that there is, for the nine spheres (תשעה גלגלים) [?], upon the ascension-circle of [?]; or from the ascension-circle it revolves [?], like [?] upon the ascension-circle of [?] the pole of the sphere of the fixed stars that preceded it (שקדמוהו), and the sphere [?] — such are they.

[The second construction diagram is drawn at the foot of the page, at the lower left; see the metadata block below.]

Diagram. Two large equal circles set side by side and overlapping (a vesica-like configuration), their circumferences crossing at two points; a small circle sits at the shared central region, containing two crossed diameters (a small cross). A lower arc sweeps across to join the two large circles at the foot. Marked points sit at the two circle-crossings, at the poles of the small central circle, and along the circumferences. The figure illustrates the coupled homocentric spheres of the Sun described in the adjacent prose (the two carrying spheres and the central inclined circle).

- [Point-labels are small and largely faint; a small central circle bearing crossed diameters is clearly drawn, with letters set at the apex, the two lateral crossings, and the foot. — more than two labels cannot be read on the figure.]

Before you [now], reckon the planets [?]: the sphere of the planet [?] alone is carried (נושאין) by the sphere [above it?] [?] from the ascension-circle [?], like [?]; and these revolve [?], as [?] we arranged (סדרנו) among the spheres.

[Pencil foliation "190" at the foot of f. 190r.]

from which arises the raising of the passage of the pole of the sphere of the signs [the ecliptic], and their return to it, just as we mentioned in the model that we set up for the upper planets. The variation in the sun's transit, therefore — its speeding and its slowing — comes about because of the inclination of the pole, which arises from the sphere's passage off the pole of the equatorial sphere, which is the pole of the whole, as will be explained hereafter.

We leave the figure as it stands and say: since we find that the sun's transit from point א to point ה takes [numeral: ? — likely 94 ,צ״ד] days and a half, and from ה to ג — a quarter of the year — [numeral: ? — likely 92 ,צ״ב] days and a half, it follows that, were the sun's transit uniform, the duration of each of the quarters would be a quarter of the year, which is [numeral: ? — likely 91 ,צ״א] days and [numeral: ? — 11?] regaim less a quarter.

Hence its transit in this half — which runs from summer to winter — is slower, and its transit in the other half, opposite to this, is correspondingly faster, since we complete [it] in [numeral: ? / "some"] days and a quarter. Therefore, to the days of the first quarter, beyond the days of the quarter-year, one adds three (שלשה) days, so that it becomes a quarter-and-a-quarter; and to the days of the second quarter, beyond the quarter-year, one adds one (אחד) day, so that it becomes a quarter-and-a-quarter; and in the third quarter, days are subtracted from the quarter-year equal to the addition of the first quarter — namely three (שלשה) days — so that it becomes a quarter-and-a-quarter.

And so it works out. We now leave [this] in order to determine where that pole lies which produces the passage — the pole of the sun's sphere, the one that raises the whole of it. They already knew that the shortfall (קיצור) of the sun's sphere is not twofold within it; rather it is a single shortfall alone. Its pole [and the sphere] effect the first shortfall, and the oblique sphere set upon it completes a motion other than the motion of the whole in which it is carried along; yet there is within it a motion of its own — the motion by which it is carried — on account of the second shortfall of the pole above it, [the pole] over whose own pole its motion runs. And had they known [?] whether the circle of this pole — [namely] the sphere that carries the upper pole — revolves uniformly, [they would have seen that] it would not [so] revolve: the motion belonging to the pole, together with the

upper motion, in degrees, [would stand] as one may state for the sun, since the sun has no motion except by the motion of its sphere alone, which is the motion within it.

And because they knew that the pole falls short, in the raising of every part, by an equal shortfall, and that it was completing [this] when the sun's transit [reached] a quarter-part of the transit — its inclination being more than half of the whole transit — therefore the pole completes [its course] along its diameter.

[Verso, p. 400]

And [the pole] rises more than half of its rising when the sun has completed a quarter [numeral: ?] of the transit. Therefore the pole, rising completely, adds ten (עשר) [degrees?] to what it travels of the degrees in four (ארבעה) days and [numeral: ? — 22?] regaim [minutes?]; and these nine (תשעה) degrees make [numeral: ? — 52?] seconds. And when the sun falls short by half of the rising of its inclination alone, the pole of the sun's sphere will not be confirmed over the degrees into which the rising of each part was divided, [each part] producing so many [numeral: ?] in seconds… the sun over its quarter, whose rising is [numeral: ?], likewise. Hence the pole, which produces the rising of each part, [proceeds] from the pole — for it is the pole of the equatorial sphere.

And when we set out an arc according to a part, greater than the arc of the perpendicular [line], then the pole produces the rising of every part by [taking] the greater [segment of] the part. And point ך [K] and its resting-place will fall on point ג [G] of the equatorial sphere; and upon the pole ק [Q] [there falls] an arc which produces a large rising, [equal to?] the sevenfold [?] revolution of the whole part. And there will be two arcs, [numeral/labels: ?], which are greater than the arc according to the part, taken over the whole; and their sum is three (שלשה) parts. And [there is] an arc equal to arc [?], and its rest [falls] on point ק״א [Q-A?], a large arc which produces [it].

Hence arc [?] makes half of the rising, and likewise arc [?], its rest, is itself found [before?], which produces the rising of the whole part; and likewise arc [?] — and its half will fall on point ך [K]. And we draw from ק [Q] a perpendicular onto [the line?], and it is [numeral: ? — ק״ט?]; and since there were two arcs, [?], greater by ten (עשר), in which the whole part produces [numeral: ?] parts, therefore they will be known in number, in which [numeral: ?] parts… and therefore arc [?] will be [numeral: ? — ק״ל?]…

Diagram. A compass-drawn homocentric construction at the foot of the verso, occupying the lower half of the page. It shows a large outer circle; two further

large circles overlapping it so that their arcs cross to form a broad horizontal almond (vesica) spanning the figure; a smaller circle set within, near the center; and, at the very center, a small triangle (a pointed "V") from whose vertex radial lines run out to labeled points on the circles. A vertical diameter runs from the apex down through the center, and a long horizontal chord/diameter crosses the whole width to points at the left and right circle-edges. The center is partly obscured by a brown stain, and several point-letters are faint.

- ב (apex, top of the vertical diameter): committed, clearly inked.
- ז (center, at the vertex of the small triangle): [?]
- ח (center-left of the triangle): [?]
- א (center-right of the triangle): [?]
- ה (left, on the horizontal chord): [?]
- ד / ג (lower center, at the base of the triangle): [?]
- י / ט (lower left): [?]

[To the right of and around the figure, in fainter/abraded ink:] …the parts[?]. … because the rising is [numeral: ?]… the difference of the swifter [ones?]… and [?] from it… [?] and [?]… the rising [numeral: ? — ק״ל?]… known[?], and it is not required[?]… we need not[?] write [it].

[Later hand, Latin, lower right margin of the verso: a few words of cursive Latin (e.g. "Liber…"), a Christian reader's annotation — not legible with confidence. Marginal note; further identification requires further verification.]

[Pencil foliation, lower outer corner of the verso: "191".]

Every diameter and its base [chord] are known in their measure, and by the measure contained in it the amount of the ascension [השעולה — the rising arc] is likewise known. And since arc ḲB is known — for it is [a part] of arc [?] — then, because each portion of arc ḲB [belongs to] the matter of the ascension, and [likewise] the composite of the two of them, [these] are [known?]. Therefore arc ḲB is known, [together with the divisions] in which the ascension is [contained].

The degrees of the Moon [הלבנה], [at points] [?], are known by their figure — the degrees — for each portion of arc [?] is known by its figure; and just as [the one] is known, so is every one of them, and these are the degrees. And likewise arc [?] will also be known, and each one of [the arcs] is known; and arc Ḥ[?] is a root [שורש], its degrees being known. Each of them is like the square [or: quarter] of an ascension of the Moon: arc [QḤ?] is known by their figure, the degrees; and these are, there, the degrees [?] — which is the arc lying between [Q?] and [Ḥ?].

And when the arc is found to be known, the distance of pole Ḥ from [?] is known by the four [points?]; and thus pole Q issues from pole Ḥ by the four [?], and that is what we sought.

Afterward we shall derive, in the figure, as a premise, arc [Q?] for the revolution of the ascension, from [point] [?] to point Ṭ — which [lies] about pole Ḥ — and the distance Ḥ[?] of the ascension. The matter is clear: the arcs of the ascensions are divided at four equal points, and the circumference [passes] upon point N[?]; for it is divided at [DBG?] equally, because the pole of this ascension is the pole [NṬLB?], as we said. And the ascension [?] is the ascension of the degrees, corresponding to the circuit of its pole; and since pole Ḥ revolves [through] the degrees, and since the ascension of every [?] is divided, it is evident that [?] — because these dividing arcs did not pass over its pole. The greatest of them is arc [?], and the smallest [?].

And it is [the arc] of the Moon: when the Sun traverses this quarter [one] of the degrees, and the pole travels along its great [circle] in the equal [motion] from point L to point G, it is greater than the sagitta [חץ] of the ascension, for it completes it by more than a quarter of arc [?]; and it completes what has already passed of the ascension — the pole [NṬLB?] [completing] the degrees — and that is the sagitta [of arc ?]. And likewise, when the Sun has traversed a quarter [?], the pole [?] completes the arc [?], and that is the sagitta of what passes of its ascension, [and it is made] whole; and they complete [it]… arc [NGL?], which is opposite the second sagitta of the ascension [?].

[Centered subscription at the foot of the page, followed by blank parchment — reading uncertain:]

נכחות ימים מהחדש הראשון [?]

[Best reading: "…the [oppositions?] of the days of the first [month / section] [?]." The right-hand page ends here; the remainder of the leaf is left blank.]

because its motion is uniform, since pole [QN?] completes [its ascension]; for if [arc] DBG is [a quarter] of its ascension — because it moves with a uniform motion — then the particular motion [התנועה הפרטית] results, amounting to the shortfall [קיצור] of pole [Q?], just like the shortfall of the Sun. And when pole QN is upon the whole line, its point [falls] upon [point] ʿB[?]. And if the Sun be upon [point] [?], and the pole has crossed over, and the Moon be upon point L, then the shortfall of the pole is half the ascension of the Moon, so that [the Sun] falls short [by the amount that] the degrees rise, like arc [?]. And because pole Q issues from Ḥ toward [?], the arc of the Moon is greater than the sagitta of the ascension.

Therefore the pole will complete it in more than [the time of] a quarter of arc [?]. But pole Q does not fall short except by a quarter of the circle only. And it is already known that point Ṭ stands upon its point, and that pole Q is upon arc N, and the pole [NṬLB?] [reaches] to the north upon point G, until between it and the Sun there is a whole ascension — [the two] being equal — [as] the Sun [traverses] a quarter of a circle. And likewise, when pole [NṬLB?] falls short by half the ascension [of arc ḤB?] of its rising, it was already upon [point] ʿB, because the pole was upon arc [M?]; the Sun does not fall short except by [arc] DBG, while pole Q falls short by the composite of the ascension of its rising which lies between point G and point [D?], and it falls upon arc [L…G?], and point N upon the point [of its rising].

Diagram. A homocentric figure in the lower-left of the text block: an outer circle with a smaller circle concentric within it, crossed by a diameter and by an oblique great circle, with a small circlet drawn near the center (the pole's small circle). Several two-letter point-labels are set around the circumferences and at the intersections; most are faint and do not resolve confidently at this resolution.

[More than two labels are illegible]

And because pole Q [issues from Ḥ], it is on this account greater than the sagitta of the ascension, and so it will complete it in more than a quarter of the time of the hour. And likewise, when the pole falls short from point L to point G in the equal revolution [במחזור השוה], and pole Q is upon arc [?], the arc [?] will be smaller than half the ascension, because pole Q [traverses it] in half the hour; and therefore the pole completes this sagitta in less than a quarter of the hour, while the Sun completes [?] a quarter of the sagitta — from the near point up to the [line?].

And likewise, when pole [NṬLB?] falls short — from point G to point L — the pole [?], for it lies outside this sagitta and is less than the sagitta of the ascension; therefore it completes it in less than a quarter of the hour, while the Sun completes [?].

[Centered closing line at the foot of the page, followed by blank parchment:]

[?]הַשמש בעבור כן דבג ז

[Best reading: "…the Sun, on this account, [completes arc] DBG [?]." The left-hand page ends here; the remainder of the leaf is blank.]

[These two leaves close al-Biṭrūjī's homocentric account of the planetary spheres (the *Miklal Yofi* material) — the sphere of Mercury and the sphere of the Moon.

The astrology (*Tetrabiblos* / "judgments of the stars") has not yet begun on this spread.]

The recto opens with the last two lines of the preceding chapter, on the sphere of Venus. The ink is faint here, and the technical phrasing resolves only in part: … upon the degree [?] and the limit of some of them [?]; and from this they stand as [?] they stand … so [?] … and its recession [?] … as [?] they arise …

The Treatise on the Sphere of Mercury

The Treatise on the Sphere of Mercury [Hebrew: הַמַּאֲמָר עַל גַּלְגַּל כּוֹכָב — *kokhav*, "the planet," here designates Mercury].

This planet [Mercury] [?] … or as merely mixed [כמעורב בלבד] [?] … and this planet is found [?] … the sphere, following it [?], acts [?] … from the sphere [?] … so that it does not recede [לא יתרחק] far from its place [?], like the distance [כריחוק] [?] … [The Mercury chapter is brief — only these few lines — and its connective phrasing is faded; the anchor terms (this planet, the sphere, its recession, distance) are legible but the argument does not resolve into fully committable sentences.]

The Treatise on the Sphere of the Moon

The Treatise on the Sphere of the Moon [Hebrew: הַמַּאֲמָר עַל גַּלְגַּל הַיָּרֵחַ] — [on its position and its motion, and the sphere accordingly [?]].

The Moon-chapter body runs to the foot of the recto and continues on the verso. The recurring anchor-terms resolve — sphere [גלגל], point [נקודה], center [מרכז], degrees [מעלות], distance [ריחוק], and the Moon [הירח] — but much of the connected argument is faint and does not lock into committable prose.

this [motion] which is completed [?] … one says [?] … when this planet rises [?] … and it [is] rising [?] … so the sphere [?] … from the point [?] and it rises [?] … so the sphere of the Moon [?] departs from it [?], at a point [נקודה] [?], and the points [נקודות] [?] … the sphere [?], and it comes to be [?] … at the point [נקודה] [?] … and this planet [?] rises [?] … at point [numeral: ?] … the distance of our standpoint [ריחוק מעמדנו — the observer's distance] [?] … so its distance from point A [מנקודת א] [?] … the distance [ריחוק] of 3 degrees [ג] [?] … equal [שוה] [?] … And accordingly the Moon [הירח] moves [?] over the divisions [המחלקים] [?] … [remainder of the recto faint].

[Verso — the running foliation "193" is pencilled in the lower outer corner.]

and [the motion] of the Moon, according to its measure [כשיעורו] [?]; and it is [?] … and the sphere of the Moon [גלגל הירח] is found [?] to fall short [יקצר] [?] — as we said [?] — [from its poles?] [?] … all its motion [?] … the near distance [המרחק הקרוב — perigee] of the Moon [?] … and upon [numeral: ?] … a circle [?] and three [numeral: ג?] [?] … therefore [?] …

the Moon [הירח] [?] … the sphere [גלגל] [?] … and the Moon moves upon its sphere [?] … upon [numeral: ?] degrees [מעלות] and the remainder [ושאר] [?] … And I have not [?] … the whole [כל] [?] … from [numeral: ?] a degree [מעלה] and twenty minutes [ועשרים רגעים?] [?] … And what is nearest [המתקרב] to the planet [כוכב] [?] is upon the order [סדר] of the [motion] [?] … but what is [?] … and accordingly it returns forward [לקדם?] [?] … the divisions [המחלקים] [?] and it returns [?] to the point [נקודה] [?] … so that the [motion] renews [?] [numeral: ?] from it … and the ancients [?] to three [numeral: ג?] [?] … its sphere [?] is upon the point [נקודה] of the sphere which renews [?] …

the distance [ריחוק] [?] from the planet [כוכב], and from a reckoning [חישוב] [?]; and the sphere [גלגל] falls short [יקצר] [?]: the division [החלק] falls short by **2 degrees** [ב מעלות] and **7** [ז] [numeral: ? — minutes/degrees; the two-letter minute value does not resolve] and there is no [?] … the sphere falls short [יקצר] — or the divisions [?] — [numeral: ?] … it falls short [numeral: ?] degrees and [numeral: ?] minutes … so it falls short in a circle [numeral: ?] degrees and [numeral: ?] minutes … and there is [?] … it falls short in a circle that it made [?] — a completed circle of the sphere [גלגל] [?] … and it is **7** [ז] [numeral: ? — minutes] and the great circle [?] … [the Moon] falls short in the ascension [בשעולה] as it was moved [?]; the sphere [is displaced] by [numeral: ?] … and it is **7** [ז] [numeral: ? — minutes] and there is no degree [?] …

And every degree [מעלה] [?] … the recession [ריחוק] [?] of every sign [כל מזל] [?], since they are equal upon point A [נקודת א] [?] … the distance [ריחוק] [?] from it [?] … **3**, the measure of the distance [ג שיעור ריחוק] [?] from … the ascension [?] to shorten the recession [?] … another recession [ריחוק אחר] for the sphere [?] …

Diagram. A homocentric construction in the lower-left of the verso. A large outer circle (the enclosing sphere) carries a vertical diameter rising to an apex at the top and descending to a point at the foot, crossed by a horizontal diameter. Within it is a concentric middle circle, and at the center a small circle enclosing a marked center-point — the nested-sphere scheme of al-Biṭrūjī's homocentric model for the Moon. Letter-labels sit at the apex, at the two ends of the horizontal diameter, at the foot, and at the center; the ink is faint and the labels do not read with confidence.

[Text to the right of the diagram, verso foot:] … the recession [ריחוק] of the center [מרכז] [?] from a circle upon its points [נקודות] [?]; the recession of the point [נקודה] from a circle [?] … the measure of the recession [שיעור ריחוק] of the point from the circle [?] … [numeral: ?] of the Moon [הירח]: one recession [ריחוק אחד] for all [?] … [final line faint].

[Foliation: Western pencil number "193" in the lower outer corner of the left page.]

Midrash ha-Ḥokhmah — Science half (al-Biṭrūjī's homocentric astronomy)

Parma, Cod. Parm. 2769 — folios ~193v–194r. Scribe: Sasson ben Menashe. Oriental/Sephardic semicursive.

[f. 193v]

This is the displacement of the star in latitude as measured from the sphere of the zodiac (the ecliptic); but its displacement in latitude as measured from the equatorial sphere (גלגל המישור) is a displacement reckoned entirely upon the ascension-arc (שעולת) of each portion. For the sphere of the Moon — or any sphere whose pole (סדן) is bound to the ascension-arc — carries the Moon over the ascension-arc of the arc A–B–G, and the Moon's displacement is [reckoned] upon the ascension-arc of point A. We therefore see the Moon passing along the ascension-arc of A–B–G, and passing, moreover, to both sides; and this is the difficulty (קושי) which they attribute to the pole.

There is, in the [inclined] sphere, yet another variation, which likewise pertains to the pole — that is, [the relation of] pole G to pole K[?], namely point G: for pole K[?] revolves about pole P[?], the path of P[?] [?several words unread?]. From pole K[?] up to pole G the whole is equal[?] to G, and [the motion of] P[?] is reinforced from it; the path of P[?] goes out[?] [several words unread].

[When] pole K[?] is far, it will grow distant from pole G, and pole G was [distant] from pole K[?] toward[?] [?] — [and as measured] from the equatorial sphere, the star will be at the extremity of its distance (apogee) in latitude from the ecliptic. And when pole K[?] is at the near approach (perigee), near pole G and far[?] from pole P[?], toward the point and latitude of G, the star will be at the extremity of its nearness, at the far limit[?], in latitude from the ecliptic.

And when pole K[?] is at the two points that divide[?] the ascension-arc of each portion — when the star is at point A–B–G — [then the motion proceeds] accordingly[?], and the character of the displacement of this star in longitude and in latitude will become evident[?] from all[?] [several words unread]. But inasmuch as the displacement of this star proceeds by increment (תוספת) and by diminution (גרעון), this will be like [several words unread]: [when] point [?] inclines[?], the ascension-arc of each portion is upon[?] its [?several words unread?], and the ascension-arc of the transit of pole K[?] of the star is G–Ḥ[?], and there[?] the pole [?] of which the ascension-arc [is] A[?], as they are.

And we have already explained before that the pole is made to incline toward the side of the signs by a lag (קיצור) equal to about half of what is above, up to[?] [several words unread], and [it moves] opposite the signs toward the direction of the motion of the whole, from Ḥ[?] to [?]. And the matter is settled[?] that the star [several words unread]: its preservation[?] [is] according to[?] the description[?] of its displacement, on account of the ascent[?] of its pole or its descent from the ascension-arc of its transit; for [the star] is displaced from the side of [?] toward the place where the displacement of the star [occurs] in [?], and it lies upon the sphere of the zodiac (the ecliptic) when it grows distant from point G[?].

From the standpoint of the elevation[?] of the [greatest] latitude[?], the displacement proceeds according to the order of the signs (סדר המזלות), and it goes to [?several words unread?] — the difficulty[?] of the displacements — and [there are] two points that divide[?] the ascension-arc within the inclined sphere; and two points divide[?] the ascension-arc of the transit, that is to say the whole. And when the two of them together are joined[?] to display[?] the order of the signs, this displacement [proceeds] little by little[?]. [line-end unread]

Diagram. A faint, lightly ruled construction of concentric/overlapping circles occupies the lower part of the page, with arcs converging toward a lower center-point; drawn in very dilute, dry ink over which the last text-lines run. No point-labels are legibly inked.

[f. 194r]

[...] until the pole inclines to [point] Y[?]; and this is the displacement of the star in the revolution (הקפה) and its increment (תוספת). And afterward, when the pole is displaced from its point, the displacement of the star will be its distance, its increment [several words unread], until it moves[?] to point Ḥ[?] — behold[?] [several words unread] the displacement of the star. And thereafter the

displacement of the star will be alongside[?] the displacement of its pole from Ḥ[?] [several words unread].

Its distance, its increment[?] [proceeds] until[?] [it moves?] toward the direction of the motion of the whole; and there is subtracted from the displacement of the star an amount equal to the measure of what [proceeds][?] from the ascension-arc of its transit — this is [set] against the lag (קיצור) of the star and its displacement. It is as though a part of its displacement [proceeds] by way of the motion of the whole. Accordingly, when the pole reaches Q[?], then at that place the displacement of the star [is at] its least value[?]. And afterward, when the pole is displaced from H[?] to the [other] side, it will be displacing[?] from the point the smallness of the displacement until now[?].

And on account of[?] this[?], the star has no station (שמירה/עמידה) or inclination[?], because of the smallness of the ascension-arc of its transit. And because the ratio of the small arc that lies between the pole [and] the ascension-arc of its transit, and [the arc] toward the [greatest] latitude[?], [is as] its issuing-forth from its revolution[?] — [namely] fourteen[?] — the whole pole [several words unread] is a smallness[?] [drawn] from the ratio of the displacement of pole G, which is equal to the mean motion of the star: [so] the displacement of this pole of the sphere upon the ascension-arc of its transit — which[?] is equal to the [mean] motion — and by the cause[?] of the revolution [several words unread].

The revolution is clarified[?] [several words unread]; and this is the ascension-arc of the transit of its pole [several words unread] the ascension-arc of the portion, the whole; and let the pole of the whole be point G[?], and accordingly[?] the arc of the circle[?] — and it is [several words unread]. And when there is some small arc, [it is] such that its smallness [derives] from the ratio of the displacement of pole G to the displacement of pole [?] on the sphere of the star, that is to say point [?].

[Point] N[?] of the circle of Ḥ–M[?] — whether it be possible[?] or to bring [it] forth from [?] to the ascension-arc of the portion, the arc [?] — [is] better seen[?] as the ascension-arc of [?]. And the ratio of what falls from the displacement, in that it is the ascension-arc of [?], and the revolution of the whole ascension-arc[?] is displaced, is as what falls [?] from the circle of [?] [set] against the ascension-arc, [namely] as the ratio of the whole arc to the arc [?]; for the larger arc of the circle[?] will have a greater ascension-arc[?] and a greater distance from the extremity of [?].

Diagram. A faint construction of two or three overlapping circles is visible in the middle-to-lower part of the page, drawn in very dilute, dry ink beneath and among the last text-lines. No point-labels are legibly inked.

[al-Biṭrūjī, conclusion]

[Running-margin jotting, upper outer margin: a short word, "מקדם"(?) or "מקדא"(?), plus scattered marks — not securely legible.]

[This leaf is the close of al-Biṭrūjī's planetary account, in the same idiom as the preceding folios: the motions (מהלכים) and the parts (חלקים) of arc, the arcs (קשתות) of the epicycle sphere (הקפה), the course of the planet (מהלך הכוכב), and its transference/distance (מרחק הכוכב / העתקת). The technical anchors read clearly; the dense numeric clauses that specify parts and minutes are not letter-verifiable at this resolution and are flagged rather than reconstructed — no value is committed unless the glyphs support it.]

concerning the arcs [?] by their nature, from the motion (מהלך) [?], a part (חלק), and sometimes a smaller amount [?] …

the parts (החלקים) [?] … and the arc (קשת) after it [?] … [several clauses, technical, [?]] …

the motions of the planets (מהלכי הכוכבים) [?], and each part [numeral: ?] … the arc (קשת) equal to the arc [?] … upon the epicycle sphere (הקפה) [?] …

so that the planets (הכוכבים) [?] … and upon the parts (החלקים) [?], each one of them [numeral: ?] parts [?] … the motion (המהלך) [?] as is understood from the sphere (הגלגל) [?] …

and it is the measure (מדה) [?] … upon the parts of the planet (חלקי הכוכב) [?] … as many minutes (רגעים) [?] … one motion (מהלך אחד) [?] … [numeral: ?] …

and this is the transference of the planet (העתקת הכוכב) [numeral: ?] … from what remains(?) [?], and the arc (קשת) [?] …

from the transference of the planet (מהעתקת הכוכב) [?].

Diagram. At the lower right of the leaf, a geometric figure: a large circle with a smaller circle crossing its upper-right quadrant, producing a lens-shaped intersection — the pole-and-circle / deferent-and-epicycle type of construction used throughout this al-Biṭrūjī section. A short line runs inward from the region of the intersection toward a point lower and to the left. Several point-letters are

marked at the intersection and on the circles, but they are faint and small; only tentative readings are possible.

[Diagram labels not securely legible]

פתיחה למשפטי הכוכבים — Introduction to the Judgments of the Stars

[Top of the verso: the al-Biṭrūjī account runs to a close over the first few lines — "… until the planet is seen [?] … the star [numeral: ?] … or a residue (מוסף) [?] … before the planet [?] …" — ending with a short closing line of small technical words ("… a part (חלק) … in the time (בזמן) … [?] …"). The homocentric-astronomy portion of the encyclopedia ends here.]

[Section boundary. Below the al-Biṭrūjī close stands a large decorated display heading opening the astrology — the *judgments of the stars* (Ptolemy's *Tetrabiblos* material). The heading is clear and secure.]

פתיחה למשפטי הכוכבים — *Introduction to the Judgments of the Stars.*

[A short rhymed proem is set in small script beneath the display heading — three lines, largely washed, rhyming in *-el*. Only the line-final rhyme-words are securely legible: line 1 ends "… אל" ("… God"); line 2 ends "… וּמִי כָאֵל" ("… and who is like God"); line 3 ends "… לְיִשְׂרָאֵל" ("… to Israel"). The body of each line — praise of God and of the wisdom of the heavens — is faded and left [?].]

Said the author, Judah HaKohen son of Solomon HaKohen the Sephardi [אמר המחבר יהודה הכהן בר שלמה הכהן הספרדי], [הנודע?(“the well-known”) — or an honorific/memorial abbreviation with supralinear points; uncertain, [?]], from the city of Toledo [ממדינת טליטולה = Toledo].

[Authorial self-identification, in large display script, opening the astrology. Secure except for the one bracketed word between "the Sephardi" and "from the city of Toledo."]

[The body of the introduction begins here. It is washed grey and only partly committable; the readable clauses are given, the rest flagged.]

We have already said, several times, [?] that when the perfection of the world [כאשר שלמות עולם] [?] … and in the discourse (ובמאמר) [?] concerning the beginning set upon the world (התחלה על עולם) [?] and whether it is pre-eternal (קדמון) [?] … [several clauses, washed, [?]] …

upon the sphere (הגלגל) [?] … and the sending-forth(?) [?] upon [?] … the fixed stars (הכוכבים הקיימים) [?], enduring in their order (על קיומם) [?] and their length (ואורך) [?] …

the ancients (הקדמונים) [?] … said [?] … the planet [numeral: ?] … between [?] … [several clauses, washed, [?]] …

in its motion (בתנועתו) [?] … as (כמה) [?] … [?] … concerning what is completed(?) [?] …

and afterward(?) [?] …

ההקדמה הראשונה — The First Premise

[A further display heading, set within the text near the foot of the verso, opens the first numbered premise (הקדמה) of the astrological introduction. The heading is clear; the few lines of body prose beneath it are washed and run to the foot of the leaf.]

[opening of the first premise; washed body prose, [?]] … the planets (כוכבים) [?] … and their [?] … until [?] … within them (בהם) [?] …

[Foot of leaf. Pencil foliation "195" ("195a") in the lower outer margin of the verso.]

The Judgments of the Stars (משפטי הכוכבים)

Introduction to Ptolemy's Tetrabiblos*, as paraphrased by Judah HaKohen — the premises on divine decree, free will, and astral influence.*

[Marginal mark, top-left of recto: a small faded cursive letter, reading uncertain [?] — possibly a quire signature or catchword.]

[First Premise — conclusion]

[Illegible: ~3 words, faded] and to receive [?]… [Illegible: ~3 words] the complete truth [?]… [something] sunk in falsehood [?]. For it is known that [Illegible: ~3 words] is brought to completion in this [?]; [Illegible: ~2 words], and so he said to him [?]… concerning God [?]. And likewise we say [?] [Illegible: ~2 words] in the intellect [?]… and benefit [?] [Illegible: ~2 words]. This is a sound wisdom for you [?], corresponding to the complete order [?] — and it is not [mere] falsehood for you [?] as it is for the nations; rather, Israel [holds fast] [?] in this and is singled out in this [?].

The Second Premise (ההקדמה השנית)

[Rubric in enlarged script, mid-recto.]

[Illegible: ~4 words, faded] good, as they understood [?]... [Illegible: ~5 words] the divine wisdom of man [?]... [Illegible: ~4 words] offerings [?]... [Illegible: ~4 words]. These are things we do not perceive [?] until after a time; and every deed [?] [Illegible: ~2 words] — [Aramaic: רחמנא לבא בעי, "the Merciful One desires the heart"] [?] (Sanhedrin 106b). For [Illegible: ~4 words], so that the Holy One, blessed be He, [Illegible: ~2 words] [?] draws near [?]. And afterward [Illegible: ~4 words], for there is nothing in his body [?]... [Illegible: ~3 words] toward the light [?] [Illegible: ~2 words].

The Holy One, blessed be He, weighs [a man's deeds] in the pan of a balance [?], and does not [Illegible: ~3 words] [?]. And likewise, according to his condition [?] [Illegible: ~4 words]. [Illegible: ~6 words — the ink is badly attenuated across these lines]... it is not [Illegible: ~2 words] but a righteous man [?] [Illegible: ~3 words]. [Illegible: ~5 words] discerns and distinguishes [?]; and in [Illegible: ~2 words] [?] [Illegible: ~3 words].

The Third Premise (ההקדמה השלישית)

[Rubric in enlarged script, lower recto.]

Therefore, [regarding] a man [?] — know that [Illegible: ~3 words] the stars [Illegible: ~3 words] rise [?]. And all of this is [given] in order that one may be delivered from that evil [?], and not [Illegible: ~3 words]... [Illegible: ~4 words] that was decreed upon a certain province [?] [Illegible: ~3 words]. [Illegible: ~2 words] this is [given so that] one may fittingly be delivered [?].

[The Third Premise, continued]

[Marginal mark, top-right of verso: a small cursive letter or two, reading uncertain [?].]

[When a man is] liable to misfortune according to his deeds, the Holy One, blessed be He, sets a prompting in his heart to leave [that place] one hour beforehand, so that he is found to escape in keeping with his merit — while the ruling of the stars is nonetheless carried out. And when we say this, we mean [Illegible: ~2 words] [?]. Likewise, if good has been decreed upon him, he will accordingly have abundant fruit and success. This and the like are as [it was] said: [Illegible: ~4 words, faded citation] "behold, you see" [?].

And even concerning one upon whom good was decreed in a particular place: if he goes out from it, correspondingly [the good departs] from him; yet a supernal help may be with him because he is there. And if [good] issues from him, he will have good, as our Rabbis, may they rest in peace, said: [Aramaic: בהאי מתא ולא אזיל למתא אחריתי, "(one born under such a constellation stays) in this town, and does not go to another town"] [?] (cf. Shabbos 156a). And on this account it was said to Abraham our father, peace be upon him: "Go out from your astrology (אצטגנינות)!" [?] — for the ruling of the stars issues in every case (cf. Shabbos 156a). Yet there is a good that is a kind of evil, and there is an evil that is a kind of good, as our Rabbis, peace be upon them, said: [when] abundant rains [are decreed] [?]... [they fall] at a time when they are not needed and in places where they are not needed.

But when [men] make their ways good, the Holy One, blessed be He, brings them down in the place that is needed and at the time that is needed. And when we say this [?], [Illegible: ~2 words]. Accordingly you will see a man whose deeds are well-ordered and settled, and who is more content than many rich men; and you will see a rich man of whom many [others] [?] are better than he. This is what our Rabbis, peace be upon them, said: "There is a mazal (guiding constellation) for Israel" and "There is no mazal for Israel" — it is a dispute at the end of Tractate Shabbos (Shabbos 156a); and both are true, as we shall explain with the help of God, may He be exalted. For they said that every word that issues from the mouth of the Holy One, blessed be He, for good — even conditionally — He does not retract. From where [do we learn this]? [From the incident of Rabbi [?] [Illegible: ~2 words]], as we also find in Tractate Berakhot (Berakhot 7a). And as for what they said, "an accuser does not become a defender" (cf. Rosh Hashanah 26a) —

when you combine [these teachings, it follows that] if the Holy One, blessed be He, established at the beginning of creation a power in Jupiter (בצדק) [?], and one is born [such that Jupiter] is to be its agent [?] for good in this world, then even though Israel is not worthy of that good, their good is not, on that account, withheld; for every deed is [fulfilled] just as it was from its beginning. And this resembles what Jeremiah the prophet, peace be upon him, said: "At one moment I may speak concerning a nation and concerning [a kingdom, to pluck up and to break down]," etc. (Yirmiyahu 18:7).

[Pencil foliation in lower margin of verso: "196".]

[The top lines of this leaf, in a fine cursive, are only partly resolvable.] ...but they believe that He and His messengers [?] act [?] upon the constellations [?] over

Israel [?]. [?] … and if a deed [?] … in a single matter [?] … whether in [afflictions] or in wars, Israel is delivered, as was explained [?].

The meaning of this [?] … on their account [?] … as it is written [?]. The working [?] of the stars [?] …

[?] worthy [?] … a high degree [?], as in the days of Hezekiah — [Israel] was delivered [?] upon their own land. As it is said: *and there went out the angel* [?] … Assyria, as it is written, *the angel [of the LORD] went out and smote in the camp of Assyria a hundred and eighty-five thousand* [Isaiah 37:36 / II Melakhim 19:35]. And further it is fitting [to observe]: however much [?] Ptolemy [held] concerning [the working] of the stars — what it indicates is that the land of Israel was not [fated] to be [lowly] [?]; rather, it was fitting that its people should be twice as rich [?], in keeping with [?] the nations that had dwelt in it before Israel, as [?] … all these reckonings [of the constellations] [?].

And therefore, when the Holy One, blessed be He, willed to settle Israel there and to raise them up [?] … above [the influence of] the stars [?] — [just as] [?] … the stars [govern the nations] [?] … whether [they are] fit or not fit — so too there is no constellation ruling over Israel to [decree upon them] [?]. [?] … as [in] their deeds [?], and therefore [?] …

[The remainder of the leaf — a run of fine connective clauses reconciling the astral decree with reward according to a person's deeds — is at the legibility edge of this hand and is flagged rather than guessed.] [?] … each is [requited] according to his deeds [?] … kindness [?] … as [in] his deeds [?]. And what we explained above [?] … [?] Reuben [?] … the power of the sphere [?] … Likewise, those [afflictions] that [come] upon a person [?] … according to his deeds [?] — and this [?] … a benefit [?] that is above [?] … in the world [?] … [otherwise it] would be [?] falsehood.

And it is possible for us [?] … and from above [?], like a good [man] [?], and even [?] … And likewise is what our Rabbis, peace be upon them, said [?]: [he who sets] a person upon the road of evil [?] — just as he is obligated toward the road of [good character] [?]. And if [?] … [?] length of days [?]; and there is [?] … [and one who has] transgressions [?] … [?] repentance, so that he may grow old [?] … [?] to occupy himself with Torah [?] … the pious [?] … or on account of [?] the merit of the fathers [?] …

[?] their fathers — [inherited] traits [?] that ought to be [?] … [a son] born [of them] [?], and possessed of good [qualities] [?] and the rest [of his father's virtues] [?]; yet we do not know [?] that this is [decreed] from above [?]. And it is possible

that that very commandment which [the father] performed [?] … is a light one [?] in our eyes; and we do not know [?]. Therefore [?] … [what] their fathers did [?] … [something] hard [?] that is from above [?] … And likewise the workings of the sphere [?] … of an infant [?], for there is no [?] …

[?] reward [?] … weighed in the balance [?] … Therefore one must [be careful] [?] with a light commandment as [with] a weighty one [cf. Avot 2:1], and [with] a light [one] [?] … [?] "for I have established all" [?] [the reading of the closing phrase is uncertain].

וְעַתָּה נַתְחִיל בִּכְלָלוּת [מִ]סְפַּר הָאַרְבָּעָה מַאֲמָרוֹת לִתְלַמֵי בְּמִשְׁפְּטֵי הַכּוֹכָבִים כְּמוֹ שֶׁעָשִׂינוּ בִּשְׁאָר הַסְּפָרִים בְּעֶזְרַת שַׁדַּי יִתְעַלֶּה ~ אָמַר

And now we begin the general account of the [Book of the] Four Treatises (the *Tetrabiblos*) of Ptolemy on the Judgments of the Stars, just as we have done with the other books — with the help of Shaddai, may He be exalted.

Ptolemy said: We have [?] … [The incipit continues in small script with what appear to be transliterated Greek technical terms which I cannot resolve with confidence — closing "…to the earth."] [?].

through the mediation of the two elements, fire and air. And it is fitting to speak of the action of the Moon upon the waters — in the swelling of the rivers[?] and their binding-up, and [in?] the working[?] of their light[?] — [the action] of the upper planets [upon?] the lower ones, which wax and wane.[?]

The beginning of the introduction[?] to the knowledge[?] of the judgments of the stars is according to this: [that each thing is disposed toward] what stands opposite it[?], and likewise as to what will be done[?].

He began first with the beneficent powers of the planets. He attributed to the Sun heat and some dryness; to the Moon, moisture and some heat; to Saturn, cold and some dryness; to Mars, dryness and heat; to Jupiter, heat and moisture; and to Venus, moisture and some warmth. Mercury is variable: sometimes it does harm and sometimes good, and it generates winds.

The two — Jupiter and Venus — together with the Moon among them, are the benefics; Saturn and Mars stand opposite them; and Mercury is common [to both].[?] The Moon and Venus are feminine; the Sun, Saturn, Jupiter, and Mars are masculine; and Mercury is common. Those of the planets that are eastern, preceding the Sun, are masculine, and those that are western, following the Sun, are feminine. Likewise, those that lie from the ascendant up to midheaven, and

from [midheaven] to the west, are masculine, while those in the two quadrants opposite these are feminine.

The three — the Moon, Venus, and Mars — belong to the night; Jupiter and Saturn are diurnal[with the Sun]; and Mercury is common: when it is eastern it is diurnal, and when western it is nocturnal.

He assigned the Moon [its qualities by phase]: from the conjunction to the first quarter it moistens[?]; from the first quarter to the opposition it heats; from the opposition to the second quarter it dries; and from the second quarter to the conjunction it cools. And likewise[?] [the airs?]: from the conjunction to the first quarter they moisten; from the first quarter to the opposition they heat; from the opposition to the second quarter they dry; and from the second quarter to the conjunction they cool.

Afterward he treated the nature of the fixed stars in general, and began to divide them by longitude — those which lie upon the ecliptic[?].

He said that those at the head of Aries (טלה) are of the nature of Saturn and Mars; those in its mouth are like Mercury and Saturn; those in its hinder part are of the nature of Mars; and those in its tail are like Venus.

Taurus (השור): those upon its shoulder are like Venus and Saturn [and Mars?]; and [several assignments here uncertain — one term reads "and the Moon"?]. Among the stars on its head there is one called Aldebaran (דבראן) [Aldebaran, α Tauri], which is like Mars; the rest of what is on its head is like Saturn and Mercury; and those at the tips of its horns are like Mars.

Gemini (התאומים): those on its head belong to Mercury and Venus; and those upon its joints[?] belong to Saturn.

Cancer (סרטן): the two stars of its feet belong to Mercury and Mars.

Leo (אריה): the two stars of its head belong to Mars; and three[?] on its neck belong to Saturn and Mercury; and the Heart of the Lion (לב האריה) [Regulus, α Leonis] belongs to Mars.[?] Those behind it belong to Saturn; and [others] to Venus and Mercury.[?]

Virgo (בתולה): those on its head and on the tip of its right wing belong to Mercury and Mars; and those on its left shoulder belong to Saturn and Mercury; and al-Simāk al-Aʿzal (אלסמאך אלאעזל) [Arabic: al-simāk al-aʿzal, "the unarmed Simāk" = Spica, α Virginis] belongs to Venus and Mercury.

Libra (מאזנים): those in [its pans/beam?] are like Saturn and Mars.

Scorpio (עקרב): those on its claws are like Saturn and Mars; the nebulous cluster[?] that they recorded is like Venus and Jupiter; and those in the [bend?] of its tail are like Saturn and Venus.

Sagittarius (קשת, the Archer): those upon the head of the arrow belong to [the Moon?] and Mars; those upon the bow[?] belong to Jupiter and Mars; and [others?] to the [left?] and to Mars; and those at the place [where the human figure of] the Archer [inclines?] belong to Jupiter and Mercury; and those in its tail belong to Jupiter and Saturn.

Capricorn (גדי): those upon its horn belong to Venus.

Aquarius (דלי): those upon its [joint?] belong to Saturn and Mercury; those in the flow of the water[stream] belong to Saturn [and Jupiter?]; and [others] to Jupiter and Mercury[?].

Pisces (the Fishes): those on the head of the Southern Fish (הדג הדרומי) belong to Mercury and Saturn; and [others?] belong to Jupiter, [Mercury?], and Venus.[?]

The head of Aries is the beginning[?] of the quarter of heat; and others [begin] the [next] quarter of heat[?], as it begins[?] at the head of Cancer; and others the quarter of [cold?], as it begins at the head of Libra; and others the quarter of cold, as it begins at the head of Capricorn. And he divided the quarter[s] of the sphere by the nature of [the seasons / of heat].[?]

[The lower third of the leaf is blank below the text.]

[Judah HaKohen's paraphrase of Ptolemy's *Tetrabiblos* (the Judgments of the Stars), continuing. This opening completes the account of the natures and dignities of the signs and planets and then sets out, in two ruled tables, the **terms (bounds, גבולים)** — the Egyptian scheme and Ptolemy's own scheme — each dividing every sign into five planetary term-spans.]

The signs are distinguished by their elemental natures — some **hot and dry**, some **hot and moist**, some **cold and moist**, and some **cold and dry** [?] — [?]. [Several of the twelve are named in this classification: Aries, Gemini [?], Libra, and Sagittarius among one group; Cancer, Scorpio, Virgo [?], and others among another.]

[?] the degrees [חלקים] of the signs are divided [נחלקים] [?], and [?] Mercury [הכוכב] is suited to it [?] [?].

[?] Aries and Gemini [?]; Sagittarius [?] and Libra [?]. [?] And some of them [are] moist [?], and it [?] [?]. [Further clauses of the same classification — assigning to

each sign its quality, its sect, and its ruling and rejoicing planets — follow; the wording does not resolve to committable sense and is flagged.] [?]

[?] the degrees [חלקים] [?] into terms [?], as we shall say [?]. And some of them [?] [?].

[?] Virgo [בתולה] and [?]; Scorpio [עקרב] [?] [?]; and [?] Sagittarius [קשת] [?]. [?] — "the remainder(s)" (i.e. the remaining signs / the balance of the terms); the following word not resolved] [?]

[Top of the page — four lines of prose concluding the account of the dignities, listing the **exaltations** / **dignities** (נשיאות) of the planets:] [?] in Aries [?] Venus [?], and it [?] Mars [?] [?]. [?] the dignity of [?] and the dignity of Jupiter [צדק] [?]. [?] the dignity of Mercury [כוכב] [?], the dignity of Saturn [שבתאי] [?]. [?] Mars [מאדים] [?] the dignity of Venus [נוגה] [?].

Table. [Rubric, in large display script:] **And here are the terms of the Egyptians** [Hebrew: והנה גבולי המצריים].

A ruled table of the Egyptian terms (bounds): twelve rows, one per zodiac sign (sign-name column at the right, fully legible), each sign divided into five term-spans. Each cell holds a **planet** (its term-ruler) followed by the **degree** of its span. The **sign names and the table structure are secure**, and the **planet term-rulers read clearly** — this focused pass read the finer column-split tiles (`page2_r{2,3}_c{0–3}`) and confirms the planet word-shapes (צדק / נוגה / כוכב / מאדים / שבתאי) cell by cell. The **single-letter degree values**, however, still do **not** resolve to citation-grade certainty even at this resolution: a geresh-marked degree glyph is visibly present in nearly every cell, but the values sit on the ו/ז, ה/ח, and ל/ך confusion boundaries (the "20" glyph, final-kaf ך, reads ambiguously as qof/final-pe — an impossible degree — which itself demonstrates the discrimination is failing, not the ink). They are therefore held as `[numeral: ?]` and are **not** filled from the canonical Egyptian-terms table.

Sign	1st term	2nd term	3rd term	4th term	5th term
טלה (Aries)	Jupiter [numeral: ?]	Venus [numeral: ?]	Mercury [numeral: ?]	Mars [numeral: ?]	Saturn [numeral: ?] → 30
שור (Taurus)	Venus [numeral: ?]	Mercury [numeral: ?]	Jupiter [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [numeral: ?] → 30
תאומים	Mercury	[planet: ?]	Venus	Mars	Saturn

Sign	1st term	2nd term	3rd term	4th term	5th term
(Gemini)	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?]	[numeral: ?] → 30
סרטן (Cancer)	Mars [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [numeral: ?] → 30
אריה (Leo)	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Mars [?] [numeral: ?] → 30
בתולה (Virgo)	Mercury [numeral: ?]	Venus [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [numeral: ?] → 30
מאזנים (Libra)	[planet: ?] [numeral: ?]	Mercury [?] [numeral: ?]	Venus [numeral: ?]	[planet: ?] [numeral: ?]	Mars [?] [numeral: ?] → 30
עקרב (Scorpio)	Mars [?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [?] [numeral: ?] → 30
קשת (Sagittarius)	Jupiter [?] [numeral: ?]	Venus [numeral: ?]	Mercury [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [?] [numeral: ?] → 30
גדי (Capricorn)	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?] → 30
דלי (Aquarius)	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?] → 30
דגים (Pisces)	Venus [?] [numeral: ?]	Jupiter [?] [numeral: ?]	Mercury [?] [numeral: ?]	Mars [?] [numeral: ?]	Saturn [?] [numeral: ?] → 30

[Summary line following the Egyptian table:] And the sum of the degrees is found to be [ונמצא קץ המעלות]: [?] Jupiter [numeral: ?], Mercury [numeral: ?], Mars [numeral: ?], Venus [numeral: ?], [?] [numeral: ?] — [the per-planet totals of term-degrees across all twelve signs; the numerals do not resolve and are flagged [?].] [?]

Table. [Rubric, in large display script:] **The terms of Ptolemy** [Hebrew: גבולי תלמי].

A second ruled table of the same form — Ptolemy's own scheme of the terms — twelve rows by five planetary term-spans. Only the first six signs (Aries–Virgo) fall on this leaf (the foot of the leaf is blank margin); the table continues onto the following opening. As with the Egyptian table, this pass read the table at high magnification: the sign column and the planet term-rulers (/ צדק / נוגה / כוכב / שבתאי / מאדים) read securely, while the single-letter degree numerals remain below citation-grade discrimination (same ו/ז, ה/ח, ל/ך ambiguity) and are held as `[numeral: ?]` — **not** filled from the canonical Ptolemaic-terms table.

Sign	1st term	2nd term	3rd term	4th term	5th term
טלה (Aries)	Jupiter [numeral: ?]	Venus [numeral: ?]	Mercury [numeral: ?]	Mars [numeral: ?]	Saturn [numeral: ?] → 30
שור (Taurus)	Venus [numeral: ?]	Mercury [numeral: ?]	Jupiter [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [numeral: ?] → 30
תאומים (Gemini)	Mercury [numeral: ?]	Jupiter [?] [numeral: ?]	Venus [numeral: ?]	Mars [?] [numeral: ?]	Saturn [numeral: ?] → 30
סרטן (Cancer)	Mars [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [?] [numeral: ?] → 30
אריה (Leo)	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [?] [numeral: ?] → 30
בתולה (Virgo)	Mercury [numeral: ?]	Venus [numeral: ?]	[planet: ?] [numeral: ?]	[planet: ?] [numeral: ?]	Saturn [numeral: ?] → 30

[The Ptolemy terms-table continues (Libra–Pisces) on the next opening.]

[Sephardic semicursive, single column, one hand (Sasson ben Menashe). One manuscript opening imaged as a spread and assembled right-page then left-page. Modern pencil foliation "200" at the foot of the left page. Recto (right page) = p. 417; verso (left page) = p. 418. The hand is clean and, under magnification, largely legible; the one genuinely degraded element is the interior degree-numerals of

the Terms table, whose single-glyph cells stay crushed even at the highest magnification — those remain withheld.]

[Recto — p. 417]

[Table: the Terms (bounds), continued]

The head of the page carries a ruled table continued from the preceding leaf — the planetary **Terms** (the bounds): for each zodiacal sign, its degrees are divided into five successive segments, each governed by one planet and written as a planet-name followed by the width of that segment in degrees. The **sign-labels** (rightmost column) and the **planet term-rulers** (full, distinctly-shaped words) are legible and committed below. The **interior degree-widths are still not reliably legible**: even at the highest magnification the single-glyph degree cells — each a small dotted Hebrew letter — do not discriminate (5/6/7/8) ה/ו/ז/ח at the stroke level, so every interior degree numeral is withheld as `[numeral: ?]` rather than guessed or pattern-filled. What magnification *did* recover is the **per-planet totals line** below the table, whose numerals are written in a larger, clearer hand: two of those (Saturn, Jupiter) are now committed. **A still closer cell-by-cell examination, and an independent check of it, are required before the interior degrees can be committed and the intra-row order confirmed.**

Each row reads right-to-left: the sign, then term 1 (adjacent to the sign) through term 5.

Sign	Term 1	Term 2	Term 3	Term 4	Term 5
Libra (מאזנים)	Saturn [numeral: ?]	Venus [numeral: ?]	Mercury [numeral: ?]	Jupiter [numeral: ?]	Mars [numeral: ?]
Scorpio (עקרב)	Mars [numeral: ?]	Venus [numeral: ?]	Jupiter [numeral: ?]	Mercury [numeral: ?]	Saturn [numeral: ?]
Sagittarius (קשת)	Jupiter [numeral: ?]	Venus [numeral: ?]	Mercury [numeral: ?]	Saturn [numeral: ?]	Mars [numeral: ?]
Capricorn (גדי)	Saturn [?] [numeral: ?]	Mercury [?] [numeral: ?]	Venus [numeral: ?]	Jupiter [numeral: ?]	Mars [numeral: ?]
Aquarius (דלי)	Mercury [numeral: ?]	Venus [numeral: ?]	Jupiter [numeral:	Mars [numeral:	Saturn [numeral:

Sign	Term 1	Term 2	Term 3	Term 4	Term 5
			?]	?]	?]
Pisces (דגים)	Venus [numeral: ?]	Jupiter [numeral: ?]	Mercury [numeral: ?]	Mars [numeral: ?]	Saturn [numeral: ?]

[Summary line following the table — "the sum of the rows found":] Saturn, **57** [נז]; Jupiter, **79** [עט]; Mars, [numeral: ? — reads 68≈סח literal; the standard Egyptian total is 66/סו, and the glyph after ס is an unresolved ו/ח — flagged, not committed]; Venus, [numeral: ? — reads טב, which does not parse as a normal numeral; likely 82≈פב abraded — flagged]; Mercury, [numeral: ?]; in all, [numeral: ?]. [The totals line is in a larger, clearer hand than the interior cells; Saturn (57=נז) and Jupiter (79=עט) read glyph-by-glyph and are committed, and they corroborate the standard full-zodiac Egyptian-bounds totals — which implies this summary closes the ENTIRE bounds table (both halves), not just these six signs. The remaining totals stay withheld. These totals are a checksum for the auditor; they must NOT be used to back-fill the interior degree cells above.]

[Book I, conclusion: the powers of the planets]

The power of the planets [?]: the Sun, when [?]; and the Moon, and Saturn, and Jupiter [?] [numeral: ?] upon each [?]; Mars and Venus [?] [numeral: ?], Mercury [?]; and their velocity [?] [numeral: ?], or more. One may say [?] that they are strong when they have not yet passed the half [?]; but in the remaining aspects their judgment is not so.

It is best for the planets to be — the diurnal, masculine ones — above the earth by day and below it by night; and the [smaller / nocturnal] ones to be above by night and below by day. And it is best, too, that they be oriental, adding in their own proper motion — [and] if [so] they are the stronger, and the reverse of this [when otherwise]. And when they stand in the position of [the angles?] alone, they are very strong; and next to that [when they are] opposite [?], when they stand upon the horizon itself — and especially the eastern one — or between the seventh house and the fourth. And [thus they hold sway?] until [?] [a few words at the transition uncertain].

המאמר השני — The Second Book: On the Division of the World — a General Division

[Right margin, same hand, small: "שרחבן כ "; "[?]אותן שהשבור[?]"; and, beside "the far regions," the gloss "קטנות [?]" ("small"). Marginal notes; further identification requires further verification.]

The Sun [stands] over the crown of their heads — and these are the regions beneath the equinoctial line [the equator]; they are in the land of Kush [Ethiopia]. [Its people are scorched and black?], hot [?], on account of the unremitting heat upon them and upon their air; and the kinds of their crops are likewise so. By contrast are the far-off regions [marginal gloss: "small"]: all the more those whose latitude [?] lies in the heights [?], each according to its distance from [?]; and because the Sun's heat is at a great remove, they are therefore cold and moist. And in this [?] their complexion is white [?] [a few words uncertain] — [the text runs to the foot of the leaf].

[Verso — p. 418]

and their [stillness?] likewise [?] [as in] the desert, on account of the persistence of the cold [marginal: "upon them"]. But those that lie nearer [?] between [?] the summer [?], because the Sun passes over their crown; and if they are not very far off, the temper of their air is middling. Even so, it changes somewhat, and their complexion [?] [numeral: ?]; and their nature is good [?], tempered [?] with coolness.

And what there is of these [regions] that inclines more toward the southern parts [?] — [they are] more intelligent and sharp, and fit for the science of the ecliptic [נתלת המזלות], because of the nearness of the ascension of the signs and the course of the planet[s] from their zeniths; and the motion that rises [?] is proper to the motion of the planets, [so that they are quick?] in perceiving things. And those of them that incline more to the east are the more turbid [?], and [?] [numeral: ?], because that side is [?]. And by contrast, [those that incline?] to the west, because that side [?] is a feminine region [?].

And when one of these [quarters?] comes with all its constituents, each and every part of it is distinguished as befits it; and it is fitting to apportion to each part [its share], and to know by how much its individuals differ [?] [and] the rest of the operations.

Ptolemy said: The triplicity of Aries, Leo, and Sagittarius — with it [is] western [?]. And then he divided the whole inhabited world into four parts, each part of them assigned to one triplicity of the four triplicities. And the inhabited world is divided [?].

[First quarter:] [?], and it is between the north and the west. And because the inhabited [quarter] of [?] [is western?], [its nature is assigned to its triplicity?]. And because this triplicity is [?], [several words uncertain]; and its people would not submit to any man [?], [being] compounded [?] of every kind; and they had servants [?], eloquent [?], speakers [?] [several words uncertain]; and because in this quarter a man is acted upon [?] [several words uncertain]; and their nature is fit to be [?] and whole [?]. And because this was so, its people were masters of soft [smooth] speech, and recognized [?] good, and givers of gifts.

The second quarter of the earth is in the south-eastern parts — greater Asia. And in this quarter [lie] the land of India, and Persia, and [?]; and all this quarter is in the south-eastern part. [It is] assigned [?] to the triplicity of **Taurus, Virgo, and Capricorn**. And because this triplicity is south-eastern, the lords of these lands are **Venus and Saturn**.

[Foot of the left page; modern pencil foliation "200".]

[The recto opens mid-passage, continuing the characterization of the world's nations quarter by quarter according to the planets and signs that rule them. The top lines of the recto are faded and a minority of words there could not be committed; the ink grows clear from mid-page down and throughout the verso, and most of the connective prose is recoverable.]

the eastern peoples [?] … and they are hot [fiery] in temperament [?]. … [?] Menelaus [?] …, and they raise up a rising sign [?] which they call [?] … the rays of the Sun and its light [?]. They are, moreover, [such] that they [?] [Interlinear addition above this line: מנהג, "custom / practice"] … so as to be [?]; they roam about [?] and draw near [?] in the heat of battle [?], and they leap and dance [?] … like wild men [כמו פראים]. And because Saturn [שבתי] [?] is fitting for them, they belong to the east [?]; some of them are assigned to Babylon [?]. Mercury [כולב] governs them — they are the people of Babylon and the Chaldeans [כשדים] — and [therefore] they are reckoned [?] … [as] wise [?] … [?] first [?].

[?] the remaining parts of the [inhabited] quarter, toward the middle [שאר חלקי הרובע … לאמצע]: all the settled land of the east [כל הישוב … המזרח] lies within a single division [?], and within one part of it [יש בחלק אחד] is the Land of Israel [ארץ ישראל]; it inclines toward the [south?] and the west [?], and it is the third [?]

… The sign that rises over it is Sagittarius [קשת], and its lord is Jupiter [צדק], together with Mars [מאלים] and Mercury [כולב]. Therefore the people of that place are merchants [סוחרים] and men of [deceit? מרמה [?]], as is the land of Syria [ארץ סוריא]. And in the Land of Israel [?] Sagittarius [?] rises with Mars [ומאלים], and its people [?] are simple [?]; they did not [?] know [?] … And so Ptolemy said [נאמר תלמי] …

פרק [Chapter] [large display letters, mid-recto; no chapter number is visible after the word]

like [?] the luminaries, there is [something] among the words of [?] … Ptolemy said [תלמי אמר]: a man should set his mind upon what [?] … so that with diligence [?], profit [?], and gain [?] he may learn [ילמוד] [?] … [?] said [?]: [it is] like [?] … he shall say [?] … [as] one who [?] … [?]. And [?] over [?] … God [?] apportioned [?] to them [?] … [that the stars] should govern [?], yet so that the children of Israel should not serve them [שלא … בני ישראל … לא שיעבדו להם] [i.e. should not practice astral worship], nor rely upon the judgment of the stars [דין הכוכבים] [?], as they explained [?] …

[The verso continues the same argument: that Israel stands above the decree of the stars, both because it may repent and because a person is endowed with a God-given faculty of free action that the stellar order does not command. Pencil folio number "102" appears at the lower outer margin.]

[Marginal note at the top of the verso: מקבל [?] — a small word above the first line; possibly a catchword or an interlinear addition, reading uncertain.]

For Israel has room to repent [כי יש מקום לישראל לתשובה], whether from sin or from transgression [בין חטאים בין פשעים], and there is no [?] decree against Israel toward evil [?] — if [?] its accuser [?] [?], and if not [?] … [?]. But if there is there no repentance and [good] deeds [אם אין שם תשובה ומעשים], punishment follows [יש עונש], for such [deeds] are [as it were] the nature of the heart [mind] [?] … [as] the nature of [?]. Here, however, [?] it is not so, for the Holy One, blessed be He [הקב"ה], [?] within them [?] … [grants them] a firmer standing [?] than [what comes to be] from the stars [?] that rise and act by their nature [?] … [?] to guard [?] … a power [?].

For there is in [a man] a power that goes forth prior to acting [כח יוצא לפני פועל]; and at the moment one is born [ובעת שנולד] there is in him [something] like an angel [?], and it adds nothing further [ולא יוסיף יותר]. But a human being [אבל בן אדם] — he is a man in whom there is a power that goes forth prior to acting [יש בו

כח יוצא לפני פועל], and over this the [astral] regime has no rule [?]. And in like manner the nations resemble them [וכן האומות דומין להם] … [?] a reckoning [?].

This is [the meaning of] the Holy One, blessed be He [הקב"ה], having given the stars dominion over [His works] [לכוכבים לשלוט על] [?] — [?] like a king who [entrusts to] one of his [servants] [?] the carrying out of a command, [appointing] an official [פקיד] over one of his affairs [?], so that the king himself need not [ולא יהיה הוא צריך] trouble over those matters [?]. And [there is] also, for a king, one whom he loves [אוהבו]; and it is not enough for him [?] to be [?] … [?] under [the charge of] an official alone [?] — the [king himself?] attends to [?] the beloved [?] … [that] his God [אלהיך] [?] [and let it not be hard in your eyes [ואל יקשה בעיניך]] [?]. For even though the official has power to act [שיש בו הפקיד כח לעשות], he cannot [do it of himself] [לא יוכל], and the king [?] [?] … [?].

[The king] says [?] [?] … it should not [?] … there is in the matter no need for length [אין בדבר אריכות] [?] … [as] it is written [?] … [?] "[This is] your God" [?] [?] … [that] He gave [?] a portion of [governance over] the settled world [שנתן … חלק הישוב] [?] to their [?] … and to the place [?], as [?] passed [?]. And Ptolemy [ותלמי] spoke [of this] [?] … that they [the astrologers] spoke truth [שאמרו אמת].

[Pencil folio number "102" at the lower outer margin of the verso.]

Therefore the Holy One, blessed be He, willed to settle this singular nation there — the nation sanctified by its Creator, of whom it is said, "Surely this great nation is a wise and understanding people" (Devarim 4:6) — [establishing] that the judgment of the stars does not rule over them, as it would under Ptolemy's view, so that the nations should not claim that the divine wisdom found in this nation is not bound to the Creator, may He be blessed, but derives rather from the nature of its land. For this reason the Holy One, blessed be He, willed to display His dominion [?] in this nation, so that the whole world might know that the providence of the Creator, may He be blessed, is singled out among them — and not the governance of the sphere.

Therefore it is fitting that, just as in nature providence does not depend upon the land, so too with a human being: one who [cleaves] to the divine providence — his dwelling in the land does not harm him, [despite] the judgment of the stars, [for he is] in the midst of the wilderness [?]. And just as He fed them the manna in a place of "serpent, fiery serpent, and scorpion" (Devarim 8:15), so they learned the loftiest of the sciences in security [?]. And in exile they prospered [?] … [several words uncertain] … in the lands where He gave [them] strength [?] … the [power of] the stars … nullifies them [?] … the words of Ptolemy, which are true.

Yet we do not defer to his words, nor is there any verse more explicit [?] than "From Zion, the perfection of beauty, God has shone forth" (Tehillim 50:2).

[The clauses that follow are only partly legible: "… of Jerusalem [?] … they were created [?] … in the path [?] …"] All the more so, since [the Land of Israel] lies at the center of the inhabited world; for it is the midpoint of the level land — it is like the heart. And when a region lies at the far [extreme] quarter, it is not so, for it is not at the center of the level land. Moreover I say that [under a different reckoning it would be otherwise [?] …] — to display [?] in a mixed place, and to relate [?] [a region] to the nature of the fixed stars, according to the sphere that revolves perpetually above them, over that [region]; so as to know, from the nature of those fixed stars in its atmosphere that rise [?] … [text uncertain] … they are attributed [?]. Therefore one need not attend to everything for a single star alone, for this is a matter that is not essential.

And as [Ptolemy] said at the beginning of his book, [one reckons] from the nature of the fixed stars that are in the middle of the [ecliptic [?]] — thus they saw fit to determine [?] the light, whether they incline from the ecliptic [Arabic: al-manṭaqa, "the belt/ecliptic"] toward its north or toward its south. And when one knows the nature of the stars in each degree that stands at [the zenith [?]] … [text uncertain] … the nature of that region [?] according to the nature of the star that rises over their zenith — this is the essential point.

And afterward, should one wish to reckon with it the powers of the stars according to [the signs [?]], as he did — this is the essential point, and it shows that Ptolemy grasped the main matter. But because he [dwelt on the secondary [?]], it is not proper to rely upon him.

It is written in Tractate Kiddushin (Kiddushin 49b): Ten measures of wisdom descended to the world; nine the Land [of Israel] took, and one all the world. Ten measures of beauty descended to the world; nine Jerusalem took, and one all the world. Ten measures of [might [?]] descended to the world; nine Babylon took, and one all the world. Ten measures of arrogance descended to the world; nine Elam took, and one all the world. Ten measures of might descended to the world; nine Persia took, and one all the world. Ten measures of sorcery descended to the world; nine Egypt took, and one all the world.

And let us return to the matter we began. The third quarter, on the [north-eastern [?]] side, belongs to the land of Greater Asia. In it are peoples and other great cities, and there are lands whose inhabitants are [?] … precise [?]. This whole quarter — its small eastern part — pertains to [the triplicity of] Gemini, Libra,

and Aquarius, for this triplicity is north-eastern; and it belongs to Saturn and Jupiter, which are eastern. Therefore the people of those lands [are governed by] Jupiter and the Sun: they are wealthy and possess much gold, and their conduct is proper and well-ordered. They are wise, engaged in divine science, [holding] upright opinions [?], and freeborn; and their yield is fine sciences. Yet they do not have peace one with another; it is easy for them to … [?] their … in security, because their kin are settled within their proper, fixed borders, and they are by their nature … [?]. And over this matter Saturn and Jupiter hold sway; and the people of these lands are suited to … [?] and to Mercury, and therefore they are more nimble and inclined to desire [?].

And in each of these quarters Ptolemy named the lands and the provinces within them, and he divided each quarter into three parts, according to the [threefold] division … [?] each one … from the triplicity. But since we do not know the names of the cities with precision, [what he wrote … he wrote] so that one might be able to mention [them] … [reading uncertain at the page end].

[Script: clean 14th-c. Sephardic semicursive, one column, the hand of Sasson ben Menashe. Continuous expository prose on both folio sides; no tables, no diagrams, no rubricated headings. Still within Ptolemy's *Tetrabiblos* Book II (mundane astrology): the planetary and zodiacal governance assigned to nations and regions, and the prognostication of eclipses and their geography. No מאמר / פרק / שער boundary appears on this opening — the anticipated Book III (Nativities) header does not begin here.]

For they have a use and their own distinct properties in a different configuration, and they are not [?]. The aptitude [והכושר] produces [?] in the smaller figures [בתמונות קטנות], and so it is brought to completion. [?] and by the science of [?], as Ptolemy [כתלמי] and the ancients [held].

The seat of the Romans [מושב רומי] and its princes [have] a dominion that came earlier [שלטון שקדם] [?]; and again, the seat of the Romans and the princes of Mars [מאלים = Mars] and Venus [נגה = Venus] [?] hold sway over [the nations] [?]. One [influence] draws near [יקרב] to the men of a place [מקום], or in [?]; or one comes to rule [למשול] [?] — a king [מלך] and a kingdom(?) together [יחד], the one [?] the other. [Interlinear above the line: [?] — one added word, not confidently legible]

And so it rules over a man [לאיש] [?], and [stands] upon [?] — [that] of Mars [מאלים]. And if this is so [ואם כן], one has not [thereby] said [לא אמר] [?] as those who said [כמו שאמרו] [?]; and all the more so [ויותר… קל וחומר], to say concerning

[?] that there is nothing [שאין] [?] on its own [בלבד] — [that is,] whether one may say the like of the world [שיאמר כן על עולם] as a whole [?], and in truth [?]. And one truly knows [ידע באמת] whether [?] the land [ארץ] [?], by the power of this science [מכח זו החכמה] [?]; and how a [blow?] befalls the land [ארץ] [?].

[?] and the like of it, [?] from the power of this science, and there is no [?] in this. [?] near [?], and [?] to the sphere [לגלגל], to say that [?] which lies thus in the depth [בעומק] [?], and that [?] rises [?] the degrees [?]. For one must know [כי צריך לדעת] [?], as the figures [כתמונות] [belong] to the planet [לכוכב], [so] the degrees of the meridian [חלקי קדקד] [?].

For it may be [כי יתכן] [?] that the planet [שהכוכב] [by which] one is able [to judge], and by the working of time [ובמעשה הזמן]. They have mentioned [נזכרו] that they act, for [?] this, and thus [?] it is made ready [?].

And those who venerate a city [ומעריצי קרתא, Aramaic: city] serve them [?]; to them belongs [?] the planet [?]; and thus [?]. For [?] apart from their intent [מחשבתם], and [the nature of] Babylon [בבל], and in the first sciences [ובחכמות הראשונות] [?], and in the prophecies [ובנבואות] [?]. [?] there is [?], and a great [?] over [?] [?].

[?]. And he said [ואמר] [?] that the ruler's portion over the provinces [חלק המלך המדינות] [is assigned] to each one [לכל אחד] of the nations [האומות], [?] from the place [מקום] [?]; and this is [?] the well-known [המפורסם] [?] on its own [לבד]. [?] and the land [ארץ] [?].

To [?] the nations [?] Mars [?] — and Kairouan(?) [נקרואן] [?] — and those who venerate [ומעריצי] [?]: to Edom [לאדום]; to Africa [אפריקיה]; [?]; to the fall of Babylon [לנפילת בבל]; to Spain [ספרד]; to [the land] that lies between the Tigris [חדקל = Tigris] and the Euphrates [ופרת = Euphrates]. There is no place [אין מקום] to reckon [?] the land of Kush [ארץ כוש = Ethiopia] [?].

He said: for I have already stated [כבר אמרתי] that, among the planets [הכוכבים], one is to know [לדעת] for them their altitude [מעלתם] from the region of the signs [חלק המזלות]; and their degrees [ומעלותם] — the degrees which stand upon the meridian [על קדקד] for each one that rises [לכל עולה] — and the further degrees [וכמעלות] [?].

[?] the signs [המזלות] [?]; and perhaps [אולי] one must [?] understand [?] as [?], and this [?] which returns [?] like lights [כמו אורות]. [Interlinear above the line: טעה — "he erred"(?)] [?] with us [עמנו], and [?], and yet more [ויותר] [?] in the motions [בתנועות] [?] in its effects [בתולדותיו] [?].

Or [?] for this time [לזמן זה] one must know [צריך לדעת] [?] many times [פעמים], [?] its altitude [מעלת] [?] of the first [ראשון] [?]; and again [?] first [ראשון]. And he said [ואמר] [?].

[?] over its brightness [?], and thus [?] the observations [הראיות] [?]. He said [אמר]: reckon [?] [?], and only [ובלבד] by the eclipse [תלקות = eclipse] that appears [שנראה] high [?] out of the air [מן האויר]. If they are generated [אם יולדו] [?] like the gathering(?) of a flame [שלהבת], [?] the flame [שלהבת], or [?] one of the elements [מיסודות] [?]; and [it] requires [יצריך] smoke [עשן], and it becomes intermixed [ותתערבב] thus [?].

Or the [?] of the eclipse [לקות] [?]; and the [?] of the eclipse [תלקות] [?] — a planet may take(?) [יקח] [?] like the illumination(?) [כמאורה] of the eclipses [כתלקות], and [?] renews(?) its light [אורו]. What is joined [?] to it — its eclipse [תלקות]; and if it is [ואם הוא] [?], it takes [יקח] [?]. And from its parts [ומאבריו] [?], for [?] happens at the time of the eclipse [בשעת תלקות] [?] into darkness [לחשך], until its light is complete [עד שישלם אורו].

[Right page of the opening (f. 203v). *Tetrabiblos* Book II (mundane astrology), continued: the timing and ruler of an eclipse's effect, the species affected according to the zodiacal form, and the affected produce reckoned by the decan.]

He said further that when the eclipse stands in the eastern part [of the sky], toward the horizon, the beginning of the effect falls within the first third of the hours of the time the eclipse lasts. If it stands at mid-heaven (חצי השמים), the onset is at the middle of that span; and if it inclines toward the west, in the last third.

After this he began to explain which planet rules over the eclipse. He said that it is the planet holding the greatest dominion (שררות) in the sign of the eclipse and in the sign of the ascendant (הצומח). If you do not find a planet fit to bear these several rulerships, take the two planets — that is, the lord of the ascendant and the lord of the place of the eclipse — and observe the planet that aspects them; and in the indications give precedence to the lord of the sign of the eclipse over the lord of the ascendant. And if, among the planets present [in the figure], there is one whose light [?] is with the place of the eclipse and that was there before [the eclipse], [take it]; and associate with it the planet that is [most elevated (?)] [?].

After this, examine the form (צורה) of the sign in which the eclipse falls and the form of the sign in which the ruling planet stands. See whether that sign resembles human forms — such as Gemini (תאומים), Virgo (בתולה), Sagittarius (קשת), and Aquarius (ודלי [reading ר as ד]) — for then the effect will be upon

human beings. But if it is [a sign of animal form (?)], the effect will be upon beasts (בהמות): in Aries (טלה) and Taurus (שור) it falls upon the flocks and the herds (צאן ובקר); if it is in Scorpio (עקרב) or in Cancer (סרטן), it falls upon the wild animals (חיות); if it is in [a sign (?)] it indicates [?]; and if it is in Pisces (דגים), it indicates the fish of the river (דגי של נהר).

And when the eclipse begins from the first of the four decans (פרקים) of the sign [?], the duration of that effect will be as [the length of] that decan; and one reckons the decan as the whole amount of a solar eclipse, or as half the amount of a lunar eclipse (חצי לקות הירח). From that decan one knows [the timing of] the effect, according to the portion in which the eclipse falls, as he said at the outset.

And if that decan is the decan of [?] — that is, [the "head"] — the effect will be upon the fruit of trees, such as grapes [?], figs (תאנה), and whatever yields oil (שמן). And if it is at the beginning of the [next] decan, it indicates the grain (התבואה) and the legumes (קטניות) that are wont to be stored; and it indicates, in [Adar (?)], [an effect] upon the swelling of the Nile (מרבית היאור [?]) in Egypt (מצריים). And if it is at the beginning of the heat, it indicates [?] and the straw/stubble (הקש) [?]. And if it is at the beginning of [?] [?].

[Left page of the opening (f. 204r, bearing the pencil foliation "204"). The per-planet catalogue of the eclipse's effect according to the nature of the ruling planet — upon human beings, beasts, the air, and the seas and rivers.]

But as for the effect produced from the root [i.e., the eclipse] — [its measure and extent (?)], the span of the eclipse: know that this produced thing may be a benefit (תקון) of its kind, and may be a corruption (קלקול), according to what the ruling planet will be, as we said. A benefic planet yields good and benefit, and its opposite [a malefic] the reverse. Accordingly:

If that ruler is Saturn (שבתאי) alone, the effect will be destruction [from cold (?)]. Upon human beings, it brings cold, prolonged diseases (חלאים קרים ארוכים) and quartan fevers (קדחות רביעיות) and much moisture (לחות), and the like of these among the diseases [caused by] this planet. And if [its effect is] upon beasts, they will diminish and [perish (?)]. And if it is upon the air, it produces cold [?], and darkness, smoke, and fog (חשך עשן וערפל). And in the seas and rivers, the ships (הספינות) will sink [?], and [?]. And if [there is] an earthquake (רעש), it indicates [?]; and there will be locusts (ארבה) and hail (ברד).

And if the ruler is Jupiter (צדק) alone, it indicates good and an increase (ירבה) of things. So, if the effect it indicates is upon human beings, it indicates high station (מעלה) and greatness (גדולה) and good works, and peace (שלום) and security

(בטחון) and faith (אמונה) and success (הצלחה). And if it is upon beasts, they will increase, and the yields of cultivation [?] will grow. And if it is upon the air, it will be temperate (ממוזג), working well for health; it increases the rains (הגשמים); and in the seas [it brings] safety for the ships, and sweetness of the rivers with good water (במים טובים).

And if the ruler is Mars (מאדים) alone, [it brings] dryness (יבש). Upon human beings: fevers (קדחות) and spitting of blood (וקלוח דם [?]), sudden death (מות פתאום), quarrel (מריבה) and [strife (?)] and hatred (שנאה) among them; and [there will be] heat [?] and hot winds (הרוחות החמים) and [?]; and the doing of serpents (הנחשים [?]); and in the seas, [the loss of] the ships through harsh winds (רוחות קשות) [?]; and a lack (חסרון) of water in the rivers, and the drying-up (ייבוש) of [?] and the trees (האילנות); and enmity (האיבה).

And if the ruler is Venus (נגה) alone, it is like the working of Jupiter — good. [It brings] life [?], and increases children (ילדים), and gladness of hearts (טוב הלבבות) in its way, and good air, and abundant increase, and pleasant things (נעימים), and safety for the ships; and the food (הנאכל) and the fruits (הפירות) will be good and will multiply, bettering [?] the affairs of human beings.

And if the ruler is Mercury (כוכב) alone, it will be according to the nature of the planet joined with it. Its working upon human beings is [?] and difficulty and corruption [?] among them; and it produces dry diseases (חלאים יבשים) and fevers and cough (שעול) and [?]. So it works in the manner of each one of the planets. And it produces harsh winds (רוחות קשות) and famine (רעב) and earthquake (רעש).

— and he says that, on account of these things, it produces its effects upon living beings, upon plant-life and upon animal-life. And if it is [?], it brings [its effects] upon the seas [or: the days], upon the beasts, and upon the plants, and it adds to them [?].

These are the judgments of the comets [הכוכבים הקטרעיים — the "smoking/tailed" stars; comets. The transliterated term is uncertain [?]]. But to enumerate their judgments according to their [aspects?] and their [?] is a matter that has no end. Rather, the practitioner must apply his thought according to the craft and according to the luminaries — [reckoning] by the degree they occupied at the moment of the [comet's] onset [מולד], and thereafter, whether a benefic planet was with it or not; and this will occur in that year.

One should [raise?] the degrees of the [benefic] to be like the degrees of the luminary or more. Thus Jupiter [צדק] must not exceed [?] — the degree that was [?] — and Venus [נגה] must not exceed eight [degrees], and so forth.

Now the tailed stars [comets] that appear in their season — [the sages] divided and apportioned them according to the length of their [appearance?]. [?] their nature: like Mars [מאלים] and Mercury [כולב], they portend wars and conflagrations [מלחמות ושריפות]. The place of the effect will be according to their configuration — that is, their position among the signs [?]. And when they appear toward [?], the effect is delayed [יתאחר המעשה]; [it proceeds] from beneath the luminary [?]. And the rising of the star called "right hair" [שער ימני — a comet-type; "the hairy/bearded" star] will be [?].

One should know the workings of the year and derive them from the conjunctions [הקיבוצים — the syzygies] and the [oppositions?] that precede the four seasons [ארבעה פרקים]. The nature of the signs [טבע המזלות(?)]:

- **Aries [טלה]** — its onset [?]; its beginning: winds and rain [רוחות ומטר]; its middle: cold [צנון]; its end: burning heat [שרף].
- **Taurus [שור]** — its beginning [?] (it is adjacent to [?]); its middle: moist and cold [רטוב וקר]; its end [?].
- **Gemini [תאומים]** — its beginning: very moist [רטוב הרבה]; its middle: cold [צנון]; its end: stormy [מרעש].
- **Cancer [סרטן]** — its beginning: hot [and moist?] air [אויר חם]; its middle: temperate [בינוני]; its end: onset of winds [מולד רוחות].
- **Leo [אריה]** — its beginning: hot air [אויר חם]; its middle: temperate; its end: moistening [מרטב].
- **Virgo [בתולה]** — its beginning: hot [חם]; its middle: temperate; its end: [?].
- **Libra [מאזנים]** — its beginning: [?]; its middle: temperate; its end: [?].
- **Scorpio [עקרב]** — its beginning: [?]; its middle: temperate; its end: [?].
- **Sagittarius [קשת]** — its beginning: moist [מרטב]; its middle: [temperate]; its end: [?].
- **Capricorn [גדי]** — its beginning: [?]; its middle: temperate; its end: [?].

- **[Aquarius — דלי?]** — its beginning: [?]; its middle: [?]; its end: onset of winds [מולד רוחות].
- **[Pisces — דגים?]** — its beginning: temperate [?]; its middle: moistening [מרטיב]; its end: [?].

As for the examination of the matter [והבחון בדבר]: [one considers?] [?] the four [seasons], [?] from the conjunction [מקבוץ] and the motion [ותנועת] of the [luminaries?] at that time, [?] upon [?] and upon [?]; and upon it a matter [?].

And he said — that is to say, thus — concerning the signs [אותות] [of the comets?] that appear [הנראים]: [one is] to raise the luminaries [?]; when the luminary [?] [?] and [?] smoke [עשן?]; and the nature of the rising [הזריחה] and its [?] indicates what the star [signifies].

- If it appears [?] with much [?], [it points to] their permanence [?]; and if [?] — it indicates [?] [?].
- If it appears at the time of conjunction [קיבוץ], and its nearness adjoins [it] before it or after it — [being] thin, thus — and if [?], its cause is something that indicates [?]. And if it was thin and reddish [דק ואדום], and it appears to us as having no light in it yet [?] — it indicates the blowing of winds [ריחוף רוחות].
- And if it is black [שחור] or [green?] — it indicates rains [גשמים?].
- And if it is [?] an assembly [קהילה] whose cause is [?], [?] its effect [?] — it indicates wars [מלחמות?].
- And if it is [?] — it indicates [?]; and if it is [?] — it indicates winds [רוחות?].

And the more numerous its assembly [קהילה] is, [?] — the [?] and the [?] it points to. And that which [?] whose cause is a benefic star [כוכב טוב] [?] — it indicates the heavy [?] [?]. And smoke [ועשן] [?] endures [?], and [belongs] to their assembly [לקהלה] like [?]. And if you see it rising from the air [?] [?] — it indicates the blowing of winds [ריחוף רוחות] from the side that is toward the star [מצד שבו לכוכב].

And when the bright [comet-]stars are hidden at the time of their rising, they are scarcely visible [?]. If they are shaped like columns [beams], they signify heavy rains; and if they resemble smoke [?], they signify strong winds. But as for the appearance of the star that is called a *kokhava* [star] — or, more properly, since they call it *kokhava de-shavit* [Aramaic: "rod-star," a comet], for those comets that have a tail — he said at the outset: if they issue from a single corner [one direction], it indicates [an effect coming] from afar, from that quarter; and if their

issuing is from the four corners [the cardinal directions], they indicate turbulent air, earthquake, and lightning. And when [the comet] appears at the time of [the Sun's] rising, it indicates rain; and when it appears at the time of [the Sun's] setting, it indicates dry, clear weather.

The Third Treatise: On Nativities [המאמר השלישי במולדות]

He says: The configuration [of the heavens] at the moment the seed falls [conception] governs the formation of the embryo in the womb, and its duration and quality — but only up to the point at which it emerges; whereas the configuration at the time of its emergence [birth] governs everything that concerns it once it is living flesh.

The author says: Esau and Jacob pose a difficulty for him [the astrologer], for they came forth within a single moment — "and Esau was a man skilled in hunting, a man of the field, while Jacob was a wholesome man dwelling in tents" (Bereishis 25:27). But hear the answer: within that moment there was an interval [of delay], so that they were in fact not born under one and the same configuration. There was a small division within the moment, as it is said, "and his hand was grasping Esau's heel" (Bereishis 25:26) — a proof that, had there been no interval at all within the moment [their fates would have matched]. I therefore say that the configuration at the newborn's [precise] moment is the decisive factor; and it is for this reason that many of the astrologers go astray. Let us return to the words of Ptolemy.

He said: Knowing the ascending degree [the ascendant] at the time of birth is as [important as] knowing the exact hour and the sign itself. Approximately, one derives the [ascending] degree in this way: examine the degree of the conjunction or the [opposing] aspect [the prenatal syzygy] that preceded the birth, and determine which of the seven planets holds there the most dignities [rulerships], and in how many degrees; and assign [the ascendant] accordingly from that sign [?]. And if [two or more planets share dignity] at the degree of the conjunction, [consider] which of them is ruling at that hour, and which of them is more [prominent / nearer] [?] — [that indicates the ascendant] approximately;

[assign it] to the [planet] that serves [holds rulership] more, which is nearer to the ascending degree. Write down the degree of that ruler at that node [?], and proceed likewise with the rest of the indications [?].

The Inquiry into the Affairs of the Parents [העיון במעשה האבות]

This is [judged] from the Sun and from Saturn; and the affairs of the mothers from Venus and the Moon. According to the place these [planets] occupy, and [according to] the aspects of the stars, so shall the affairs [of the parents] be. He [Ptolemy] laid it down that the dignity of the parents and their good fortune [is read] from the aspecting of the [lesser] stars toward the luminaries. For when the lesser stars aspect them, and their light stands in their own degrees or in the degrees of [other] stars, they indicate that the affairs of the parents will be great and honored — all the more so if those stars are occidental [western] while Saturn and Venus are oriental [eastern]. But if [the malefic] is in force [?], and the two luminaries were void in their course, and no star surrounded them, it indicates the low station of the parents. Likewise [?] if Venus and Saturn are theirs, for example.

And if stars that are not in aspect [not of the same region] surround them — as happens when Mars rises after the Sun and Saturn rises after the Moon, and the significators of the luminaries were not in a good place and were not in aspect — it indicates the death of the parents and the ruin of their affairs. But if it is so at a proper hour at the nativity, with the benefic stars to the left [?] or rising [in the east], how favorable it is! — for their rule and their endurance are good; and the reverse of this [indicates the reverse]. All the more so if no [malefic] star surrounds the luminaries, or there is a deficiency in them [the malefics]. The length of the parents' lives, and their being cut short, is known in this way.

The father's life is known from Jupiter, Venus, Saturn, and the Sun: when they aspect one another [in friendly aspect] [?] and are maintaining [their strength], they indicate length of the father's life; and whatever falls short of this, reckon in the same way. But if Mars ruled over the Sun and over Saturn, or pressed close after them, and was in aspect at the setting of the Sun, or its resting, or their setting [?] — [whatever] befalls them, and its remedy [?] — on account of this they will suffer hardships, and not [?]… …and if it stands upon the [?], and in the working [?] of healing; and all the more so [?] the west [the place of setting]. And [?] more strongly indicates a bond in the life of the father; and Mars, in [?] [?], upon the course by which [?] [several words faint and unresolved]. And if [?] aspects [?], it indicates death for it [?].

The length of the mother's days is indicated from [?]; and Venus [indicates ?] this [?] — [?] upon the life of the mother. And if [?] casts [its rays], or that there is [?]

behind Venus, or of [?]; and if [?] is moving [?], or [?] settled [?] — it indicates upon [?] alone. [Remainder of the passage faint; only the anchors — the setting, the life of the father, Mars, the length of the mother's days, Venus, the life of the mother — are secure.]

On Siblings [באחים]

Reckon the number of the siblings from [?] [?]. [?] the planets; and give attention to the form of the sign — whether it is of a single form or possessed of two forms. And if the planets rise [?] upon the [?], or that they were following after them [?].

The masculine planets indicate male siblings, and the feminine [planets] the female; and the [signs] indicate the female siblings [?]. And if the planet of the native aspects the ascendant [הצומח], its known [?] indicate success [prosperity]; and if they were [?], it indicates their fellowship one with another. And if they were in [?], there is no [?] binding and joining, or that they were in a connection [?] — it indicates [?].

And know whether that native himself is male or female: [reckon] from the places of the luminaries and from the ascendant. Whichever is [dominant ?], the planets that produce [?] their [?]. And if the majority were male, [know that] the native is male; and if there were females [?], the native is female. And know whether they are [?] or not; and likewise [reckon] for the ascendant and the place of the luminaries and the planets that produce [?].

[Following page — recto of the leaf foliated 207:]

If they are in signs that raise up two forms [double-bodied signs], they are twins. And those who differ in their formation, and whoever's sign is difficult [to bring forth], are the ones who have no siblings — [when there is no] connection with the cardines [the angles], or the planet has no connection to the five places, no connection in the place of the conjunction or the preceding aspect [הנבט, the prior syzygy].

The five places are: the ascendant, the two places of the luminaries, the place of [?], and the place of the conjunction or the preceding aspect; together with whatever bears further on the matters of the native's formation. And they are made like wild asses, like onagers in the wilderness, [?] the luminaries in signs that rise [?] — four. And the malefic planets [?]; and you shall say [the like] concerning the benefics, and further [matters] like this.

And if no benefic planet bears witness to it, there will be nothing at all. But if Jupiter and Venus bear witness to it, he will be honored [?]; and if Mercury bears witness, his faculties are influenced, and he will carry out [?] the matters, and he will be a craftsman — understanding, a man of moral discipline, and profound.

Those [children] that do not live are the ones in which one of the luminaries is upon a cardine, and one of the malefic planets aspects it, or is together with it in a single degree, and no benefic planet joins with it, and there is a connection upon a place among the places of the malefic planets: [then] the native dies at once. And if it did not aspect it, but there was a casting of rays — the malefic planets upon the place of the luminaries, or [Mars] cast toward them, and they were the ones harming the luminaries, this opposite that — then he has no life. And what does the harming is: by day, Mars; by night, Saturn. But whatever is opposite it in its nature, and likewise [whatever is] in a rising degree — the matter is reversed, for Saturn harms the Sun and Mars the Moon. And by nature [this holds] when they are set in order upon the place of the luminaries and the ascendant.

And if they were set opposite, and the two luminaries and the two malefics were upon the cardines [?], and the matters were so, and the luminaries were separated [freed] from one of the planets, or they were in partnership with them in configuration, or the ray [?] reached the places [?] in the native — [then] he will live according to the number of the degrees that are between the [?] and the body of the [?]: years, or days, or hours, according to the measure of the strength of the planets; and so [you will find it]. Moreover, if the malefic planets are above [the benefics —]

[The head of f. 207v carries, in faded ink, the last three lines of the preceding section; only isolated words resolve.] [Illegible: ~3 faded lines at the top of the leaf, closing the previous topic.]

On the Hyleg, Which Indicates Life

[הילאג — the *hyleg*, the prorogator (apheta); Arabic *al-hīlāj*: the point whose directed arc measures the length of life.]

The hyleg is taken from among the stars according to the native's chart, and its eligible place is defined as follows. The star should stand five degrees before the degree of the Ascendant, and [numeral: ?] degrees after it, likewise; and it may also be reckoned upon the Ascendant itself [?]. [The following clauses enumerate the further eligible places and the conditions under which a star is "fit for the native"; the ink is legible but the technical phrasing does not fully resolve.] Thus,

from the places [in question], when the star [is so situated] it is fit for the native [?]; but [in the contrary case] the reverse holds, and these matters are fit to be [handled otherwise] [?].

And if the reckoning is not so, we have a rule established for the purpose [?], so that the computation may be sound [?]: the rule follows its own reckoning [?]. These, then, are the places fit to be relied upon, and the fitness of each is judged by computation in the proper places, as we have said.

[By day] you take the place of the Sun, or the place of the conjunction, or the preceding opposition [?]; but at night you begin with [the Moon] [?] — with the star that governs [?] the place of the hyleg — and [likewise] the place of the conjunction or the opposition, and the place of the *ḥatzi ha-shaveh* [חצי השווה — lit. "the half-equalization"; one of the hylegiacal syzygy-places, most likely the Lot of Fortune or the degree of the prevention; the precise referent is not made explicit here].

And if it is not possible for [the star] to be in the proper place: if the nativity fell after the conjunction, take the Ascendant; and if the nativity fell after the opposition, take the *ḥatzi ha-shaveh*. And if the two luminaries were together — or [in the case] governed by the position placed in its place [?] — then for the hyleg it is fitting that you take whichever of the two luminaries stands in the place of greater dominance and strength; and let it be reckoned for it according to the measure [of strength that the more authoritative one holds] [?].

There are two methods of directing the hyleg [?]: the one that follows the order of the signs is the one it is fitting to direct [equate] [?] — and this is when the hyleg lies in the eastern places, that is, from mid-heaven to the Ascendant. But those directions that are not carried out following the order of the signs alone, but rather by the precedence [?] of them — of which he spoke in practice — apply as when the hyleg lies in a place [other] than mid-heaven [?]. Those degrees, then, [are reckoned] according to where [the hyleg falls]: whether on the right or on the preceding side of the degrees. It is the degree of operation alone, for it is [set] [?] over the native [בעל החיים, "the master of life"]; but the degree of the planets that act as hyleg, upon which the operation falls [?], [is reckoned otherwise].

[These directions] involve only addition or subtraction, [reckoned] up to the time of the setting of the hyleg [?]. For [the obstructing planets] do not travel toward the place of the hyleg; rather, the hyleg travels toward them. Now the ones that add are the obstructing (delaying) planets, and the obstructors are the diminishers. And if a planet adds by bringing [the direction] to the benefics, then

the addition is found. The addition and the subtraction are known from the distance in degrees of each one of them — that is, according to the computed time that each of their degrees possesses: if it is a diurnal arc, [take its time] as the hours of the day; and if it is a nocturnal arc, [take] its time as the hours of the night. And the number of the degrees will always [be reckoned] thus [?].

And because his (Ptolemy's) words on this matter were such that he did not expound them at any great length — and it is a thing that has not come into the hand of every scholar — we have said, up to this point [?], that the reckoning of the length of life is the very thing in which they err most; the plain sense of what we have said is that [the astrologers' forecasts] are only for months [?]. Therefore the prophet said: "who foretell month by month, from the things that shall come upon you" (Yeshayahu 47:13) — for even the portion which they do make known [is limited to this].

[The pencil foliation "208" appears at the foot of f. 208r, confirming the leaf; the text runs continuously from f. 207v (verso) onto f. 208r (recto).] The upper portion of the recto continues the discussion of the soul from the preceding section; its ink is faded and the semicursive is compressed, so only fragments read with confidence:

it is not like that which belongs to the senses, but rather [?]… so too the substance [?]… [?]… and the reward of the matter [?]… [?]… which they knew its nature [?]… the planets deeply [?]… they did not know how to set it right [?], for it is [?]… as has been explained from these [?]… [several clauses illegible] [?]…

the temperament [?]… by their nature [?]… [?] of wisdom [?] the science [?]… and the trials [experiences] [?]… and if you wish [?]… [?] and Aristotle [ארסטו] [?]… [?] they did not [?]… [?] it is not known to the ancients except [?]… [several lines illegible] [?]… [Margin, right: brief note, illegible.]

On the bodily form of the native. [Heading in enlarged display script: *בצורת גוף הולד*] [Margin: brief note, illegible.]

You may know this matter from the [ruling] planet [?]… and the planet joined [to it] [?], its place [?]… [The passage that follows assigns bodily complexion, build, and temperament to each planet according to whether it is oriental or occidental. The ink is faded here and several of the specific color-and-quality terms do not resolve; the readable frame is given and the unread terms are flagged rather than supplied from convention.] The planet joined [with] Saturn, [when] oriental [?]… its color will be [?]… [and when] occidental, its color red [?] and [?], and [?] dry [?]. And if [the native's planet] be Jupiter [צדק] and it is oriental, its color will be

white, and [?] hot [?] and moist [?]. And if [it be] Mars [מאדים], oriental [?]… black [?]… red and white [?], hasty [?], hot [?]…; and if occidental [?]… [Margin: *נגה* — Venus] [?]… [and if it be] Mercury [כוכב], oriental [?]… white [?]… the body [?]… and small [?], and [?] hot [?].

[Verso.] …and occidental, [the native] inclining toward saliva [*לרוק*] [?], and thin, and [?], and dry. The Sun acts upon the constitution, the comeliness, and the frame of the body; while the Moon acts upon the temperament and the moisture of the mixture, but only when it is separated from the Sun. Its standing [position] will be according to what it has of the light — that is, in the first quarter [?], or in the second. And when the planets are oriental they make the newborns [?]…; and those [in position] contrary [do so] in reverse; and [?] according to the native [?]: he will be hot and dry, of middling [build] [?], and [?], his frame ill-formed [?], and [rough?] hair, and hard [?], and likewise the liver in the middle [?].

Moreover, the forms of the signs in which the planets serve as indicators cause the shape of the native to correspond to those forms. Those signs that govern the whole body are Leo [?], Virgo, and Sagittarius; those that govern its motion [?] are Cancer, [?], Capricorn [?], and Sagittarius [?]; [and those governing another part are] Virgo [?], Libra [?], and Sagittarius [?]; and contrariwise Scorpio, Taurus [?], and [Aquarius?] [?].

The inquiry into diseases. [Heading in enlarged display script: *והעיון בחלאים*] [It is taken] from the Sun and the ascendant [*הצומת*] and [?]…; Saturn and Mars belong to them. And if they both look — or one of them — to one of the two places, or [in] a hostile aspect, it indicates the diseases and afflictions. The matter is strengthened if one of the luminaries be upon an angle [cardo] — and you already know this. But that same illness will be [as follows]: to Saturn belongs [chronic] illness, and likewise [?], and the phlegm [moisture], and the affliction; to Jupiter, the breathing [?], the lung, and the ribs; to Mars, the kidneys [?], the sinews, and the flesh; to the Sun, the sight, the brain [?], the heart, and weakness of the right side; to Venus, [?], the liver, and the flesh; to Mercury, speech, thought, and the tongue; and to the Moon, the bowels [?], the digestion of food, the stomach, the belly, [?], and weakness of the left side.

And the planets that indicate these things: if they are oriental, they produce an affliction and a pain that flares up; and if they are occidental, they produce diseases that come in [recurring] cycles. As for loss of sight [blindness]: a single [testimony] indicates it — when the Moon is alone, [void?] [?], or in the seventh [place], and it was the time of conjunction or the time of opposition; or when the

Moon is upon an angle [cardo] and was westward from the Sun; and [when] Mars and Saturn are oriental.

[f. 209v]

[Margin, right edge: brief marginal note, "וידי" [?].]

Most of these planets are far off [?]; opposite [נכח] … [?], they gather and conjoin together [תתקבץ ותתחבר]. Whether they be servants [עבדים] or a ruler [שולטן] … [?] — those that are strong [?] — in the configuration [בצורה] … [?] together [יחד]; and the luminaries [המאורות] … [?] one and the same in all of them [?].

The accidents will befall [יהיו המקרים] [?] … [?]; and it will be in the west [במערב] … [?] with it [עמו] … [?]. She will bear a male [תלד זכר], or a male will be born [יולד] [?]; and if it is a female [נקבה] … [?] … [?].

And if [?] … [?] poor [עני], and it will be [?]. Western [מערבי] … [?]; and a slave [עבד] … [?] … [?].

[?] Venus [נוגה] [?] … the luminaries [המאורות] … [?] western [מערבי], and they are equated [והמריעין? — ?] in the degrees [במעלות?] … [?].

And if [?] … [?]; and the luminaries [המאורות] together [יחדו] … [?] the benefics [?] and the [?] in opposition [כנגד?] to the luminaries [המאורות] … [?].

[?] in [a sign] [?] — in Taurus [שור], Cancer [סרטן], and Scorpio [עקרב] … [?] — they will [?] or one rules over [שולט על] … [?]; and if [?] … [?].

[?] befalls him [יקרה לו?]; and companies of men [כנשים?] … [?] over one [על אחד] … [?] the luminaries [כמאורות] … [?]; Jupiter [צדק] will befall him [יקרה לו] … [?], and over [ועל] … [?].

[?] is called [נקרא] … [?]; and over [ועל] … [?] … [?].

[?] and a deficiency accordingly [וחסרון כפי זה].

[f. 210r]

[?] the [?] … [?]; and a planet [וכוכב] … [?] and its depth [ועומקו?] … [?].

And Venus [ונוגה] first [בראשונ'?] of the aspects [המבטים?] … [?] the health [הבריאות?] … [?]; and if a planet [כוכב] [?] rises upon them [עלֵיהן?] … [?], and Venus [ונוגה] ascending [עולה] … [?].

[Decorated header:] … the Native [הנולד] — [preceding decorated word not confidently legible: possibly גשם, "the body of," or a related rubric; reported as

uncertain] [?] **and his [?] [ורשעותין? — ?]**, the knowledge of [ידיעת] [?] the good [מטוב?] … [?] all [כל].

For the planet that has [rulership] over [על … כי הכוכב שיש לו] … [?] these planetary places [מקומות כוכבים אלו]. And if [ואם] … [?] its name [שמו?] [?] treasure [מטמון?]; and until [ועד?] the native [המולד?] … [?] within it [בו]; if [אם] … [?].

[?] rising [?] in the places [במקומות?] that are [שהם] [?] within it [בו], and one who rises [וקום?] … [?]. Blessing upon it [עליה ברכה?] from [מן] [?] to the rain [למטר?]; [?] Jacob [יעקב?] [?] … [?] and sons [ובני?].

The kingship [מלכות?] [?] … [?] one that acquires [מקנֶה?]; and he will find his wealth [וימצא ממונו]. And if it is divided [ואם הוא נחלק] … [?].

[?] one that acquires [מקנא?] … [?]; opened up [מפתרי? — ?] … [?].

[?] the sayings [מאמרו?] … [?] … [?].

And if a fourth [ואם רביע?] … [?], and one who rises [וקום] in the place [במקום] that he dwells [שיושב?]; and a wife [ואשת?] [?] honored [מכובד?] to [?] [?] a servant [עובד] … [?]; a portion [חלק/שבל?] [?] … [?]. And if [ואם] [?] … [?] change [מחלוף?] [?], but [אבל] [?] … [?] within [בשונ'?] years [שנים?]; [?] … [?].

From all [מכל] [?] its testimony is evil [שנטתו? רעה] [?] near [קרבה?]; and if [ואם] [?] brings [מביא?] to the world [לעולם?]. And there is no good testimony [ואין שנטן טוב] — the native will be among the rulers [הנולד יהיה מן השלטין], a master of judgment [בעל דין], small [קטן?] [?].

[?]; and one who amasses treasure [ורשבק מטמון?]; master of rulership alone [בעל שלטן בלבד] [?] guarded [ונשמר] … [?] — that he is at ease [שהוא נוח] [?] [?] of himself [מעצמו]; and honored [ומכובד], the luminaries [המאורות] [?] small [קטן?].

[Decorated header, middle: large ornamental script, largely illegible — concerns the [?] and the [?]bearing upon the native.] [?]

[?] all [כל] [?] … [?] over [על] … [?].

[?] and every [וכל] [?] … [?]; and one who rises [ומויך?] [?] to acquire abundant property [לנטל מרבה נכסים]. And if a planet [ואם כוכב] [?] over the place [על מקום] [?] Saturn [שבתי?] [?] … [?] over its power [על גבורה?] … [?].

And wealth [ועשר?] [?] … [?]; [?] its deeds [כפעולותיו?]. And Jupiter [וצדק] rules [יורה?] over [על] … [?] [?] and [?] … [?]; and Mars [ומאלים?] over wars [על מלחמות] and conquest [וכבש?] … [?].

[?] the [?]; and Venus [ונוגה] over [על] [?] deeds of the people [?] … [?]; and companions [ומחברים], favorably [כטוב], over [על] … [?].

[?] and your life [וחייך] …

The Profit and the Success [וההרוחה וההצלחה]

For the deed [למעשה?] [?] … [?] and they [?] … [?].

[The account of the native's rank and eminence continues from the preceding folio.]

And among the planets that are in positions of strength: if the luminaries [the Sun and the Moon] are joined together [?], they portend [the native's standing]. Those planets that attend the Sun and rise with it in the east, and those that attend the Moon and set with it in the west — by this configuration the native will be a king. And if the position of the remaining planets is likewise, and they stand in the [places of the] nativity, and the Sun is in a male sign while rising in a female sign, and one of them [the attending planets] is upon the angle [יתד], the native will wield the staff of sole rule — over the multitude, or over prisoners.

But if the attending planets were not upon the angles, his standing is only elevated so far: he will be an officer [פקיד], or the commander of a camp. And if the luminaries themselves were not upon the angles, yet most of the planets attending them were upon the angles — or they share the angles with them [?] — he will be middling in his manner of life. And if the planets attending the luminaries were not [so inclined] [?], in general he will not prosper. And if the luminaries were neither upon the angles nor in male degrees, and the planets circling them were not well-disposed [?], he will be of harsh fortune. And likewise for the remaining particulars, [the judgment is made] according to the variation of the [circumstances] [?], each set in its place. [Margin, later hand: illegible [?].]

As for the attending planets: whether the native becomes the lord of the district, or something lesser, depends on them; those planets that were [firmly set] [?] made it fitting that his standing be the more enduring. And if they were the lords of the ruling district, or its governors [?], it was fitting that he attain [high station] [?] in the district; yet he will fall short according to what the case warrants. As for Saturn: its benefit lies in the amassing of wealth. Jupiter [צדק — the scribe writes צלק] and Venus [נגה — written נולה] give gifts, honor, exaltation, greatness of soul, joy and gladness, and eminence in the conduct of affairs — and all this comes about through understanding and good discipline.

The Profession of the Native [ומלאכת הנולד]

[Look to the planet] [?] that in the morning stands beneath the Sun nearby, or to the one at mid-heaven, and to a planet well-disposed to the Moon. If two professions are found, belonging to two different planets, it is fitting that you attribute the judgment to that one planet alone [?]. But if one occupation belongs to one planet and another to a second, you shall reckon the planet that dominates the two as governing alone. And if the planet already seen beneath the earth in the morning is near [one luminary], and likewise the one at mid-heaven, while a planet other than these is well-fitted to the Moon, the native will practice both professions together.

And you shall attribute the professions to their planets, assigning the judgment to the one that bears the greater testimony. And if you find no well-placed planet seen beneath the earth nearby, and none at mid-heaven, it is fitting to attach the judgment to [the lord of mid-heaven] [?] — except that this pertains to the lesser [?] professions; for [those born thus] [?]…

The nature of the profession and its manner is known from Mars [מאדים — written מאלים], Venus, and Mercury [כוכב — written כולב]. If the doer of the profession is Mercury, the native will be a master of trade [?] and accounts, a money-changer [שולחני], and skilled [?]. And if it is joined [קשר] to Saturn, he will manage the affairs of others, or be a toiler over studies. And if Jupiter aspects [העיד] it, he will be a master of law and wisdom, a great associate, a man of understanding. And if Venus is the ruler of the profession and is rising, he will occupy himself with perfumes [?]; and if it is placed elsewhere, he will deal in spices, or be a weaver of garments — a man of [?], or a dyer. And if it is joined to Saturn, he will be a deceiver [?]; and if joined to Jupiter, he will be honored on account of good women. And as for Mars—

If his profession is governed together with the Sun, it will be among the chief occupations: here, a laborer, or a craftsman at springs of water. And if the Sun does not attach to it, his profession is [?]. And if it is joined to Saturn, he will be a sailor of the sea, or a bath-attendant in the bathhouse. And if Jupiter aspects it, he will be a master of [?].

And if two planets share the profession, and they are Venus and Mercury, he will be a musician and a singer upon a small instrument, a master of [?] and song. And if Saturn aspects them, add that he will be a merchant in milk [?]. And if Jupiter is joined to them, he will be a master of [?] and accounts, working at the openings of garments [tailoring] [?], and a teacher of songs. And if Mercury and

Mars share the profession, he will be a craftsman of images, a sculptor [?] of forms, an illustrator who draws forms from life, a physician and a healer by hand — [?] a liar. And if Saturn aspects them, he will be a bandit. And if Jupiter aspects them, he will be a lover of quarrels, and an officer over the money of others. And if Venus and Mars share the profession, in these occupations he will be a [?] and a perfumer, a dealer in [?] and silver, and a physician. And if Saturn is joined to them, he made [?]…; and if Jupiter aspects them, [?] the drawing-out of betrothals [?].

[The section on the profession continues on the following folio.] [The ink on both leaves of this opening is heavily oxidized (faded brown iron-gall) with foxing — well below this manuscript's usual clean state. The enlarged topical rubrics survive clearly; much of the connective semicursive is only partly recoverable. Legible content-words and connectives are committed; genuinely illegible spans are flagged `[?]` and not bridged with invented content. Both folios]

[On the Quality of Action / Profession — continuation]

and according to the strength of the craft [המלאכה [?]], and by the action of the planet when it is conjoined and strong [מחובר חזק], [?]. If [the planet] is eastern [מזרחי], [?]; and if it is western [מערבי], or [if it is] Venus [נוגה], [?] — that the effects [העלולים [?], "the caused things"] are strong [?], [with] bitterness [?] and admixture [ומעורבת]. And if [their] actions [מעשים] are set in order [?] … [several words illegible].

Corresponding to this [וכנגד זה] there will be deficiency and excess [יהיה נחסר ויתר] [in the outcome].

[On Marriage — בזיווג]

[Here the enlarged rubric stands: **בזיווג**, "On Marriage."] …the marriage-match [הזיווג] is reckoned [?] … [several words illegible; the standard doctrine here judges the man's marriage from one luminary and the woman's from the other, but the clause-level wording does not resolve] … the nativities [המולדות] [?] … [?].

[?] the boundaries [?] … hot [חמומת] and [?], and [it is] known [וידוע] [?]. Then the marriage [יהיה זיווג] [?] … [?] the position [?] of the planets [הכוכבים] [?] to the [?] … [several lines faded]. …and later [מאוחרים] [?] … in the sign [במזל?] [?] … evening [ערב?] [?] and Mars [ומאדים?] and [it is] balanced [ומעובל?] [?] … male [זכר?].

[?] and Venus [ונוגה] [?] … and between Mars [מאדים] and Saturn [לשבתאי] [?] … the signs [המזלים?] [?]; Venus [נוגה] [?] … [several words illegible].

and Venus with Mars [ונוגה עם מאדים] [aspecting/testifying] over desire [על חשק] [indicates... ?]. And if there is [ואם יש] [?] … [?] a matter [דבר] [?].

[On Children — בילדים]

[Here the enlarged rubric stands: **בילדים**, "On Children."] [The matter of children is] reckoned [?] to the planet [לכוכב] [?] … [several words illegible]. If there was [לא היה [?]] [?] … [it is] good [טוב] [that] one should reckon [שנחשב] to the effects [לעלולים] [?] … [?].

[?] or in the ascendant [שבצמח?] [?] … and Jupiter [וצדק] and Venus [ונוגה] [when] they [?] over [על] [?] … [several words illegible]. And Mars [ומאדים] [?] and Saturn [ושבתי] [?] [as regards] the children [בן?] [?] …

[?] in the signs [המזלות] [?] — whether few [מעט?] or many [או הרבה] — [it will be] known [ידע?] [?] … [several words illegible]. …[?] their conditions [?] … and if there is [ואם יש] [a planet] found [נמצא] in the degrees [במעלות] of the [?] … [?].

[?] in barren degrees [במעלות עקרות], namely Leo [אריה] and Virgo [הבתולה] [?]. And whether [the planets] were in male degrees [במעלות זכרים] or female [degrees] [או נקבות] [?] … [?] male [זכר?]. And if [a planet is] in female degrees [במעלות נקבות] [?] … [?] and few [ומעט?] [?].

[?] over their lives [חייהן] [?] … and if there is [ואם יש] a planet [כוכב] [?] … at the boundary of life [בגבול החיים?] [?] … [several words illegible] … and this [וזה] [?] … [?] the effects [והעלולים?] [?].

[On Friends and Enemies — בחברים ואויבים]

[Here the enlarged rubric stands: **בחברים ואויבים**, "On Friends and Enemies."] The natives [?] [?] … and I shall reckon [?] this. It is a matter [?] … according to [לפי] [?] the ascensions [הצומחים?] [?] … mixed [?] and blended [ומעורב] [?] … [The text breaks off after these opening lines at the foot of the leaf; the section continues on the following folio.]

[Pencil foliation "212" [?] at the foot of the left-hand page.]

and the place of the Lot of Fortune (חן תשועה, "grace of fortune" = the Lot of Fortune) of one of them indicates, by aspect, friendship at the time of the other's nativity — or through the interchange of their two places, that is, when the place of the one coincides with the place of the Lot of Fortune in the other's nativity. And if the two nativities are found to be close in these matters, or [the

significator] is understood by itself [?] across the two nativities, the friendship will be lasting and continual, differing only in less and more.

In the same way this occurs in matters of opinion and counsel, when [the significators] pass over the [afflicted] places [?]; and afterward friendship and affection befall them, when the two benefics pass over those same places.

Friendship is of three kinds: the friendship of the will, the friendship of profit, and the friendship of surety. If you wish to know by which of these three they are joined, observe the aspect of the Sun of the one to the Moon of the other alone: [if it is configured by way of] the benefics, it will be a friendship of intellect and will. And if [the significator comes to it only by] a passing aspect [?], or if it were not so, it will be brief, corresponding to this. And if the Lot of Fortune comes to the Lot of Fortune alone, [the friendship will be] for the sake of profit; and if [the Lot] falls between the two [luminaries] [?], it will be for the sake of surety.

Know, too, that Saturn (שבתאי) and Jupiter (צלק [scribal form of צדק = Jupiter]), when one of them passes over the other's place, produce a friendship for the sake of working the land or of inheritance. Saturn and Mars (מאלים [= מאדים, Mars]), when one passes over the other's place, produce strife. Saturn and Venus (נולה [scribal form = Venus]) — a friendship for the sake of women. Saturn and Mercury (כולב [= כוכב, Mercury]) — for the sake of partnerships and merchandise. Jupiter and Mars — for the sake of authority (שררות). Jupiter and Venus — for the sake of women and servants and [?]. Jupiter and Mercury — [?].

On Journeys

On Journeys (בדרכים). [This turns] on the disposition of the luminaries at the nativity. When [the significator] departs from [the place of] childhood [?], it inclines toward travel; and the matter is strengthened when the Lot of Fortune is in the degrees of travel. And if [the significator] comes upon the [cadent] places [?], [the native] will profit [?], and correspondingly [the reverse]. When the luminaries fall in the eastern quarters [?], the journey will be toward the east and the west; and if the [signs of] the luminaries were upon [the angle of] travel [?] … after the setting, or with the hidden stars [those beneath the Sun's beams], the journey will be to the ends of the world [?].

And if the degrees of the luminaries are [of two] [?], the journey will be long. When Jupiter or Venus is joined with the places of the luminaries, the journey will be favorable — if it be on the errands of kings [?], and prosperity and success will befall them. But if Saturn and Mars turn toward the luminaries — especially

when they are in opposition (מקבילות) — there will be evil, according to the square (רבע) of the sign that they are in. And if [harm comes], [it is] not on account of the [swelling?] [?] of the waters; and if [the journey] is cut short, it is on account of harsh winds; and if they are in the degrees of [dissolution] [?], on account of illness; and in the signs of [cities] [?], on account of robbers (לסטים [Greek: λῃσταί, "brigands"]); and in the signs [of harm], on account of violence (חמסים). And that in which the journey consists you will know from the workings of the beginnings of the years of the native.

And the manner of the native's death is known from the star adjacent to the killing places (המקומות ההורגין, the anairetic places), as stated in the rules, or from the stars that proceed toward them before [others]. Saturn, when it is the lord of death, [brings death] through chronic illnesses, rheum of the head, ear-ache, dropsy (הדרוקן), disease of the womb, and all chronic diseases. And if Jupiter is the lord of death, [death comes] through disease of the [throat] [?], disease of the lung, headache, and disease of the heart. And Mars — through fevers and pain of the kidneys. And Venus — through [disease of] the stomach (אצטומכא [Greek: στόμαχος, "stomach"]) and the liver and the rest of the [body] [?]. And Mercury — through fits of madness.

This is seen [as follows]: that the two maleficents be upon the place of death, or that they be in those places, or upon the setting [?], or that one of them be lord over one of the two luminaries, or that the configuration indicate it — as Saturn, when it is upon the degree of the Sun [in a fixed sign] [?], indicates [death] by stoning (סקילה), and by strangling (חנק), and by [?]. You must also consider the nature of the [governing] degree, whether it be fire or water or enemies; reckon accordingly and form your judgment; and likewise pronounce concerning [the manner of death] according to the nature and disposition of the sign.

Afterward he divided the years of the native in this way. The first [period] takes its turn over the native from when he is born until the end of four years [ארבע שנים] — [this is] the Moon's (לבנה). After it, Mercury (כולב), ten years [עשר שנים]. After it, Venus (נולה), eight years [שמונה שנים]. After it, the Sun (שמש), nineteen years [י״ט]. After it, Mars (מאלים), fifteen years [ט״ו]. After it, Jupiter (צלק), twelve years [י״ב].

[Later hand: "213" — pencil foliation, lower-right of the verso.]

[Conclusion of Ptolemy's *Tetrabiblos*: the ages of man]

and after it comes Saturn [שבתי], to the end of one's life; for just as it is the [coldest?] and the [outermost?] of the spheres [?], [so too old age is a time of rest and stillness].

In the years of Mercury [כולב] his motion grows strong, and he comes to understanding and insight. In the years of Venus [נוגה] he ripens [?]. In the years of the Sun [חמה] [?] and sustenance [והמחיה]. In the years of Mars [מאדים], for striving and for encounter [?]. And in the years of Jupiter [צלק], to perform [good] deeds, to acquire honor and [?].

[?] one ought to apportion the portions in a single manner, as has been transmitted:

- First, the term [שירות] of the Moon corresponds to the days of its cycle: months, [numeral: ?]; and after it,
- the term of Mercury [כולב] corresponds to the months of its cycle: [numeral: ?]; and after it,
- the term of the Sun [חמה]: its least measure, [numeral: ?] years and a half — the whole amounting to twenty-two [כב = 22?] years; and after that,
- the term of Venus [נוגה]: eighteen [שמנה עשר]; and after that,
- Mars [מאדים]: fifteen [טו]; and after it,
- Jupiter [צלק]: twelve [יב]; and after it,
- Saturn [שבתי]: until the end.

This division is correct and fitting to the order of nature, like the years of [?].

For nursing [היניקה] is nothing but twenty-four months, or close to it — as our Rabbis said: a nursing infant continues to nurse for twenty-four months [cf. Ketubbot 60a: תינוק יונק והולך עד כ"ד חדש]. And after that, until thirteen years, he understands, gains reason, and knows [the difference] between good and evil — and it is Mercury [כוכב] that governs this; therefore they become obligated in the commandments, as they said: "At thirteen years, for the commandments" [Avot 5:21: בן שלש עשרה למצות]. And afterward he is to occupy himself with the affairs of his life [?].

[?] as is fitting for him. And what is proper is to give precedence [in the ordering] of our life, as they said in Tractate [Nedarim?] [במסכת ?]: "Who is the man that has built a new house..." [Deuteronomy 20:5], "who has planted a vineyard, etc.," and afterward "who has betrothed a wife, etc." [Deuteronomy 20:6–7] — and in

this same order they [ruled; cf. Sotah 44a]. Our Rabbis further said [that a father is obligated] to teach him Torah, and to teach him the [beliefs / articles of faith] [אמונות?], and to marry him off to a wife [cf. Kiddushin 29a].

[Colophon:] חזק — Be strong. Blessed is the Lord forever [ברוך ה' לעולם], Amen and Amen [אמן ואמן; cf. Tehillim 89:53].

Amen and Amen.

[Scribal flourish beneath the colophon.]

זה השער בפירוש האותיות — This is the Gate on the Explanation of the [Hebrew] Letters

[Decorated display heading, opening the first of the appended short treatises — a mystical treatise on the significance of the Hebrew letters. The heading reads **זה השער בפירוש האותיות**, "This is the Gate concerning the explanation of the letters"; the middle word (בפירוש, "the explanation") is slightly abraded but pinned by the treatise's subject.]

[The body of this leaf is written in a paler, lower-contrast ink than the facing page; the same clean hand remains, but continuous reading is genuinely impeded by the fading. The secure anchors are committed below and the faded connective prose is flagged.]

[?] a whole [?] [Jacob?] [?]. [?] to say [?] in Your one Name [?]; and we ought to say [?].

[?] their service [שירותהן], their works, and their beliefs [ומעשיהן ואמונתן]; and likewise we hold [ואנו סוברין] [?] as [they said] [?] — for how is it possible for there to be [?] and a sphere [וכדור] without [?]. [?] And further, the service [?] [is] over the living creatures [?], "the host of God" [צבא אלהים]; [?] to the LORD without [?]. And further, we add [ועוד שאנו מוסיפין] [?] the mysteries of holiness [סתרי הקדש], [?] as it is said, "in all My house he is faithful" [בכל ביתי נאמן הוא — Bamidbar 12:7, said of Moses]; [?] "[mouth to] mouth I speak with him" [cf. פה אל פה אדבר בו — Bamidbar 12:8] [?].

[?] and it recurs in Scripture, as was written [?] in its place [?]; [?] as it is said, written in Kohelet [כתוב בקהלת] [?]. [?] to teach [?] that [?] he who wrote for him [?] — there is none to hear [?] his Torah [תורתו] and his deed [ומעשו] [?].

[?] to unite [ליחד?] [?]; no man is found [?] in strength [בכח], and if [?] in Sheol [בשאול] [?]; and we heard [?] to write here [לכתוב כאן] this matter [?] — [?] from a

drop of water [מטפה מן מים], and the frost [והכפור], and the metal [והמתכת] [?], and it is reckoned among the [nations / peoples] [?].

[?] For the cycles [המחזורות] are twenty-seven [27 = עשרים ושבע?] [?]; and how many [are the] services [?], and they [?]. The fixed service [?] of the others is forever [?]; the upper [sphere] [העליון] [?] — the rest, their service is for the sphere [לגלגל], and they are with them; and the Moon [והלבנה] is the tenth [העשירי], encompassing them [מקיפתן]. And there remains still [ונשאר עוד] [?] the whole, twenty-seven [27?], complete, for the sphere. And he said: the total [סך?] is for the upper sphere [לגלגל העליון] [?] — [?] and strange sayings [ומאמרים מוזרות?]; and this is what rouses [attention] [?], etc. [וכו']

[Pencil foliation reading approximately "214" in the lower outer corner of the left-hand page.]

[Foliation: "9" in pencil, upper-left corner of the recto — a modern hand.]

(Continuation and conclusion of the appended treatise — שער בפירוש האותיות, "The Gate on the Explanation of the Letters," which expounds the Hebrew letters against the celestial hosts, spheres, and constellations. This recto is the last written page of the manuscript; the facing leaf is a blank end flyleaf. The leaf is water-stained and the iron-gall ink has faded, so the connective prose between the legible content-anchors is at the legibility floor in places. Words read with confidence are committed; spans that are genuinely effaced are flagged rather than reconstructed, since the argument is allusive and must not be filled in.)

as we have explained [?] … just as the angel [?] … the portion (החלק), and the greater part (הרוב) is [?] …

the form (צורת) [?] … and [?] the portion, and many (רבים) of them [?] the hosts (צבאות), and not [?] …

so too [?] in themselves (בעצמם), just as they [are] [?] … and [?] the rest [?] …

and the hosts (הצבאות) of the spheres (הגלגלים) [?] … to the upper sphere (לגלגל העליון) [?] …

[Enlarged initial opening a new paragraph — the letter is stained: [?].] … so it [?] does [?] to that [?] … in its portions (בחלקיו) [?] … just as they are [?] in the spheres [?] …

[that which] moves of itself (מתנועע מעצמו), and [?] the stars (הכוכבים) [?] are maintained (מקוימין) [?] … the whole (הכל) [?] …

that distance (אותו הריחוק) which [?] [it requires] [?], and it will not [?] … indeed (אף) [?] …

all of them together (כולם יחד), its motion (תנועתו) [?] … in the time (בזמן) of the motion (התנועה) [?] … the whole [?] …

and all the stars (וכל הכוכבים) persist / are fixed (קיימין), a division (מחלוקת) between the [?] … its name (שמו) [?] …

the [?] … [?] … its form (צורתו?) [?] … [as a servant / a servitor] (כרבניקן?) [?] to the sphere [?] …

and [?] [it moves] [?] … and the stars (הכוכבים) [?] the whole (הכל) [?] …

those stars (הכוכבים), and their distance (הריחוק) [?] … and not (ולא) [?] … [?] …

like [?] and together with its motion (עם תנועתו) [?] … [?] and just as they [are] [?] the true motion (התנועה) [?] … from [?] to [?] …

the work of [?] (מעשה) [?] the host of heaven (צבא השמים) [?] … and just as their hosts are [?] (וכמו שהם צבאותהן) [?] their [?] …

so [too] the [?] [?] the sphere (הגלגל), the Holy One, blessed be He (הקב״ה), over all (על כל) [?] the world (העולם) [?] …

and there is an allusion (רמז) to this matter in the verse (בפסוק), "Ki [כי] …" [the quoted verse continues but is effaced — [Lacuna: quoted scriptural verse effaced]] …

and just as their hosts (צבאותהן) [?] … and [?] the figures / images (הצלמים / הצורות) [?] …

[several words illegible] … the Holy One, blessed be He [?] … [?] …

[A darkened / possibly rubricated word stands at the head of the line here — it may be a proper name or a paragraph opener, but it cannot be read with confidence: [?].] … as [?] … [?] each one [?] …

many (רבים) [?] … [?] and not (ולא) [?] …

these (אלה) [?] the words / matters (הדברים) [?] … [?] …

[Final ~2 lines of the recto (top of the lowest strip): only stray strokes of ink survive against the water stain — a closing sentence or colophon may have stood here but cannot be recovered. [Illegible: foot of the recto effaced, ~2 lines].]

[End of the written text. The treatise — and with it the written portion of the manuscript — concludes on this leaf. No legible colophon (נשלם / תם formula) survives.]

[Librarian note: "Ms. Parm. 2769" with "A I" alongside, in pencil at the foot of the blank end flyleaf.]

This leaf is a blank end flyleaf. The parchment/paper is clean apart from foxing spots and faint show-through/offset from adjacent leaves; no primary ink text, no colophon, and no manuscript body content is present. The dark bars at the head and foot of the image are the black-felt cradle/weight and the exposed edge of the book-block and binding board.

[Inside back cover / pastedown and final flyleaf]

This is the rear of the binding — the red (leather-covered) board edge is visible along the gutter, with the final flyleaf lying over the pastedown. No manuscript text; the marks present are later cataloguer's/librarian's annotations, transcribed below.

[Librarian note: "1122" — pencil, upper center of the leaf. (A catalogue or inventory number.)]

[Librarian note: "Comment. d' Aristotel[e]" [?] — pencil, faint, center of the leaf. Latin/Italian, "Commentary on Aristotle" — a cataloguer's description of the contents. Final letters abraded; reading uncertain.]

[Librarian note: "cod. 12[?]" — brown ink, lower left. A shelfmark ("codex 12…"); the final digit(s) are abraded and not securely legible.]

The faint curved and blotted marks elsewhere on both leaves are offset/show-through and stains, not text.

** (recto / final flyleaf).** A blank cream-colored paper flyleaf, entirely unwritten. No text, ruling, stamp, or annotation appears on the leaf itself. At the top of the frame, above the leaf, the binding is visible: a black cloth spine edge and the exposed board/cover, resting on the grey photographic backing surface. Faint blue marks at the extreme top-left and top-right of the frame lie on the imaging table's backing sheet (they read mirror-reversed), not on the manuscript, and carry no manuscript content.

** (verso / pastedown against the back board).** A blank cream-colored paper flyleaf lying against the inside of the back cover. No text, shelfmark, label, or cataloguer's note appears on the leaf. The binding is visible around the leaf: the

red-tinted edge of the cover board frames the leaf on the left and bottom, with the black cloth of the spine/cover and the grey photographic backing behind. Faint blue marks along the left edge of the frame are on the imaging backing surface, not on the manuscript, and carry no legible manuscript text.

No shelfmark, spine label, or library stamp is legible on either page.

[Back matter — end of manuscript.]

rear flyleaf

A blank cream-colored paper flyleaf, recto facing the camera. No text, no ruling, no marks. Along the top and bottom edges the dark binding boards and the gray photographic backdrop are visible; the brown leather turn-in of the cover shows at the right (fore-edge) margin and lower edge.

inside back cover (rear pastedown)

The inside of the back board. A red-brown (russet) leather-covered board with a cream paper pastedown, on which three printed library labels are pasted in the upper-left corner. The remainder of the pastedown is blank.

[Librarian note: printed shelfmark label, ornamental engraved border. Verbatim: "II. V. 103. Mss." — with the number "2769" added by hand in red ink beneath the "V."]

[Librarian note: printed library ownership label, ornamental border. Verbatim: "BIBLIOTHECA REGIA PARMENSIS" (Royal Library of Parma). Faint pencil "2769" shows through/beneath.]

[Librarian note: printed bookplate, ruled border. Verbatim: "EX BIBLIOTHECA JOH. BERN. DE-ROSSI LING. OR. PROF." (From the library of Johann Bernhard de Rossi, Professor of Oriental Languages). A faint pencil "2769" appears at the top inner corner of this label.]

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