

## NEWLY DISCOVERED ILLUSTRATED TEXTS OF ARATUS AND ERATOSTHENES WITHIN CODEX CLIMACI RESCRIPTUS\*

### ABSTRACT

*This article presents texts recovered by post-processing of multispectral images from the fifth- or sixth-century underwriting of the palimpsest Codex Climaci Rescriptus. Texts identified include the Anonymous II Proemium to Aratus' Phaenomena, parts of Eratosthenes' Catasterisms, Aratus' Phaenomena lines 71–4 and 282–99 and previously unknown text, including some of the earliest astronomical measurements to survive in any Greek manuscript. Codex Climaci Rescriptus also contains at least three astronomical drawings. These appear to form part of an illustrated manuscript, with considerable textual value not merely on the basis of its age but also of its readings. The manuscript undertexts show significant overlap with the  $\Phi$  Edition, postulated as ancestor of the various Latin Aratea.*

**Keywords:** Aratus; *Catasterisms*; Codex Climaci Rescriptus; Eratosthenes; palimpsest

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## INTRODUCTION

This article presents an initial edition of Greek astronomical texts associated with Aratus and Eratosthenes which have been found since 2012 in the underwriting of a palimpsest. The underwriting appears to date from the fifth or sixth century A.D. and extends across nine folios of Codex Climaci Rescriptus (hereafter CCR). CCR consists of 146 folios, and takes its name from John Climacus, Abbot of the Convent of St Catherine on Sinai, whose *Scala Paradisi* and *Liber ad Pastorem*, translated into Syriac, constitute the overtext. This palimpsest came into the possession of A.S. Lewis between 1895, when one folio was purchased at Cairo, and April 1906, when forty-eight were purchased at Port Tewfik.<sup>1</sup> Another eighty-eight folios were received by Lewis from an unidentified ‘Berlin scholar’ in October 1905.<sup>2</sup> One folio is in the Mingana Collection in Birmingham,<sup>3</sup> and eight remain in the Convent of St Catherine.<sup>4</sup>

Of the 146 folios, 109 (including the Birmingham and St Catherine’s folios) have as their undertext Christian Palestinian Aramaic theological material, especially translations of the Old and New Testaments, while 27 contain as their undertext Greek biblical texts.<sup>5</sup> Folio 55 appears blank. This article is about the remaining nine folios (47–54 and 64), which have long been known or suspected to contain Greek undertext, but which defied decipherment before the advent of more recent multispectral imaging techniques.

The Convent of St Catherine is the presumed source of CCR. Lewis bought manuscripts in Egypt, Sinai and Palestine, and Alphonse Mingana bought manuscripts in Egypt, Sinai, Palestine and Syria. The discovery of eight folios of CCR at the Convent of St Catherine among the New Finds of 1975 (catalogued as Syriac NF 38) confirms that part of the codex resided at the Convent before coming to the attention of scholars in the west.

## DECIPHERMENT

Lewis gave her folios to Westminster College, Cambridge, and these were put up for sale by the College at Sotheby’s in 2009. After initially failing to sell, they were purchased by the Green Collection in 2010 and donated from the Green Collection to Museum of the Bible, Washington, DC, in 2012, where they form MS.000149. In 2012 Tyndale House, Cambridge was invited to take responsibility for publication of the underwriting, with the encouragement to engage students in the process of

<sup>1</sup> For an account of how the manuscript came into the possession of Lewis, see A.S. Lewis, *Codex Climaci Rescriptus* (Cambridge, 1909), xi–xii.

<sup>2</sup> For speculation as to the identity of this scholar, see I.A. Moir, *Codex Climaci Rescriptus Graecus* (Cambridge, 1956), 3 n. 2. J. Soskice, *Sisters of Sinai* (London, 2009), 285 refers to the purchase of a Syriac palimpsest at Port Tewfik in April 1906, which, Lewis realized, was ‘the remainder of a manuscript she had recently purchased from a dealer in England’. Lewis herself ([n. 1], xi, xii), refers to ‘a foreign scholar ... in October 1905’ and then to the portion of the manuscript which had come to her ‘by way of Berlin’.

<sup>3</sup> Mingana Collection, MSyr637.

<sup>4</sup> For the eight folios of CCR at St Catherine’s, see <https://sinai.library.ulca.edu> and C. Müller-Kessler, ‘The missing quire of the Codex Climaci Rescriptus containing 1–2 Corinthians in Christian Palestinian Aramaic (Sinai, Syriac NF 38)’, in J. Gruskova, G. Kessel, G. Rossetto and C. Rapp (edd.), *New Light on Old Manuscripts: Recent Advances in Palimpsest Studies* (Vienna, forthcoming 2022 [not seen]).

<sup>5</sup> From Joshua (folio 5), Psalms (folios 26 and 27) and the Gospels (folios 65–72 and 81–96).

researching the multispectral images. At that time the palimpsest was believed to contain only theological texts in Greek and Christian Palestinian Aramaic. Undergraduate students were engaged in this research during university vacations from 2012 to 2017. In July 2012, Klair, then a University of Cambridge undergraduate, discerned in the underwriting of folio 48 recto, column ii lines 4–6, the sequence of words ἀβ|τὸν τεθῆναι ὅτε | εἰς Νόξον. He identified the text through the *Thesaurus Linguae Graecae* as part of *Scholium in Aratum* 73.<sup>6</sup> This discovery led to the identification of further astronomical material by students over the succeeding years. In March and July 2017 the Early Manuscripts Electronic Library (EMEL) and the Lazarus Project undertook new spectral imaging of the manuscript.<sup>7</sup> In Tyndale House in May 2018 a residential week of collaboration between textual scholars and imaging scholars from EMEL, the Lazarus Project at the University of Rochester, New York,<sup>8</sup> and the Rochester Institute of Technology led to further breakthroughs in identifying text and images, since image processors were guided by textual scholars to develop optimal algorithms for recovery of erased ink from particular parts of specific pages.<sup>9</sup> As the last of the ten groups of undertext within CCR to be deciphered, the astronomical texts are known as CCR10, when it is necessary to distinguish them from other groups of underwriting.

#### CODICOLOGY

The non-biblical Greek content in the undertext of CCR occupies folios 47–54 (which are currently bound as a single quire) and folio 64. Conjugate folios are 47 with 54, 48 with 53, 49 with 52, and 50 with 51. Together these form quire 7 of CCR. Folio 55 (seemingly without underwriting, though probably ruled) along with folio 64 functioned as the outermost leaves or fifth bifolium of quire 8, which otherwise consists of folios 56–63, all of which have Christian Palestinian Aramaic undertext. Folios 55 and 64 are isolated leaves which probably did not form a single bifolium of the undertext.<sup>10</sup> The layout is shown in Diagram 1 below.

The central sheet of quire 7, namely folios 50 and 51, contains a continuous Greek text of the anonymous Proemium II to Aratus sections 1–6 in the sequence 51r, 51v, 50r and 50v. Therefore, this sheet must also have been the central sheet of a quire in a codex that was recycled to make CCR, and it is clear that the sheet not only was rotated prior to reuse but was also turned over. The hair and flesh sides were identified through autopsy by P.M. Head: the hair sides are (working from the centre of quire 7) 51r with 50v, 52v with 49r, 53r with 48v, and 54r with 47v, along with 55r and 64v from quire 8.

Folios 49, 50, 51 and 52 were rotated 180° for reuse such that the Greek undertext is upside down in relation to the Syriac overtext.

<sup>6</sup> This was later recognized to come from Eratosthenes' [*Cat.*] 5.

<sup>7</sup> <http://emelibrary.org>.

<sup>8</sup> <http://www.lazarusprojectimaging.com>.

<sup>9</sup> An overview of processing methods is given in R.L. Easton, Jr. and D. Kelbe, 'Statistical processing of spectral imagery to recover writings from erased or damaged manuscripts', *Manuscript Cultures* 7 (2014), 35–46.

<sup>10</sup> The edges of folios 55 and 64 do not match, and a strip of material missing from the inner edge of folio 55 appears to match the material stuck in the blue stitching at the end of quire 7 (folio 54). Folio 64 seems to be complete on its inner edge, except for a piece missing near the top. Whether that edge matches the edge of 55, which seems to be stuck in the blue thread on top of folio 54, remains inconclusive. The fact that folio 64 has text but none has yet been detected in folio 55 may be a further reason to doubt the connection between these two folios.

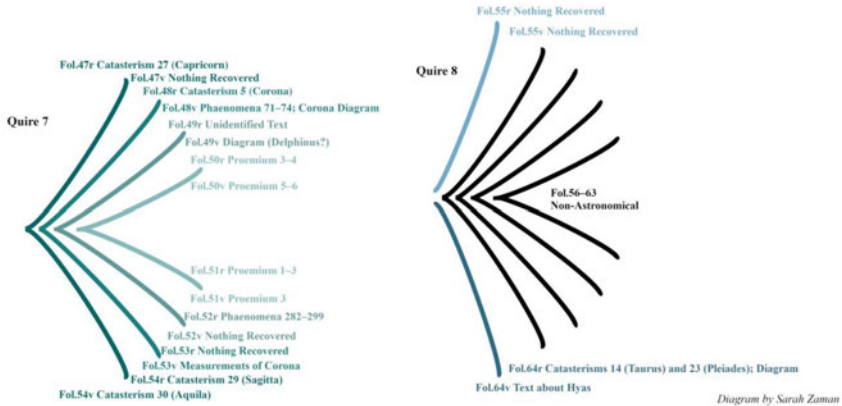


DIAGRAM 1: Quire Structure of the Astronomical Leaves within CCR

Moir reported that ‘The average size of the sheets is now about 23 or 24 cm. × 18 or 19 cm. or 9¼ × 7½ in., but there is evidence that at least some parts of the MS. were upwards of an inch longer and also broader and that they have been trimmed to suit the present format.’<sup>11</sup> Several folios have lost not only their outer margin but even some of their undertext as a result of this trimming (for instance both 48v and 52r have lost the ends of their hexameters).

Other than Aratus’ hexameters, which are laid out in a single column, texts are laid out in two columns of twenty-six lines, most commonly with thirteen or fourteen letters per line.

#### DATE

Lewis writes: ‘The upper-script is in Edessene Syriac, in a hand which has been ascribed by the Rev. G. Margoliouth and Mr A.G. Ellis, of the British Museum, to the beginning of the ninth century.’<sup>12</sup> In contrast to this, Mingana, who considered only Mingana Collection MSyr637, dated the upper writing to ‘about A.D. 1100’.<sup>13</sup> J.F. Coakley has noted analogies between the upper script and the writing of British Library Add. Ms. 17,194, dated to A.D. 885–886.<sup>14</sup> Samples from three folios of CCR (folios 10, 52, 122) were sent for radiocarbon dating. The result for folio 52, the only leaf containing astronomical text to be dated, is shown in the table below, followed by the results of folios 10 and 122 for comparison.<sup>15</sup>

<sup>11</sup> Moir (n. 2), 4–5. Lewis (n. 1), xvi reported the measurements as ‘nearly 23 cm. by 18½’.

<sup>12</sup> Lewis (n. 1), xi.

<sup>13</sup> A. Mingana, *Catalogue of the Mingana Collection of Manuscripts now in the Possession of the Trustees of the Woodbrooke Settlement, Selly Oak, Birmingham. Vol. III: Additional Christian Arabic and Syriac Manuscripts* (Cambridge, 1939), 78.

<sup>14</sup> Coakley email to Williams, 21 December 2020. See W.H.P. Hatch, *An Album of Dated Syriac Manuscripts* (Boston, 1946), pl. CX.

<sup>15</sup> Calendar ranges reflect the latest radiocarbon calibration curve, IntCal20, the ‘translation guide’ for converting carbon quantities into years. The table was updated in March 2021 by J. Dru when reviewing this account Dru provided to Williams as Museum of the Bible curator in August 2014: ‘A sample from fol. 52 of the CCR was taken from [a photographed] area where there was a pre-existing tear in the parchment. Relative to the Syriac text, the sample was located along the bottom margin, at the outer corner: lower left on recto, lower right on verso. The sample measured approximately 50 mm<sup>2</sup> (13 mm wide × 2-to-6 mm high). This sample was taken [in Oklahoma City] by

Table 1

CCR sample from	Likely calendar age of parchment: 95.4% probability (68.3% in brackets)	Fraction of Modern Carbon detected in sample
fol. 52	A.D. 436–569 (especially 443–560)	0.8241 ± 0.0012
fol. 10	A.D. 442–580 (especially 542–564)	0.8255 ± 0.0011
fol. 122	A.D. 551–602 (especially 565–595)	0.8295 ± 0.0015

Though the sloping ogival majuscule hand of the undertext permits a wider range of dates, a date from the mid fifth to the mid sixth centuries is not in conflict with any obvious palaeographical data.<sup>16</sup>

## CONTENTS

Nine folios contain or share a bifolium with astronomical material, while a tenth (folio 55) is merely physically associated with these by its current placement in the manuscript. Five pages (47r, 48r, 54r, 54v, 64r) contain several of the *Catasterisms* that were attributed to Eratosthenes, and a further page (64v) contains the same type of material, albeit previously unknown in Greek. Three pages (48v, 49v, 64r) contain diagrams or drawings. Two folios certainly (48r and 53v) and probably a third (54v) contain astronomical measurements. Four hair sides (47v, 49r, 52v, 53r) as well as the isolated but codicologically associated folio 55 have not yet revealed either identifiable word sequences or indications that diagrams were once present.<sup>17</sup> Folio 48 shows that the manuscript integrates the text of the *Phaenomena* with *Catasterisms* and illustrations. The manuscript thus appears to belong to the family of the  $\Phi$  Edition which Martin posited.<sup>18</sup> The contents in their current order are shown in the following table.

Clifford Keister, Museum of the Bible Project Manager, on 16 July 2013, and sent that same day to the Geochronology Laboratory of Illinois State Geological Survey at the University of Illinois at Urbana-Champaign. The scientists at Illinois prepared the sample and then, following their usual procedure, sent the CO<sub>2</sub> to the W.M. Keck Carbon Cycle Accelerator Mass Spectrometry Laboratory at the University of California, Irvine, for radiocarbon testing using the AMS equipment there. The director of the Illinois lab reported the results to Keister on 7 August 2013. The lab report identified the carbon content of this parchment as 0.8241 [ $\pm$  0.0012] fraction of MC [Modern Carbon], or 1555  $\pm$  15 <sup>14</sup>C years BP.' Dru summarizes: 'Radiocarbon analysis suggests that mid/late sixth century is the most likely period of origin for all three samples of parchment, though the material for fol. 52 might also be from mid/late fifth century.'

<sup>16</sup> On this type of script, see especially P. Orsini, 'La maiuscola ogivale inclinata: contributo preliminare', *Scripta* 9 (2016), 89–116; G. Cavallo and H. Maehler, *Greek Bookhands of the Early Byzantine Period, A.D. 300–800* (London, 1987), 4, 38–9, 42–3, 64–5, 86–7, 90–1.

<sup>17</sup> For previous discussion of how many pages lacked writing, see Lewis (n. 1), xi; Moir (n. 2), 5 n. 2.

<sup>18</sup> J. Martin, *Histoire du texte des Phénomènes d'Aratos* (Paris, 1956), 69–72.

Table 2

<i>Folio</i>	<i>Content</i>	<i>Text identified by</i>
47r	Eratosth. [ <i>Cat.</i> ] 27	Madin
47v	No continuous text recovered	
48r	Eratosth. [ <i>Cat.</i> ] 5	Klair
48v	Aratus, <i>Phaen.</i> 71–4 followed by circular diagram	James
49r	No continuous text recovered	
49v	Diagram of marine creature	James
50r	Proemium, Anonymous II, sections 3–4	Klair
50v	Proemium, Anonymous II, sections 5–6	Klair
51r	Proemium, Anonymous II, sections 1–3	Darley
51v	Proemium, Anonymous II, section 3	Burke
52r	Aratus, <i>Phaen.</i> 282–99	Klair
52v	Nothing recovered	
53r	Nothing recovered	
53v	Astronomical measurements	Gysembergh, Williams, Zaman, Zingg
54r	Eratosth. [ <i>Cat.</i> ] 29	James and Williams
54v	Eratosth. [ <i>Cat.</i> ] 30	Klair
55r	Nothing recovered	
55v	Nothing recovered	
64v	Text about Hyas	James, Williams, Zaman
64r	Eratosth. [ <i>Cat.</i> ] 14, 23 and a diagram	Darley and Burke

Our provisional reconstruction of the quires of the original astronomical manuscript is given in Diagram 2.

### TRANSCRIPTIONS

The erasure of the undertext of this part of the codex was generally more thorough than for other parts.<sup>19</sup> Much of the undertext of this palimpsest is not legible, either being obscured by the overtext or, more frequently, because the undertext was erased so thoroughly. Since the transcriptions are based on study of various multispectral images, letters that are legible in one image may be invisible in another which in turn does not show the letters visible in the first image. Underdots have been reserved for letters that are uncertain, substantially obscured or lost; square brackets [ ] are used for breaks in the parchment and angle brackets < > for modern editorial additions. Round brackets ( ) enclose text which has been editorially restored using space calculations, and not in response to visible remains of letters. Text within such brackets must be regarded as particularly uncertain when it covers more than several letters, since within this

<sup>19</sup> Moir (n. 2), 5: 'Except in the case of foll. 47–55, the process employed to remove the underwriting was not a very thorough one and the writing can be deciphered with a large measure of certainty by the aid of ultra-violet light.'

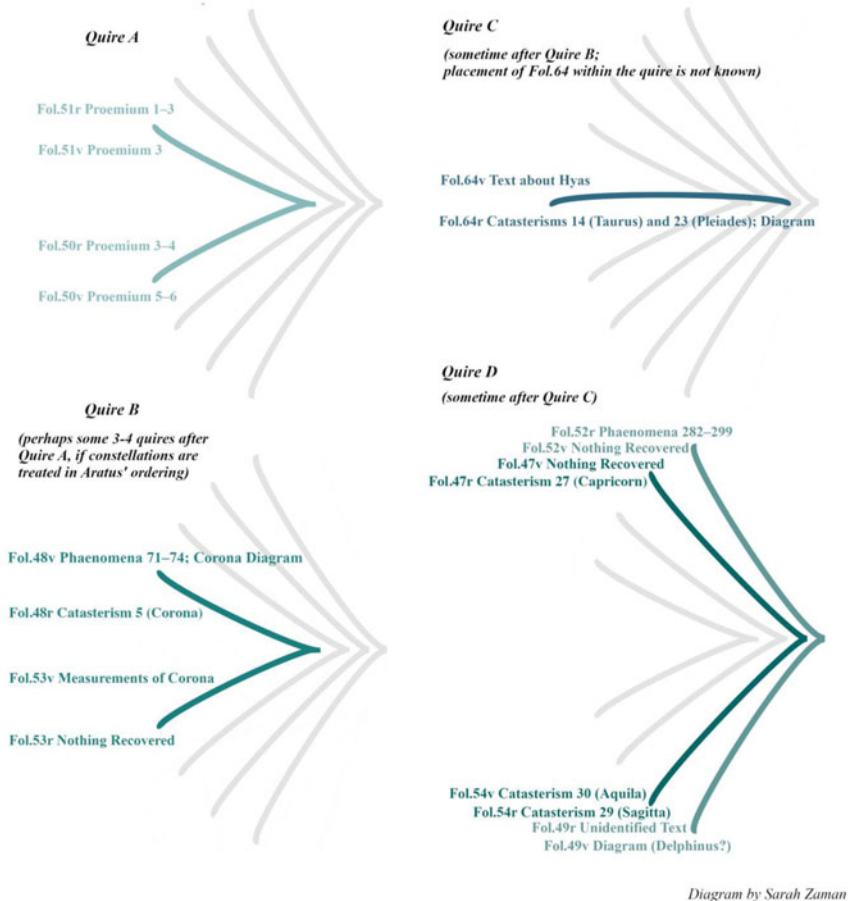


DIAGRAM 2: Proposed Quire Structure of Original Astronomical Codex

manuscript letter size and spacing vary as does the number of letters per line. Round brackets also enclose modern section and line numbers. Where text is recorded as undeciphered, individual letters and words may have been read, but extended sequences have not been read with confidence. Except where specifically noted, all breathings, accents, apostrophes and most spaces between words are editorial, while any punctuation outside of round brackets is from the manuscript—though judgements about the presence of punctuation are often uncertain within a palimpsest. Absence of punctuation in the transcription should not be taken as an indication of its absence in the manuscript. Diaeresis, other than in restored sections, is from the manuscript, and its representation is given priority over accents and breathings. CCR often uses ε for αι—for example 64r λέγοντε (i 7), καλίτε (ii 4), ὀρώντε (ii 4-5), λέγετε (ii 9-10) and μιγῆνε (ii 11 and 13-4)—and these and other non-standard spellings are preserved in our transcriptions. Iota adscript is generally used in CCR, but only occurs at the end of words. Capitalization represents enlarged letters in the manuscript, and has otherwise

been avoided in the transcriptions, in order better to highlight the enlarged letters. Opening letters of paragraphs or columns are generally enlarged, though the degree of enlargement varies. Columns mostly begin with ekthesis. In the manuscript Greek letters used as numbers have overlines, and overlines have been editorially restored in some cases of presumed numbers. Discussion has been ordered by bifolia in the presumed order in which their first text occurred in the original manuscript.

Select images of the relevant pages of the manuscript are available at [motb.me/codex-climaci-rescriptus](http://motb.me/codex-climaci-rescriptus) and <https://tyndalehouse.com/CCRimages>.

### FOLIOS 51 AND 50: ANONYMOUS II PROEMIUM TO ARATUS

Folios 51 and 50 contain sections 1–6 of the Anonymous Proemium II to Aratus, deciphered in reliance on the edition of Maass,<sup>20</sup> who dated this Proemium to the sixth century A.D. or earlier.<sup>21</sup> Based on the radiocarbon date for folio 52, the sixth century should be taken as the latest possible date for this material. Folios 51 and 50 present the longest sections of continuous text recovered from CCR. A number of readings particularly agree with witness group Λ, or with a significant number of its members: 51r i 18–19 κάτω ἐπί; ii 20 καί; ii 22–4 omission of ἐπεὶ προεῖρηται μὲν ἔχων; 51v ii 6–7 omission of κατητέριται before κρατήρ; ii 14 ἐκτός; ii 21 omission of τε καί; ii 22 omission of ὑάδες; 50r i 18 τούτων ἐξήγησιν; i 21–2 περιελθόν; 50v ii 2 ἀτάκτως; ii 8 presumed omission of μέσων before ἀγκῶνα on grounds of space.

#### *Folio 51 recto*

Some text from the right-hand side of column ii may have been lost through trimming but, because legibility decreases at the right margin, it has not always been possible to identify precisely where this has occurred. The title ending φαινόμενα ἀράτου, which other words may have preceded, was added in a later, less elegant, hand.

Table 3

	i	ii
	φαινόμεν(α) ἀράτου <i>uacat</i>	
1 (§1)	Τὴν μὲν δεῖξιν τῶ φαινομέγων (δέ)ογ ποιεῖσθε (πρὸς τῶι) νότῳι (ἀντίσθ εἶχον)	Νοῦντα αἰγὸ[κερῶ ἐπ(ὶ τοῦ χειμερι) γ(οῦ τροπικοῦ ἀνα) (τολικὸν κριὸν ἐπὶ)

<sup>20</sup> E. Maass, *Commentariorum in Aratum reliquiae* (Berlin, 1898), 102–26. Transcriptions of the main Aratus Latinus manuscripts are available at <https://aratea-digital.acdh.oeaw.ac.at/pages/toctranscriptions.html>. For the textual history of this section, see Martin (n. 18), 116–25.

<sup>21</sup> Maass (n. 20), xxi.



5	τα τὰς ἄρκτους (δε) ξιάς τὰς ἀγ(ατολάς) εὐφῶν(ύμους δὲ τὰς) δύσεις· (ἡ δὲ φυσικὴ θέσις) τῆς σφαίρας τοῦ (κό)		(τοῦ ἡμερινοῦ δυτι) (κὰς χ)η(λάς δράκον) τ(οσ κεφαλὴν ἄνω) πρ(ὸς τῶι ὀρίζοντι) ἔπ(ου μίγονται)
10	μου ἐστὶν τοιαύτη ὥστ' ἔχ(ειν μεσουρα) νοῦντα καρκίον ἐπὶ τοῦ θερινοῦ τρο		δύσεις τε (καὶ ἄντο) λα(ὶ ἀλλήλησιν· ἔχει) δὲ (κ)α(ὶ πόλους δύο) ἀρκτικὸν (ὄλον) τοῦτον μετέωρον
15	λάς ἐπὶ τοῦ ἡμε ρινοῦ δυτικόν κρινὸν δράκοντος κεφαλὴν κάτω ἐπὶ ὀρίζοντι(·) περι		τὸν καὶ βόρειον λεγόμενον ἀ(νταρκτι) κὸν δὲ ἐν (τῶι) ἄ φανεῖ τὸν καὶ γό τιον λεγόμενον·
20 (§2)	έχεται δὲ ὑπὸ τοῦ ὀρίζοντος(·) ἡ δὲ κα τὰ τὴν ἐξήγησιν θέσις τῶν ἀράτου φαινομένων ἐ	(§3)	Ἔχει δὲ καὶ κύκλους μεγάλους μὲν τέσ σαρας χωρὶς τοῦ ὀ ρίζοντος μεσημ βρινὸν εἰσημερι νὸν ζωδιακὸν
25	στὶν τοιαύτη ὥστ' ἔχειν μεσουρα		Γαλαξίαν ἐλαχίστο<υ>σ

- i 8 The reconstructed line is unusually long, and could be shortened by omitting δέ.  
ii 2–14 The reconstruction of these lines is tentative. The assignment of text to lines often only illustrates a possibility.  
ii 26 The final three letters of the column are clearly τος, which we take to be in error. The ekthesis presumably is to mark the following content about the smaller circles beginning with ἐλαχίστο<υ>σ as a new unit.

*Folio 51 verso*

Table 4

i	ii
5	Ἰσον ἔχει τὸ ὑπ(ἐρ) γῆ καὶ τὸ (ὑπὸ γῆ) ἐφ' ᾧ(τι κατατέ)ρις ταὶ ζ(ώδια) uacat ἱβ̄· ἱπτος· ὀφιοῦχος ἐφ' ᾧ ἔφισ· ὕδρος ἐφ' ᾧ κρατήρ· κόραξ(·) προ κῶν· ἀετὸς(·) δελ) φίς· ὠρίων(·) οἰςτός· δελτωτὸν· ἄνδρο μέδα(·) λαγῶς(·) κῆ
10	

	δια ἡ βοώτης(·) κτέ φανός· ἐνγόνασι· καρσιέπεια· ἡνίο	τος· κύων· ὄστ' εἶναι τὰ πάντα ζώδια λ· τὸν ἀριθμὸν ἐκτός
15	χος· ὄρνις· περσεύς· Ὁ δὲ χειμερινός τρο πικὸς πλεῖον ἔχει τὸ ὑπὸ γῆν ἦσσον	τῶν ἐπισημῶν ἐν αὐτοῖς κατηγετρι μμένων ἀστέρων· οἶον ἐπὶ τοῦ βοῶ
20	δὲ τὸ ὑπὲρ γῆν ἐφ' ὦι κατηγετέριςται ζώ δια ἕ ἡριδανός· ἀρ γώ· <i>uacat</i> κένταυρος	τοῦ ἀρκτοῦρος· ἐπὶ τοῦ ἡνιόχου· αἴξ· ἔριφοι· ἐπὶ τοῦ
25	ἐφ' ὦι θηρίον· ἰχθύς μέγας νότιος ἀφα νής· <i>uacat</i> ὁ δὲ ἰση μερινός κύκλος	ταύρου· πλιάδες· ἐπὶ τῆς παρθένου· τάχους· προτρογη τήρ· ἐπὶ τοῦ κυνός· σεῖριος· καὶ εἴ τινα

- i 3–4 The spellings ζώδια and ζωδιακός without iota after the omega are consistently used in CCR, which only uses iota adscript at word endings.
- i 13–14 λύρα is omitted between ἐνγόνασι and καρσιέπεια.
- i 20 κατηγετέριςται or κατεκτήρικται.
- i 23 CCR's θηρίον appears haplographic alongside the traditional θηρίον, θυστήριον.
- ii 15 The reading ἐν rather than ἐπ' agrees with the correction in L<sup>II</sup>.
- ii 16–17 CCR exhibits an unparalleled word order: κατηγετριμμένων ἀστέρων. This phrase is not followed by eta (= 8) as in Maass's edition.

## Folio 50 recto

Table 5

	i	ii
	Τούτοις ὅμοια· <i>uacat</i> Ὁ δὲ ζωδιακὸς κύκλος ἔχει ζώδια ιβ̄ καρ κίνον· λέοντα· παρ θένον· χηλάς· σκορ πίον· τοξότην· αἰγόκερω· ὑδροχόον ἰχθύας· κριόν· ταῦρον· διδύμου(ς)· ὄστ' εἶναι τὰ πάν τα ζώδια ιβ̄· <i>uacat</i>	Νοσ ἀπὸ τοῦ ὀρίω νος ἐπιδή λαμπρός ἐστι οὗτος· τὰ δ' ἀπὸ τοῦ ζωδιακοῦ γότια πάντα κατα λέγ(εται μέχ)ρι τοῦ ἀγαρκτηκοῦ· εἰ (θ') οὔτω(ς) μέτεϊον ἐπὶ τὰ ἐξῆς· τούτ[ω οὖν οὔτω(ς) ἐ)χόντ[ω λοιπὸν μετ(α)β(α)τέσ (ἐ)πὶ (τοὺς τέμνο)ντας κύκλους καὶ τὰ τε μόμεγα ὑπ' αὐτῶ ζώδια· ὁμοίως δὲ ἐπὶ τε τὰς ὄυνανα
5	Εἰςὶ δὲ καὶ πλάνητες ἀστέρεις χωρὶς ἡλίου τε καὶ σεληνης	
10	ἕ· κρόνος· ζεύς· ἄρης· ἄρης· ἀφροδείτη·	
15		

(§4)	έρμης· <i>uacat</i> τὴν δὲ τούτων ἐξηγήσιν ἄρατος πεποιηται	τολάς καὶ τὰς συν καταδύεις αὐτῶν
20	ἀρξάμενος ἀπὸ τῶν ἄρκτων καὶ περι ελθὼν πάντα τὰ	ὅπως μὴδὲν ὑπο λίπωμεν τῶν πρ[ό]ς τὸν κατακτηρικ[ό]ν·
25	βόρεια κυκλόθεν μέχρι τοῦ ἀρκτικοῦ ζωδιακοῦ· εἶτα δὴ μεταβάς ζ ἀρξάμε	πλήν νοητέον τῶ το ὅτι κατὰ πλάτος ὁ ἄρατος τὸν περι αὐ τῶν λόγον πεποίη τε διὰ τοῦ ποιήμα

- i 5 With Aratus Latinus CCR lacks the gloss ὁ ἐστὶ ζυγός after *χηλάς*. Some of the other witnesses present such an explanation after *παρθένον*, but in different forms: *ζυγὸν χηλάς σκορπίου* (Λ) and *χηλάς ἄς ζυγὸν ὀνομάζουσιν* (A P).
- i 15–16 Dittography of ἄρης, possibly with the second ἄρης being replaced in correction by ὁ γ, with breathing, but without overline. There may be up to two additional letters at the end of i 16.
- i 24 The presence of ἀρκτικοῦ is unique to CCR.
- i 25 Agrees with A P in adding δὴ after εἶτα.
- i 26 ζ as an abbreviation for καί is an interpretation of a shape more like β, with a possible extension to the lower right.
- ii 2 CCR shows agreements with L<sup>II</sup>: ἐπ<ε>ιδή (with itacism, instead of ἐπεῖ) and οὔτοσ at ii 3.
- ii 16 The anomalous overline slightly precedes the second sigma.
- ii 17–18 For non-assimilation of συν- in συνκατάδυσσις, cf. 50v i 14 and ii 1–2.
- ii 21 CCR seems to have read not *κατακτηρικμόν* ‘instellation’, from *κατακτηρίζω*, but *κατακτηρικμόν* ‘establishment, installation’, as if from *κατακτηρίζω*.<sup>22</sup>

*Folio 50 verso*

Table 6

i	ii
(Τοσ μὴ πάντα ἀκριβῶς)	Ἀγατολάς τε καὶ σῦ
κατα(λεξάμε)νοσ	καταδύεις ἀτάκτως
ἄ(λλά τινσ παρσ)	(ὄν τρόπον) ἕξτιν
λιπ(ὄν) ἄπερ ἐπὶ τῆς	(ἐπὶ τῆς σφαιρίσ)

<sup>22</sup> See J. Pàmias and A. Zucker, *Ératosthène de Cyrène: Catastérismes* (Paris, 2013), lxxiv–lxxv.

5	ρφαίρα(ς θεωρεῖται) ἐ(γὼ δὲ τὰ παραλελειμ) μέννα ὑπ' αὐτοῦ προ(ς) ἀποδώσω ὅπως μῆ δὲν (ἐλλείπει τῶν)	(§6)	(θεάσασθαι) ὁ μὲν (ἀρκτικὸς κύκ)λος τέμ ν(ει) ζώδια (β) βοά του ἀγκῶνα κηφέ (ως κτήθη οὐκ εἴρηκε
10 (§5)	πρὸ(ς τὴν θεωρίαν) Ἐγγένο(ντο) δὲ τ(ρις) ρα(ἰ ττάσεις περι) κυνατολῶν καὶ κυκαταδύσεων·		δὲ π(ερί τούτου) ἄρατος· ὁ (δὲ θε)ρινὸς τρο (πικὸς τέμ)νει ζώδια ἤνιόχου γόνατα· ὀφιούχου ὄμους·
15	οἱ μὲν γὰρ ἐφασαν τὴν πραγματίαν γενέσθε τῷ ἀράτω ἀρχοντος ἀνατέλ λειν τοῦ ζωδίου·		ὄφως τράχλον· ὄρνιθος κεφαλήν κα(ἰ τὸ ὑπαυχένιον) ἵπτου ὀπλάς· περσέ ως ὦμον ἀριστεροῦ·
20	οἱ δὲ δὴ μεσοῦντος οἱ δὲ ἀπὸ τῆς ὅλης ἀνατολῆς· τοῦτο δ' οὐκ ἔστηκεν ἀπὸ γὰρ ἀρχῆς ἕως τε		κνήμην ἀνδρο μέδας· χεῖρα δεξιάν· διδύμων κεφαλάς· καρκίνον μέσον· λέοντα παράμεσον·
25	λευτῆς τοῦ ζωδίου διεξέρχετε τὰς εὐ		παρεῖται ὀφιούχου ὦμο(ς) ὄφως τρά

i 23 The smooth breathing on ἔστηκεν follows the clear use of οὐκ, not οὐχ.

i 26 διεξέρχεται in the sense 'recount' seems preferable to the reading ἔρχεται in other manuscripts.

ii 2 See 50r ii 18 for the spelling κυκαταδύσεις as a plural.

ii 6–7 Another possible reading is 6 (ἀρκτικὸς κύκλος) | 7 (τέμνει ζώδια) β βοά, treating the most prominent letter at the end of the line as sigma rather than tau, and holding the signs read as a small εμ as insignificant.

ii 26 The final three letters begin τράχλον. Indeed, further letters of τράχλον may be visible.

#### FOLIOS 48 AND 53: ARATUS, *PHAENOMENA* WITH DIAGRAM, AND *CATASTERISM*

*Folio 48 verso: Aratus, Phaen. 71–4 followed by circular diagram*

Four lines of text appear at the top of the page with a diagram underneath.<sup>23</sup> Lines 1–3 (*Phaen.* 71–3) are visible between the lines of oertext. However, line 4 (*Phaen.* 74) is almost entirely obscured by oertext. Its letters can therefore only be read tentatively, especially before the φ of κτέφανος. The right margin is lost. Statistical processing by Easton shows that the diagram consists of four concentric circles in two sets, which were made using drawing compasses. The radius of the outer circle is 46 mm, and of the others 43 mm, 33 mm and 31 mm. Since all texts on this bifolium concern

<sup>23</sup> D. Kidd, *Aratus Phaenomena* (Cambridge, 1997) was consulted for information about the witnesses for the *Phaenomena* of Aratus and as a base text for collation.

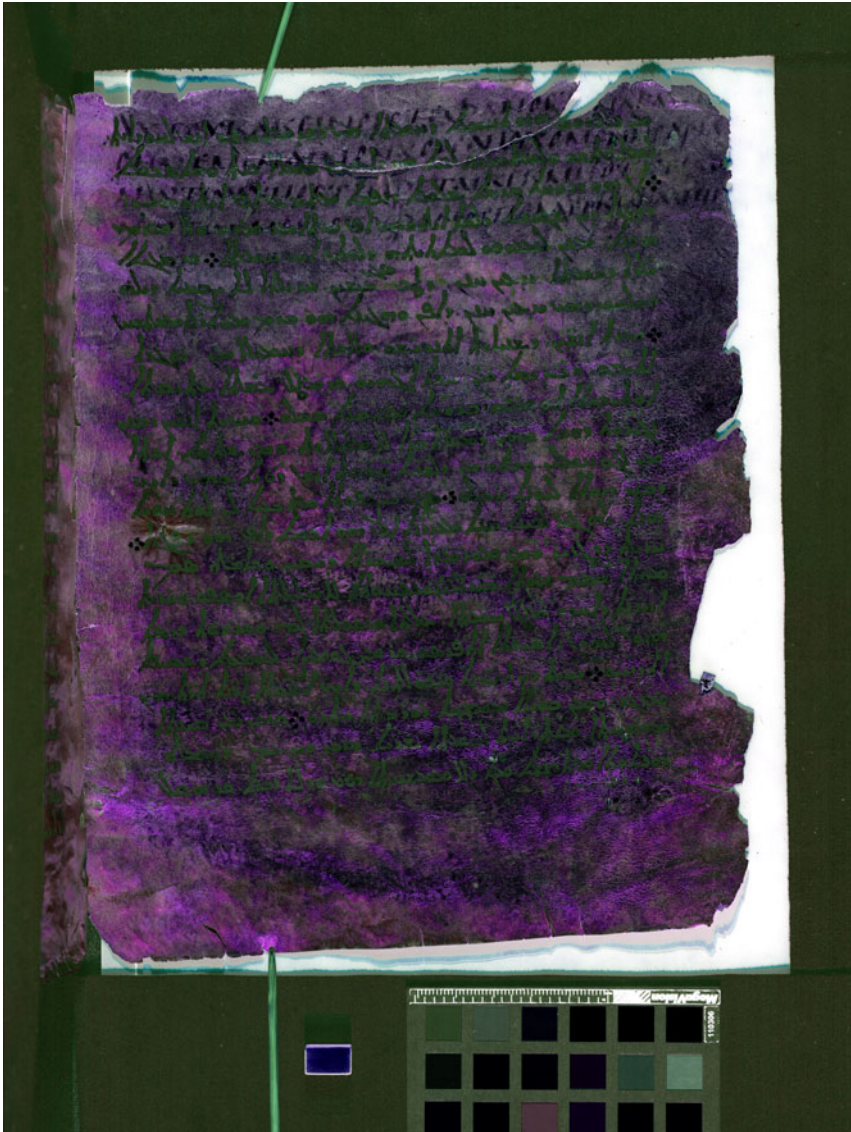


FIGURE 1 Courtesy Museum of the Bible Collection. © Museum of the Bible, 2021. Image shared under Creative Commons BY-SA 4.0 license, 2022. All conditions apply. Spectral imaging by the Early Manuscripts Electronic Library and the Lazarus Project of the University of Rochester. Image processing by Vasilis Kasotakis.

Corona Borealis, we interpret this as a depiction of that constellation.<sup>24</sup> The lines of the *Phaenomena* read thus:

<sup>24</sup> For analogies, see Klosterneuberg Codex 685 fol. 72v, Paris BnF Latinus 5239 fol. 216r, Paris BnF Latinus 5543 fol. 161r, Vaticanus Latinus 643 fol. 187v, Zwettl Codex 296 fol. 87r. All images are available at <https://www.thesaxlproject.com/assets/Uploads/De-signis-caeli.pdf>.

Table 7

(71)	Αὐτοῦ κάκεινος στέφανος τ[ὸ]ν ἀγαλόν[ος] [ἔθηκε
(72)	σῆμ' ἔμεινα διόνυκος ἀποιχομένης ἀριάδ[νης]
(73)	νότωι ὑπο στρέφεται κεκμηότος εἰδ[ό]λοιο·
(74)	νότωι μὲν στέφανος πελάει· κεφαλήι γε μὲν ἄκρι

- 71 We read ἀγαλόν against ἀγαλόος in manuscripts M E S. Only traces of the final letter remain, which are more suggestive of a nu than of a sigma, but nevertheless could represent either reading.
- 73 CCR does not allow us to distinguish ὑπο στρέφεται and ὑποστρέφεται. κεκμηότος agrees with manuscripts M E S, against κεκμηκότος in manuscript C.
- 74 Punctuation in the manuscript. The extract from the *Phaenomena* ends mid sentence, being followed immediately below by the diagram.

*Folio 48 recto*: [Cat.] 5, Corona, followed by astronomical position of Corona Borealis, continued on *Folio 53 verso*

We infer from the continuous text between 48r and 53v that they formed the centre spread of their original quire. Likewise, 51v and 50r, the only other pair which constitute the central spread of a quire, are flesh sides. These centre spreads fit the typical codex pattern of consistent alternating pairs of flesh or hair facing pages.<sup>25</sup> Although 48r was initially identified as containing *Scholium in Aratum* 73, Pàmias subsequently suggested that this text was a version of Eratosthenes' [Cat.] 5.<sup>26</sup> This text conforms closely to the form of [Cat.] 5 in the *Fragmenta Vaticana*.<sup>27</sup> Here we have clear evidence of a connection between the text of Aratus on 48v and the *Catasterism* on 48r, both of which concern Corona. The final six lines (ii 21–6) begin a section on astronomical measurements, which is continued on 53v. This is previously unknown Greek text showing the integration of astronomical measurements in a bifolium containing Aratus, Eratosthenes and an illustration. This material has extremely close structural parallels with measurement material which has survived for constellations which are treated towards the beginning of *Aratus Latinus*—namely, Ursa Major, Ursa Minor and Draco.<sup>28</sup> Because this is new material, we give a provisional translation. The text and understanding of this section emerged out of extended correspondence with V. Gysembergh and E. Zingg.

<sup>25</sup> In the eastern Mediterranean flesh sides are more commonly the centre spread: E.G. Turner, *The Typology of the Early Codex* (Philadelphia, 1977), 56.

<sup>26</sup> J. Pàmias, personal communication 5 March 2015.

<sup>27</sup> J. Pàmias, 'Il testo dei *Fragmenta Vaticana* nella tradizione dei *Catasterismi*', in F. Guidetti and A. Santoni (edd.), *Antiche stelle a Bisanzio: Il codice Vaticano greco 1087* (Pisa, 2013), 77–90; Pàmias and Zucker (n. 22), cxvi–cxviii, 18–19.

<sup>28</sup> See Maass (n. 20), 183–9. These parallels were pointed out to us by V. Gysembergh. This material is identified as derived from Hipparchus in V. Gysembergh, P.J. Williams and E. Zingg, 'New evidence for Hipparchus' star catalogue revealed by multispectral imaging', *Journal for the History of Astronomy* 53 (2022), 383–93.

Table 8

	i	ii
	[Οὔτος] λ[έ]γεται ὁ	ναί ἐκ τοῦ λαβρινύ
	τῆς ἀριάδνης· διό	θου ποιούντος φέγ
	νυκος δὲ αὐτὸν εἰς	γος· <i>uacat</i> ἐν δὲ τοῖς ἄ
	τὰ ἄστρα ἔθηκεν ὅτε	ετροικ ὑπερον αὐ
5	τοὺς γάμους οἱ θεοὶ	τὸν τεθῆναι ὅτε
	ἐν τῇ καλουμένῃ	εἰς νάξον ἦλθον ἄμ
	ἰδαία ἐποίησαν αὐ	φότεροι σημεῖον τῆς
	τοῖς βουλομένοις	α<ι>ρέσεως· συνεδόκει
	ἐπιφανῆς γενέσθε·	δὲ καὶ τοῖς θεοῖς· φαεὶ
10	ῶι πρῶτον ἢ νύμ	δὲ καὶ τὸν πλόκαμῶ
	φη ἔστεφανώσατο	ταύτης εἶναι τὸν φαι
	παρ' ὤρων λαβοῦ	νόμενον ὑπὸ τὴν
	σα καὶ ἀφροδίτη<c>· ὁ	κέρκον τοῦ λέοντος·
	δὲ τὰ κρητικὰ γε	Ἔχει δὲ ἀκτέρας ὁ στέ
15	γραφῶς λέγει· ὅτε	φανος θ̄ ἐν κύκλωι
	ἦλθεν ὁ διόνυκος	κειμένους ὧν οἱ
	πρὸς μίνω φθίρε	ᾗ λαμπρότατοὶ εἰ
	βο](υλ)όμενος αὐτήν	σιν· οἱ κατὰ τὴν κε
	δῶρ]ον δέδωκεν ὦι	φαλήν τοῦ ὄφεως
20	ἠπ]ατήθη ἢ ἀριάδνη·	διὰ τῶν ἄρκτων·
	ἠφ]αίτου δὲ ἔργον	ἽΟ στέφανος ἐν τῶ(ι)
	εἶνα]ί φασιν ἐκ χρυ	βορείου ἡμιφαι
	σοῦ] (πυρώ)δους καὶ	ρίωι κείμενος κα
	λι](θω)ν (ι)νδικῶν·	τὰ μῆκος μὲν ἐπέ
25	ἱστορίται δὲ διὰ τοῦ	χει μ̄ θ̄ (καὶ δ̄) ἀπὸ
	του τὸν θησέα ζω<θη>	τῆς ἄ μ̄ τοῦ σκορ

i 6–7 ἐν τῇ καλουμένῃ / ἰδαία ‘on the island (?) called Idaea’: CCR preserves an otherwise unattested reading that is plausible, not only as an unfamiliar name for the island of Crete (the scene of the myth: cf. i 14, 17 and ii 1–2),<sup>29</sup> but also as an explanation of the reading of all the manuscripts ΙΔΗΙ (that is, Ἴδηι), for which Koppier’s conjecture of Δίαι has been widely accepted. Greek and Latin stories of the marriage of Dionysus and Ariadne give the location either as Naxos or as Dia,<sup>30</sup> which is either another name for Naxos or the name of an island near to Crete.<sup>31</sup>

i 13 The rough breathing is in the manuscript.

i 17 φθίρε, that is, φθειρα.

ii 1 The first letter of this column seems to be both a theta and a nu, one being a correction of the other, though it is hard to tell which. Presumably, in i 26–ii

<sup>29</sup> Steph. Byz. s.v. Κρήτη (κ 217 Billerbeck) notes Idaea as an alternative name for Crete: καλεῖται δὲ ἡ νῆσος καὶ Ἀερία καὶ Χθονία καὶ Ἰδαία. Cf. his comments s.v. Ἀερία (α 70 Billerbeck).

<sup>30</sup> Cf. Callim. fr. 601 Pfeiffer ἐν Διῇ τὸ γὰρ ἔσκε παλαιότερον οὐνομα Νάξω; Hom. *Od.* 11.325 Διῇ ἐν ἀμφιρύτῃ; also Ov. *Met.* 3.636, 3.640, 3.690, 8.174; *Ars am.* 1.528; Catull. 64.52; Ap. Rhod. *Argon.* 4.433–4.

<sup>31</sup> Σ Hom. *Od.* 11.325.

- 1  $\omega\theta\eta\gamma\alpha\iota$  is intended and some confusion has occurred during the movement between columns.
- ii 1–2 The spelling  $\lambda\alpha\beta\iota\rho\acute{\upsilon}\nu\theta\omicron\upsilon$  is clear.
- ii 25 The abbreviation  $\mu$  (*mu* with circlet over it) here and on 53v stands for  $\mu\omicron\iota\rho\alpha\iota$  ‘degrees’.<sup>32</sup> The restoration is based on the number suggested by Victor Gysenbergh.

*Folio 53 verso: Measurements of Corona Borealis*

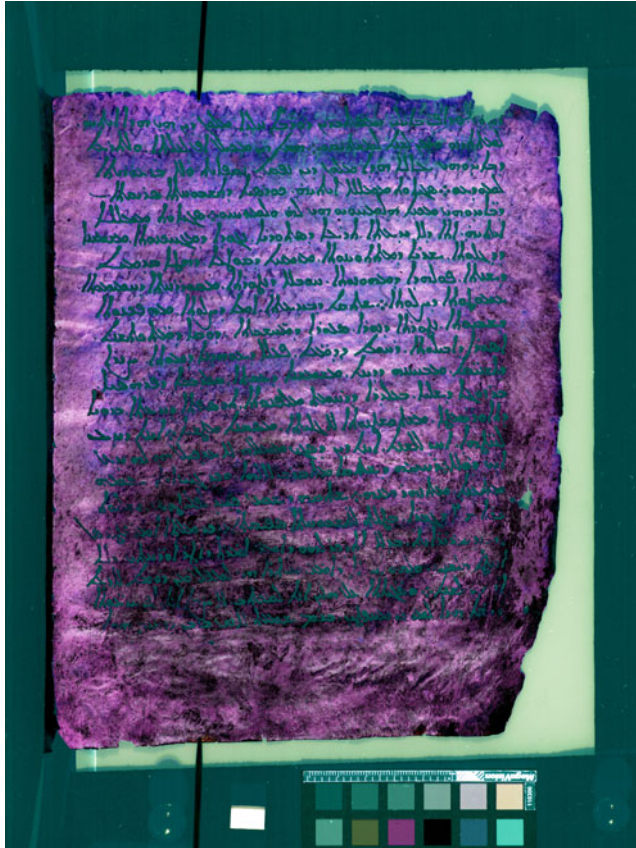
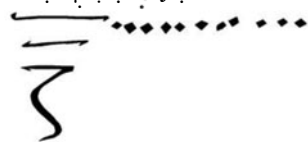


FIGURE 2 Courtesy Museum of the Bible Collection. © Museum of the Bible, 2021. Image shared under Creative Commons BY-SA 4.0 license, 2022. All conditions apply. Spectral imaging by the Early Manuscripts Electronic Library and the Lazarus Project of the University of Rochester. Image processing by Vasilis Kasotakis.

<sup>32</sup> See K. Manitius, *Hipparchi in Arati et Eudoxi Phaenomena commentariorum tres libri* (Leipzig, 1894), 27 and, for example, Florence BML Plut. 28.39, fol. 8v, last line (references supplied by Gysenbergh).



Table 9

	i	ii
	Πίου ἕως τῷ μέγης τοῦ αὐτοῦ ζωδίου κατὰ πλάτος δ' ἐπέ χει μ̄ τ̄ και δ'	Τοῦ βορε[ίου] πό[λου] μ̄ μ̄θ̄ νοτιώτα τος δὲ ὁ γ̄ ἀπὸ το[ῦ] λάμπρου πρὸς ἀν[α]
5	ἀπὸ μ̄θ̄ μ̄ ἀπὸ τοῦ βορείου πόλου ἕως μ̄ ν̄ε και δ'	τολάς ἀριθμούμε νος ὅς ἀπέχει τοῦ πόλου μ̄ ν̄ ε̄ και δ'
10	προηγείται μὲν γὰρ ἐν αὐτῷ ὁ ἐχόμε νος τοῦ λαμπροῦ ὡς πρὸς δύσιν ἐπέ χων τοῦ σκορπίου τῆς ᾱ μ̄ τὸ ἡμικυ ἕσχατος δὲ πρὸς ἀνα	
15	τολάς κείται Ὁ δὲ ἐχόμενος ἐπ' ἀνα τολάς τοῦ λάμπρου ἄστέρως . . .	No text detected
19–26	Undeciphered text	

*Provisional translation of 48r ii 21–53v ii 7*

'Corona [Borealis], lying in the northern hemisphere, in longitude spans  $9\frac{1}{4}$  degrees from the first degree of Scorpius to  $14\frac{1}{2}$  [corrupted from  $10\frac{1}{4}$ ?] degrees of the same zodiacal constellation [that is, in Scorpius]. In latitude it spans  $6\frac{3}{4}$  degrees from 49 degrees from the [equatorial] North Pole to  $55\frac{3}{4}$  degrees. Within it, the star [β CrB] next to the bright one on the Western side leads, occupying half of the first degree of Scorpius. It lies last towards the East.

The one which is to the East of the bright star ...

... 49 degrees from the North Pole. Southernmost [δ CrB] is the third from the bright one counting towards the East, which is  $55\frac{3}{4}$  degrees distant from the North Pole.'

- i 1 Though the initial letter is not enlarged, there appears to be ekthesis and the initial letter of ii 1 also appears slightly enlarged. We have therefore taken this as the first line. The word σκορπίου was thus spread between 48r and 53v. The number has also been read as τ̄β̄. The number is thus  $14\frac{1}{2}$  or  $12\frac{1}{2}$ , or, if μέγης is taken as subtractive,<sup>33</sup>  $13\frac{1}{2}$  or  $11\frac{1}{2}$ . A possibility is that τ̄δ̄ μέγης is corrupted from τ̄ <καὶ> δ' μ̄, which allows the addition to work.<sup>34</sup>
- i 4 C here and in i 7 and ii 7 represents the manuscript's symbol, which we take to mean  $\frac{1}{2}$ . We infer its meaning not based on the shape of analogies in other manuscripts but from its position within sequences of numbers from the greater to the lesser. The number in this line is 6,  $\frac{1}{2}$  and  $\frac{1}{4}$ , that is,  $6\frac{3}{4}$ .
- i 13 The number δ̄ is also possible.

<sup>33</sup> For this usage, see, for example, Hipparchus, *In Arati et Eudoxi commentariorum 2.5 passim* in Manitius (n. 32), 186–200.

<sup>34</sup> Suggestion of Gysembergh.

- i 14–18 In their extant form these lines are problematic since i 14–15 cannot go with the preceding lines which have dealt with the most westerly star. The translation above is thus of a text which is presumed corrupt. Textual confusion has probably occurred owing to the resemblance of i 14–15 with i 16–17 (δέ is in second position in both, ἀνατολάς in the same position in both, and ἔχρατος shares much visually with ἐχόμενος). We expect here a description of the last star to appear, namely ε CrB, rather than the easternmost star ι CrB. On the analogy of νοτιώτατος δὲ ὁ γ̄ ἀπὸ τοῦ λάμπρου πρὸς ἀνατολάς ἀριθμούμενος in ii 2–6, we may conjecturally restore ἔχρατος δὲ πρὸς ἀνατολάς κείται ὁ δ̄ ἐχόμενος ὁ ἐπ' ἀνατολάς τοῦ λάμπρου ἄκτερος,<sup>35</sup> ‘In last place towards the East lies the one which is fourth to the East of the bright star.’
- ii 8 Underneath the text is a scribal flourish, about three lines in height. Sketch by Zaman.

*Folio 53 recto: nothing recovered*

#### FOLIO 64: NEW MYTHOLOGICAL TEXT AND *CATASTERISMS*

Based on purely physical considerations it is not possible to determine which of 64r and 64v is to be read first, since it is probably a single leaf, not part of a bifolium. Whereas most CCR bifolios were recycled intact, with the trimming process producing a wide inner margin and a narrow or absent outer margin, folio 64 has narrow margins on both sides of the text intact. It may therefore have been trimmed on both the inner and the outer edge before reuse. However, the content of 64v does not readily follow on from 64r, and therefore 64v should be judged as coming first.

*Folio 64 verso, new text concerning Hyas*

This text concerning the naming of the Hyades after their brother Hyas ranges from the exceedingly clear to the currently obscure in quick succession. Column i lines 5–8 are sufficiently clear to indicate the subject matter. Column i and the name Hyas (ὑϊας), though not fully visible in i 4, are restored on the basis of the close parallel in the story attributed to Musaeus in Hyginus’ *De astronomia* 2.21: *quod earum Hyas fuerit frater, a sororibus plurimum dilectus; qui cum uenans a leone esset interfectus, quinque de quibus supra diximus lamentationibus assiduis permotae dicuntur interisse.*<sup>36</sup>

<sup>35</sup> Conjecture originally suggested by Gysembergh.

<sup>36</sup> G. Viré, *Hygini De astronomia* (Stuttgart and Leipzig, 1992), 64, which notes the variant spellings for *Hyas*: *Yadis* (R), *Hiades* (P), *Yas* (R<sup>corr</sup>), *Hias* (P<sup>corr</sup>). See also Musaeus F88 in A. Bernabé, *Poetae epici Graeci: Testimonia et Fragmenta. Pars II Fasciculus 3* (Berlin and New York, 2007), 45–7.

Table 10

	i	ii
	Τούτων δὲ ἀδελφῶ ἕνα συναυξηθέν τα ἄγανόν ὄνομα ῥῖαν ὑπὸ παρῶν ἀγαπηθῆνε γενό 5 μνον δὲ φιλοκῦ νηγον ὑπὸ λέοντος ἀπολέσθαι τοῦτῳ οἶν τὰς μὲν εἰ διὰ 10 νυκτερίας εἰ (...) τῶν θρήνων εφω	Τὸ γεννώμενον οἰκτίραντα καὶ ἐν τῷ οὐρανῷ μνή μα αὐτῶν κατα ετηράμεν(ον) ταῖς εἰ ἰσαρίθμους ἀρτέ 15 ρας διακαλέσαι ῥῖ δας διὰ τὴν τοῦ ἀ δελφοῦ (...) προσηγορ(ίαν)
12–24	undeciphered text	undeciphered text
25	undeciphered text ραρ	undeciphered text
26	τὰς πάραρ undeciphered text	undeciphered text

### Translation

Column i [It is said that] of these [Hyades] one brother having grown up with them—a fair name Hyas—was loved by all [his sisters]. But becoming a hunter, he was destroyed by a lion. Him therefore five of them through night toil ... of their lamentations [perished].

...

Column ii ... the one that was born. [It is said that Zeus] pitied them and in the heavens established a memorial for the five [sisters]. The same number of stars bear the name Hyades because of the designation of their [...] brother.

### Comment

- i 3–4 ἄγανόν is highly uncertain, as it is generally found in poetry and is awkward as an adjective with an accusative of respect, though it is elsewhere used in the context of mortality in a hunting context. Another possibility is to read αθανον by parablepsis for ἀθάνατον. ῥῖαν ‘Hyas’ is a reading suggested by Zingg.
- i 8 Our translation treats τοῦτῳ as an object and therefore assumes that subsequent lines contain a verb. Another possibility is that τουτῳ is for the feminine plural τούτων, referring to the sisters.
- i 9–10 διὰ could also be λιᾶ. The restoration νυκτερ<ε>ίας, taken to refer to night toil, is not fully satisfactory, and a variety of lexemes beginning νυκτερ- or διανυκτερ- would render sense. As all dotted letters are uncertain, there are further possibilities.
- ii 7 Much of this line is uncertain and if this interpretation is correct, the letters are more compressed than other lines.
- ii 9 To judge from traces, the line may end with the same word which we have hesitantly transcribed as ἄγανόν in i 3.

*Folio 64 recto: [Cat.] 14 and 23, Taurus and Pleiades*

The collocation of Taurus and Pleiades is found in the Latin tradition of Hyginus but not in other Greek manuscripts of Eratosthenes. The wording here shows both significant alignments with and differences from existing traditions, including additional material, for example text with analogies to Anonymous II at i 19 and the longer explanation for the presence of seven stars in ii 3–7.<sup>37</sup> Since this section is already dealing with the positions of the stars in Taurus, we must assume that the mythology of Taurus preceded 64v and also that the treatment of Taurus and its associated constellations (Pleiades and Hyades) continued onto the page following 64r. Thus Taurus and associated material occupied at least four sides.

Table 11

	i	ii
	Ἐφ' ἑκατέρων λαμ πρότερον· ἐπὶ τῆς ἀριστερᾶς ᾠ· ἔφ' ἑ κατέρωγ τῶν ὀφθαλ μῶν ᾠ· ἐπὶ τοῦ μυ κτῆρος ᾠ· οὗτοι ὑά δεσ λέγοντε· ἐπὶ δὲ τοῦ ἀριστεροῦ γόνα τος ᾠ· ἐπὶ δὲ τῆς χη λῆς ᾠ· ἐπὶ τοῦ δεξι οῦ γόνατος ᾠ· ἐπὶ τῆς χηλῆς ᾠ· τρα χήλου β· ἐπὶ τῆς ράχεως γ· τὸν ἔσχα τον λαμπρόν· ἐπὶ τὴν κοιλίαν ᾠ· ἐπὶ τοῦ (στ)ήθ(ου) ᾠ· τοὺς πάντας (ε τῆ·) Ἐπὶ τῆς ὀποιομῆς τοῦ ταύρου τῆς κα λουμένης ῥάχεως ἢ πλει[άκ] ἐστιν· συνηγ μέ]νη(ε δ') αὐτῆς εἰς ἀκ]τέρας ζ· λέγουσι εἶν]αι τῶν ἄτλαντος θυγ](ατέ)ρων(v) possible text	Κύμβολον αἶ ἦσαν ἐπτά τὸν ἀριθμῶ· διὸ καὶ ἐπτάστερῶ καλίτε οὐχ ὀρών τε δὲ ἀλλὰ ἐξ ὧν ὁ ἔβδομος ἀμαυρός ἐστιν σφόδρα· τὸ δὲ αἴτιον δι' ὃ τοῦτ' ἔ στιν οὕτω πως λέ γετε· τὰς γὰρ ἐξ θε οῖς φησιν μιγῆνε· τὴν δὲ μίαν θνητῶι· τρίε μὲν οὖν μιγῆ νε διεί ἠλέκτραν ἐξ ἧς δάρδανος· μαῖαν ἐξ ἧς ἐρμῆς· ταυγέτην ἐξ ἧς λακεδέμων· ποσει δόνι δὲ δύο ἀλκυό νην ἐξ ἧς ὁ ὑριεύς ἐγένετο· κελαϊνώ ἐξ ἧς λύκος(·) εἴτερ(ό) πη δὲ ἄρει ἐξ ἧς οἱ νόμαος ἐγένετο· μερόπη δὲ κισύφωι σὺν θνητῶι διόπερ
5		
10		
15		
20		
25		

<sup>37</sup> For Anonymous II, see Maass (n. 20), 212–13.

- i 2 The punctuation appears mistaken.
- i 6–7 Possibly ὑάδαϛ was corrected to ὑάδεϛ.
- i 12 Preposition appears to be missing.
- i 15 This line is read as having atypically few letters, but further text may be present.
- i 21 It is uncertain whether the article is present.
- i 22 Letters are lost in a tear in the manuscript.
- ii 3 The presence of the final supralineal stroke on ἐπτάτερο̄ is uncertain, but this appears more likely than ἐπτάτεροϛ.
- ii 5 The syntax is awkward. ζ̄ may have been omitted between δέ and ἀλλά.
- ii 11 CCR most probably reads φηϛiv with L, not the plural φαϛiv of E, but it is possible that it has both readings with alpha or eta overlaid on the other as a correction.
- ii 19 Reading ποσειδόνι for ποσειδῶνι.
- ii 22 CCR supports Heyne's conjecture λύκοϛ against λεῦκοϛ in E.
- ii 26 CCR supports Kiesslingius's conjecture διόπερ. In the lower margin, set to the left, there appears to be a diagram consisting of lines and small triangles, which, if contemporary with the rest of the underwriting, might be the horns of Taurus. The diagram, however, is surprisingly flattened relative to the other two known diagrams in CCR and this, combined with its position in the margin, may suggest that it is not part of the initial astronomical work. Sketch by Zaman.

#### FOLIOS 52 AND 49: ARATUS, *PHAENOMENA*, A DIAGRAM AND UNDECIPHERED TEXT

We do not know the distance between these folios in the original codex, but we note that both known sides feature aquatic entities. We tentatively order them 52r, 52v, 49r, 49v, so that the creature we identify as Delphinus would be nearer to the part of Aratus' poem which follows the section on 52r. In our provisional reconstruction (see Diagram 2 above) folio 49 comes after folio 54, but it is treated here in order to keep its treatment next to that of folio 52, with which it is physically connected.

*Folio 52 recto: Aratus, Phaen. 282–99*

The top and left margins are preserved (in relation to the undertext), but the right-hand side of the folio has been trimmed with the result that the ends of the lines have been lost. In addition, in the upper lines the writing becomes less legible towards the right-hand side. The text ends about three quarters of the way down this page and its ending appears to be marked with a *paragraphos*. Above the top line, there is a fingerprint which we presume to be ancient. The tau at the start of line 282 is about twice as large as the rest of the letters. Thus the beginning of a new section coincides with a new page in the manuscript, as well as with the paragraphing of Kidd's edition. The codex is the earliest witness for these lines of the *Phaenomena* except for a scholium to line 294 preserved in *P. Berol.* 5865 (fourth century).<sup>38</sup> CCR agrees with the

<sup>38</sup> Discussed by R. Luiselli in G. Bastianini, M. Haslam, H. Maehler, F. Montanari, C. Römer, *Commentaria et lexica Graeca in papyris reperta (CLGP)*, Pars 1, Vol. 3 (Berlin, 2011), 60–96.



FIGURE 3 Courtesy Museum of the Bible Collection. © Museum of the Bible, 2021. Image shared under Creative Commons BY-SA 4.0 license, 2022. All conditions apply. Spectral imaging by the Early Manuscripts Electronic Library and the Lazarus Project of the University of Rochester. Image processing by Vasilis Kasotakis.

manuscripts against Stobaeus (293 and 296) and vice versa (294, twice) and most often agrees with manuscript E (284, 291 and 293); 297 is the only example of a disagreement with E.

Table 12

(282)	Τὸν δὲ μετασκαίροντα δὴ ἴχθυες ἀμφινέμονται
(283)	ἵππον πὰρ δ' ἄρα (οἱ κε)φαλῆι χεῖρ ὑδροχόοιο
(284)	δεξιτερὴ τάνυται ὁ δ' ὀπίστερος αἰγοκρηῆος
(285)	τέλλεται αὐτὰρ ὅ γε πρότερος κ(αἰ) γει[όθι μάλλον
5 (286)	κέκλιται αἰγόκερος ἵνα ἴσ τρέπετ' ἠελίοιο
(287)	μὴ κείνῳ ἐνὶ μηνὶ περικλύζοιο θαλάσσει
(288)	πεπταμένῳ πελάγει κεχρημένος(·) οὔτε κεν ἦοι
(289)	πολλὴν πειρήνειασ ἐπεὶ ταχινώτα[ταί εἰσιν
(290)	οὗτ' ἂν τοῖ νυκτὸς πεφοβημένῳ ἐγγύθεν ἦος
10 (291)	ἔλθοι καὶ μάλα πολλὰ βοωμένοι οἱ δ' ἀλγεῖνοι
(292)	τῆμος ἐπιήσσουσι νότοι ὀπότ' αἰγοκρηῆ
(293)	συμφέρετ' ἠέλιος τότε (δ)ὲ κρύος ἐκ δι(ός) [ἔστι
(294)	ναύτηι μαλκίοντι κακώτατον ἀλλὰ κ[αὶ ἔμπη
(295)	ἦδη πάντ' ἐνιαυτὸν ὑπὸ στείρησι θάλασσαν
15 (296)	πορφύρει ἴκελοι δὲ κολυμβίειν αἰθιύη[ει
(297)	πολλάκις ἐκ νηῶν πέλαγος πε(ε)ριπατ[ίνοντες
(298)	ἡμεθ' ἐπ' αἰγιαλοῦς τετραμμ(έ)νοι(·) οἱ δ' ἔτι π[όρω
(299)	κλύζονται ὀλίγον δὲ διὰ ξ(ύ)λον ἄϊδ' ἐρύκει
	>—

- 1 (282) Reading μετασκαίροντα with the direct manuscript tradition. Since the text in the codex is not accented, it does not provide evidence in relation to Martin's division as μετὰ σκαίροντα.
- 3 (284) CCR has τάνυται with E *in ras* S, against τετάνυται in M and τετάνυται in P. The reading in CCR requires hiatus at the caesura (cf. 287, though not at the caesura, 292, and 296, which involves an initial digamma). The reading of M requires elision of -αι, which is possible in Aratus (for example 293).
- 5 (286) With ἴσ τρέπετ' ἠελίοιο] CCR supports the earlier position of ἴσ, as conjectured by Grotius and adopted by Kidd, against the readings transmitted by the manuscripts: ἵνα τρέπετ' ἠελίοιο M\* S; ἵνα τρέπετ' ἠελίοιο ἴσ M<sup>2</sup>; ἵνα τρέπετ' ἠελίου ἴσ E; ἵνα τε τρέπετ' ἠελίου ἴσ A.
- 10 (291) ἔλθοι with E S, against ἔλθοις M.
- 11 (292) ἐπιήσσουσι displays simplification of geminate -ρρ-, but metre shows that -ρρ- is required.
- 12 (293) συμφέρετ' with the direct manuscript tradition against ἐμφέρειτ' in Stobaeus. τότε δὲ with M E, against τότε δὴ S, and τὸ δέ τοι V.
- 13 (294) μαλκίοντι with Stobaeus, against μαλκιώντι of the codices. κακώτατον, again with Stobaeus, against κακώτερον of the codices.
- 15 (296) κολυμβίειν uniquely, and problematically, as an adjective, with the direct manuscript tradition, against the adjective κολυμβάειν of Stobaeus.
- 16 (297) πολλάκις with S, against πολλάκι δ' in M and E.

*Folio 52 verso: nothing recovered*

*Folio 49 recto: contains undeciphered text*

To date no clear words have been recovered, but there is at least some prospect of future decipherment for this page.

*Folio 49 verso: drawing of aquatic creature*

Statistical processing of the images of 49v by V. Kasotakis resulted in Independent Component Analysis images which show that this page contained a line drawing of an aquatic creature. Although the aquatic creature is upside down in relation to the Syriac overtext, that was not the original orientation of the drawing as a whole. Since the text on the conjugate folio (52r) is also upside down in relation to the Syriac overtext, we know that the bifolium was rotated 180° prior to reuse and thus that the drawing originally represented an upright aquatic creature. When rotated to its original position it is on the left-hand half of the page with its tail rising to the right. The creature faces away from the manuscript's binding with its mouth in the outer margin and preserved intact. No traces of a label or other text have been recovered. The seven or more groups of four dots which show up clearly in the image are not part of the same layer, but are punctuation in red ink accompanying the Syriac upper writing. This may suggest that the aquatic creature, which is only visible after digital processing, is also in red ink.

This drawing bears a remarkable resemblance, both in its form and in its orientation, to a drawing labelled δελφῖν on folio 306v of the fourteenth-century Codex Vaticanus Graecus 1087, the earliest manuscript hitherto known of the *Fragmenta Vaticana* of the *Catasterisms*. Space above the image is sufficient for the text of *Phaen.* 316–18 concerning Delphinus, or possibly for 316–21, which would follow *Phaen.* 282–99 which was identified on 52r, the conjugate folio of this bifolium.

#### FOLIOS 47 AND 54: *CATASTERISMS*

*Folio 47 verso: unidentified Greek text*

No continuous sequences of words have been recovered, but like the majority of other material recovered, this appears to be a Greek text in two columns of about twenty-six lines.

*Folio 47 recto: [Cat.] 27, Capricorn*

It is noteworthy to find the *Catasterism* of Capricorn in CCR, because Capricorn is mentioned three times in the passage of the *Phaenomena* preserved on 52r (lines 284, 286 and 292). These are, of course, not the only references to Capricorn in Aratus, but they are a cluster of references and the first in the *Phaenomena*. This confirms the close connection between elements of the *Phaenomena* and the *Catasterisms* also seen on folio 48. The left margin has been trimmed but without loss of Greek undertext.



Table 13

	i	ii
	(Οὐ)τός ἐστι μὲ(ν ὄ) (μοιοc) τῶι αἰγίπαν(ι) (ἐ)ξ ἐκείνου γέγονε ἔχει (δὲ) θηρίου τὸ 5 κάτω καὶ κέρατα ἐπὶ τῆι κεφαλῆι(·) ἐπιμήθη δὲ διὰ τὸ σύντροφον εἶναι τῶι διῖ καθα περ φρεῖν ἐπιμε 10 γίδης ὁ τὰ κρητικὰ ἱστορῶν ὅτι ἐν τῆι ἴδιη συνῆν αὐτῶι (ὄ)τε ἐπὶ τοὺς τιτᾶνας ἐστρατεύετο(·) οὐτ(οc) 15 δοκεῖ εὐρεῖν τὸν κόχλον ἐν ᾧ τοὺς συμμά(χοις καθώ) πλι(c)ε διὰ . . . undeciphered text 20 undeciphered text undeciphered text undeciphered text ὁ οἱ τιτᾶνες ἐφυγῶ παρ᾽ αὐτῶν δὲ τῆ 25 ἄρχην ἐν τοῖς ἄστροις αὐτὸν ἔθηκεν <sup>καὶ</sup> τῆ	Αἶγα τὴν μητέρα· διὰ δὲ τὸν κόχλον εὐρεῖν ἐν θαλάσσει παράρημον οὐραν ἰχθύος ἔχει <i>uacat</i> Ἔχει δ' ἀτέρας ἐφ' ἕκα τέρωι τῶν κερᾶτων αὐτοῦ ᾧ ἐπὶ το(ῦ μυ) κτῆρος ᾧ λαμπρῶ ἐπὶ τῆς κεφαλῆς β̄ ὑπὸ τὸν τράχηλον ᾧ ἐπὶ τοῦ στήθους β̄ ἐπὶ τοῦ ἐμπροσθίου ποδὸς ᾧ ἐπ' ἄκρου αὐτοῦ ᾧ ἐπὶ ῥάχεως ζ̄ ἐπὶ γαστροῦς ε̄ ἐπὶ οὐραίου β̄ λαμπ(ροῦς· τοὺς πᾶν) τας κδ̄ undeciphered text αἰγόκερω(c) undeciphered text 3–4 letters εω undeciphered text 3–4 letters υκ undeciphered text undeciphered text undeciphered text undeciphered text undeciphered text

- i 1–2 Reconstruction of dotted letters is particularly uncertain.
- i 3 There is probably insufficient space for δέ after ἐκείνου, though its absence is not certain.
- i 10 The spelling κρητικὰ for κρητικά seems likely, as the crossbar of the second eta appears visible.
- i 19–22 Traces of letters are visible and it seems likely that the text here was longer than has otherwise been preserved in the Greek tradition. See, for instance, *Hyg. Poet. astr.* 2.28.
- i 26 There is no space between ἔθηκεν and τὴν and therefore the corrector has added καὶ immediately above them.
- ii 17 The reading οὐραν rather than οὐραίου is possible, but fits the space less well.
- ii 19 κβ̄ is also possible.

*Folio 54 verso: [Cat.] 30, Aquila and measurements*

Though most of column ii is undeciphered, the use of ἐπέχει ‘spans’ and ἀπέχει ‘is distant’ (lines 1 and 7) as well as their position in relation to the catasterism suggest

that this column contains measurements of Aquila analogous to those of Corona on folios 48r and 53v.

Table 14

	i	ii
	Δὲ καὶ γενόμενον	ὄς ἐπέχει τοῦ
	ἐν ἡλικίαι τὴν τῶ	undeciphered text
	θεῶν βασιλείαν κα	undeciphered text
	ταρχεῖν· ἐξορμῶν	undeciphered text
5	τοσ δ' ἐκ τῆς νάξου	τερος το undeciphered text
	ἐπὶ τοὺς τιτάνας	4 letters ατω undeciphered text
	ἀετὸν φανῆναι	ὄς ἀπέχει ἀπ undeciphered text
	αὐτῶι θύοντι· τὸν	undeciphered text
	δ' οἰωνισάμενον ἰξ	undeciphered text
10	ρὸν αὐτοῦ ποιήσας	undeciphered text
	θε(·) διὸ τοῦτο τῆς	undeciphered text
	ἐν τοῖς ἄστροις τι	undeciphered text
	μῆς ἀξιωθῆναι·	undeciphered text
15–26	Ἔχει δὲ ἄς(τέρας) δ	undeciphered text
	undeciphered text	undeciphered text

- i 1 It is not certain that this is indeed the first line of text. It has not been possible to count 26 lines of text on this page.
- i 7–8 Compare Anonymous II ἀετὸν αὐτῶι φανῆναι θύοντι κτλ.<sup>39</sup>

*Folio 54 recto:* [Cat.] 29, *Sagitta*

The left (outer) margin has been lost through trimming of the bifolium for reuse. However, it seems that almost no text was lost when the bifolium was trimmed, as the degree of continuity evident in κεραιὸν ἐργασαμένους in i 6–7 illustrates. The kappa at the start of line 6 is only slightly damaged, but the mu at the start of the next line remains intact. The order of the *Catasterisms* in CCR differed here from the traditional ordering. Since 54v preceded 54r in the Greek codex (the bifolium was not rotated prior to rewriting), [Cat.] 30 must have preceded [Cat.] 29.

Table 15

	i	ii
	Τ]οῦτό ἐστιν βέλος	(H)ρ(ακλείδης ὁ πον)
	τ]οξικὸν ὃ φασιν εἶ	τικός φησιν ἐν τῶι
	γαὶ ἀπόλλωνο(ς) ὦι	περὶ δικαιοσύνης·
5	τοὺς κύκλωπας ἃ	ᾔθεν (εἰς τὰ ἄστρα)
	γεῖλε τοὺς τῶι δι	τέθει(κε τὸ βέλος ὃ)
	κεραιὸν ἐργασα	ἀπόλλ(λων) εἰς (ὑπό)

<sup>39</sup> Maass (n. 20), 244.

	μένους(·) οὐς ἀνεῖ	μνημα (τῆς ἑαυτοῦ μά)
	λεν δι' ἀκκλητιῶν·	χης καταστερίας
	ἐκρυσσε δε αὐτῷ	Ἔχει (δε ἀ)στερία(σ δ)
10	ἐν ὑπερβορείοις	ἐπὶ τ(οῦ ἄκρου) α
	(ο)ῦ ὁ ναός ὁ πτέρινος·	undeciphered text
	λέγεται πρότερον	undeciphered text
	ἀνεν(ηνέχθαι ὄ)τε	undeciphered text
	τοῦ φ(όνου αὐ)τ(όν)	undeciphered text
15	ὁ ζεῦς ἀπέ(λυσε καὶ)	undeciphered text
	ἐπαύσα(το τῆς παρὰ)	undeciphered text
	ἀδμήτωι λατρείας	undeciphered text
	(περὶ ἧς λέγει εὐρι)	undeciphered text
	(πίδης ἐν τῇ ἀλκή)	undeciphered text
20	(στιδι) δοκεῖ τότε	undeciphered text
	ἀνα(κομ)ισθῆναι	undeciphered text
	ὁ ὄϊςτος (μετὰ) τῆς	undeciphered text
	καρποφόρου	undeciphered text
	(δήμητ)ρος (διὰ)	undeciphered text
25	τοῦ ἀέρος· ἦν (δε)	undeciphered text
	(ὑπερ)μεγέθης (ὡς)	undeciphered text

## CONCLUSION

CCR10 appears to contain closely connected folios from a single codex consisting of a Proemium to the *Phaenomena*, single-column parts of Aratus' *Phaenomena*, and related parts of Eratosthenes' *Catasterisms*, with illustrations, and some astronomical measurements. It is provisionally dated to the fifth or sixth century and contains numerous textually significant readings. It confirms Martin's hypothesis of an integrated Φ Edition of Aratean and Eratosthenic material in Greek and points to the inclusion within at least some Φ Editions of astronomical measurements with parallels in *Aratus Latinus*. Given the extent and range of the surviving material, it is reasonable to suppose that the astronomical folios of CCR once belonged to a manuscript which contained large parts or all of the *Phaenomena* and the *Catasterisms*, numerous illustrations and further astronomical material besides. The serious level of erasure during the palimpsesting process presents difficult challenges even for a large-scale collaborative decipherment, but there remains the prospect that the foundation of this initial article can lead to further decipherment in the future. Nevertheless, significant challenges remain as hair sides have proven particularly resistant to decipherment and pages with essentially known text have proven easier to read than those for which we have no guide. The manuscript requires further research, both to correct the inevitable missteps taken when a palimpsest is first deciphered, and to expand on the readings offered here. It also calls for a fresh evaluation of the Aratean and Eratosthenic textual traditions. Methods of processing images continue to improve, and therefore there is the likelihood that more of the undertext will be read in the future. Since the manuscript appears to come from St Catherine's Monastery in Sinai, where eight pages with the same overwriting are known to exist (albeit with Aramaic undertext) and numerous

other palimpsests, there is also the prospect that further parts of the same astronomical undertext will be identified as the palimpsests of St Catherine's are further investigated.

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