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A Synoptic Study of the Number of Stars in the Constellations of Hipparchus's Catalogue*

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The present study aims to accomplish two things: first, to provide in tabular form all known extant manuscript evidence for the numbers of stars in each constellation of Hipparchus's star catalogue (including two manuscripts not used in previous editions); and, second, to propose a reconstruction of the numbers in the archetype. In doing so, this paper follows in the footsteps of OLIVIERI 1898, REHM 1899, BOLL 1901 and WEINSTOCK 1951. The results largely confirm Weinstock's edition, although a few significant changes will be suggested. To this extent, the study can be viewed as a preliminary step towards a new edition of the star catalogue, which the author hopes to undertake in due course.

The manuscripts bearing witness to the star catalogue are the following (using different sigla than Weinstock and his predecessors for clarity's sake):

- A** Rome, Biblioteca Angelica, greco 29 (olim C.4.8), f. 158r. 1388 AD.
- O** Oxford, Bodleian Library, Selden Supra 17, f. 180v. 15th c.
- P₁** Paris, BnF, grec 2419, f. 24v. 15th c. (= R Weinstock)
- P₂** Paris, BnF, grec 2420, f. 194. Early 16th c.
- P₃** Paris, BnF, grec 2424, f. 141. Late 15th c.
- P₄** Paris, BnF, grec 2506, ff. 126v–127. Early 14th c.
- P₅** Paris, BnF, suppl. grec 387, f. 162. 14th c. (= S Weinstock)
- S** El Escorial, Real Biblioteca, Φ I 16, f. 131v. 1548 AD.
- T** Toledo, Biblioteca Capitulare, 96–37, ff. 248v–249. 16th c.

The first reference to the catalogue in the hitherto untapped manuscripts of El Escorial and Toledo seems to have been made in the *Catalogus codicum astrologorum graecorum* and in the online database *Pinakes*, respectively.¹ **S** descends from **P₅**,² and **T** is closely related to **A**. As previously noted by Boll,³ **P₂** descends from **P₄**. On the basis of titles, lacunae and numbers of stars, the

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1 For **S**, see ZURETTI 1932, p. 109; for **T**, see pinakes.irht.cnrs.fr/notices/cote/63499/.

2 As noted already by ACERBI 2017, p. 177.

3 BOLL 1901, p. 186.

following groups of manuscripts can be formed (with derivative manuscripts in parentheses):⁴

$$\begin{aligned}\alpha &= \mathbf{AT} \\ \gamma &= (\mathbf{P}_2)\mathbf{P}_3\mathbf{P}_4 \\ \delta &= \mathbf{P}_5(\mathbf{S}) \\ \omicron &= \mathbf{OP}_1\end{aligned}$$

Furthermore, groups γ and δ have the permutation of their entries for Aql and Sga in common. Examination of the number of stars shows that these two groups are closely related, so that (when they agree) they can be called β :

$$\beta = \gamma\delta = (\mathbf{P}_2)\mathbf{P}_3\mathbf{P}_4\mathbf{P}_5(\mathbf{S})$$

The variations in the language of the manuscripts, though interesting in themselves, have been left aside for further study.

What follows, in tabular form, is the result of collating digital reproductions of all the manuscripts listed above (*lac.* notes cases when the constellation is named, but no number is given; *abest* notes cases where both name and number are missing).

Table 1. Northern Constellations

	α		β					\omicron	
	A	T	\mathbf{P}_2	\mathbf{P}_3	\mathbf{P}_4	\mathbf{P}_5	S	O	\mathbf{P}_1
UMa	24	24	24	24	24	24	24	24	24
UMi	7	7	7	7	7	7	7	7	7
Dra	15	15	15	15	15	lac.	lac.	15	15
Boo	19	19	19	19	19	19	19	14	14
CrB	9	9	9	9	9	9	9	lac. ⁵	lac.
Her	24	24	24	24	24	24	24	9	9
Oph	17	17	17	17	17	17	17	24	24
Lyr	8	8	18	18	18	8	8	23	23
Cyg	24 ⁶	24	14	14	14	14	14	8	8
Sge	4	4	4	4	4	4	4	18	18

⁴ Titles: ἐκ τῶν ἱππάρχου περὶ τῶν ἀστέρων ποσοῦ A ἐκ τῶν ἱππάρχου περὶ τῶν ἄστρων τοῦ πόλου T ἐκ τῶν ὑπάρχων ἄστρων γ ἐκ τῶν ἱπάρχου δ περὶ τῶν ἀπλάνων ἀστρων θέσεως \mathbf{P}_1 om. O. For lacunae and numerals, see Tables 1–4 below.

⁵ In O and \mathbf{P}_1 , CrB and Her are merged to form ‘kneeling Stephanus’ (Στέφανος ὁ ἐν γόνασιν)! This may be due to a reminiscence of protomartyr Stephanos, who knelt while being stoned to death (*Acts* 7:60: θεῖς δὲ τὰ γόνατα).

⁶ The corruption of 14 to 24, a misreading of ι as κ, is also attested in α for Cas. That ιδ (14) was the original reading is shown by its presence in both β and \omicron .

⁷ In α , the entry Aql (ἀετός) was omitted through haplography (the following entry is δελτωτός, ‘Triangle’, standing for δελφίς, ‘Dolphin’). This implies that it had undergone previous corruption (AETOS > ΔΕΛΤΟΣ in uncial script, the form δέλτος being attested in β).

	α		β					\circ	
	A	T	γ			δ		O	P ₁
			P ₂	P ₃	P ₄	P ₅	S		
Aql	abest ⁷	abest	4	4	4	4	4	4	4
Del	9	9	9	9	9	9	9	4	4
Equ	18	18	18	18	18	18	18	9	9
Cep	19	19	19	19	19	19	19	18	18
Cas	24	24	14	14	14	14	14	19	14
And	20	20	20	20	20	20	20	14	19
Tri	3	3	3	3	3	3	3	8	14
Per	8 ⁸	8	19	19	19	19	19	3	20
Aur	8	8	8	8	8	8	8	19	13
Capella	abest	abest	abest	abest	abest	abest	abest	abest	19
Haedi	abest	abest	abest	abest	abest	abest	abest	abest	8

Table 2. Southern Constellations

	α		β					\circ	
	A	T	γ			δ		O	P ₁
			P ₂	P ₃	P ₄	P ₅	S		
Eri ⁹	abest	abest	abest	abest	abest	abest	abest	13	13
Hya	27	27	27	27	27	27	27	27	17
Crt	10	10	10	10	10	10	10	10	10
Crv	7	7	7	7	7	7	7	7	7
Nav	abest	abest	13	13	13	13	13	26	26
Cen	26	26	26	26	26	27 ¹⁰	27	24	24
Lup	13	13	lac.	lac.	lac.	lac. ¹¹	lac.	8	20
Ara	4	4	4	4	4	8 ¹²	8	abest	20
CrA	lac. ¹³	lac.	lac.	lac.	lac.	lac.	lac.	abest	7
PsA	18	18	12	12	12	12	12	12	4
Cet	13	13	14	14	14	20	20	13	20
Ori	18	18	18	18	18	18	18	18	13

⁸ In α , 8 was probably copied by mistake into the entry Per from the entry Aur.

⁹ Note that O also has Ἡριδανός (another name for the same constellation), without a number of stars, after Lep.

¹⁰ In δ , 27 is the sum of 26 stars for Cen and 1 for Lup, because, as the manuscripts state, 'it (viz. the Centaur) holds in its right hand Lupus, a star' (θηρίον δὲ ἔχει ἐν τῇ δεξιᾷ χειρὶ ἄστρον)!

¹¹ In δ , the entry for Lup was taken for a single star, as noted above. Thus, the numeral 8 shifted down to Ara.

¹² The numeral 8 has shifted down from Lup, causing the elimination of the original 4 present in α , γ and \circ (for \circ see Table 4 below).

¹³ A has a dotted omicron with *spiritus asper* after the constellation name. As noted by OLIVIERI 1898, p. 23, although the letter looks like a theta ($\theta = 9$), this is a highly unlikely reading, and the absence of the abbreviation for ἀστέρους ('stars'), otherwise used throughout, indicates that there is a lacuna.

	α		β					\circ	
	A	T	γ			δ		O	P ₁
			P ₂	P ₃	P ₄	P ₅	S		
Lep ¹⁴	21	21	26	26	26 ¹⁵	27	27	7	18
CMa ¹⁶	abest	abest	abest	abest	abest	abest	abest	lac.	7
CMi	3	3	3	3	3	3	3	3	3

Table 3. Zodiacal Constellations

	α		β					\circ	
	A	T	γ			δ		O	P ₁
			P ₂	P ₃	P ₄	P ₅	S		
Cnc	6 ¹⁷	6	16	16	16	16	16	lac.	lac.
Leo	19	19	19	19	19	lac.	lac.	lac.	lac.
Vir	19	19	19	19	19	19	19	lac.	lac.
Lib	4	4	4	4	4	4	4	lac.	lac.
Sco	15	15	15	15	15	15	15	lac.	lac.
Sag	15	15	16	16	16	16	16	lac.	lac.
Cap	26	26	26	26	26	16	16	lac.	lac.
Aqu	18	18	18	18	18	18	18	lac.	lac.
Psc	41	21 ¹⁸	41	41	41	lac.	lac.	lac.	lac.
Ari	17	17	17	17	17	17	17	lac.	lac.
Tau	18	18	18	18	18	18	18	lac.	lac.
Gem	abest	abest	19	19	19	19	19	lac.	lac.

Branches α and β present few problems: the necessary explanations are given in the footnotes to Tables 1–3. As for branch \circ , a further table will help to understand the several downward shifts in the numerals. In the leftmost col-

¹⁴ As explained below, the entry CMa was quite prone to being omitted. It seems that the numbers for Lep in α and β were compounded with those for CMa. Indeed P₄, with its strange sign similar to the abbreviation for ἡμέρα and, hence, to the Arabic numeral 6, harbors traces of confusion. This manuscript may well be an illustration of the intermediate stage that led to 26 in the rest of γ . 21 in α is a plausible number for CMa (which contains 20 stars in the *Epitome* of the *Catasterisms*); but another possibility is that κζ (27) is the mere juxtaposition of original κ (20) for CMa and ζ (7) for Lep (this last is attested by \circ , see Table 4 below). This second possibility, although more complicated in terms of paleography, seems preferable, because the vast majority of entries in the *Catalogue* give the same number as the *Epitome* of the *Catasterisms*.

¹⁵ The numeral 6 is written with the sign for ἡμέρα (as noted by BOLL 1901, p. 187 and WEINSTOCK 1951, p. 190).

¹⁶ The entry CMa (Κύων) was doubly prone to being omitted: first, through haplography (with the neighboring entry CMi Προκύων); and, second, because the name Κύων is often used for the sole star Sirius instead of the constellation CMa.

¹⁷ The number 6 (ς) could be a corruption of 16 (ις), or vice-versa. The ι (10) could result from the misreading of a random vertical stroke, or an original ι could have been omitted, perhaps due to misinterpretation as such a stroke. Comparison with the *Epitome* of the *Catasterisms*, registering 18 stars for Cnc, indicates that 16 is the more likely reading. On the use of the *Epitome* to establish the original number in the Hipparchan catalogue, see below.

¹⁸ In T, κ (20) is a corruption of μ (40) in minuscule script, as indicated by comparison with β, where only the number 41 is attested.

umn is given the number of stars in the sub-archetype of branch o. When **O** and **P₁** disagree, we suppose that agreement with another branch of the tradition indicates the number in the sub-archetype o. Explanations of the less obvious errors are given, when possible, in the footnotes.

Table 4. Branch o

	O	P₁	o
UMa	24	24	24
UMi	7	7	7
Dra	15	15	15
Boo	14	14	14
CrB	lac.	lac.	9 ¹⁹
Her	9	9	24
Oph	24	24	23
Lyr	23	23	8
Cyg	8	8	18
Sge	18	18	4
Aql	4	4	4
Del	4	4	9
Equ	9	9	18
Cep	18	18	19
Cas	19	14	14
And	14	19 ¹⁹	20
Tri	8 ²¹	14	3
Per	3	20	19
Aur	19	13 ²²	8
Capella ²³	abest	19	abest
Haedi	abest	8	abest
Eri	13	13	13 ²⁴
Hya	27	17	27
Crt	10	10	10

¹⁹ See n. 5 above. The error here causes a shift in the numbers, with the number for CrB moving down to Her, and so on. In the far right-hand column, we restore the numbers at their original place.

²⁰ In **P₁**, a second shift downwards of the numbers begins at the entry And. The reason for this shift is not obvious, but it may be due to a failed attempt to restore the correct numerals. Henceforth, each numeral in **P₁** corresponds to the numeral two entries above in the sub-archetype.

²¹ η (8) is a corruption of κ (20) in minuscule, perhaps encouraged by the fact that the smaller number better matches the constellation's name.

²² ιγ (13) seems to be a corruption of γ (3). Random vertical strokes are easily taken for the numeral ι.

²³ The stars Capella (Goat) and Haedi (Kids), consisting respectively of one and two stars from the constellation Auriga, are only present in **P₁**. They scarcely belong with the rest of the entries, and appear to be an addition made to account for the two otherwise meaningless numbers pushed down by the double shift in this manuscript.

²⁴ The shift in numbers ceases here, suggesting that the northern and southern constellations were originally listed in separate tables.

	O	P₁	o
Crv	7	7	7
Nav	26	26	26
Cen	24	24	24
Lup	8 ²⁵	20 ²⁶	8
Ara	abest	20 ²⁷	4 ²⁸
CrA	abest	7	7
PsA	12	4 ²⁹	12
Cet	13	20 ³⁰	13
Ori	18	13	18
Lep	7	18	7
CMA	lac.	7 ³¹	lac.
CMi	3	3	3

For the remainder of this study, the following hypotheses are made (in the belief that they are supported by the evidence given above):

1. branches α , β and o have not been contaminated by one another (in particular, voluntary collation seems quite unlikely, considering the small size of the text)
2. since α and β often agree, and elsewhere often exhibit errors derived from a similar sub-archetype, the agreement of o with either α or β (or a sub-branch of β) indicates the number in the archetype.

If these hypotheses are true, we can deduce the number of stars in the archetype for all entries except Boo, Oph, Cyg, Eri, Nav, Cen, CrA, Cnc and Sag. For the nine entries where the number in the archetype cannot be deduced in

²⁵ The numeral 8 (η) comes after an entry merging three constellations (Lup, Ara and CrA). Weinstock thought that it belonged to the entry CrA. The rest of the tradition, however, shows that it belongs to Lup.

²⁶ κ (20) is a corruption of η (8) in minuscule.

²⁷ Here, in P_1 , the number 20 is carried over from the previous entry, due to the similar names of the successive constellations ($\theta\eta\rho\iota\omicron\nu$ for Lup, then $\theta\eta\pi\eta\rho\iota\omicron\nu$, originally $\theta\upsilon\tau\eta\rho\iota\omicron\nu$ for Ara).

²⁸ After Lup, O writes $\lambda\acute{\alpha}\rho\omicron\varsigma$ δ (i.e. 4) $\iota\chi\theta\upsilon\varsigma$ $\iota\beta$ (i.e. 12). The original name of PsA has long puzzled scholars. Whatever it may have been, it is clear that the numeral δ is out of place (compare the name of the constellation in the rest of the tradition: \acute{o} $\lambda\acute{\alpha}\rho\omicron\varsigma$ $\iota\chi\theta\upsilon\varsigma$ in P_1 , $\acute{\alpha}\delta\rho\omicron\varsigma$ $\iota\chi\theta\upsilon\varsigma$ in AP_5ST , and $\acute{\alpha}\nu\delta\rho\omicron\varsigma$ $\iota\chi\theta\upsilon\varsigma$ $P_2P_3P_4$). Comparison with the other branches α and β shows that it must come from the entry Ara ($\theta\upsilon\tau\eta\rho\iota\omicron\nu$), the name of which is deleted through haplography due to the resemblance with the previous entry Lup ($\theta\eta\rho\iota\omicron\nu$).

²⁹ The numeral δ (4) has most likely wandered down from the entry Ara following its deletion through haplography (see note above on Ara). This addition causes all following numbers to shift downwards once as compared to those in O.

³⁰ There is no obvious reason for what comparison with the other branches shows to be the corruption of 12 ($\iota\beta$) to 20 (κ). Fortunately, not all errors must receive a purely paleographical explanation, as the scribes were also affected by psychological factors such as distraction!

³¹ In P_1 , the entry CMA is after CMi, but this is the original order (as followed by Weinstock in his edition), for the numeral 7 is at its expected place here (following the downward shift of numerals starting from the entry Ara in P_1).

this way, it must be decided whether other star catalogues (e.g.: the *Epitome* of the *Catasterisms* or Ptolemy's catalogue in the *Almagest*) can serve as guides to the original number.

A preliminary indication is given by the fact that the numbers of stars, for those entries where they can be deduced, agree with the numbers from the latest edition of the *Epitome* of the *Catasterisms* in 27 out of 36 cases, that is 75% of the time.³² This prompts us to have a closer look at the rest of the *Catasterisms* tradition, which is less lacunose: the notes on constellations in *Aratus latinus*, the *Scholia Basileensia* and *Scholia Stroziana* to Germanicus, and Hyginus's *De astronomia*. The following table gives the totals of stars per constellation as they stand in each of the five texts, without any of the editors' corrections and supplements.³³ Bold type indicates agreement with the Hipparchan catalogue, and italics indicate those entries where the number in the Hipparchan catalogue cannot be reconstructed mechanically.

Table 5. Stars per constellation in the *Catasterisms* tradition³⁴

	Epitome	Arat. Lat.	Σ Basil.	Σ Strozz.	Hyginus
UMa	24	om.	23	24	21
UMi	7	7	7	7	7
Dra	om.	om.	15	15	15
Her	19	19	24	24	19
CrB	9	9	9	9	9
<i>Oph</i>	17	17	16 (17 π)	17	23
<i>Ser</i>	om.	23	28 (23 π)	30	17
Sco	om.	15 ³⁴	15	15	15
Lib	4	4	4	4	4
<i>Boo</i>	om.	14	14	14	14
Vir	19	19	19	19	19
Gem	om.	15	19	19	19
<i>Cnc</i>	18	10	17	16	17
Leo	om.	19	19	19	19
Aur	8	8	8	8	om.
Tau	18	18	15	18	18
Cep	om.	19	17	19	19

³² See ed. PÀMIAS I MASSANA – ZUCKER 2013.

³³ Both sets of scholia as well as Hyginus were excerpted alongside the *Epitome* in the synoptic edition of the *Catasterisms* by ROBERT 1878. For *Aratus Latinus*, see ed. MAASS 1898, pp. 180–271; for the *Scholia Stroziana* and *Scholia Basileensia*, see ed. DELL'ERA 1979a and 1979b, respectively; for Hyginus's *De astronomia*, see ed. LE BŒUFFLE 1983. According to DELL'ERA 1979b, the archetype of the *Scholia Stroziana* may be considered as an independent manuscript of the *Scholia Basileensia* tradition; here, the star totals from the *Stroziana* are given in a separate column. Not all manuscript variants are reported: in general, only the one selected by the editor is given, along with variants rejected by the editor but agreeing with the numbers from the Hipparchan catalogue.

³⁴ In all four texts, the manuscripts in fact give the total of stars for Sco and Lib, i.e. 19. We subtract 4 to arrive at the number for Sco (19 – 4 = 15).

	Epitome	Arat. Lat.	Σ Basil.	Σ Strozz.	Hyginus
Cas	om.	14	14	14	14
And	om.	20	20	20	20
Equ	om.	18	18	18	18
Ari	17	17	13 (16 P)	18	17
Tri	3	3	3	3	3
Psc	43	41	36	39	41
Per	om.	19	29	18 (19 AM)	19
Lyr	9	9	8	9	om.
Cyg	om.	9	13	13 (14 PRV)	13
Aqu	om.	18	18	18	14
Cap	22	26	26	24 (26 rell.)	20 (26 alii)
Sag	15	16	13	15	15 (16 alii)
Sga	4	4	4	4	4
Aql	4	4	4	4	om.
Del	9	9	9	9	9
Ori	om.	18	17	17	17 (18 alii)
CMa	13	20	20	20	19 (20 alii)
Lep	om.	7	7	7	6
Nav	om.	26	27	26	16
Cet	13	13	13	14	13
Eri	14	16	13	17	13
PsA	12	12	12	12	12
Ara	3	14	4	4	4
Cen	24	24	53	24	24
Lup	7 (8P)	9	10	9 ³⁵	10
Hya	27	3	27	26	27
Crv	7	4	7	7	7
Crt	6	10	10	10	10
CMi	3	3	3	3	3
CrA ³⁶	abest	abest	abest	abest	abest

The high degree of similarity that is evidenced by the fact that every number from the Hipparchan catalogue appears somewhere in the *Catasterisms* tradition does not imply that the *Catasterisms* contaminated the Hipparchan tradition. On the contrary, each branch of the tradition taken separately disagrees so often with every other that contamination seems quite unlikely. Hence, where one or more of the texts deriving from the *Catasterisms* agree with at least one of the branches in the tradition of the Hipparchan catalogue, this indicates the original number in the catalogue. This plays out as follows (the number agreeing with the *Epitome* is underscored):

³⁵ In the Schol. Strozz., the manuscripts in fact give the total of stars for Cen and Lup, i.e. 33. We subtract 24 to arrive at the number for Lup (33 – 24 = 9).

³⁶ CrA is omitted in the entire *Catasterisms* tradition.

Table 6.

Boo	19 $\alpha\beta$	<u>14</u> o
Oph	<u>17</u> $\alpha\beta$	<u>23</u> o
Cyg	<u>14</u> β	18 o
Eri		<u>13</u> o (absent from all other branches)
Nav	13 β	<u>26</u> o
Cen	26 $\alpha\gamma$	<u>24</u> o
CrA		7 o (absent from all other branches)
Cnc	6 α	<u>16</u> β
Sag	<u>15</u> α	<u>16</u> β

For Boo, Cyg, Eri, Nav and Cen, agreement with the *Catasterisms* indicates with absolute certainty what number was in the archetype of the Hipparchan catalogue. The case of Oph is interesting: 17 and 23 appear to have been the numbers of stars in Oph and Ser, respectively, in the *Catasterisms* tradition; this is proof that the archetype of the Hipparchan catalogue had both constellations, and that the entry for Ser was later omitted (by a haplography of sorts), leading in branches α and β to the omission of 23, and in branch o to the omission of 17. Incidentally, this omission has not been detected by previous editors; we would add the text Ὀφίς κγ' ("Serpent, 23") after the entry for Oph. CrA appears to be a later addition, since it is absent from the *Catasterisms* and from Hipparchus's other work; we would athetize it.³⁷ Finally, the number of stars in Sag cannot be decided.

To sum up, the numbers that were in the archetype can be reconstructed as follows (for each constellation the number in parentheses is the one assumed in Weinstock's edition, when different):

Table 7. Stars per constellation in the archetype

Northern constellations	Southern constellations	Zodiacal constellations
UMa 24	Eri 13	Cnc 16
UMi 7	Hya 27	Leo 19
Dra 15	Crt 10	Vir 19
Boo 14 (19)	Crv 7	Lib 4
CrB 9	Nav 26	Sco 15
Her 24	Cen 24	Sag 15 or 16 (16)
Oph 17	Lup 8 (13)	Cap 26
<Ser 23>	Ara 4	Aqu 18
Lyr 8	[CrA 7 (8)]	Psc 41
Cyg 14	PsA 12	Ari 17

³⁷ See BOLL – GUNDEL 1937, col. 1018.

Northern constellations	Southern constellations	Zodiacal constellations
Sga 4	Cet 13	Tau 18
Aql 4	Ori 18	Gem 19
Del 9	Lep 7	
Equ 18	CMa 20 (21)	
Cep 19	CMi 3	
Cas 14		
And 20		
Tri 3		
Per 19		
Aur 8		

The total number of stars in the 46 constellations above (including Ser, excluding CrA) is 692 or 693.³⁸

* * *

To conclude, the numbers for the reconstructed archetype are significantly closer to those in the *Catasterisms* tradition than had previously been assumed. Indeed, the numbers in the archetype may arguably have been identical to the star totals for the common source of the entire extant *Catasterisms* tradition. These conclusions lead to further questions regarding the texts' authorship.

For instance: Do the traditions ascribed to Eratosthenes and Hipparchus regarding the numbers of stars-per-constellation originate from a common textual or iconographic source, on which one or both of those illustrious names may have been applied pseudepigraphically? If so, this might explain the title of the Latin list of stars B (Maass [1898] 137), with ascriptions to both Eratosthenes and Hipparchus.

Or, conversely, was there a contamination previous to the archetype of the Hipparchan catalogue and to the common source of the extant *Catasterisms* tradition? Indeed, the existence of the *Epitome* implies that one or more unepitomized versions of the text preceded it. And these may have derived from a catalogue of stars or other work by Eratosthenes, while the archetype of the Hipparchan catalogue most likely derives from a more complete work – in the form either of a list of star coordinates grouped by constellations or of a (perhaps introductory) treatise on astronomical matters.

If both traditions of numbers do go back to their presumed authors, does this mean that Hipparchus started his own catalogue as a continuation of Eratosthenes'? Does Hipparchus's *Commentary on the Phaenomena of Eudoxus*

³⁸ As a comparison, Ptolemy's catalogue in *Almagest* VII–VIII gives the coordinates of 1025 stars.

and *Aratus* reflect a later stage of this continuation or a catalogue drawn up on an entirely new basis?

These questions and more illustrate the need for further philological work on the fragments of these two scholars and of other ancient astronomers.

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