

Hipparchus' Commentary on Aratus and Eudoxus Between Science and polemical 'furor'

Francesca Schironi
University of Michigan

Abstract: <https://camws.org/sites/default/files/meeting2021/abstracts/HipparchusAratusEudoxus.pdf>

1. Hipparchus on Aratus

1.1.§4 ἀλλὰ τὸ μὲν ἐξηγήσασθαι τὴν ἐν τοῖς ποιήμασι διάνοιαν οὐ μεγάλης ἐπιστροφῆς προσδεῖσθαι νομίζω· ἀπλοῦς τε γὰρ καὶ σύντομος ἐστὶ ποιητής, ἔτι δὲ σαφῆς τοῖς καὶ μετριῶς παρηκολουθηκόσι· τὸ δὲ συνέιναι τὰ λεγόμενα περὶ τῶν οὐρανίων ὑπ' αὐτοῦ, τίνα τε συμφώνως τοῖς φαινόμενοις ἀναγράφεται καὶ τίνα διημαρτημένως, τοῦτ' ὠφελιμώτατον ἡγήσασθαι ἂν τις καὶ μαθηματικῆς ἴδιον ἐμπειρίας.

But I think that the interpretation of the poem's content does not need a great intellectual effort. For the poet is simple and concise, and he is also clear for those who follow him even with moderate knowledge. **But to understand the things he says about the celestial bodies, what has been written in agreement with the visible phenomena and what has been written incorrectly**—one could consider this the most useful [undertaking], and an [undertaking] proper to the mathematical practice.

2. Hipparchus on the poetry of Aratus

1.1.§6 τοῦτο δὲ ποιῆσαι προεθέμην οὐκ ἐκ τοῦ τοὺς ἄλλους ἐλέγχειν φαντασίαν ἀπενέγκασθαι προαιρούμενος· (κενὸν γὰρ καὶ μικρόψυχον παντελῶς· τούναντίον δὲ δεῖν οἶομαι πᾶσιν ἡμᾶς εὐχαριστεῖν, ὅσοι τῆς κοινῆς ἕνεκεν ὠφελείας ἰδίᾳ πονεῖν ἀναδεχόμενοι τυγχάνουσιν·) ἀλλ' ἕνεκα τοῦ μήτε σὲ μήτε τοὺς λοιποὺς τῶν φιλομαθούντων ἀποπλανᾶσθαι τῆς περὶ τὰ φαινόμενα κατὰ τὸν κόσμον θεωρίας. 1.1.§7 ὅπερ εὐλόγως πολλοὶ πεπόνθασιν· ἢ γὰρ τῶν ποιημάτων χάρις ἀξιοπιστίαν τινὰ τοῖς λεγομένοις περιτίθησι, καὶ πάντες σχεδὸν οἱ τὸν ποιητὴν τοῦτον ἐξηγούμενοι προστίθενται τοῖς ὑπ' αὐτοῦ λεγομένοις.

I proposed for myself to do this not because I desire to obtain prestige by proving the others wrong (that is empty and entirely mean; on the contrary, I believe that we must be grateful to all those who happen to undertake hard work on their own for the common good). **But [I do this] so that you and the others who are intellectually curious might not be misled in the observation of the visible phenomena in the cosmos.** This is something that many have suffered, as may be expected. **For the grace of the poem lends a certain sense of trustworthiness to its content, and almost all the interpreters of this poet support what he is says.**

3. Eudoxus and Aratus on Cepheus

1.2.§11 Ἐπὶ δὲ τοῦ Κηφέως ὁ μὲν Εὐδοξος οὕτως: “ὑπὸ δὲ τὴν οὐρὰν τῆς Μικρᾶς Ἄρκτου τοὺς πόδας ὁ Κηφεὺς ἔχει πρὸς ἄκραν τὴν οὐρὰν τρίγωνον ἰσόπλευρον ποιοῦντας· τὸ δὲ μέσον αὐτοῦ πρὸς τῇ καμπῇ τοῦ διὰ τῶν Ἄρκτων Ὀφείως.”

Regarding Cepheus, Eudoxus [says] the following: “under the tail of the Small Bear Cepheus has his feet and they make an equilateral triangle toward the tip of [the Small Bear's] tail. His [i.e. Cepheus'] middle part is toward the bending of the Serpent between the Bears [i.e. the Dragon]”.

1.2.§12 ὁ δὲ Ἄρατος φησιν (*Phaen.* 184-187)·
ἴση οἱ στάθμη νεάτης ἀποτείνεται οὐρῆς

εἰς πόδας ἀμφοτέρους, ὅσση ποδὸς εἰς πόδα τείνει,
αὐτὰρ ἀπὸ ζώνης ὀλίγον κε μεταβλέψειας
πρώτης ἰέμενος καμπῆς σκολιοῖο Δράκοντος.
...

And Aratus says: “an equal line extends from the end of [the Small Bear’s] tail to both [of Cepheus’] feet, [a line that is] as long as [the line] that extends from foot to foot. And you may look a little away from his belt if you are eager [to see] the first bend of the winding Dragon” (*Phaen.* 184-187). ...

4. Hipparchus’ strategies – 1: their description of constellations is imprecise: Cepheus

1.2.§12 ...παρ’ ἑκατέρω δ’ αὐτῶν τὸ πρῶτόν ἐστι ψεῦδος· τὸ γὰρ μεταξύ τῶν ποδῶν τῶν τοῦ Κηφέως διάστημα ἔλασσόν ἐστιν ἑκατέρου τῶν πρὸς τὴν οὐρὰν διαστημάτων.

In both of them the first statement is false. The distance between the feet of Cepheus (γ κ Cep) is smaller than the distance of each toward the tail [of the Small Bear] (α UMi).

1.5.§19 Ἐξῆς <δὲ> ἀγνοοῦσι πάντες περὶ τοῦ Κηφέως, ὅτι οἱ πόδες αὐτοῦ μετὰ τοῦ ἐν ἄκρᾳ τῆς οὐρᾶς τῆς Ἄρκτου τρίγωνον ἰσόπλευρον περιέχουσιν, ὡς καὶ ὁ Ἄρατος φησιν (*Phaen.* 184-185).

ἴση οἱ στάθμη νεάτης ἀποτείνεται Ἄρκτου
εἰς πόδας ἀμφοτέρους, ὅσση ποδὸς εἰς πόδα τείνει.

ἢ γὰρ μεταξύ τῶν ποδῶν ἐλάσσων ἐστὶν ἑκατέρας τῶν λοιπῶν, ὥστε ἰσοσκελὲς τρίγωνον γίνεσθαι, καὶ μὴ ἰσόπλευρον.

In the following [lines] they are all mistaken about Cepheus, [when they say] that its feet (γ κ Cep) form an equilateral triangle with the [star] in the tip of the tail of the [Small] Bear (α UMi), as even Aratus says:

“an equal line extends from the end of [the Small Bear’s] tail to both [of Cepheus’] feet, [a line that is] as long as [the line] that extends from foot to foot” (*Phaen.* 184-185).

In fact, the line between the feet is less than the other two, so that it is an isosceles, and not an equilateral triangle.

5. Eudoxus and Aratus on Cepheus and Cassiopeia

1.2.§13 Πάλιν ἐπὶ τῆς Κασσιόπειας ὁ μὲν Εὐδοξος· “τοῦ μὲν Κηφέως ἔμπροσθέν ἐστιν ἡ Κασσιόπεια, ταύτης δὲ ἔμπροσθεν ἡ Ἄνδρομέδα...

And again, regarding Cassiopeia Eudoxus [says]: “in front of Cepheus there is Cassiopeia, ...

1.2.§14 ὁ δὲ Ἄρατος (*Phaen.* 188-189).

τοῦ δ’ ἄρα δαιμονίη προκυλίνδεται οὐ μάλα πολλὴ
νυκτὶ φαινομένη παμμήνιδι Κασσιόπεια.

And Aratus [says]: “in front of him [i.e. Cepheus] revolves miserable Cassiopeia, who is not shining greatly on the night of the full moon” (*Phaen.* 188-189).

6. Hipparchus’ strategies – 1: their description of constellations is imprecise: Cepheus and Cassiopeia (2)

1.5.§20 <Ἐν δὲ τοῖς ἐξῆς ἀγνοεῖ ὁ Ἄρατος, λέγων περὶ τῆς Κασσιόπειας (*Phaen.* 188). “τοῦ δ’ ἄρα δαιμονίη προκυλίνδεται.” κεῖται δὲ ἡ Κασσιόπεια πρὸς ἀνατολὰς τοῦ Κηφέως.> καὶ μὴν οὐδὲ τοῦτ’ ἔστιν εἰπεῖν, ὅτι τὰ πρὸς ἀνατολὰς κείμενα {ἀρρηνικῶς} πρότερα καλεῖ ὁ Ἄρατος· τουναντίον γὰρ ἐν πολλοῖς τὰ πρὸς δύσιν μέρη πρότερα καλεῖ. εὐθέως γοῦν τὰ περὶ τοῦ Κριοῦ εἰπὼν ἐπιφέρει τὰ περὶ τοὺς Ἰχθύας καὶ φησιν (*Phaen.* 239). “<οἱ δ’ ἄρ’ ἔτι προτέρω, ἔτι δ’ ἐν προβολῆσι νότιοι, Ἰχθύες,>” οἱ καὶ προηγούνται αὐτοῦ.

<In the following lines Aratus is mistaken when he says about Cassiopeia: “in front of him [i.e. Cepheus] revolves miserable Cassiopeia” (*Phaen.* 188); but Cassiopeia lies to the east of Cepheus.> ...And it is not possible to say this, namely, that Aratus calls the [sections of the sky] that lie toward the east as ‘those in front’. For, on the contrary, in many cases he calls the sections toward the west as ‘those in front’. For example, talking of the [sections of the sky] around the Ram he mentions those around the Fishes and says:

<“And even more in front, in the projecting limit of the south, are the Fishes” (*Phaen.* 239)>: They [i.e. the Fishes] also precede it [i.e. the Ram].

7. Hipparchus’ strategies – 2: Aratus is even worse than Eudoxus

1.5.§21 Ψευδῶς δὲ καὶ τοῦτο ὁ Ἄρατος περὶ τῆς Κασσιόπειας λέγει, ὅτι ἐστὶν (*Phaen.* 188-190):

οὐ μάλα πολλῆ

νυκτὶ φαεινομένη παμμήνιδι Κασσιόπεια·

οὐ γάρ μιν πολλοὶ καὶ ἐπημοιβοὶ γανώωσιν·

οἱ γὰρ πλείστοι τῶν ἐν αὐτῇ δεικνυμένων λαμπρότεροί εἰσι τῶν ἐν τοῖς ὤμοις τοῦ Ὀφιοῦχου, οὓς φησι καὶ ἐν τῇ πανσελήνῳ ἐκφανεῖς εἶναι, λέγων οὕτως (*Phaen.* 77-79)·

τοῖοί οἱ κεφαλῇ ὑποκείμενοι ἀγλαοὶ ὤμοι

εἶδονται· κείνοι γε καὶ ἂν διχόμηνι σελήνῃ

εἰσωποὶ τελέθειεν·

Aratus also makes this false statement about Cassiopeia, [namely,] that:

“Cassiopeia—is—not shining greatly on the night of the full moon; for not many [stars], with light that alternates, make her bright” (*Phaen.* 188-190).

In fact, of those [stars] that can be seen within her shape, the majority are brighter than those on the shoulders of the Serpent-Holder, which, he says, are visible also in the full moon, when he says the following:

“So bright appear his shoulders, which lie below his head; they may be visible also during the full moon” (*Phaen.* 77-79).

1.5.§22 σχεδὸν δὲ καὶ τῶν ἐν τῇ Ἀνδρομέδᾳ λαμπρότεροί εἰσι, πλὴν τοῦ ἐν τῇ κεφαλῇ καὶ τοῦ ἐπομένου τῶν ἐν τῇ ζώνῃ, περὶ ἧς φησιν (*Phaen.* 198-201)·

οὐ σε μάλ’ οἶω

νύκτα περισκέψασθαι, ἴν’ αὐτίκα μάλλον ἴδῃαι·

τοίη οἱ κεφαλῇ, τοῖοι δὲ οἱ ἀμφοτέρωθεν

ὤμοι καὶ πόδες ἀκρότατοι καὶ ζώματα πάντα·

They are almost brighter than the [stars] in Andromeda, with the exception of the [star] in the head (α And) and the trailing [star] (β And) of those in the belt, on which he says:

“I do not think you need to look hard in the night in order to see her right away; so [bright] are her head, her shoulders on both sides, and the tip of her feet, and the entirety of her girdle” (*Phaen.* 198-201).

8. Aratus on Cepheus and the rising of three zodiac constellations

Phaen. 625-627, 632-633 (when the Claws [= Balance] start to rise, Cepheus sets up to his shoulders)

Ἥμισυ δὲ Στεφάνοιο καὶ αὐτὴν ἔσχατον οὐρὴν

Κενταύρου φορέουσιν ἀνερχόμεναι ἔτι Χηλαί·

Τῆμος ...

Καὶ τὸ μὲν ἐς λοφίην τετραμμένον ἄχρι παρ’ αὐτὴν

δύνει, ἀτὰρ Κηφεὺς κεφαλῇ καὶ χειρὶ καὶ ὤμοις·

When they are still coming up, the Claws bring with them half of the Crown and the last part of the tail itself of the Centaur. At that time ...

and [the Sea-Monster], turned toward its own crest, sets up to the crest itself, **but Cepheus [sets] with his head, hand and shoulders.**

Phaen. 645-646, 649-652 (when the Scorpion starts to rise, Cepheus sets up to his belt)

...Τοῦνεκα δὴ καὶ φασὶ περαιόθεν ἐρχομένοιο
Σκορπίου
... ὁ δὲ ζώνη τότε Κηφεὺς
γαῖαν ἐπιξύνει, τὰ μὲν ἐς κεφαλὴν μάλα πάντα
βάπτων ὠκεανοῖο, τὰ δ' οὐ θέμις, ἀλλὰ τάγ' αὐτὰι
Ἄρκτοι κωλύουσι πόδας καὶ γούνα καὶ ἰξύν.

...and for this reason they say that when the Scorpion comes to the horizon **In that moment Cepheus with his belt brushes against the earth while he dips everything else, up to his head, into the Ocean, but the rest is not allowed—the Bears prevent him [from dipping] his feet, his knee and his waist.**

Phaen. 673-675 (when the Archer starts to rise, Cepheus rises up to his breast)

τόξω ...καὶ Τοξότη ἀντέλλοντι.
Σὺν τοῖς Ἑρμαίῃ τε Λύρῃ καὶ στήθεος ἄχρις
Κηφεὺς ἤψου παρελαύνεται ὠκεανοῖο,

With the bow...and with the Archer who rises.

With them the Lyre of Hermes and Cepheus, **up to his breast, move up away from the eastern ocean.**

9. Hipparchus' strategies – 3: their account of the simultaneous risings and settings is scientifically incorrect: what rises and set of Cepheus

2.2.§59 ...διαφωνοῦσι δὲ πρὸς τὸ φαινόμενον καὶ ἐν τοῖς περὶ τοῦ Κηφέως· ἢ τε γὰρ κεφαλὴ αὐτοῦ μόνον δύνει καὶ ἀνατέλλει, οἱ δὲ ὤμοι καὶ τὸ στήθος ἐν τῷ αἰεὶ φανερωῷ τμήματι φέρονται.

They are in disagreement with the visible phenomenon also in their discussion of Cepheus. **For only his head sets and rises, but the shoulders and the breast are borne in the ever-visible section.**

1.7.§20 ἐν γὰρ τοῖς περὶ τὴν Ἑλλάδα τόποις οὐχ οἶον ἕως τῆς ζώνης δύνει ὁ Κηφεὺς, ἀλλ' οὐδὲ ἕως τῶν ὤμων. οἱ γὰρ ἐν τῇ κεφαλῇ αὐτοῦ κείμενοι ἀστέρες μόνον δύνουσιν· οἱ δὲ ὤμοι ἐν τῷ αἰεὶ φανερωῷ τμήματι φέρονται, οὔτε δύνοντες, οὔτε ἀνατέλλοντες· ὁ μὲν γὰρ ἐν τῷ δεξιῷ ὤμῳ λαμπρὸς ἀστήρ ἀπέχει ἀπὸ τοῦ πόλου μοίρας λε' 4'', ὁ δὲ ἐν τῷ ἀριστερῷ ὤμῳ λαμπρὸς ἀπέχει μοίρας λδ' δ''. 1.7.§21 ὅπου δὲ ἐστὶν ἡ μεγίστη ἡμέρα ὠρῶν ιδ' 4'' ἐκεῖ ὁ αἰεὶ φανερὸς κύκλος ἀπέχει ἀπὸ τοῦ πόλου μοίρας λς', ἐν Ἀθήναις δὲ μοίρας λζ'. δηλὸν οὖν ὅτι βορειότεροι αἰεὶ φέρονται τοῦ αἰεὶ φανεροῦ κύκλου οἱ ἐν τοῖς ὤμοις κείμενοι τοῦ Κηφέως λαμπροὶ ἀστέρες ἢ, ὡς τινὲς <φασιν>, ἐν ταῖς χερσὶ τοῦ Κηφέως, ὡς ἂν διωργιωμένου αὐτοῦ τῶν ὤμων αὐτῶν ἀναστεριστῶν ὄντων.

In fact, in the places around Greece it is not possible for Cepheus to set up to the belt, but not even up to the shoulders. Only the stars that lie in his head set, while the shoulders are borne in the ever-visible section, not setting, nor rising. For the bright star in his right shoulder (α Cep) is 35 degrees and ½ from the pole and the bright [star] in his left shoulder (ι Cep) is 34 degrees and ¼ [from the pole]. **Where the longest day is 14 hours and ½ [i.e. Rhodes], there the ever-visible circle is 36 degrees from the pole and in Athens [it is] 37 degrees [from the pole].** It is thus clear that the bright stars that lie in the shoulders of Cepheus or, as some say, in the hands of Cepheus—as if he had the arms extended and his shoulders did not have any star—are always borne farther to the north than the ever-visible circle.

10. Hipparchus on the setting of Cepheus

2.2.§50 τοῦ δὲ Κηφέως ἡ κεφαλὴ μόνον δύνει· οἱ δὲ ὦμοι αὐτοῦ ἐν τῷ αἰεὶ φανερῷ τμήματι κείνται, καθάπερ προειρήκαμεν. οὐ μόνον δὲ κατὰ τοῦτο ἀγνοοῦσιν, ἀλλὰ καὶ καθ' ὅ φασι τῇ Παρθένῳ ἀντικαταδύνειν τὴν κεφαλὴν αὐτοῦ· οὐ γὰρ τῇ Παρθένῳ, ἀλλὰ ταῖς Χηλαῖς ἄρχεται ἀντικαταδύνειν· ὁ γὰρ νοτιώτερος τῶν ἐν τῇ κεφαλῇ δύνει ἀνατελλούσης {τῶν} Χηλῶν ἢ μοίρας {τῆς} μέσης.

Of Cepheus, only the head sets; but his shoulders lie in the ever-visible section, as we have said before. Not only in this are they mistaken, but also when they say that his head sets in opposition to the Maiden [= when the Claws start to rise for Aratus; cf. *Phaen.* 652-633]; in fact, it starts to set in opposition to the Claws, not to the Maiden; for the more southern (ϵ Cep) of the [stars] in the head (ϵ ζ λ Cep) sets when the middle of the 8th (= 7.5) degree of the Claws is rising (= 187.5 on the ecliptic).

11. Hipparchus' strategies – 4: rewriting Aratus and Eudoxus: the setting of Cepheus

2.6.§8 Τοῦ δὲ Κηφέως δύνει τὰ περὶ τὴν κεφαλὴν μέρη μόνον. καὶ συγκαταδύνει μὲν αὐτῷ ὁ ζφδιακὸς ἀπὸ Κριοῦ μοίρας ἢ μέσης ἕως Κριοῦ ιδ'. μεσουρανεῖ δὲ ἀπὸ Καρκίνου μοίρας θ' ἕως Καρκίνου μοίρας ιδ'.

καὶ πρῶτος μὲν ἀστὴρ δύνει <ὁ νοτιώτερος τῶν ἐν τῇ κεφαλῇ τριῶν, ἔσχατος δὲ ὁ βορειότερος αὐτῶν>.

Μεσουρανοῦσι δὲ τῶν ἄλλων ἀστέρων πρῶτοι μὲν τοῦ τε Καρκίνου ὁ νοτιώτερος τῶν ἀπ' ἀνατολῆς περὶ τὸ Νεφέλιον κειμένων, μικρὸν ὑπολειπόμενος τοῦ μεσημβρινοῦ, καὶ τῆς Ἄργου ὁ ἐν τῷ ἀκροστολίῳ λαμπρός, ἔσχατος δὲ τῆς τε Ἄρκτου ὁ ἐν τοῖς ἐμπροσθίοις γόνασι λαμπρός, μικρὸν ὑπολειπόμενος τοῦ μεσημβρινοῦ, καὶ τοῦ Καρκίνου ὁ μέσος τῶν τριῶν τῶν περὶ τὴν νοτιάν χηλῆν, καὶ τοῦ Ὑδροῦ ὁ ἐπὶ τῆς ἐκφύσεως τοῦ τραχήλου, καὶ τῆς Ἄργου ὁ ἐν μέσῳ τῷ τοίχῳ λαμπρός, μικρὸν ὑπολειπόμενος τοῦ μεσημβρινοῦ.

<Δύνει δὲ ὁ Κηφεὺς ἐν τρίτῳ μέρει ὥρας.>

Of Cepheus, only the parts around the head set. **And together with him the zodiac sets from the middle of the 8th (= 7.5) degree of the Ram [= 7.5° on the ecliptic] to the 14th [degree] of the Ram [= 14° on the ecliptic].** In mid-sky is [the section of the zodiac] from the 9th degree of the Crab to the 14th degree of the Crab. **And the first star to set is: the more southern of the three in the head (ϵ Cep); the last one [to set] is: the more northern of these (λ Cep).**

Of the other stars, the first ones to be in mid-sky are: of the Crab, the more southern of those which lie, from the east, near the Nebula (δ Cnc), which remains behind the meridian by a little; and, of Argo, the bright [star] in the stern-ornament (ρ Pup). The last ones [to be in mid-sky] are: of the Bear, the bright [star] in the front knees (θ UMa), which remains behind the meridian by a little; of the Crab, the [star] in the middle of the three [stars] near the southern claw (α Cnc); of the Water-Snake, the [star] at the juncture of the neck [with the head] (ζ Hya); and, of Argo, the bright [star] in the middle of the side (γ Vel), which remains behind the meridian by a little. Cepheus sets in 1/3 of an hour.

12. Hipparchus on zodiac constellations vs. zodiac signs

2.1.§8 ἐπεὶ δὲ οὔτε τοῖς δωδεκατημορίοις ἴσα ἐστὶ τὰ φαινόμενα ζώδια, οὔτ' ἐν τοῖς ἰδίῳις κείται τόποις ἅπαντα, ἀλλὰ τινὰ μὲν αὐτῶν ἐλάσσονά ἐστι τοῦ δωδεκατημορίου, τινὰ δὲ πολλῶ μείζονα, καθάπερ εὐθέως ὁ μὲν Καρκίνος οὐδὲ τὸ τρίτον μέρος ἐπέχει τοῦ δωδεκατημορίου, ἡ δὲ Παρθένος καὶ τοῦ Λέοντος καὶ τῶν Χηλῶν ἐπιλαμβάνει, τῶν δὲ Ἰχθύων ὁ νοτιώτερος ὅλος σχεδὸν ἐν τῷ τοῦ Ὑδροχόου κείται δωδεκατημορίῳ, πῶς ἂν εἴη δυνατόν ἐκ τῆς τοιαύτης τῶν δώδεκα ζωδίων ἐπιτολῆς <τὴν> τῆς νυκτὸς ὥραν συλλογίσασθαι;

But because the visible zodiac signs [i.e. the zodiac constellations] are not equal to their twelfths, nor do all lie in their specific places but some of them are less than their twelfth and some much greater—for example, the Crab does not occupy even a third of its twelfth, while the Maiden takes over also [parts] of the Lion and of the Claws' [twelfths], and the more southern of the Fishes lies almost entirely in the Water-Pourer's twelfth: how could it be possible, from such a [diverse] rising of the twelve zodiac constellations, to calculate the hour of the night?

13. Aratus' reported observations are taken at the latitude of Athens

1.3.§5 Πρώτον μὲν οὖν ὁ Ἄρατος ἀγνοεῖν μοι δοκεῖ τὸ ἔγκλιμα τοῦ κόσμου νομίζων ἐν τοῖς περὶ τὴν Ἑλλάδα τόποις τοιοῦτον εἶναι, ὥστε τὴν μεγίστην ἡμέραν λόγον ἔχειν πρὸς τὴν ἐλαχίστην τὸν αὐτόν, ὃν ἔχει τὰ ε' πρὸς τὰ γ'. λέγει γὰρ ἐπὶ τοῦ θερινοῦ τροπικοῦ (*Phaen.* 497-499).

τοῦ μὲν, ὅσον τε μάλιστα, δι' ὀκτῶ μετρηθέντος
πέντε μὲν ἔνδια στρέφεται καὶ ὑπέρτερα γαίης,
τὰ τρία δ' ἐν περάτῃ.

1.3.§6 συμφωνεῖται δὴ, διότι ἐν μὲν τοῖς περὶ τὴν Ἑλλάδα τόποις ὁ γνώμων λόγον ἔχει πρὸς τὴν ἰσημερινὴν σκιάν, ὃν ἔχει τὰ δ' πρὸς τὰ γ'. **ἐκεῖ δὴ τοίνυν ἡ μεγίστη ἡμέρα ἐστὶν ὠρῶν ἰσημερινῶν ἰδ' καὶ τριῶν ἔγγιστα πεμπτημορίων, τὸ δὲ ἕξαγμα τοῦ πόλου μοιρῶν λζ' ὡς ἔγγιστα.**

First of all, Aratus seems to me to be mistaken when he considers the inclination of the cosmos in the places around Greece to be such that the longest day has the same ratio to the shortest which 5 has to 3. For, regarding the summer tropic, he says:

“of this [circle], which is divided, as precisely as possible, into eight parts, five revolve during daytime and above the earth, and three [revolve] in the lower extremity [i.e. below the horizon]” (*Phaen.* 497-499).

But it is generally agreed that in the places around Greece the sundial has a ratio to the equinoctial shadow which is the same as 4 has to 3. **Therefore, there the longest day is approximately 14 equinoctial hours and 3/5, and the elevation of the pole [from the horizon] is approximately 37 degrees.**

1.3.§12 ὑποκείσθω δὲ ἡμῖν ὀρίζων πρὸς τὴν ἐπίσκεψιν ὁ ἐν Ἀθήναις, οὗ ἐστὶν ἡ μεγίστη ἡμέρα ὠρῶν ἰσημερινῶν ἰδ' καὶ τριῶν πεμπτημορίων, τὸ δὲ ἕξαγμα τοῦ πόλου περὶ μοίρας λζ'.

For our inquiry let the horizon for us be the one in Athens, where the longest day is 14 equinoctial hours and 3/5 and the elevation of the pole [from the horizon] is ca. 37 degrees.

14. Hipparchus on the latitude of his own observations

2.4.§2 ἐξῆς δὲ ὑποτάξω περὶ ἐκάστου τῶν ἀπλανῶν ἀστρῶν ἐπὶ κεφαλαίου, τίνοι τε τῶν δώδεκα ζῳδίων συνανατέλλει καὶ συγκαταδύνει, καὶ ἀπὸ πόστης μοίρας τοῦ ζῳδίου ἀρξάμενον ἕως πόστης μοίρας ἔσχατον ἀνατέλλει ἢ {συγκατα}δύνει ἐν τοῖς περὶ τὴν Ἑλλάδα τόποις καὶ καθόλου **ὅπου ἐστὶν ἡ μεγίστη ἡμέρα ὠρῶν ἰσημερινῶν ἰδ' καὶ ἡμιωρίου.**

In what follows, for each of the fixed constellations, I will outline, in short, 1) together with which of the twelve zodiac signs it rises and sets, and 2) from which degree of the zodiac sign it starts and 3) to which degree it ends its rising and setting in the places around Greece, and in general **where the longest day is of 14 equinoctial hours and a half [i.e. the latitude of Rhodes].**

1.7.§21 ὅπου δὲ ἐστὶν ἡ μεγίστη ἡμέρα ὠρῶν ἰδ' 4'' ἐκεῖ ὁ αἰε φανερός κύκλος ἀπέχει ἀπὸ τοῦ πόλου μοίρας λζ'.

Where the longest day is 14 hours and 1/2, there the ever-visible circle is 36 degrees from the pole.

15. Different latitudes and the the rising of ε Cep

2.2.§59 ...ὁ δὲ ἔσχατος ἀναφερόμενος καὶ νοτιώτερος ὢν τῶν ἐν τῇ κεφαλῇ συνανατέλλει {τοῦ} **Τοξότου ζ' μοίρα μέση.**

...while the [star] which is borne up last and is more southern of those **in the head (ε Cep) rises together with the middle of the 6th (= 5.5) degree of the Archer.**

2.5.§8 Τοῦ δὲ Κηφέως μόνα τὰ πρὸς τῇ κεφαλῇ μέρη ἀνατέλλει. **συνανατέλλει δὲ αὐτῷ ὁ ζῳδιακὸς** ἀπὸ Σκορπίου μοίρας ζ' καὶ κ' μέσης **ἕως Τοξότου ζ' μέσης**. μεσουρανεῖ δὲ ἀπὸ Παρθένου μοίρας θ' μέσης ἕως Παρθένου α' καὶ κ'. <καὶ πρῶτος μὲν ἀστὴρ ἀνατέλλει ὁ προηγούμενος τῶν ἐν τῇ κεφαλῇ τριῶν, **ἔσχατος δὲ ὁ νοτιώτερος τῶν ἐν τῇ κεφαλῇ.**>

Of Cepheus, only the parts toward the head rise. **Together with him the zodiac rises** from the middle of the 27th (= 26.5) degree of the Scorpion [= 236.5 on the ecliptic] **to the middle of the 6th (= 5.5) [degree] of the Archer [= 245.5 on the ecliptic]**. In mid-sky is [the section of the zodiac] from the middle of the 9th (= 8.5) degree of the Maiden to 21st [degree] of the Maiden. And the first star to rise is: the one that precedes the three [stars] in the head (μ Cep); **the last one [to rise] is: the more southern of those in the head (ε Cep).**

Select bibliography

- Acerbi, F., 2020, 'Hipparchus in French', *Journal for the History of Astronomy*, 51, pp. 376-7.
- Bishop, C., 2016, 'Hipparchus among the Detractors', in *Classical commentaries : explorations in a scholarly genre*, ed. by Kraus, C.S. e Stray, C., Oxford, pp. 379-96.
- Evans, J., 1998, *The history & practice of ancient astronomy*, New York :.
- Kidd, D., 1997, *Aratus, Phaenomena, edited with introduction, translation and commentary*, Cambridge ; New York.
- Lasserre, F., 1966, *Die Fragmente des Eudoxos von Knidos*, Berlin.
- Lightfoot, J., 2017, 'Hipparchus' didactic journey: poetry, prose, and catalogue form in the « Commentary on Aratus and Eudoxus »', *Greek, Roman and Byzantine Studies*, 57, pp. 935-67.
- Maass, E., 1898, *Commentariorum in Aratum reliquias*, Berlin.
- Neugebauer, O., 1975, *A history of ancient mathematical astronomy*, New York.
- Schironi F. (forthcoming) 'Aratus and His Reception' in John Steele (ed.), *Oxford Handbook of Ancient Astronomy*, Oxford 2021.
- Schironi F. (forthcoming), *Hipparchus of Nicaea, Exegesis of the Phaenomena of Eudoxus and Aratus* (edition, translation, and commentary), *Scientific Writings from the Ancient and Medieval World*, Routledge 2022.
- Tueller, M.A. e Macfarlane, R.T., 2009, 'Hipparchus and the poets: a turning point in scientific literature', in *Nature and science in Hellenistic poetry*, ed. by Harder, M.A., Regtuit, R.F., Wakker, G.C. e Ambühl, A., Leuven, pp. 227-53.