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THE TITLE(S) OF [ARISTOTLE], *PROBLEMATA* 15

All modern editions of the *Problemata* in the *corpus Aristotelicum* print as the title of Book 15 ὅσα (*sc.* προβλήματα) μαθηματικῆς μετέχει θεωρίας (910b10) – *Problems involved in mathematical theory* – and include no other title or subtitle within that book. This is true for Bekker and Bussemaker in the nineteenth century, Ruelle, Hett and Louis in the twentieth, and Ferrini in the twenty-first.[1] Similarly, every modern translation with which I am acquainted (Forster, Hett, Flashar, Louis, Ferrini) translates this title and no additional title or subtitle.[2]

I want to argue that this practice may be mistaken, and that editors and translators ought to give more consideration to the manuscript tradition (however inconclusive) and so consider restoring a longer title. But first a word on the content of *Problemata* 15.

Book 15 deals with mathematics, broadly conceived. Chapters 1 and 2 raise questions about the name 'diameter', and chapter 3 raises questions about the decimal number system. The rest of Book 15 is devoted to celestial matters, and particularly how celestial objects appear to us: this simply is the subject matter of chapters 4, 7 and 8; and the topics of the others are shadows from the sun and the moon (5, 9, 10, 13), the effect of sunlight passing through a quadrilateral (6), solar eclipses (11), and parhelia (12).[3]

In what follows, I refer to those manuscripts of the *Problemata* that scholars consider most authoritative: *Parisinus gr.* 2036 (10th c.) = Y^a; *Laurentianus gr.* 87, 4 (13th c.) = C^a; *Vaticanus gr.* 1283 (15th c.) = X^a; *Parisinus gr*. 1865 (15th c.) = Ap. Scholars agree that Y^a is the most important.[4]

[1] I. Bekker, *Aristotelis Opera* II (Berlin, 1831); U.C. Bussemaker's edition of the *Problemata*, in J.-F. Dübner, U.C. Bussemaker and J.H.E. Heitz, *Aristotelis Opera Omnia: Graece et Latine* IV (Paris, 1869); C. Ruelle, H. Knoellinger and J. Klek (edd.), *Aristotelis Quae Feruntur Problemata Physica* (Leipzig, 1922); W.S. Hett, *Aristotle: Problems*, 2 vols. (Cambridge, MA, 1937); P. Louis, *Aristote: Problèmes*, 3 vols. (Paris, 1991–4); M.F. Ferrini, *Aristotele Problemi* (Milan, 2002). Neither Bekker nor Bussemaker refers (in the apparatus criticus in the former case, in the preface in the latter) to any alternative readings nor to any subtitles. Ruelle and Louis, by contrast, each includes in his apparatus criticus relevant information about alternative readings (more on these shortly). Neither Hett's nor Ferrini's, it should be said, is a major edition with an apparatus criticus.

[2] E.S. Forster, *The Works of Aristotle Translated into English*, vol. VII: *Problemata* (Oxford, 1927); H. Flashar, *Aristoteles: Problemata Physica* (Berlin, 1962). For Hett, Louis, and Ferrini, see n. 1.

[3] Chapter numbers as in Bekker. Most major MSS treat chs. 3 and 4 as distinct, though there is almost certainly a lacuna at the opening of ch. 4. The exception is Ap, which presents them as one chapter; cf. the Aldine edition.

[4] On the MS tradition, see G. Marenghi, 'La tradizione manoscritta dei *Problemata Physica* Aristotelici', *Bolletino del Comitato per la preparazione della Edizione nazionale dei Classici Greci e Latini* 9 (1961): 47–57, and Louis (n. 1), 1.xxxv–lv. I have not looked at any MSS but have relied on the reports of editors, especially Louis. Although Louis bases his text primarily on Y^a, C^a, X^a and Ap, he occasionally refers to other MSS. A relevant example: for the titles of Books 9 and 20, he lists the variant readings from MS K^a – and he presumably would have

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The title of *Problemata* 15 adopted by modern editors (*ὅσα μαθηματικῆς μετέχει θεωρίας*) is the reading of two major manuscripts: C^a and X^a. Since, according to Aristotle, astronomy is not a discipline distinct from mathematics (more on this later), there is nothing inherently objectionable to this as a description of Book 15. But as Ruelle and Louis report, the oldest manuscript (Y^a) has the following 'title':

τὰ δὲ ἔνεστιν ὅσα μαθηματικῆς μετέχει θεωρίας ἁπλῶς καὶ ὅσα περὶ τὰ οὐράνια, ὅσα περὶ τὰ ἄψυχα, ὅσα περὶ τὰ ἔμψυχα, ὅσα μαθηματικά.

Ap has the same, though beginning with '*ἀριστοτέλους*'.

As it stands, this cannot be the title of *Problemata* 15. Aside from the fact that *ὅσα μαθηματικά* is redundant, *ὅσα περὶ τὰ ἄψυχα* and *ὅσα περὶ τὰ ἔμψυχα* are the existing titles of Books 16 and 17 respectively. What Y^a and Ap give us then is a *list* of titles; and this explains the existence of *τὰ δὲ ἔνεστιν*, which is an appropriate beginning to such a list.[5] Now if this is a list, then according to Y^a and Ap, the actual title of Book 15 is: *ὅσα μαθηματικῆς μετέχει θεωρίας ἁπλῶς καὶ ὅσα περὶ τὰ οὐράνια* – *Problems involved in mathematical theory generally, and those connected to celestial matters* – which works well as a description of the content of that book. Y^a and Ap are also alike, and different from C^a and X^a, in placing a subtitle before chapter 5 (after 911a13): *ὅσα περὶ τὰ οὐράνια ά*, the second item on the above-mentioned list.[6] (There is one other instance of a subtitle in the *Problemata*: in the case of Book 1 [*ὅσα ἰατρικά*] the manuscript tradition gives us – between chapters 29 and 30 – the subtitle: *ὅσα βοηθηματικὰ πρὸς ἴασιν*.[7])

So according to the major manuscripts, the situation regarding the Book 15 title(s) is as follows:

(i) Y^a and Ap — Title: *ὅσα μαθηματικῆς μετέχει θεωρίας ἁπλῶς καὶ ὅσα περὶ τὰ οὐράνια*
Subtitle: *ὅσα περὶ τὰ οὐράνια*

(ii) C^a and X^a — Title: *ὅσα μαθηματικῆς μετέχει θεωρίας*

done so were there such variants in the case of Book 15. Further, note that Marenghi provides readings from many more MSS in his editions of select books of the *Problemata*, and it is clear that there is in general little significant variation among book titles. (It is unfortunate, however, that he did not prepare an edition of Book 15.) See G. Marenghi, *Aristotele: Problemi musicali* (Florence, 1957) [XIX], *Aristotele: Problemi di fonazione e di acustica* (Naples, 1962) [XI], *Aristotele: Problemi di medicina* (Milan, 1965; rev. 1999) [I, VI–IX, XIV, XXVII–XXVIII, XXXI–XXXVIII], and *[Aristotele]: Profumi e miasmi* (Naples, 1991) [XII–XIII].

[5] In his apparatus criticus, Ruelle prints '*τὰ δὲ* (lege *τάδε*) *ἔνεστιν*<·> *ὅσα μαθηματικῆς κτλ.*' Note that Y^a and Ap provide a similar list for Books 20–22 and for 31–35. On the existence of *ὅσα μαθηματικά* at the end of this list, I offer the following speculation: at some point early in the development of the *Problemata*, *ὅσα μαθηματικά* could have been a broad title or content-description covering *ὅσα μαθηματικῆς μετέχει θεωρίας ἁπλῶς* (15, pt. 1), *ὅσα περὶ τὰ οὐράνια* (15, pt. 2), and *ὅσα περὶ τὰ ἄψυχα* (16, the focus of which is largely mathematical-mechanical). Later, Book 17 (*ὅσα περὶ τὰ ἔμψυχα*) was inserted as a companion to 16, though it is actually out of place in this sequence.

[6] The only difference is the *ά*, which would normally indicate that this is the title of a work in one book, but which perhaps here indicates a subtitle. I ignore it in what follows. Ap again differs from Y^a in beginning with '*ἀριστοτέλους*'.

[7] X^a has *βοηθητικὰ* for *βοηθηματικὰ*. The Arabic version (see n. 10 below) divides *Pr.* I into two books.

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The difference between (i) and (ii) does not correspond to Marenghi's division of the manuscripts into four families (α, β, γ, δ), for Y^a and C^a are both in family α, X^a and Ap in family γ. So neither (i) nor (ii) is a reading confined to a single family.[8]

Now neither (i) nor (ii) is ideal: (i) seems to give us too much, as the subtitle is redundant; (ii) arguably gives us too little, as it lacks the subtitle – which, though not absolutely necessary, is informative and would complement the brief title well.[9] Given the age and authority of Y^a on the one hand, and the redundancy of the title-subtitle combination of (i) on the other, are there improvements an editor might make that do not stray too far from the manuscript tradition? I think there are three plausible emendations one should consider: (1) accepting the long title of (i), but eliminating the subtitle; (2) accepting the title of (ii) *and* the subtitle of (i); (3) dividing Book 15 into two books, giving each its own title (the title of [ii] and the subtitle of [i]).

Reading (3) in fact receives some solid support from the Arabic version of Hunain ibn Ishāq (9th c.), which predates all extant Greek manuscripts. In this version, *Problemata* 15 is actually two books: 'About mathematics' (16) and 'About the heaven' (17).[10] This reading, but with a twist, was also adopted by George of Trebizond (Trapezuntius) in his 1452 Latin translation: Book 15 has the title *De iis que ad mathematica simpliciter pertinent*, and 16 has the title *De iis que pertinent ad caelestia*. But it must be noted that this translation renders not the title of (ii) but the slightly expanded first half of the title from (i), *simpliciter* being a translation of ἁπλῶς.[11]

Reading (1) receives some mild support from two other Latin versions. First, the mid-13th-century *verbum de verbo* translation of Bartholomew of Messina (who likely made use of Y^a or a lost MS related to it) has the title *Circa mathematica et circa celestia* and no subtitle, thus arguably supporting (1) – though to be sure, offering a compressed translation.[12] Closer to the Greek is the title in the Latin translation (1475 rev. ed.) of Theodore Gaza: *Eorum, quae ad res mathematicas pertinent: & ad coelestia*. (Gaza too has no subtitle.) This is at best minimal sup-

[8] See Marenghi (n. 4 [1961]), and the introduction to *Aristotele: Problemi di Medicina*. This is not meant as a criticism of Marenghi, whose families are well established.

[9] There are, however, problems with the subtitle; I discuss them in the penultimate paragraph of this article.

[10] See L. Filius (ed.), *The Problemata Physica attributed to Aristotle: The Arabic Version of Hunain ibn Ishāq and the Hebrew Version of Moses ibn Tibbon* (Leiden, 1999), esp. xvii–xxix and 644–61, and L. Filius, 'The genre *Problemata* in Arabic: its motions and changes', in P. De Leemans and M. Goyens (edd.), *Aristotle's Problemata in Different Times and Tongues* (Leuven, 2006), 33–54 (esp. p. 37). *Pr*. 15 becomes 16 and 17 in the Arabic version, because that version also divides *Pr*. 1 into two books. Note, however, that the Arabic Book 16 combines *Pr*. 15.1–2 into one chapter, and includes a barely recognizable rendering of *Pr*. 15.4.

[11] There is no variation in the best MSS: *BAV Urb. lat.* 1322 (which contains autograph scholia) and *BAV Vat. lat*. 5790. Many thanks to John Monfasani for providing me with this information. George's exemplar is *Marcianus gr.* 216 (15th c.) = O^a (in family β). See J. Monfasani, 'George of Trezibond's critique of Theodore Gaza's translation of the Aristotelian *Problemata*', in Leemans and Goyens (n. 10), 275–94 (esp. 282–3), and Marenghi (n. 4 [1991]), 156–7, 167, 175.

[12] See M. van der Lugt, 'Aristotle's *Problems* in the West: a contribution to the study of the medieval Latin tradition', in Leemans and Goyens (n. 10), 71–107. Unfortunately, there exists no modern edition of Bartholomew's translation. John Monfasani informs me that one MS of this translation, *Vat. lat*. 2112, has the following title (in a later hand): *De iis que sunt circa mathematica et celestia*.

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port, however, as the longstanding view that Gaza's translation of the *Problemata* is a crucially important source based on a manuscript now lost has been successfully challenged.[13]

Although not the same level of support, it is noteworthy that Reading (2) was the option chosen by both Aldus (Venice, 1497) and Sylburg (Frankfurt, 1585) in their editions of the text. The Aldine edition divides Book 15 into two parts, with ὅσα μαθηματικῆς μετέχει θεωρίας as the title for the entire book, and ὅσα περὶ τὰ οὐράνια as the subtitle for the second part. Similarly, Sylburg, in the 'table of contents' in his edition, provides two separate titles: ὅσα μαθηματικῆς μετέχει θεωρίας and ὅσα μαθηματικά περὶ τὰ οὐράνια. In the body of the text itself, however, he employs this first as the general title of *Problemata* 15, and – between chapters 4 and 5 – a shorter title in brackets: ὅσα περὶ τὰ οὐράνια.

Aside from the evidence of the manuscript tradition, there is another factor to consider, namely, the Aristotelian conception of the scope of mathematics. Aristotle held that mathematics – the mathematical arts or sciences – contain or consist of a number of sub-disciplines, astronomy being one of them.[14] For example, in *Metaphysics* Λ 8, he writes that the investigation into the number of courses of the stars should 'come from that one of the mathematical sciences with the closest affinity to philosophy, i.e. from astronomy' (τὸ δὲ πλῆθος ἤδη τῶν φορῶν ἐκ τῆς οἰκειοτάτης φιλοσοφίᾳ τῶν μαθηματικῶν ἐπιστημῶν δεῖ σκοπεῖν, ἐκ τῆς ἀστρολογίας, 1073b3–5; cf. A 8, 989b32).[15] Now as indicated above, in passing, this broad conception of mathematics provides support for the reading of manuscripts C^a and X^a and of most editors: ὅσα μαθηματικῆς μετέχει θεωρίας. On this interpretation, the subject of *Problemata* 15 is simply mathematics – in particular, geometry (chs. 1–2), arithmetic (ch. 3) and astronomy (chs. 4–12) – and thus there is no need for either the title-subtitle combination or for the longer title.

But Aristotle also wrote in the *Metaphysics* that among the mathematical sciences or arts (ἐν ταῖς μαθηματικαῖς), 'geometry and astronomy are concerned with a certain nature, whereas the universal (*sc*. mathematics) is common to everything' (ἡ μὲν γεωμετρία καὶ ἀστρολογία περί τινα φύσιν εἰσίν, ἡ δὲ καθόλου πασῶν κοινή, E 1, 1026a26–7; cf. K 7, 1064b8–9). So it is possible that a set of problems on mathematics written in the Lyceum during or close to the time when Aristotle was alive would have had one section on universal or general mathematics, and another that dealt specifically with an area of specialized mathematics in which there was a great deal of interest, namely astronomy (the branch with 'the closest affinity to philosophy'). *Problemata* 15 as it has come down to us fits this latter organization: problems about mathematics that apply universally – certain

[13] For a recent example of the erroneous appraisal of Gaza's translation, see Louis (n. 1), 1.xlvi: 'La traduction latine de Théodore Gaza ne concorde pas toujours avec le texte des manuscrits dont nous disposons. Force est donc de supposer que cet éminent helléniste du XV^e siècle a utilisé un manuscrit qui n'existe plus aujourd'hui.' For a critique of this view, see Monfasani (n. 11) and id., 'The Pseudo-Aristotelian *Problemata* and Aristotle's *Historia Animalium* in the Renaissance', in A. Grafton and N. Siraisi (edd.), *Natural Particulars: Nature and the Disciplines in Renaissance Europe* (Cambridge, MA, 1999), 205–47. According to Marenghi (n. 4 [1991]), 159, Gaza relied on these two MSS: *Ambrosianus gr.* 67 (15th c.) = A^m and *Oxoniensis Collegii Novi* 233 (15th c.) = D (both in family δ).

[14] Cf. Archytas of Tarentum 47 B 2 D.–K. and Pl. *Resp.* 524b–532b.

[15] Here Aristotle refers to the mathematical *sciences*; earlier in the *Metaphysics* he refers to the mathematical *arts*: αἱ μαθηματικαὶ … τέχναι (A 1, 981b23–4).

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geometrical or arithmetical ones, as in chapters 1–3 – and mathematical problems concerning astronomy.[16]

In conclusion, given the authority of Y^a, the additional evidence of Ap (from a different MSS family), and the further support of the Arabic version of Hunain ibn Ishāq and the Latin translation of Bartholomew, one of the complex readings (1–3) – containing both elements (*ὅσα μαθηματικῆς μετέχει θεωρίας ἁπλῶς* and *ὅσα περὶ τὰ οὐράνια*[17]) – is preferable to the simpler reading supported by C^a and X^a and accepted by modern editors since Bekker. Further, I believe there is nothing in Aristotle's conception of mathematics to tip the scales in the other direction.

Of these three, I would not recommend (3), because dividing the book in two is a fairly radical emendation (though this is not to rule out that at some point in the development of the *Problemata*, such problems were spread over more than one book). And I would not recommend (2), because the subtitle – or at least its location in the text – is somewhat suspect, despite the manuscript evidence for it. For if its purpose is to mark a subsection dealing with celestial matters, then we should expect it to have been placed between chapters 3 and 4 – the latter being the first to deal with celestial matters – but in fact it comes *after* chapter 4. So if one accepts the subtitle, it should be transferred to this more appropriate location; but such a transposition takes us even further from the manuscript tradition. I therefore find (1) preferable.[18]

In any case, that there is a problem identifying the title(s) of what has come down to us as *Problemata* 15 likely reflects the shifting, constantly-under-revision nature of the *Problemata* in antiquity, and may indicate that Book 15 contains the remnants of what were once two separate sets of problems: mathematical ones and those connected to celestial matters.[19]

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[16] The quotation earlier in this paragraph suggests that geometry is not part of universal mathematics. Nevertheless, it seems Aristotle believed that geometrical issues broadly conceived or applied did fall under universal mathematics. On the distinction between universal and special mathematics – and that certain geometrical and arithmetical issues fall under universal mathematics – see *An. Post.* I 5, 74a17–25, and *Met.* M 2, 1077a1–10 and M 3, 1077b17–1078a5.

[17] This latter understood as Sylburg did in his 'table of contents': *ὅσα* (*sc. προβλήματα*) *μαθηματικά περὶ τὰ οὐράνια*, 'Mathematical problems connected to celestial matters'.

[18] This is the reading I have adopted in my new Loeb Classical Library edition of the *Problemata*.

[19] I wish to thank an anonymous referee for the journal, for comments that significantly improved this article.

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