## Ancient Commentators on Aristotle GENERAL EDITOR: RICHARD SORABII

# PHILOPONUS: On Aristotle Posterior Analytics 1.1–8

Translated by Richard McKirahan

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#### PHILOPONUS

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## PHILOPONUS On Aristotle Posterior Analytics 1.1-8

Translated by Richard McKirahan

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## Conventions

[...] Square brackets enclose words or phrases that have been added to the translation or the lemmata for purposes of clarity.

<...> Angle brackets enclose conjectures relating to the Greek text, i.e. additions to the transmitted text deriving from parallel sources and editorial conjecture, and transposition of words or phrases. Accompanying notes provide further details.

 $(\dots)$  Round brackets, besides being used for ordinary parentheses, contain transliterated Greek words.

Philoponus' work, the earliest surviving commentary on the *Posterior Analytics*, was not the first. Theophrastus wrote a commentary in seven books,<sup>1</sup> while Galen boasts of having composed six commentaries on the first book of the *Posterior Analytics* and five on the second,<sup>2</sup> and Philoponus himself refers to Alexander's commentary.<sup>3</sup> We do not know the scale of these earlier works, but Philoponus' commentary (333 *CAG* pages on Book 1 alone) can claim to be among the longest ever written. Maximilian Wallies' edition, published in 1909, contains in addition to Philoponus' commentary on Book 1, the commentary on Book 2 that is (by general agreement<sup>4</sup> falsely) attributed to Philoponus, as well as an anonymous commentary on Book 2. The present volume is the first of a projected four which will present the first complete translation of Philoponus' commentary on Book 1 and pseudo-Philoponus' on Book 2 into any modern language.<sup>5</sup>

Interest in this commentary has waned since the Renaissance, when it was the first of Philoponus' major philosophical works to be edited.<sup>6</sup> It was twice translated into Latin in the sixteenth century, with the translations being reprinted frequently from 1534 to 1569.<sup>7</sup> In it Philoponus sets himself the task of expounding the meaning of the Aristotelian text rather than raising objections and presenting alternative theories in the ways that make some of his later commentaries (notably the *Physics* commentary) important philosophical works in their own right. Here, he is in the main content to follow the run of the text, clarifying difficulties and explaining Aristotle's statements in the light of other passages in the *Posterior Analytics* or of other works of Aristotle. Among these, he tends to limit his references to the other logical works (the *Categories, De Interpretatione, Prior Analytics*, and *Topics*), and to the *Physics, Metaphysics*, and *De Anima*. His practice of explaining Aristotle through Aristotle has been standard ever since.

The opening words of the work, 'John of Alexandria's lecture notes from the meetings of Ammonius, son of Hermeias, on the first book of Aristotle's *Posterior Analytics*, together with some observations of his own', indicate that it contains some original contributions of Philoponus, but that it is largely a record of Ammonius' views. The absence of other testimony about Ammonius' lectures on the *Posterior Analytics* makes it impossible to determine how much is due to Philoponus. That

Philoponus does not follow his teacher slavishly, however, is shown by a passage in the section translated in the present volume in which he rejects Ammonius' explanation of 72b23-4 in favour of Themistius', which 'seems to explain the thought of the present words more naturally and in a way that naturally fits the passage' (48,7-8). Criticisms of Theophrastus (71,5-19) and Alexander (3,32-4,4; 41,1-6; 62,2-22) may also display his originality, but they could equally well be due to Ammonius.

Philoponus presumably decided to offer this sort of exposition of Aristotle's work because he thought that the *Posterior Analytics* is difficult (and so, in need of a detailed guide and explanation), and also because he thought that it is important. Whatever our view of its importance, at least we may agree that it is difficult and in need of clarification. It is neither a systematic exposition of its subject (the theory of demonstration) nor does it proceed in the main by examining earlier opinions on the subject, as is Aristotle's frequent practice in other works. Its train of thought from chapter to chapter, from paragraph to paragraph, and even from sentence to sentence is frequently obscure. The expression is also more condensed and opaque than is usual for Aristotle, and there is relatively little argument, much of the burden of the discussion being carried by examples (a practice which Philoponus continues, adding additional examples of his own to the many already in Aristotle).

And he makes it clear that he considers the Posterior Analytics important. It is 'the culmination of the treatment of logic. For it is for the sake of demonstration that Aristotle gave us his other logical works' (1,5-7). Also, since 'there are several kinds of deductions – sophistical, dialectical, and demonstrative – he teaches us demonstrative deductions here and dialectical ones in the *Topics* ... [and] in the *Sophistical Refutations* he teaches us about sophistical deductions' (2,1-7). Further, 'philosophers needed demonstration as an instrument for the correct pursuit of the parts of philosophy – I mean the theoretical and the practical parts' (2,24-5). So for Philoponus, the importance of the Poste*rior Analytics* resides in the fact that it is the crown jewel of Aristotle's logic, containing Aristotle's account of demonstration (which is one of the three basic types of deductions), and in the fact that a knowledge of demonstration is useful (perhaps necessary) for anyone who would study philosophy and possibly for anyone who would put philosophy to correct use.

Characteristic of the commentary is a tendency to supplement Aristotle's discussion, sometimes by working out Aristotle's arguments and examples in greater detail, sometimes by showing how Aristotle's claims apply to cases which he does not discuss, sometimes by drawing distinctions not found in the Aristotelian text and exploring their implications for the theory of demonstration. The first of these features is found in the discussion of the law of alternating proportions. Aristotle says that there is a single proof that holds for all the things to which the law applies: numbers, magnitudes, times, etc. Philoponus argues that the subject of this proof is nameless. It is not 'quantity' because there are kinds of quantity to which the law does not apply; and it is not a subclass of quantity because it applies to certain qualities (74,3-75,3). It is noticeable also in the detailed discussion (55,31-57,13) of the brief statement 'it has also been proved that in the other figures either there is no deduction or [that there is a deduction] but not about what has been assumed' (73a15-16), in which Philoponus works out Aristotle's claim in terms of all three syllogistic figures.

The second feature is exemplified where Philoponus identifies ways in which it is possible to know something in one way but not another that are not mentioned by Aristotle (16,15-25; 18,4-20,2). Another case is the treatment of inseparable accidents at 63,8-20. Also where he employs snubness as an example of the second kind of per se relation – an example not found in Aristotle's discussion – and goes on to show how it raises a problem for the interpretation (which Philoponus adopts) that attributes that are per se in this way come in contradictory pairs (like even and odd, for number), and offers a solution to the problem (67,21-7).

An instance of the last-mentioned feature is his recognition of demonstrations that fall short of Aristotle's strict requirements. One kind is exemplified by the proof that isosceles triangles have angles equal to two right angles (which is not a strict demonstration because the predicate belongs to triangle, not to isosceles triangle) (72,1-19). Another kind is proofs that genera and differentiae belong to a subject (70,2-29). Still another is what he calls proofs by infallible signs (*tekmêria*), which proceed in the opposite direction from strict demonstrations, from effects to causes, from what is better known to us to what is better known in nature.<sup>8</sup> An example of such a proof is the inference from the pattern of the moon's phases to the conclusion that the moon's shape is spherical (31,19-32,7). (Philoponus recognizes that some signs are not infallible: having milk is a sign that a woman has given birth, but, he says, it is not infallible (21,12-15).)

Also noteworthy is the prominence of mathematical and astronomical examples.<sup>9</sup> In this practice Philoponus is following Aristotle's lead, but he employs them even more frequently than Aristotle does, and on some occasions his comments are far more extensive than would be required to explicate the text. The long treatment of the problem of duplicating the cube (102,12-105,4) is the most extreme case. With the exception of this last-mentioned case, the geometrical examples mostly come from Euclid's *Elements* and are of an elementary character. Some of the discussions of properties of numbers probably come from Nicomachus' *Introductio Arithmetica*, on which Philoponus wrote a commentary.<sup>10</sup> In this connection it is interesting that Philoponus is guilty of a number of mathematical errors (see notes 94, 354, 355, 461,

463 on the commentary), which may indicate that Philoponus had little mathematical comprehension or talent, even though he was interested in the subject.

A similar verdict may perhaps be rendered on his abilities as a logician, since he commits a number of elementary blunders, saying that if an argument employing a premise has a true conclusion, then the corresponding argument that employs as a premise the contrary of the original premise has a false conclusion (42,2-4), that nothing can be necessary unless it is inferred from things that are necessary (84,19-26),<sup>11</sup> and apparently maintaining that if a property belongs per accidens to one subject (as black belongs per accidens to crows), it cannot belong per se to any subject (94,5-10).

The final feature I will take up is Philoponus' idiosyncratic treatment of Aristotle's views on scientific principles. I will here simply sketch out some of the most salient features of his interpretation, since a thorough treatment is beyond the scope of this introduction. Philoponus begins by dividing 'the things in every demonstration' in a way not found in the Posterior Analytics (7,18-10,20): 'the problem proposed for demonstration, and the premises through which the problem is established.' Further, 'in every problem the following two things are observed: the given and the sought'. He goes on to identify the given with the subject term in the conclusion of the demonstration and the sought with the predicate. He then proceeds to bring this result to bear on Aristotle's distinction between two kinds of prior knowledge: knowledge 'that it is' and knowledge 'what it is': with respect to the given it is necessary to have both kinds of prior knowledge, while with respect to the sought it is necessary to have only the second kind and impossible to have the first kind. In effect the demonstration proves of the sought 'that it is'. Axioms are the major premises of demonstrations (8,7-8). Some axioms are common to all sciences, some are common to more than one science but not to all, and some apply only to a single science (10,27-11,3). Scientific principles are divided into axioms and theses, and theses are subdivided into definitions and hypotheses (thus far Philoponus follows Aristotle (72a14-21)). The difference between axioms and theses is that the former are self-guaranteeing and we know them from within ourselves, while the latter are self-guaranteeing too, but require some attention in order to be understood because they are not self-evident without qualification, and we take them from the teacher of a given science. Hypotheses differ from definitions in that hypotheses predicate one thing of another while definitions do not, but are identity statements. Further, there are two species of hypotheses, known respectively as hypotheses (homonymously with the genus) and postulates. Both kinds are taken from the teacher without demonstration, but hypotheses are true, appear true to the learner, and require little attention for their truth to be seen (127,31-3; 129,3-5), while postulates do not appear true (129,5-6).

Philoponus' interpretation has not been followed by other commentators, with good reason. A catalogue of some of its characteristics may provide the groundwork for a study of Philoponus' methods. First, he employs his normal practice of explaining Aristotle through Aristotle, bringing in material (sometimes uncritically) from elsewhere in the *Posterior Analytics*. This accounts for some weaknesses in his treatment of hypotheses and postulates. (Notably it depends heavily on the discussion at 76b23-34 of hypotheses that are different from the hypotheses identified at 72a18-20 as a kind of scientific principle. The hypotheses in question, and the postulates from which they are distinguished, are identified as being demonstrable, that is to say, not scientific principles, which has catastrophic consequences when this passage becomes a basis for an interpretation the doctrine of scientific principles.<sup>12</sup> One of these consequences is that Philoponus treats hypotheses as principles.)

Second, Philoponus places greater weight than other commentators on Aristotle's references to the psychological attitude appropriately held towards principles. For example, he distinguishes axioms from other principles on the grounds that we know them 'from within ourselves' (*authothen*) and without demonstration (34,10-11; 34,20-2) features which surely apply to all indemonstrable principles! If we have our knowledge of the principles 'from within ourselves' and this knowledge is 'natural to all men in common' (127,21-4), then it requires some work (which Philoponus does not provide) to square this view with the important Aristotelian distinction, fundamental in the *Posterior Analytics*, between what is better known in nature and what is better known to us. (Here too some of the difficulty is due to the account of hypotheses and postulates in 76b23-34, where the principal difference between hypotheses and postulates is that with the former the learner is ready to accept, while with the latter he either disbelieves or has no opinion on them.)

Third, he employs authorities other than Aristotle, sometimes without sufficient care. This is clear in his use of Euclid as an authority for the existence of axioms that hold in only one science – a doctrine that goes squarely against Aristotle's account. There is also reason to think that he bases some of his discussion of scientific principles on Proclus' account in the introduction to his *Commentary on the First Book of Euclid's Elements*, again not always with the best consequences.

The goal of this translation is to render Philoponus' text faithfully into acceptable English, while striving for consistency in the translation of important terms. The Greek-English Index and the English-Greek Glossary provide complete information about how individual words have been translated. Philoponus provides lemmata which indicate the stretch of text he is discussing. Since he does not discuss every sentence there are gaps between the lemmata. In conformity with the practice of this series, I have translated the entire text of *Posterior Analytics* 1, chapters 1-8. Text that is not included in the lemmata is placed in

square brackets. The translation of the Aristotelian text differs from other translations in two principal ways. First, as we can tell from the commentary, Philoponus' text of Aristotle differed in places from modern texts. Accordingly, I have translated Philoponus' text, recording the differences from Ross's edition in the notes (collected on pp. 9-11). Second, since Philoponus quotes and paraphrases the Aristotelian text throughout his commentary, I have produced a translation that is more 'literal' and less idiomatic in English than is perhaps desirable, in order to preserve the Aristotelian phraseology in translating Philoponus' text.

In fact, Philoponus guotes Aristotle more frequently than Wallies' text indicates, and the present translation makes an effort to reflect this fact by putting all the quoted material in inverted commas. However, the flexibility of Greek word-order raises a problem in this connection. As an example, consider 23,19-20: hotan tên aitian di'hên to pragma esti ginôskômen, hoti ekeinou estin aitia kai ouk endekhetai allôs ekhein, which refers to 71b10-12: hotan tên t'aitian oiômetha ginôskein di'hên to pragma estin, hoti ekeinou aitia esti, kai mê endekhesthai tout' allôs ekhein, 'when we think we know both the cause through which the thing is as being its cause, and that this cannot be otherwise.' Philoponus omits t' ('both'), he substitutes ginôskômen ('know') for oiômetha ginôskein ('think we know'), he places di' hên to pragma esti ('through which the thing is') before ginôskômen ('know') instead of after the corresponding words, and writes *esti* instead of *estin*. In the final clause he reverses the order of the words *aitia esti* (translated 'being its cause') this time writing *estin* instead of *esti*, he has *ouk endekhetai* instead of mê endekhesthai ('cannot'), and he omits tout' ('this'). The only change that makes any difference in meaning is the substitution of 'know' for 'think we know'. The appearance of *ouk endekhetai* instead of  $m\hat{e}$ endekhesthai is a grammatical consequence of this same change. The rest can be explained as the result of following a text of Aristotle that differs from our own, or of careless copying, or of a deliberate choice to vary the wording. I translate as follows, using quotation marks to indicate the directly quoted words and phrases within the sentence: 'when' we know 'the cause of the thing' 'is its cause' and that 'it cannot' 'be otherwise'. I consider *esti* and *estin* to be the same word, the presence or absence of the nu-movable being determined by the initial letter of the following word. Paraphrases are not put into inverted commas, even when the paraphrase in Greek is so close that the English translation of Philoponus is identical with that of Aristotle. This practice, although typographically inelegant, displays how closely Philoponus was working with the text of the Posterior Analytics, and helps us see how he went about his task as a commentator. I should point out, however, that there are borderline cases, where it is not clear whether Philoponus is deliberately quoting Aristotle or simply using the word he would ordinarily use, and in such cases one reader's judgement may differ from another's.

I use square brackets to indicate words that are not in the Greek but

that need to be supplied in English. And since epistasthai, ginôskein, and eidenai can all be translated as 'know', I distinguish them (and associated words such as *epistêmê* and *gnôsis*) as follows: *epistasthai* is 'know<sup>(e)'</sup>, *ginôskein* is 'know<sup>(g)'</sup>, and *eidenai* is 'know<sup>(o)'</sup>, and similarly  $epist\hat{e}m\hat{e}$  is 'knowledge<sup>(e)</sup>' (and sometimes 'science<sup>(e)</sup>') while  $gn\hat{o}sis$  is 'knowledge<sup>(g)</sup>.' In cases of doubt the English-Greek Glossary can be used as a guide. Contrary to recent practice I employ 'knowledge' and 'know' rather than 'scientific knowledge (or understanding)' and 'know (or understand) scientifically' to render epistêmê and epistasthai. To be sure, Aristotle's project in the *Posterior Analytics* is to discuss a particular way of knowing (or understanding) that is associated with bodies of knowledge that can reasonably be called sciences, for which he deploys one of the words for knowing that already existed in Greek, although not in the specific sense that emerges in the course of this work. At least at the beginning (particularly in the first two chapters) it would be jumping the gun as well as tendentious to use the more technical translations of these words.

My greatest debt, as with my previous volume in this series, is to Richard Sorabji, who invited me to contribute this volume. The five readers (Owen Goldin, Marije Martijn, and three who have remained anonymous) took the trouble to read the translation and offer suggestions for improvement, and I am grateful to them for their help and to Suthee Wiri of the Department of Chemical Engineering at University of California, Santa Barbara for invaluable assistance with the geometrical diagrams. The translation benefited from the Greek-English Indices of previously published volumes in this series. In order to achieve accuracy and completeness in the Greek-English Index of this volume and also to make the task of composing it less burdensome, I wrote a number of computer programs to manipulate the text of Philoponus given in the *Thesaurus Linguae Graecae*.

Much of the work on this volume was completed on a sabbatical granted to me for this purpose by Pomona College, during which I had the privilege of working at the American School of Classical Studies at Athens. I want to express my sincere thanks to these institutions for their support and assistance.

I dedicate the volume to my lovely wife Voula, who helped me in matters of translation and Hellenistic terminology, and to our equally lovely daughter Eleni.

#### Notes

1. Diogenes Laertius 5.42.

- 2. Galen, De suis libris 14.
- 3. The surviving material from this work is collected in Moraux 1979.
- 4. See Wallies 1909, v.

**5**. Two other volumes are currently in preparation: Book 1 chs 9-18 by F. de Haas and Book 2 by O. Goldin.

**6**. The Aldine editio princeps of 1504 was followed by a second edition in 1534 and a third in 1558 (Wallies 1909, xxiii with n.).

**7**. The first translation, by Theodosius, was first published in 1539 and was reprinted nine times during this period. The second, by Rota, was published in 1559 and reprinted in 1560. (For references, see Schmitt 1987, 216, 228.)

**8**. Proofs by signs are discussed at 21,6-15; 21,29-22,7; 28,6-17; 31,8-32,7; 48,26-50,8. They are discussed in Morrison 1998.

9. See the Subject Index for references.

**10**. This commentary has recently been published with an Italian translation and commentary (Giardina 1999); see also D'Ooge 1926.

11. This error is particularly surprising since it contradicts Aristotle's statement of the correct view only a few lines below (75a2) and Philoponus gets the point right shortly below in commenting on that passage (89,30).

12. See also 127,18-129,25.

## **Textual Information**

#### **Textual emendations**

The text translated here is that printed in *Ioannis Philoponi in Aristotelis Analytica Posteriora Commentaria*, ed. M. Wallies, *CAG* 13.3 (Berlin: Reimer, 1909), with the following emendations:

27,3 Emending to apo tês diametrou to ho diametros.

- 103,30 Reading *isôn* (with MS Ua<sup>2</sup>) in place of Wallies' *isopleurôn* (from MS R).
- 104,22 Emending Wallies' isopleurôn to isôn.
- 108,7 Punctuating with a full stop; Wallies prints a comma.

#### Notes on the text of Aristotle's *Posterior Analytics*

Discrepancies between Philoponus' text of the *Posterior Analytics* and the text as given in Ross's edition:

- 71a4 P.'s lemma has *perainontai* (6,8) where Aristotle has *paraginontai*. 71a9 The lemma has *hôsautôs de* (6,24) where Aristotle has *hôs d'autôs*. 71a13 P. omits Aristotle's *esti* (11,6).
- 71a13 P. has de amphô (11,7) where Aristotle has d'amphô.
- 71a15 The lemma has tode (11,14) where Aristotle has todi.
- 71a21 The lemma has egnôrise (17,11) where Aristotle has egnôrisen.
- 71a25 The lemma has *tina sullogismon* (18,11) where Aristotle has *sullogismon*.
- 71b14 The lemma has *auto* (22,9) where Ross, following most of the Aristotle MSS, has *autoi*, which gives the meaning: 'the former think that they are in this condition' namely, the condition of knowing the cause and that it cannot be otherwise. Ross's MS C agrees with the lemma.
- 71b22 P. has houtôs (25,16) where Aristotle has houtô.
- 71b25-6 The word order in the lemma varies from Aristotle's by placing *ouk estin* after *to mê on* (26,16).
- 72a6 The lemma has tauton (29,15) where Aristotle has tauto.
- 72a6 P. substitutes legô ('I say') (29,15) for esti ('is').

- 72a11 Wallies prints *ho ti* (32,25) where Ross prints *hoti*. Ross's text is translated 'because it is true'.
- 72a27 The lemma has tad' (37,16) where Aristotle has tadi.
- 72b11 The lemma has *ei de* (46,4) where Aristotle has *eite*.
- 72b11 The lemma has *histantai* (plural) (46,4) where Aristotle has *histatai* (singular).
- 72b15 The lemma has *ekeina estin* (46,10) where Aristotle has *ekeina éstin*.
- 73b23 The lemma has te(47,21) where Aristotle has t'.
- 72b23 The lemma has *houtôs* (47,21) where Aristotle has *houtô*.
- 72b25 The lemma, agreeing with the second hand of two Aristotle MSS (C and n) has *d*' (48,19) where Ross, following most of the Aristotle MSS has *te*.
- 72b31-2 The lemma has *hê ginomenê* (50,3) where Aristotle has *ginomenê g'*.
- 72b34 P. has  $epeid\hat{e}$  (52,29) where Aristotle has ei.
- 72b35 The lemma has de(53,1) where Aristotle has d'.
- 73a2 The lemma has legein einai (54,3) where Aristotle has einai legein.
- 73a8 The lemma has einai ti (54,24) where Aristotle has ti einai.
- 73a14 P. has tôi (55,28) where Aristotle has tois.
- 73a25 The lemma has eisi (58,20) where Aristotle has eisin.
- 73a30 The lemma has tonde (59,15) where Aristotle has tond'.
- 73a34 The lemma has *huparkhei* (60,13) where Aristotle has *huparkhei ti*.
- 73b7 The lemma has *leukon* (63,22). The Aristotle MSS have *to leukon*. Ross inserts a second occurrence of this word immediately afterwards: *to leukon* <*leukon*>.
- 73b14 The lemma has *tis sphattomenos* (64,27) where Aristotle has *ti sphattomenon* ('something died while *its* throat was being cut').
- 73b14 The lemma has sphagên (64,27) where Aristotle has tên sphagên.
- 74a1 P. has tou (72,13) where Aristotle has toutou.
- 74a6 The lemma has prôton katholou (72,22) where Aristotle has katholou prôton.
- 74a18 The lemma has *hoti enallax* (76,26) where Aristotle has *hoti kai* enallax.
- 74a25 The lemma has *hekaston trigônon* (77,23) where Aristotle has *hekaston to trigônon*.
- 74b7 P. has ha (82,7) where Aristotle has ta.
- 74b14 The lemma has anankaion (84,11) where Aristotle has anankaiôn.
- 74b38 The lemma has *ton houtôs ekhonta* (88,29) where Aristotle has *houtôs ekhonta*, which would be translated 'things that are in that condition'.
- 75a29 P. has kath' hauto (97,10-11) where Aristotle has kath' hauta.
- 75a30 P. has kath' hauto (97,15) where Aristotle has kath' hauta.

- 75a40 The lemma has to apodeiknumenon sumperasma (99,5-6) where Aristotle has to apodeiknumenon, to sumperasma.
- 75b25-6 The lemma has *katholou autou* (107,5-6) where Aristotle has *kath' holou autou*.
- 75b26 The lemma has *hotan d' êi toiautê* (108,13) where Aristotle has *hotan d' êi*.
- 75b29. P. along with some Aristotle MSS, has to men estai to de ouk estai (108,18-19) where Ross, following other Aristotle MSS reads tôi men estai tôi de ouk estai.
- 75b34 The lemma has toiaide (110,11) where Aristotle has toioud'.

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## PHILOPONUS On Aristotle Posterior Analytics 1.1-8

Translation

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#### John of Alexandria's lecture notes from the meetings 1.1 of Ammonius, son of Hermeias, on the first [book] of Aristotle's Posterior Analytics, together with some observations of his own

This – I mean, of course, the discussion of demonstration – is the 5 culmination<sup>1</sup> of the treatment of logic. For it is for the sake of demonstration that Aristotle gave us his other logical works namely, the doctrine on simple verbal expressions in the *Categories*, that on propositions in *De Interpretatione*, and that on deductions in the *Prior Analytics* – in order that we may proceed systematically in 10 this way through those [other treatises] to this one as the culmination of the rest. It was very reasonable for him to do this. For just as a person cannot know<sup>(g)</sup> the Lydian or the Dorian mode without knowing<sup>(0)</sup> how to play the lyre at all, nor can anyone write in pointed script, for example, without knowing<sup>(0)</sup> how to write at all, it is impossible for a person to know<sup>(g)</sup> demonstrative deductions before learning deductions without gualification.<sup>2</sup> Next, since deductions without gualification are composed of propositions, and since without propositions it is not possible to know<sup>(g)</sup> deductions without qualification, he gave us the De Interpretatione in which he teaches about propositions. And since in turn it is impossible to know<sup>(g)</sup> propositions without the simple verbal expressions of which they are composed, before the *De Interpretatione* he gave us the *Categories*, in which he 2.1teaches us about the power and meaning of simple verbal expressions.

And since, as we have demonstrated in the Prior Analytics through several [arguments], there are several kinds of deductions - sophistical, dialectical, and demonstrative<sup>3</sup> - he teaches us demonstrative deductions here and dialectical ones in the Topics, where he teaches 5 how to argue for both sides. Further, to keep us from being deceived by people we converse with, in the Sophistical Refutations he teaches us about sophistical deductions, as if providing us with a protective drug to avoid sophistical nuisances (as he calls them),<sup>4</sup> the same way that doctors are taught about poisonous drugs not for the sake of 10 using them but in order to avoid them.<sup>5</sup> For let no one suppose that philosophers' discourse is about sophistical deductions, as the many think; instead, that kind of deduction is characteristic of people who are playing and are not serious. For example, 'everything that is above [something] is greater than what it is above; a cabbage is above the earth; therefore a cabbage is greater than the earth'.<sup>6</sup> Instead, to the contrary, in that work Aristotle teaches us refutations of that kind 15

of deception. This is why the book is entitled *Sophistical Refutations* and not *On Sophistical Deductions*. For philosophers' discourse is concerned with demonstrative deductions, which have their being not from reputable<sup>7</sup> propositions but from ones that are both neces-

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sary and self-guaranteeing.<sup>8</sup> This is why a person who pursues this kind of necessity in arguments cannot be persuaded to change his mind. For we must not be at all persuaded by reputable persons (since this is the mark of a thing that is moved by something else<sup>9</sup>), but we must pursue the truth with demonstration even if no one likes it.

It has thus become clear that demonstration is the culmination of the treatment of logic. Philosophers needed demonstration as an instrument for the correct pursuit of the parts of philosophy – I mean the theoretical and the practical [parts].<sup>10</sup> For just as a carpenter distinguishes straight wood from bent by using a straight-edge, and as a builder [distinguishes] a wall that is perpendicular from one that leans with a plumb-line, so it is by the standard of demonstration that the philosopher distinguishes true from false in a theory and 3.1 good from evil in action.<sup>11</sup> Demonstration is a scientific<sup>(e)</sup> deduction

3,1 good from evil in action.<sup>11</sup> Demonstration is a scientific<sup>(e)</sup> deduction which is drawn from self-guaranteeing propositions that have been granted.<sup>12</sup>

The present book<sup>13</sup> is prior in order to the *Sophistical Refutations*. That it should follow the *Topics* we demonstrated in that [work].<sup>14</sup>

- 5 For if we have been trained on plausible [arguments] it will be easier to notice those that are necessary. But that it precedes the *Sophistical Refutations* is clear from the following considerations. That treatise is completely useless for demonstration and it would be out of place to insert it among the treatises that contribute to demonstration. And besides, before knowing<sup>(g)</sup> what is true a person should not spend time on falsehoods, because if he has come to be in possession
- 10 of evil, he can use them to escape notice. And third, if falsehood is refuted by juxtaposition with the truth, it follows that [we should] first know<sup>(o)</sup> the truth and then, having come to be in possession of it, subsequently proceed to the refutation of falsehood by comparison with this.

Note<sup>(0)</sup> that here too Aristotle is consistent with himself in the manner of his teaching and begins with more general [claims]. For he says, 'All teaching and all learning that involves reasoning is based on pre-existing knowledge<sup>(g)'15</sup> and then he comes to the particulars, namely, the present topic. For since he wants to teach about the things on which demonstration is based, he first wants to establish this very thing, that demonstration is based on things previously known<sup>(pg)</sup>, and then [to establish] just what those things are. So in

20 order to prove that demonstration [is based] on things previously known<sup>(pg)</sup>, he proves universally that both 'all teaching and all learning' 'is based on'<sup>16</sup> things that pre-exist and are previously known<sup>(pg)</sup>. And if this is so, and [if it is true that] demonstration too is an

instance of teaching and learning, it follows that demonstration too is obtained from pre-existing knowledge<sup>(g)</sup>, namely, from common notions.<sup>17</sup> Otherwise it is impossible to demonstrate, if we have not first taken from among the common notions premises that have been granted.<sup>18</sup> For just as in the case of geometrical theorems it is not possible to establish that two sides are greater than the remaining one before we know<sup>(g)</sup> the triangle without qualification or the angle without qualification, so it is impossible to know<sup>(g)</sup> a demonstration<sup>19</sup> without pre-existing knowledge<sup>(g)</sup>.

**71a1-2** All teaching and all learning [that involves reasoning is based on pre-existing knowledge<sup>(g)</sup>.]

It is important to know<sup>(g)</sup> that there are two procedures on which all 30 knowledge<sup>(g)</sup> is based, as Plato says as well:<sup>20</sup> learning and discovery. For we know<sup>(g)</sup> either because we learn from someone else or because we ourselves discover.

Alexander here declares wrongly that he [Aristotle] here called 4.1discovery knowledge<sup>(g)</sup>, so that the meaning is 'all teaching and all learning is based on pre-existing discovery'.<sup>21</sup> But this is not true. For further down<sup>22</sup> he clearly gives us his account of discovery. And besides, investigation must precede discovery, and so what is discov-5 ered is not anything self-guaranteeing, that is, it is not a common notion or anything known<sup>(g)</sup> by perception.<sup>23</sup> For the intuition of these is primary and does not have its confirmation from other things, and there is no investigation of them. And so every discovery too 'is based on pre-existing knowledge<sup>(g)</sup>, just like learning. How, then, does 10 understanding 'is based on pre-existing knowledge<sup>(g)'</sup> [to mean that it is based] on learning differ from [understanding it to mean that it is based] on discovery? For in both cases something must be previously known<sup>(pg)</sup>. But this is impossible, i.e., for the learning and the knowledge<sup>(g)</sup> to [happen] at the same time, for that [instance of learning] too must be based on another [instance of] learning, and so ad infinitum.24 Therefore 'knowledge(g)' should not be understood as discovery, but [the claim is] simply [that teaching and learning are based] on something previously known<sup>(pg)</sup> and previously granted, no matter in what way the knowledge<sup>(g)</sup> of that thing may have come to 15pre-exist - whether from discovery or from learning or even if [the thing in question] is self-guaranteeing and indemonstrable.

Teaching and learning are the same in substrate<sup>25</sup> and differ only in relation. For as the road from Athens to Thebes and the [road] from Thebes to Athens differ in relation but are the same in substrate, the same holds for learning and teaching. For the activity proceeding from the teacher to the student is called teaching, while the activity or affection that occurs in respect of the student himself is called learning. He does well to say 'from pre-existing knowledge<sup>(g)</sup>'. For if

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25 'all teaching and all learning are based on pre-existing' learning, the account goes on ad infinitum. For again, we are obliged to investigate learning presupposed in that learning, and another [presupposed in] this, and it [goes] ad infinitum. In this way all knowledge<sup>(g)</sup> would be eliminated and nothing could be known<sup>(g)</sup>. For in order to learn one thing we would have to learn [an] infinite [number of] things previously, whereas there is no knowledge<sup>(g)</sup> of the infinite. But this is absurd. And so he did well to say 'from pre-existing knowledge<sup>(g)</sup>'.

30 And it is marvellous that he adds 'that involves reasoning', to

- 5,1 make a contrast with perceptual knowledge<sup>(g)</sup>. For perceptual knowledge<sup>(g)</sup> does not involve pre-established knowledge<sup>(g)</sup>.<sup>26</sup> For example, that this is white;<sup>27</sup> perception teaches this even if prior knowledge<sup>(pg)</sup> is not pre-established. Likewise, that this is Socrates; it was perception that brought him to my attention although he was formerly unrecognized. And besides, in saying 'that involves reasoning', not 'demonstrative' he ascends to the more general in order to include
  - every deduction, including dialectical and sophistical [deductions] – and also induction and rhetorical proofs.

Such a deduction takes place in the first figure: demonstration is knowledge<sup>(g)</sup> that involves reasoning, all knowledge<sup>(g)</sup> that involves reasoning 'is based on pre-existing knowledge<sup>(g)</sup>', therefore demonstration 'is based on pre-existing knowledge<sup>(g)</sup>. It is called knowledge<sup>(g)</sup> that involves reasoning (5,10) since this <is the kind of knowledge<sup>(g)</sup> that > gets through to its and and provides us a way to

knowledge<sup>(g)</sup> that> gets through to its end and provides us a way to the demonstrative sciences<sup>(m)</sup>.

After saying that 'all teaching and all learning' is based on pre-existing knowledge<sup>(g)'</sup>, he confirms this from the other arts and deductions, and from induction and through rhetorical argument, which consists in enthymemes and examples. [It is clear] through the

- 15 other arts, for example, that a person who intends to make shoes knows<sup>(o)</sup> and has previous knowledge<sup>(pg)</sup> that leather can be cut and that iron cuts; having this previous knowledge<sup>(pg)</sup>, he applies himself to it and then he is taught in addition in what way he should cut. Likewise a doctor, having previous knowledge<sup>(po)</sup> that the body can be
- 20~ cut and that iron cuts, applies himself to surgery. This is how prior knowledge^{(pg)} is seen in the arts.

In deductions<sup>28</sup> too it is certainly necessary for the premises to be  $known^{(pg)}$  previously and to be assented to as granted, and then, after putting them together as the  $art^{29}$  demands, to infer the conclusion. In this way [the claim] can be confirmed by induction. For if I wanted to learn whether every animal moves its lower jaw, I say that since

25 humans, horses, dogs, and oxen [do], the rest [of the animals] move their lower jaw too. For I knew<sup>(o)</sup> at this point that the knowledge<sup>(g)</sup> of each of the particulars<sup>30</sup> is pre-existent, from which we then deduce the universal. Further, it is possible to deduce from enthymemes in the same way as with rhetorical [arguments]. For example, such and

such a person dandifies himself, so he is an adulterer. These leave out the premise that states 'every man who dandifies himself is an adulterer'. These people have prior knowledge<sup>(pg)</sup> that dandifying oneself is discredited. It is called an enthymeme because it leaves it to the intelligence to think of<sup>31</sup> the one premise. Prior knowledge<sup>(pg)</sup> is seen in examples in the following way: for example, Aeschines must not be given money, since when Pisistratus took [money] he became a tyrant.<sup>32</sup> And so Aristotle does well to say that 'all teaching and all learning that involves reasoning is based on pre-existing knowledge<sup>(g)'</sup>.

**71a2-7** [This is evident to those who consider them all.] For the mathematical sciences<sup>(e)</sup> proceed<sup>33</sup> in this way [as do all the other arts. Likewise too concerning arguments, both those proceeding through deductions and those proceeding through induction. For both kinds produce their teaching through things previously known<sup>(pg)</sup>.]

Note how after beginning from universals he descends to particulars by obtaining confirmation through them. He says 'this is evident', 10 [namely] that 'all learning is based on pre-existing knowledge<sup>(g)</sup>,<sup>34</sup> to those who consider all cases. 'For the mathematical' sciences<sup>(e)</sup>, i.e., the logical ones, are pursued correctly 'in this way', i.e., through prior knowledge<sup>(pg)</sup>, as we have said. 'Likewise' this can be seen also in 'the other' 'arts' 'and concerning arguments' – by which he means 'deductions'. For those who confirm both universals from particulars and particulars from universals through deductions confirm [them] from pre-existing knowledge<sup>(g)</sup>.

**71a7-9** The former taking [premises] as if [granted] by people who understand them, [the latter proving the universal by virtue of the fact that the particular is clear.]

By which he means 'by the people they are conversing with'. For if I want to establish that the soul is immortal, it is necessary first to 20 take from the person I am conversing with as previously known<sup>(pg)</sup>, that the soul is self-moving, and that what is self-moving is always-moving.<sup>35</sup> If he does not accept this, it is necessary to establish from other [premises] that what is self-moving is always-moving and so to demonstrate that the soul is immortal.

**71a9-11** Rhetorical [arguments] too persuade in this way,<sup>36</sup> [for [they persuade] either through examples, which is induction, or through enthymemes, which is deduction.]

He says that just like the deductions of philosophers, 'rhetorical 25

[arguments]' are based 'on pre-existing' 'knowledge<sup>(g)'.37</sup> For as we showed, both examples and enthymemes 'are based' 'on pre-existing' 'knowledge<sup>(g)'</sup>. He does well to say 'persuade', for Plato too says in the *Gorgias* that there are two kinds of proofs: those that teach and those that create conviction.<sup>38</sup> Philosophers use the kind that teach, since they are discussing the truth, while orators use the kind that create conviction since their aim is to persuade rather than promote the truth.

**71a11-13** There are two ways in which it is necessary to have prior knowledge<sup>(pg)</sup>. [For some things it is necessary to assume in advance that they are, for others it is necessary to understand what the thing being said is, and for some both.]

After saying that 'all teaching and all learning' is based on pre-existing knowledge<sup>(g)</sup>,<sup>39</sup> and confirming it from the other arts, from deduc-

- 10 tions, from induction and from rhetorical proofs, he now wants to teach what things should be known previously<sup>(pg)</sup>. But since the present topic is not the particular sciences<sup>(e)</sup> but simply demonstrative science<sup>(m)</sup>, we should not investigate what should be known previously<sup>(pg)</sup> in each science<sup>(e)</sup> but simply what concerns demonstra-
- 15 tive [science]. We cannot know<sup>(g)</sup> this unless we learn in what ways what is known previously<sup>(pg)</sup> is known previously<sup>(pg)</sup>. And in turn we will not obtain this unless we learn in general in what demonstrative science<sup>(e)</sup> consists and through what it proceeds. Therefore it is necessary to treat this first.

I state that the following two things are observed in every demonstration: the problem<sup>40</sup> proposed for demonstration, and the premises

- 20 through which the problem is established. Again, in every problem the following two things are observed: the given and the sought.<sup>41</sup> For example in the problem whether the soul is immortal, the subject term, namely, soul, is given, and the predicate [term], whether it is immortal, is sought. And it is not only in problems that investigate
- 25 per se attributes of things that we find the given and the sought, but the same division is also observed in those [problems] that go on to investigate whether it is at all.<sup>42</sup> For example, in the problem that investigates whether a goat-stag is an animal, animal is the given and goat-stag is the sought; for the problem investigates not that animal is (for this is evident), but whether such an animal does. For
- 8,1 the additional specification 'goat-stag' grants that animal is and goes on to investigate a quality of it.<sup>43</sup> Likewise if we investigate whether a place is void, the place is the given, and whether it is void is the sought. And so the totality of premises through which the problem is established are at least two, which each particular demonstration<sup>44</sup>
  - 5 must assume in advance, since it is not possible to conclude anything unless all the premises are known<sup>(g)</sup>.

However it is perhaps impossible to have previous knowledge<sup>(pg)</sup> without qualification of both premises of a demonstration, but it is

necessary [to have previous knowledge of] only the major [premise]. which certainly must be one of the common axioms without which it is impossible for anything to be demonstrated.<sup>45</sup> But since the minor premises are infinite (for in each theorem some [minor premises] are taken that are unique),<sup>46</sup> it is arguably impossible for the minor 10 premises of every demonstration to be previously known<sup>(pg)</sup> without qualification.

However, the minor [premises] are contained potentially<sup>47</sup> in the major premises, namely, the axioms. For example, if three straight lines A, B, and C are posited, if I say that since A and B are both equal to C, A and B are therefore equal to one another because 'things which are equal to the same thing' are 'also equal to one another',<sup>48</sup> clearly the 15minor premise, 'A and B are equal to C' is contained in the [premise] that says 'things which are equal to the same thing are also equal to one another'. And in the deduction 'man is an animal, animal is a substance, man is a substance', the minor premise, 'man is an animal', is clearly included in the major [premise], 'animal is a substance'.49

And so there are three things that should be assumed in advance 20universally in every demonstration: the given, the sought, and the axiom. For example, in Euclid's first theorem,<sup>50</sup> which investigates constructing an equilateral triangle on a given finite straight line, the finite straight line is the given, the equilateral triangle is the sought, and the axiom in the preliminary deductions<sup>51</sup> is 'straight lines' 'extend-25ing' from the centre 'to the circumference of a circle'52 'are equal to one another<sup>53</sup> and that 'things which are equal to the same thing are also equal to one another' and [the axiom] in the conclusion is that a triangle contained by three equal straight lines is equilateral.<sup>54</sup>

Consider how all the things mentioned are assumed in advance by the geometer: what a straight line is, what finite is, what an equilat-30 eral triangle is, and the remaining axioms as well. But certain things are omitted by the geometer, for example what base, coinciding, and equal are, since these are familiar in common usage.<sup>55</sup>

You will find these same things in the other sciences<sup>(e)</sup> as well and in the arts too, if you go through them in detail. As in medicine the given is, for example, that a person has fever,<sup>56</sup> and the sought may be what kind of fever it is or the immediate cause and principle of its onset,<sup>57</sup> and 5 the axiom may be that contraries are cures of contraries.<sup>58</sup>

But although the sciences<sup>(e)</sup> have in common as prior assumptions their axioms and the terms through which the demonstrations take place,<sup>59</sup> it is not possible for this to occur in the same way for the arts such as the study of nature or medicine.<sup>60</sup> They cannot do this because they are indefinite.<sup>61</sup>

However, it is important to know<sup>(0)</sup> that sometimes the given becomes the sought and the sought the given. For instance, in the 10 first theorem we have the straight line as the given; but this straight line which is now given becomes the sought in the fourteenth theo-

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rem,<sup>62</sup> which states, 'if with any straight line, and at a point on it, two straight lines not lying on the same side make the adjacent angles equal to two right angles, the two straight lines will be in a straight

- 15 line with one another'.<sup>63</sup> For if I prove that the straight lines are in a straight line with one another, then I am showing that they are one straight line, since in fact a straight line is one that lies evenly with the points on itself.<sup>64</sup> And so the given has become the sought. Again, if I say that 'in every triangle two sides are greater<sup>65</sup> than the remaining one',<sup>66</sup> I take the triangle as the given. However, if I take the square *ABCD* and draw diagonal *BC* and bisect it at point *E* and
- draw two straight lines AE and DE from angles CAB and BDC to
- 25 point *E*, I investigate whether ACD is a triangle, which now becomes the sought. For if I prove that [line] *AE* and [line] *ED* are one straight line, clearly ACD is a triangle.<sup>67</sup>



Diagram 1

However, it is important to know<sup>(0)</sup> that there are some givens that 30 never become sought.<sup>68</sup> For example, if I say that I moved a given magnitude, the magnitude will never be the sought.<sup>69</sup> Again, if I speak of a sphere, I never make this the sought since it is always given.<sup>70</sup> A

- 10,1 circle too is always given among plane [figures]. However, in solid [figures] we find it as the sought, as in the following theorem: if a sphere is cut by a plane, the section is a circle. Now no one investigates whether this is a sphere, whether this [figure] in a plane is a circle, or whether this is a magnitude. For these are grasped by perception.<sup>71</sup>
  - 5 The things in which demonstration consists are these. In these and through these every demonstration proceeds. The ways in which we have previous knowledge<sup>(pg)</sup>, he says, are two: what it is or what it signifies, and that it is. And, he says, in the case of the given<sup>72</sup> it is necessary to have previous knowledge<sup>(pg)</sup> both that it is and what it signifies or what it is, but in the case of the sought [it is necessary to have previous knowledge] not that it is but what it signifies or what
  - 10 it is. For example, if a finite straight line is given, it is necessary to

have previous knowledge<sup>(pg)</sup> both that the straight line is finite and what the term signifies, but in the case of the sought, i.e., the equilateral triangle, only what it signifies. For in this case it is not necessary to have previous knowledge<sup>(pg)</sup> that it is, since otherwise it would not be the sought.<sup>73</sup>

However, in the case of the axioms, namely, 'things which are equal to the same thing are also equal to one another', etc., it is necessary to have previous knowledge<sup>(pg)</sup> only that they are. And if anyone poses the puzzle: 'Why? Must we not know<sup>(o)</sup> what it signifies<sup>74</sup> as well?', we will say, very much so; he omitted this on the grounds that it is granted; for anyone who does not know<sup>(o)</sup> what something signifies cannot know<sup>(o)</sup> that it is,<sup>75</sup> just as a person cannot know<sup>(o)</sup> what goat-stag signifies if he is ignorant that it is.<sup>76</sup> However, anyone who knows<sup>(o)</sup> that it is cannot be ignorant of what it signifies.

Further, what it signifies is not assumed for whole premises, only for terms. This is why in the case of the given and the sought, since they are terms, it is necessary to have previous knowledge<sup>(pg)</sup> of what each term signifies. However in the case of the axioms, since they are premises, we investigate<sup>77</sup> not what they signify but that they are. For [the question of] what it signifies would be relevant to terms rather than to an axiom,<sup>78</sup> and not to a whole premise. For a premise indicates that one thing belongs to another.

It is also necessary to know<sup>(0)</sup> that some of the axioms are in the foundations of all sciences<sup>(e)</sup> universally, others in some, and others in only one. For example, 'in every case either the affirmation or the negation'<sup>79</sup> will be relevant to every science<sup>(e)</sup>, since we employ such an axiom even in the ordinary arts and in conversations. However, 'things that are equal to the same thing are also equal to one another' and 'if equals be subtracted from equals, the remainders are equal'<sup>80</sup> apply to several sciences<sup>(e)</sup>, since music,<sup>81</sup> geometry, and arithmetic employ them. On the other hand, 'things which coincide with one another are equal to one another'<sup>82</sup> belongs to geometry alone.

'There are two ways in which it is necessary to have previous knowledge<sup>(pg)</sup>' and what follows. After saying 'there are two ways in which it is necessary to have previous knowledge<sup>(pg)</sup>', he goes on to give 5 three ways. For he says 'for some things it is necessary to assume in advance that they are, for others it is necessary to understand what the thing said [is]<sup>83</sup>, and<sup>84</sup> for some both'. And the reason is clear from what has been said, namely, that there are three things in each science<sup>(e)</sup> that must be assumed in advance, but the ways in which it is necessary to know<sup>(g)</sup> them are two: 'that it is' and 'what it signifies'.

**71a13-14** For example, [regarding the principle] that everything may be truly asserted or denied, [it is necessary to assume in advance] that it is.

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15 This<sup>85</sup> is an example of an axiom, in which it is necessary to have previous knowledge<sup>(pg)</sup> only 'that it is'.

**71a14-15** [Regarding] the triangle, [it is necessary to assume in advance] that it signifies this.<sup>86</sup>

This is an example of the sought, in which it is important to have previous knowledge<sup>(pg)</sup> of 'what it signifies'.

**71a15-16** [Regarding] the unit, both – both what it signifies and that it is.

This [is an example] of the given, in which both ways of prior knowledge<sup>(pg)</sup> are assumed. For we often take the unit as the given, for example, if a unit measures a number and a different number.

- 20 for example if a unit measures a number and a different number measures another number an equal number of times, then the unit will measure the third [number] an equal number of times as the second [number measures] the fourth.<sup>87</sup> For it is necessary to have previous knowledge<sup>(pg)</sup> both that this is a unit and what the term 'unit' signifies.
- 12,1 **71a16-17** For each of these is not clear to us in the same way.

For the given has both 'that it is' and 'what it signifies', the sought [has] only 'what it signifies', and the axiom [has only] 'that it is'.

**71a17-20** It is possible for a person to recognize things he has previously come to know and also [to recognize] things at the same time as he acquires knowledge<sup>(g)</sup> of them, [for example, everything that falls under a universal of which he has knowledge<sup>(g)</sup>. For he had prior knowledge<sup>(po)</sup> that every triangle has [its angles] equal to two right [angles].]

After saying that 'all teaching and all learning' is based on pre-existing knowledge<sup>(g)', 88</sup> he now proposes to speak about discovery and to show that it too 'is based on pre-existing knowledge<sup>(g)'</sup>. For since knowledge<sup>(g)</sup> that involves reasoning comes to be present in us either through teaching and learning or through investigation and discovery, and since it is necessary in both types of cases for our knowledge<sup>(g)</sup> to be based on certain things previously known<sup>(pg)</sup>, this is why after showing [this] in one of the types of cases he turns to the remaining one, with the result that it is clear that all knowledge<sup>(g)</sup>

- that involves reasoning, whether it comes from teaching and learning or from investigation and discovery, comes to be present from certain things previously known<sup>(pg)</sup>.
- 15 But before discussing discovery he proposes to teach about recognizing as being more universal, as we will show as we proceed in

detail. Now there are two ways of recognizing. One [occurs] when we have previous knowledge<sup>(pg)</sup> of something and notice it again without having forgotten in the meantime. For example, when, after seeing someone for the first time and subsequently having memory of him, we see him again, we are said to recognize him. But if we have forgotten in the meantime and again obtain our previous knowledge<sup>(pg)</sup> of him, such a case is not said to be recognizing, but recalling. This is one way.

The second is when we possess the notion of the universal and notice some particular which we have not previously observed and then apply<sup>89</sup> this to the universal of which we have knowledge<sup>(g)</sup>. For example, if someone observes a magnet attracting iron, if he does not have previous knowledge<sup>(pg)</sup> that every stone of that kind attracts iron, such a person is not said to recognize that it is a magnet, but if he acquires a teacher he learns for the first time that every magnet attracts iron. But if he has previous knowledge<sup>(pg)</sup> of this, when he notices the particular magnet, he immediately recognizes that this is included under that universal kind.



There being two ways of recognizing, Aristotle says that discovery 13.1takes place in the second way, when, attending for the first time to certain particular theorems not previously known<sup>(pg)</sup> to us, we obtain knowledge<sup>(g)</sup> of them from certain more universal ones that are previously known<sup>(pg)</sup>.<sup>90</sup> For example, if in isosceles triangle ABC we  $\mathbf{5}$ draw a perpendicular AD from the apex to the base BC so as to bisect the base, and of necessity two triangles ABD and ADC result, if it is proposed to us for investigation whether the resulting triangles. namely, ABD and ADC, are equal or not,<sup>91</sup> we will discover knowl-10edge<sup>(g)</sup> of this by applying it to certain other more universal theorems previously known<sup>(pg)</sup> to us. For since we have previous knowledge<sup>(pg)</sup> that 'in isosceles triangles the angles at the base are equal to one another'92 and that 'if two triangles have the two sides equal to two 15sides respectively, and have the angles contained by the equal

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straight lines equal, they will also have the base equal to the base, the triangle will be equal to the triangle, and the remaining angles will be equal to the remaining angles respectively, namely, those

- 20 which the equal sides subtend',<sup>93</sup> and since we have in the present case (since triangle ABC is isosceles) angle ABC equal to angle ACB, and two sides are equal to two sides AB [equal] to AC because it is isosceles, and BD to DC because base BC is bisected by the perpendicular  $AD^{94}$  clearly also the whole triangle ABD is equal to the
- 25 whole [triangle] ADC and the remaining angles [are equal] to the remaining angles, ADB to ADC and DAB to DAC. We say that we have investigated and discovered this theorem if certain theorems are presupposed, and we have obtained knowledge<sup>(g)</sup> of it by applying the present case to them. And, to keep my account brief, it is like this in all cases.
- 30 However, it is important to know<sup>(o)</sup> that when I say that knowledge<sup>(g)</sup> is based on certain universal things that are previously known<sup>(pg)</sup>, I do not mean more universal in the way we say that the genus is more universal than the species, but simply that it [is based]
- 14,1 on certain other universal theorems.<sup>95</sup> And we say that knowledge<sup>(g)</sup> is more universal than discovery because discovery occurs only in the second way of recognition, when we apply the things sought to things granted, whereas knowledge<sup>(g)</sup> is observed [to occur] in more cases.
  - 5 For [it occurs] in the former way [of recognizing] as well. But I am not claiming that recognition and discovery are the same thing, but that discovery occurs in the same way as the second kind of recognition [does]. In fact there is a difference, that recognition applies the particular to the universal without investigation and when there is no previous ignorance, but discovery arises through investigation when there is previous ignorance. Now it has been shown that all
  - 10 knowledge<sup>(g)</sup> that involves reasoning, whether through teaching and learning or through investigation and discovery, comes to be present in us from certain things previously known<sup>(pg)</sup>.

On this basis he also solves the puzzle in the Meno. When Socrates proposes there to investigate some topic and tells [Meno] to define

- 15 virtue<sup>96</sup> and he cannot,<sup>97</sup> then, when Socrates says that if we investigate we will certainly discover,<sup>98</sup> Meno poses an additional puzzle in his speech and declares that there cannot be discovery at all.<sup>99</sup> For the sought, he says, must either be previously known<sup>(pg)</sup> or not. Now if it is not previously known<sup>(pg)</sup>, even if we were to notice it we could not recognize that this is what we are seeking; for if we do not know<sup>(9)</sup>
- 20 Socrates we cannot recognize him if we meet him. But if we do have previous knowledge<sup>(pg)</sup> of him, we would not say that we are investigating him or discovering someone we already know<sup>(o)</sup>. And so it is not at all possible either to investigate anything or to discover it. In response to this, Socrates brought Meno's slave<sup>100</sup> and by asking him questions made him discover a theorem which he did not know<sup>(o)</sup>

before, namely, that the square described on the diagonal of a square is double the square whose diagonal it is.



The proof proceeds as follows.<sup>101</sup> He describes square *ABCD* and draws AD, a line from angle to angle, namely, its diagonal. From side BD he also describes square BFDE and from AB another square ABGH, and from BH another [square] BFHI. Now clearly each of the sides of square ABCD is equal to the sides of the other square BFDE. 30 Likewise, each of the [sides] of *ABGH* is equal to the [sides] of *BFHI*. And to speak briefly, he puts a gnomon around the first square and draws the lines from angle to angle of the remaining squares, namely, AH, HF, FD, DA. Now clearly CEGI is a square four times the square 5 ABCD, since three things equal to it were put around it. Therefore, the four, being equal, are four times one of the squares. The servant grants this because it is evident. And since the diagonals of the four described 10 squares cut each [of the squares] into two equal triangles because the diagonal of every quadrilateral bisects it, each of the eight triangles is therefore equal to each of the rest. And so square *CEGI* is double the square ADFH, since it contains four more triangles. But square CEGI 15is four times square ABCD. Therefore square ADFH, which was described on diagonal AD, is double the square ABCD. Q.E.D.

This is how by questions Socrates made Meno's servant discover a 20theorem he did not previously know<sup>(0)</sup>, leading him to the sought from certain previously granted things. And so the things that come to our knowledge<sup>(g)</sup> through investigation and discovery come to be present in us from certain previously known<sup>(pg)</sup> things. And the person who is investigating and discovering must not both know<sup>(0)</sup> and learn the same things, but [he must] be investigating some things and [must] make the 25discovery of the things that are sought on the basis of other things, things that have previously been granted. And neither will Meno's puzzle that eliminates discovery be relevant nor will the [puzzle] of the sophists that eliminates knowledge<sup>(0)</sup> universally in the following way.

Hiding a triangle (for example) under their hand, they ask as

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follows: 'Do you know<sup>(0)</sup> that two sides of any triangle are greater than the remaining one?' When we say 'Indeed', they hold out the triangle.

- saying, 'But you did not know<sup>(0)</sup> that this is a triangle; but if you did
- 16,1 not know<sup>(0)</sup> that it is a triangle neither did you know<sup>(0)</sup> that it has two sides greater than the remaining one. Therefore you both know<sup>(0)</sup> and do not know<sup>(0)</sup> the same thing, which is absurd'. Now some do a bad job of solving these puzzles, saying that every triangle that I know<sup>(0)</sup> I know<sup>(0)</sup> that *this* has two sides greater than the remaining one;
  - 5 and likewise for similar cases. Aristotle denounces these people for doing a bad job of attempting to solve those other people's puzzles. For nowhere in the theorems have we received the additional specification 'that you know<sup>(o)</sup> is a triangle' or 'that you know<sup>(o)</sup> is a square', but [the theorems are stated] universally of every triangle or every square.

And after rebuking them, he presents the true solution on the basis of what has already been said: that it is not at all surprising that the same thing is known <sup>(0)</sup> in one way and not known<sup>(0)</sup> in another. For as to the triangle hidden by a hand, I know<sup>(0)</sup> in respect of the universal that it has two sides greater than the remaining one, even though I do not yet know<sup>(0)</sup> that very particular. In this way we know<sup>(0)</sup> all humans in respect of the universal even though we are ignorant of particular ones. And again, knowing<sup>(0)</sup> universally that no mule is pregnant, if we suddenly see a mule with its belly swollen we are deceived and think

she is pregnant, if we do not apply the particular to the universal.

Vice versa, it is possible to know<sup>(o)</sup> something in respect of the particular but to be ignorant of it in respect of the universal.<sup>102</sup> For example [it is possible to know] that in an isosceles triangle two sides are greater<sup>103</sup> than the remaining one – for in fact even the layperson is not ignorant of this – but not yet [to know] that also in every triangle [two sides are greater than the remaining one]. And so he knows<sup>(o)</sup> the particular but not the universal.

20 But it is not only in this respect that it is possible to know<sup>(0)</sup> something and not know<sup>(0)</sup> it, but also in respect of the way of knowing<sup>(g)</sup>. For it is possible for a person who knows<sup>(0)</sup> something directly not to know<sup>(0)</sup> it by *reductio ad impossibile*, and vice versa. For example, that the diagonal is incommensurable with the side<sup>104</sup> is proved by the geometer by [a proof] *per impossibile*, but some philosophers have attempted to prove it directly as well. And so it is possible for a person who knows<sup>(0)</sup> the theorem by a proof *per impossibile* to be ignorant of it by direct [proof].<sup>105</sup>

**71a17-18** It is possible for a person to recognize things he has previously come to know and also [to recognize] things at the same time as he acquires knowledge<sup>(g)</sup> of them.

It is possible to apply both of these to the two ways of recognition respectively, [applying] one of them to each; and both [can be applied]

to the second, in this way. 'It is possible for a person to recognize 30 things he previously recognizes': this will apply to the first way, in which we recognize the very same thing which we have known<sup>(g)</sup> 17.1previously. But the claim 'and also [to recognize] things at the same time as he obtains knowledge<sup>(g)</sup> of them' applies to the second way, in which at the same time as we notice something we recognize it even if we have not known<sup>(g)</sup> it previously, by applying it to the universal. But both [apply to] the second [way], as follows. 'It is possible for a 5 person to recognize things he previously recognizes', i.e. the universals, 'and also [to recognize] things at the same time as he obtains knowledge<sup>(g)</sup> [of them]', i.e., the particulars which when we notice them for the first time we are said to recognize because we apply them to the universals previously known<sup>(pg)</sup> by us. The examples were brought in relation to the second way.

71a20-1 But he recognized<sup>106</sup> that this [figure] in the semicircle is a triangle at the same time as he performed the induction.

By 'performing the induction' he means 'noticing it by perception', since knowledge<sup>(g)</sup> of particulars is being called induction,<sup>107</sup> and we know<sup>(g)</sup> particulars through perception. Instead of saving 'in a hand', <sup>108</sup> he says 'in the semicircle'. And so, regarding the unnoticed triangle, 15it is through the universal that he recognized [that] as a triangle [it has two sides greater than the remaining onel, but it is through induction, not on the basis of certain presuppositions, that he recognized such a thing as a triangle.<sup>109</sup> All perceptual knowledge<sup>(g)</sup> is of this kind, and we do not call it recognizing but simply knowledge<sup>(g)</sup>. However, that it has three angles equal to two right angles, he recognized without induction because he had pre-existing in himself the account of the universal, that every triangle has its three angles 20equal to two right angles.<sup>110</sup> So at the same time as he got to know<sup>(g)</sup> that it is a triangle, he immediately got to know<sup>(g)</sup> that it has [angles] equal to two right angles.

71a21-4 For the learning of some things occurs in this way and the extreme does not come to be known through the middle – all that are in fact particulars and [are] not [predicated] of any subject.

To the preceding point he answers that we learn some things not by 25applying them to others but obtaining our first knowledge<sup>(g)</sup> of them at the same time as we notice them, for example that this is a triangle or circle or anything else. These things we are not said to recognize but to learn for the first time. But they are all particulars. And he too 18,1reveals this when he says 'all that are in fact particulars and [are] not [predicated] of some subject'. However, when we observe a trian-

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gle and deduce that it has its three angles equal to two right angles. we are said to recognize this by applying it to the universal through some middle [term]. For example, [we deduce] that every triangle has

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its three angles equal to two right angles, this is a triangle, and therefore this has its three angles equal to two right angles. But it should be noted that he called knowledge<sup>(g)</sup> through perception learning.<sup>111</sup> With regard to this, at the beginning when he said 'all teaching and all learning', he said 'that involves reasoning'112 in order to make a contrast, since some learning is also perceptual. For in inductions we know<sup>(g)</sup> only particulars and not universals.

71a24-9 But perhaps it should be said that before performing the induction or grasping some<sup>113</sup> deduction he knows<sup>(e)</sup> in one way, but not in another. [For if he did not know<sup>(o)</sup> without qualification if something is, how did he know<sup>(0)</sup> without qualification that it has [its angles equal to] two right [angles]? It is clear that he knows<sup>(e)</sup> in the sense that he knows<sup>(e)</sup> universally, but he does not know<sup>(e)</sup> without gualification.]

That is, before we notice the concealed triangle by perception we are said to know<sup>(e)</sup> it in some way, by virtue of knowing<sup>(o)</sup> that every 15triangle has its three angles equal to two right angles. For it is clear that in this way we potentially know<sup>(g)</sup> the concealed triangle too. But in another way we are ignorant, by virtue of not knowing<sup>(o)</sup> whether the concealed thing is a triangle at all. For if we are ignorant that it is a triangle, clearly we do not know<sup>(g)</sup> if it has [angles] equal to two right angles. The idea is this: that every triangle has its three angles equal to two right angles, he had prior knowledge<sup>(po)</sup> in respect of the 20universal. But he was ignorant that the thing concealed<sup>114</sup> in the semicircle is a triangle. Therefore neither did he know<sup>(o)</sup> whether it has [angles] equal to two right angles.

> **71a29-30** But if not the paradox in the *Meno* will arise, [for either he will learn nothing or [he will learn] what he knows<sup>(o)</sup>.]

'But if', he says, what we said were 'not' true – that it is possible both to know<sup>(o)</sup> and not know<sup>(o)</sup> the same thing: to know<sup>(o)</sup> in respect of the universal, but to be ignorant in respect of the particular – the puzzle 25'in the Meno', which we have already stated in anticipation, will be relevant.

19,1**71a31-b5** [We must not speak like some who attempt to solve the problem:] 'Do you know<sup>(o)</sup> that every pair is even [or not?' And when [the answerer] says yes, they produce some pair which he did not think exists, and so neither [did he think that

it is] even. They solve [the puzzle] by saying that they do not know<sup>(0)</sup> that every pair is even – only pairs that they know<sup>(0)</sup>. But they know<sup>(0)</sup> what they have a demonstration of and of what they have assumed [that it has a given attribute], and they did not assume [it to hold] of everything that they know<sup>(0)</sup> is a triangle or a number, but of every number or triangle without qualification. For no premise is assumed of the form 'whatever number you know<sup>(0)</sup>' or 'whatever rectilinear figure you know<sup>(0)</sup>', but rather [premises are assumed to hold] in every case.]

Having said that we will not solve the puzzle in the way that some have wrongly attempted to solve it, Aristotle first presents the puzzle, next their seeming solution, and then his own.

**71b5-7** But nothing, I think, prevents a person from knowing<sup>(e)</sup> what he learns in one way and being ignorant of it in another.

Then he presents the true solution of the puzzle, that there is 'nothing' that prevents a person from 'being ignorant' in one respect and 'knowing<sup>(e)</sup>' in another: 'knowing<sup>(e)</sup>', for example, in respect of the universal, but 'being ignorant' in respect of the particular, or vice versa, or 'knowing<sup>(e)</sup>' by a proof *per impossibile* but 'being ignorant' of it by a direct [proof],<sup>115</sup> or vice versa.<sup>116</sup>

**71b7-8** For it would be absurd not if he knows<sup>(o)</sup> what he is learning in some way, but if [he knows<sup>(o)</sup> it] in *that* way, namely, the way in which he is learning it, and how.

That is, 'the way in which he is learning': either in respect of the universal or in respect of the particular. For if he is learning in respect of the particular, it is possible to know<sup>(o)</sup> in respect of the universal the very thing that he is learning. Likewise too if he is learning something in respect of the universal, it is not impossible for him to know<sup>(o)</sup> in respect of the particular the thing he is learning. Also, if he is ignorant of it actually, it is not absurd for him to know<sup>(o)</sup> it potentially. However, both to know<sup>(o)</sup> and not to know<sup>(o)</sup> the same thing in the same respect is impossible.

'And how', i.e., in respect of the way of learning. For if he learns in the direct [manner of proof], it is impossible for him to have prior 20,1 knowledge<sup>(po)</sup> in the direct manner of proof. Likewise also if he learns in the *per impossibile* way.<sup>117</sup>

**71b9-12** We think we know<sup>(e)</sup> each thing without qualification, not in the accidental sophistical way [when we think we know<sup>(g)</sup> both the cause through which the thing is as being its cause, and that this cannot be otherwise.]

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- 5 There being two ways in which we know<sup>(g)</sup> something, either teaching and learning or investigation and discovery, after showing that in both cases knowledge<sup>(g)</sup> comes to be present in us from certain things previously known<sup>(pg)</sup>, and after saying what the things are that should be previously known<sup>(pg)</sup>: that without qualification in every science<sup>(e)</sup> the common<sup>118</sup> axioms [need to be previously known] – for example, in every case either the affirmation or the negation<sup>119</sup> – and
- 10 likewise in the particular sciences<sup>(e)</sup> the things proper to each science<sup>(e)</sup> [need to be previously known], and that in each demonstration it is necessary for the given and the sought to be previously known<sup>(pg)</sup> in addition to the axioms, now he next wants to treat demonstration and say precisely what demonstration is and that demonstrative deductions result from premises that have been granted.
- He chooses [to say] 'knowledge<sup>(e)</sup>' and 'knowing<sup>(e)</sup>' to mean 'demonstration' since these [terms] are more familiar even to the many than demonstration is. At any rate, everyone thinks he knows<sup>(e)</sup> something, but most people do not know<sup>(o)</sup> precisely what it is to demonstrate. Knowledge<sup>(e)</sup> and knowing<sup>(e)</sup> are different from demonstration because knowledge<sup>(e)</sup> is the very disposition about things that occurs in us, whereas demonstration is the procedure by which the knowledge<sup>(g)</sup> of these things comes to be. And besides, knowl-
- 20 the knowledge<sup>(e)</sup> of these things comes to be. And besides, knowledge<sup>(e)</sup> is more general than demonstration. For if something is a demonstration, it is certainly also a case of knowledge<sup>(e)</sup>,<sup>120</sup> but it is not automatically the case that if anything is a case of knowledge<sup>(e)</sup> it is also a demonstration. For the common notions are cases of knowledge<sup>(e)</sup> but are not demonstrations. For the common notions are cases of indemonstrable knowledge<sup>(e)</sup>. But knowledge<sup>(e)</sup> also has a more specific meaning which coincides with demonstration, and this is the [kind of knowledge] he is now investigating. He does not proceed from demonstration as a species to knowledge<sup>(e)</sup> as a genus, but for demonstration he made the substitution of the equivalent kind of knowledge<sup>(e)</sup> as something clearer, as we will show when we discuss the passage.

Now in order for us to learn precisely what demonstration is, he first teaches precisely what knowledge<sup>(e)</sup> is. He declares that we are said to know<sup>(e)</sup> a thing to be so-and-so when we know<sup>(g)</sup> both 'the' 'cause' in virtue of which it is so-and-so, 'and' also that this<sup>121</sup> 'cannot be otherwise'. For example, that a lunar eclipse is due to the earth's screening [the sun's light], while a solar [eclipse] is due to the moon's passing underneath [the sun] in its course. And we are said to know<sup>(e)</sup> this because we are persuaded that the previously mentioned attributes are their causes and that they cannot be otherwise.<sup>122</sup> That this is knowledge<sup>(e)</sup> is confirmed by the notion about it that is common to all.

'We think we know  $^{\rm (e)}$  each thing without qualification'. By 'without qualification' he means 'in the strict sense'. It is not because he

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thought that all [kinds of knowledge] apart from scientific<sup>(e)</sup> knowledge<sup>(g)</sup> are sophistical that he contrasted the sophistical way with knowledge<sup>(e)</sup> in the strict sense. For clearly there are other deductions, in between sophistical ones and scientific<sup>(e)</sup> ones, that establish 10 truths on the basis of likely [premises], but in neither the demonstrative nor the sophistical way. For example, people who say 'such and such a person is a dandy, so he is an adulterer' or 'such and such a person wanders around during the night, so he is a thief' or 'the woman has milk, so she has given birth'. These are plausible signs, but they are certainly not the causes of the conclusion.<sup>123</sup> For it is possible for someone to be a dandy but not an adulterer or to be wandering around at night but not a thief, and to have milk but not 15 to have given birth.

But since the sophists, reasoning illegitimately, declare that the attributes of accidents belong to the subjects as well, and vice versa that the [attributes] of subjects belong to accidents as well - for example, 'that white thing is a swan, a swan is an animal, so the white thing is an animal; white is a colour, therefore a colour is an animal'; declaring that what belongs to a subject (for animal belongs 20to swan) belongs to the accident, and vice versa, as follows: 'psim $muthion^{124}$  is white, white is a colour, so *psimmuthion* is a colour' – declaring that what belongs to the accident also belongs to the subject. Again, 'time [is found] in motion, motion [is found] in what is moved, therefore time [is found] in what is moved' – declaring that 25what belongs to the accident also belongs to the subject.<sup>125</sup> For motion [is found] in what is moved, but time is the measure of motion, since there must be a plurality of times [for motion to occur]. But as it is, it is one and the same time that serves as a measure of every motion.<sup>126</sup> Now sophistical deductions make their illegitimate inferences from accidents, as has been said.<sup>127</sup>

But it is not the case that if some deduction establishes something 30 from an accident it is automatically sophistical. For if I say 'the woman has milk, so she has given birth' or 'there is smoke here, so there is fire too', the deduction is from accidents, but it is not on that account sophistical too. Therefore, since, as we said, sophistical 22,1deductions are based on accidents and the other [deductions] which we have stated do not establish [their conclusions] on the basis of [attributes] belonging to things per se, but on the basis of [attributes belonging] accidentally (for it happens that the adulterer dandifies himself and that the thief wanders around at night, but it is certainly not the dandifying or the wandering at night that are the causes of  $\mathbf{5}$ the previously mentioned things), in this way he called all [deductions] apart from demonstrative deductions by the common name sophistical deductions.

**71b12-16** [Now it is clear that knowing<sup>(e)</sup> is something of this sort.] For both those who do not know<sup>(e)</sup> and those who do know<sup>(e)</sup> – the former think that this is how it<sup>128</sup> is, [while those who know<sup>(e)</sup> in fact are in that condition, and so that of which there is knowledge<sup>(e)</sup> without qualification cannot be otherwise.]

- 10 For example, some think that peoples<sup>129</sup> are so called because when Zeus commanded Deucalion after the flood to throw stones behind him in order for humans to be generated, the [stones] became humans as they were being thrown, and they say that they know<sup>(e)</sup> that 'this is how' this 'is', because they think that this is the 'cause' of the word for peoples and they say that 'this' 'cannot' 'be otherwise'.
- 15 Likewise those who think that the earth is stationary on account of the swift revolution of the heaven think they know<sup>(e)</sup>, because they believe that this is the cause and they think that the earth could not otherwise be stationary. Now if this is knowing<sup>(e)</sup>, clearly demonstration is a deduction that produces knowledge<sup>(e)</sup>, since in fact, as we have already said, demonstration is knowledge<sup>(e)</sup> [that takes place] through deduction, since in fact a deduction whose conclusion is
- 20 'from' premises 'that are true', 'immediate, better known<sup>(g)</sup> than, prior to, and causes of the conclusion', implants in us some knowledge<sup>(e)</sup> and knowing<sup>(e)</sup>. But because every deduction is based on premises, he enumerates what [attributes] must belong to the premises of a *demonstrative* deduction.

# 25 **71b16-17** Now if there is also another way of knowing<sup>(e)</sup>, we will tell later.

Since he has now spoken about knowledge<sup>(e)</sup> that is due to demonstration, but there is also another kind of knowledge<sup>(e)</sup> which is not demonstrated but is self-guaranteeing and without deduction, for example knowledge<sup>(g)</sup> of the axioms (for this does not come to be present in us through demonstration but is self-guaranteeing, and he

5 will tell about it a little below),<sup>130</sup> this is why he now says that 'we will tell later' about the other kind of knowledge<sup>(e)</sup>; but we are now speaking about knowledge<sup>(e)</sup> through demonstration. Therefore we did well to say that he is not discussing knowledge<sup>(e)</sup> as a genus and generally, but [knowledge] in a more specific sense, which is equivalent to demonstration.

**71b17-23** But we assert that we do know<sup>(0)</sup> through demonstration. [I call a demonstration a scientific<sup>(e)</sup> deduction, and I call scientific a deduction one by virtue of possessing it we know<sup>(e)</sup>. Now if knowing<sup>(e)</sup> is as we have posited, demonstrative knowledge<sup>(e)</sup> must be based on things that are true, primary and

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immediate, and better known<sup>(g)</sup> and prior to and causes of the conclusion. For thus the principles will be appropriate to what is proved.]

After saying that 'we will tell later'<sup>131</sup> about the other way, he goes on 10 to say, 'but we assert that we do know<sup>(0)</sup> through demonstration' substituting 'know<sup>(0)</sup>' for 'know<sup>(e)</sup>'. Then, after substituting 'know<sup>(0)</sup>' in exchange for 'know'e', he continues, 'I call a demonstration a knowledge<sup>(e)</sup>-producing deduction, and I call knowledge<sup>(e)</sup>-producing [a deduction] in virtue of which we know<sup>(e)</sup> by possessing it'. And so, even if he said 'but we assert that we do know<sup>(o)</sup> (by which he means 15"know<sup>(e)</sup>") through demonstration', he now identifies knowledge<sup>(e)</sup> with demonstration. For after saying precisely what knowledge<sup>(e)</sup> is, he says about demonstration too that it is 'a knowledge<sup>(e)</sup>-producing deduction, which is equal to knowledge<sup>(e)</sup> due to a deduction. For he said what we believe knowledge<sup>(e)</sup> to be: 'when' we know<sup>(g)</sup> 'the cause of the thing' 'is its cause' and that 'it cannot' 'be otherwise'.<sup>132</sup> There-20fore, when we obtain knowledge<sup>(g)</sup> of this kind through a deduction, we declare such a thing to be a demonstration. And so knowledge<sup>(e)</sup> of this kind is equivalent to demonstration. Rather, if one were to observe more precisely, knowledge<sup>(e)</sup> is the end of demonstration and the state that occurs in the soul as a result of the same knowledge<sup>(e)</sup>, whereas demonstration falls under deductive knowledge<sup>(e)</sup> and is the 25procedure that takes place in this way.<sup>133</sup>

Now that it has been stated what demonstration is, he enumerates what [attributes] must belong to a demonstrative deduction. For he declares 'demonstrative knowledge<sup>(e)</sup>' 'must' 'be based on things that are true'. For<sup>134</sup> it is possible for a deduction to turn out true, but not to be based on true things. For example, 'man is a stone, a stone is an animal, therefore man is an animal'. The conclusion is true and the form is deductive, but it is not based on true premises. However, a demonstrative deduction must be based on true premises. 5

#### 71b21 Primary and immediate.

He does well to add 'and immediate' to 'primary'. For if I assume that the soul is immortal and then deduce something else, for example, that there are souls in Hades, I have deduced from things that are primary,<sup>135</sup> but not immediate. For it is not granted that the soul is immortal, but this needs demonstration too. So the demonstration of this too must be based on things that are immediate or indemonstrable, and so ad infinitum. And so a truly knowledge<sup>(e)</sup>-producing deduction must 'be based on' 'primary' 'and immediate' (i.e., indemonstrable and self-guaranteeing) premises. For since every demonstration, or rather deduction, proceeds through certain middle terms, this is why he declared that the premises employed in demonstrative

deductions must be immediate, i.e., that they do not need a middle term through which the predicate is proved to belong to the subject.

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But perhaps it is possible that 'primary and immediate' is also said in this way because there are some things that are immediate but not primary and prior to the things that involve demonstration, but ultimate and particular. For example, 'this *psimmuthion* is white' is an immediate premise (for it does not need a middle term for confirmation), and also 'this is Socrates'. But demonstrations have no need of immediates of this kind, but rather of things that are primary, i.e., common notions, which the things that involve demonstration follow in the way that things posterior in nature [follow] things that are prior and as effects [follow] their causes.

# 25,1 **71b21** And better known<sup>(g)</sup>.

For the things employed in demonstrations must be not only immediate and primary, but also known<sup>(g)</sup>. For it is possible even for some axioms not to be known<sup>(g)</sup> by the many through failure to notice them,

5 for example 'things that are equal to the same thing are also equal to one another' is self-guaranteeing, but the many would not easily recognize it. So it is necessary to establish them as known<sup>(g)</sup>.

## 71b22 And prior to and causes of the conclusion.

That<sup>136</sup> a demonstration must be based on things that are prior is clear. For if they are employed in a proof, it is necessary to employ
them as prior [to the conclusion].<sup>137</sup> But these things that are prior must also be causes of the conclusion. For it is possible to employ things that are prior but not causes. For example, if someone wanted to prove that the soul is immortal and assumed that 'things that are equal to the same thing are also equal to one another', he assumed things that are prior and immediate but not causes of the conclusion. However, along with being primary and immediate, the things employed in demonstrations must also be causes.

<sup>6</sup>For thus', he says, 'the principles will be appropriate to what is proved'.<sup>138</sup> And so if the principles must be appropriate 'to what is proved', clearly it is necessary to take proximate causes, not simply causes, for more remote causes can be causes of something else as

20 well and not be appropriate to what is proved. The four elements are causes of our body, but not its proximate causes, for they are [causes] of the other composite bodies as well, whereas the proportion of the humours is proximately the cause of our body.<sup>139</sup> This is in the sense of material [cause]; on the other hand, the father, or the particular nature in each thing, is the proximate cause in the sense of efficient cause.<sup>140</sup>

This whole [phrase]<sup>141</sup> is to be read as a single [expression], 'prior

causes'; for just as he combined 'primary' with 'immediate', he now 25says 'prior causes'.<sup>142</sup> We must understand 'prior' to stand for 'proxi-26.1mate', 'for thus', he says, 'the principles will be appropriate to what is proved'.<sup>143</sup> To take dandifying as proof of adultery is not a principle appropriate to the conclusion, nor is the first the cause of the second. Also, that the sun and moon move in the ecliptic is a cause of the 5 eclipse of the sun, but not the proximate cause. However, that a solar eclipse occurs when the moon passes underneath the sun in its course and comes to be perpendicularly below it is the appropriate and proximate principle of the demonstration concerned with the eclipse of the sun. Also, the progression of the demonstration must make its beginning from things that are causes and primary and must end up 10 at things that are effects and posterior. For example, beginning from screening and ending up at the eclipse: 'the sun is screened by the moon, what is screened is eclipsed, therefore the sun is eclipsed'.<sup>144</sup> For if we go backwards from the effect to the cause, such a thing is no longer a demonstration but a sign. For example, 'the sun is eclipsed, that which is eclipsed is screened, therefore the sun is 15screened'.

**71b25-6** They must be true, because it is not possible to know<sup>(e)</sup> what is not [for example, that the diagonal is commensurable].<sup>145</sup>

He explains each of the enumerated [attributes]. This is why, he declares, we said that demonstrations must be 'based on things that are true':<sup>146</sup> that if they are not 'based on things that are true' knowledge<sup>(e)</sup> cannot occur. For there is no knowledge<sup>(e)</sup> of what is not, i.e., the false. For he employs 'what' 'is not' to mean 'the false'.

If someone were to say, 'Why? Is there not knowledge<sup>(e)</sup> of what is not – that it is not?<sup>147</sup> But he does not mean this, but that 'it is not possible to know<sup>(e)</sup> what is not<sup>'148</sup> as something that is. For to know<sup>(e)</sup> that what is not is not, *is* knowledge<sup>(e)</sup>. That he does not mean this he shows in his example. For he mentions 'that the diagonal is commen-25surable': that the diagonal of a square is commensurable with the side, which in fact is false. For if it was proved above<sup>149</sup> that the 27,1[square] on the diagonal is double the [square] on the side, then even if the [square] on the side is commensurable with one of the triangles on the side<sup>150</sup> it is necessary for <the diagonal><sup>151</sup> to be incommensurable. For example, if the square on the side is 25 in area, the side being 5 somethings, the [square] on the diagonal must be 50. But if 5 you investigate you will discover no number applying to the diagonal and commensurable with the side. For it is not 7, for then the square would be 49. Nor is it 8, for then the square would be 64. But neither is it 7 and a fraction, since every number plus a fraction if multiplied by itself ends in a fraction,<sup>152</sup> whereas the square on the diagonal does 10 not end in a fraction. And so there is no number, either a whole

number or [a whole number] plus a fraction, which the diagonal will have and which is commensurable with the side.

**71b26-7** Based on primary indemonstrables, because we will not  $know^{\scriptscriptstyle{(e)}}$  unless we have demonstration of them.

What<sup>153</sup> he called 'primary' 'immediate' above,<sup>154</sup> he here [calls] 'primary indemonstrables', since, as we said, every demonstration proceeds through certain middle terms. The reason why, he declares, we<sup>155</sup> said 'based on primary indemonstrables' is that if the things assumed in a demonstration are demonstrable, demonstration will not occur unless they too have been demonstrated previously. Besides, the things employed in the demonstrations of these latter things are either primary and immediate, or demonstrable. And we must either proceed ad infinitum or arrive at some things that are primary and immediate from which knowledge<sup>(e)</sup>-producing deductions proceed.<sup>156</sup>

**71b28-9** For to  $know^{(e)}$  things of which there is demonstration, not accidentally, is to have a demonstration [of them].

After saying that unless the primary things on which demonstrations are based are indemonstrable, 'we will not know<sup>(e)</sup> unless we have' 'demonstration'<sup>157</sup> of the primary things as well, he establishes this very point in the present passage, saying precisely what knowing<sup>(e)</sup> is. For, he declares, 'to know<sup>(e)</sup>' not accidentally' is 'to have' 'a demonstration' of those things in respect of which a demonstration can occur. He adds 'of which there is demonstration' since, as we have already said, <sup>158</sup> we also know<sup>(e)</sup> the common notions, but not by virtue of having a demonstration of them. For the knowledge<sup>(e)</sup> of them is stronger than that which is in virtue of demonstration.

He adds 'not accidentally' because it is possible to know<sup>(0)</sup> not per se but accidentally.<sup>159</sup> For example, a surface is said to be visible not per se, but in that colour, which is visible per se, is an accidental

- 10 attribute of it. Also we are said to know<sup>(e)</sup> that the moon is spherical, but not per se; rather [we know that the moon is spherical] because having phases of the kind it does is an accidental attribute of it, and from there we ascend from things that are posterior and effects to things that are primary and causes. Likewise we say that souls are immortal because offerings to the departed take place. For this would not take place if souls dissolved into non-being at the same time as
- 15 the dissolution of the body. But all proofs of this kind are not knowledge<sup>(e)</sup>-producing, but are based on accidents and not on per se attributes of things, whereas demonstrations must proceed from the per se attributes of things.

**71b29-33** [They must be both causes and better known<sup>(g)</sup> and prior; causes because we know<sup>(e)</sup> [something only] when we know<sup>(o)</sup> the cause,] and prior if they are causes, and previously known<sup>(pg)</sup> not only in that we understand [them] but also in that we know<sup>(o)</sup> that they are.

This<sup>160</sup> is why, he declares, we have said that they must be prior, since they are also causes (since causes pre-exist effects<sup>161</sup>) and still should be previously known<sup>(pg)</sup> in both ways of prior knowledge<sup>(pg)</sup>, in which we know<sup>(g)</sup> both that it is and what it signifies. It should be noted here that after saying at the beginning<sup>162</sup> that the axioms must be previously known<sup>(pg)</sup> only as regards that they are, not also as regards what they signify, he says here that they must be previously known<sup>(pg)</sup> in the two ways. For how is it possible to know<sup>(o)</sup> that this is unless we know<sup>(o)</sup> what it signifies? In fact this is why we said also at the beginning<sup>163</sup> that he omits this as something that has been granted.

**71b33-72a5** Prior and better known<sup>(g)</sup> in two ways. [For the same thing is not prior in nature and prior to us or better known<sup>(g)</sup> [in nature] and better known<sup>(g)</sup> to us. I call prior and better known<sup>(g)</sup> to us the things that are closer to perception, and prior and better known<sup>(g)</sup> without qualification those that are more remote. The most universal things are the most remote, while particulars are closest, and these are opposite of one another.]

Since<sup>164</sup> he mentioned [the word] 'prior', saying that demonstrations must be based on things that are prior and previously known<sup>(pg)</sup>, and since there is not just one meaning of 'prior', he now wants to say how many meanings 'prior' has and in what meaning 'prior' is employed  $\mathbf{5}$ here. He says what he has frequently said.<sup>165</sup> that the things that are primary in nature, i.e., universals, which are posterior to us, are prior and better known<sup>(g)</sup> in the strict sense, whereas things that are first known<sup>(g)</sup> to us, i.e., the particulars, are called prior in another way, [prior] relative to us. For we know<sup>(g)</sup> these first because we first engage in perception. Now if demonstrative deductions must be 10 based on things that are primary in nature, the primary things employed here are not the things that are primary and better known<sup>(g)</sup> to us, but those [that are primary and better known] in nature. And these are opposites of one another. For what is clear and primary in nature is posterior and less clear to us, while what is less clear and posterior in nature is prior and more clear to us.

**72a5-7** 'Based on things that are primary' is 'based on appropriate principles'. For I say that what is primary and a principle are identical.<sup>166</sup>

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He already said this above. But since in the meantime he made a division of 'prior', he repeats his account, and explains more clearly how he means that demonstration must be 'based on things that are primary' and precisely what those primary things are.

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For, by 'based on things that are primary', he says, 'I am saying'<sup>167</sup> 'based on appropriate principles'; for the principle is primary to that whose principle it is. He goes on to say what the principles of demonstration are.

**72a7-8** A principle of demonstration is an immediate premise. An immediate [premise] is one to which there is no other [premise] that is prior.

For the premises are the principle of every deduction, for they are the causes of the conclusion. In this way the conclusion too is said to be referred to the premises as a principle. But the premises of dialectical deductions are reputable [premises], while those of sophistical [deductions] are false overall, getting their falsity for the most part from homonymy,<sup>168</sup> while the [premises] of demonstrations are immediate.

- 5 Premises are immediate that have their confirmation from within ourselves<sup>169</sup> and need no middle term for a demonstration that the predicate belongs to the subject. For, he says, 'an immediate [premise]' is 'one to which there is no other [premise] that is prior'. For every deductive proof occurs when some middle term is employed that connects the extreme [terms] through itself, and the premises
- 10 employed in demonstrations must be absolutely primary and not demonstrated through other [premises]. This is why he called these premises immediate, i.e., indemonstrable. Of this sort are the common axioms, to obtain conviction of which we do not need a middle term that connects through itself the more specific with the more universal, because there is nothing that is more basic than them.

For example, if I want to prove that the soul is impassive in respect of its essence,<sup>170</sup> because such a proposition is not primary and immediate I use some middle term which through itself binds together the extremes. For example, 'the soul is immortal, what is immortal is impassive in respect of its essence, therefore the soul is impassive in respect of its essence'. Further, when the assumed premise is not absolutely primary or self-guaranteeing, I again need some other middle term for a proof for it – [a middle term] that in

20 turn binds together the extremes through itself, and I do this until I arrive at premises that are immediate and indemonstrable. For example, 'the soul is always-moving, what is always-moving is immortal'; since in turn we do not have conviction from within ourselves of the fact that it is always-moving, there is need of another term in between that establishes this, for example, that the soul is self-moving or something of the sort.

Likewise if I want to prove that man is a substance, I use animal 25 as a middle term, because animal is a substance. And if this is not yet immediate, again I use a middle term to obtain conviction of this, because animal is self-constituted, and what is self-constituted is a substance. And in this way I infer that man is a substance. And this premise, namely, that what is self-constituted is a substance, is absolutely primary and immediate, since it has arrived at the definition of substance, for substance is that which exists per se and does not need something else for it to be.<sup>171</sup> But if we make the deduction after arriving either at the definitions or at the common axioms, we do not proceed further, for nothing is more basic than either the definitions or the common axioms on which every demonstration is based.<sup>172</sup>

He does not say [this] on the grounds that we must use this 5 procedure in demonstrations. For demonstration in the strict sense in fact should confirm things that are secondary and less clear on the basis of things that are primary, immediate, and better known<sup>(g)</sup>. But since what is better known<sup>(g)</sup> in nature is not in all cases better known<sup>(g)</sup> to us too, it often happens that we construct our proofs of things that are prior on the basis of things that are posterior, on 10 account of the fact, as I said,<sup>173</sup> that the things that are prior are not better known<sup>(g)</sup> to us. And this kind of proof is called [a proof] from a sign and irrefutable. As a result it has received the name demonstration as well. For demonstration in the strict sense, as I said, is one that confirms things that are secondary on the basis of things that are prior, when being primary and known<sup>(g)</sup> in nature and being better known<sup>(g)</sup> to us coincide.<sup>174</sup> But when this does not obtain, but we are compelled to confirm things that are prior on the basis of 15things that are posterior, this kind of proof is called [a proof] from a sign, and because of the irrefutability of signs, it has been deemed worthy of the name 'demonstration'.175

For example, if the sought is whether the moon is a sphere in respect of its shape, and if we can neither know<sup>(o)</sup> this directly nor confirm it on the basis of certain things that are more basic, we confirm that it is spherical on the basis of its phases, which are 20secondary to and effects of its shape, which is primary to the phases and is their cause. For since each month we see it twice becoming a crescent, twice a half moon, twice gibbous, and once a full moon, we deduce from this that its shape is spherical. For if it were a disk, its whole disk would simultaneously either be completely shone upon or 25not shone upon when the sun strikes it. But since it is spherical and the sun is above it, it follows that the part of it that is turned towards the sun is always illuminated, and that this happens to a part [of the moon] until [the moon] is diametrically opposite it [the sun], and the hemisphere turned towards it is illuminated.<sup>176</sup> Therefore its pattern of phases is a sign of its shape, and it is not because it is illuminated 30

- 32,1 in that way that it is spherical, but it is illuminated in that way *because* it is spherical. Now it is consistent to deduce the properties of its phases from its being spherical the effect from the cause; but since that which is primary in nature and the cause, namely, the spherical shape, is unclear to us while its phases are clear, in view of
  - 5 the circumstances, we use the posterior to obtain conviction of the prior. And since such indicators or signs are irrefutable, this is why we call proofs based on them demonstrations, according to a secondary standard of demonstration.

**72a8-9** A premise is either part of a proposition, one thing [predicated] of one thing.

- 10 Since he mentioned premises generally, he wants to remind us of the meanings of 'premise', 'proposition', and 'contradiction', and he says what he said about them elsewhere. 'A premise', he declares, 'is' 'either part of a proposition'.<sup>177</sup> A proposition is something more general, since it covers affirmations and negations.<sup>178</sup> Now since a
- 15 proposition is per se something indefinite he does well to add 'either part', i.e., either the affirmative or the negative. He adds 'one thing [predicated] of one thing' since, as is also said in *De Interpretatione*,<sup>179</sup> the premises employed in demonstrations must not employ homonymous terms, which is characteristic of the sophists,<sup>180</sup> but by what is
- 20 signified by the subject and the predicate they must either affirm or deny a single thing. It is also clear that a proposition, premise, problem, etc. are the same in substrate, but differ only in relation. For a proposition is called a premise when it becomes part of a deduction.<sup>181</sup>

**72a9-11** A dialectical [premise] is one that assumes either [part] indifferently, a demonstrative [premise] one that assumes one of them determinately, whichever<sup>182</sup> is true.

- 33,1 For<sup>183</sup> a person who demonstrates will not assume either of the parts of a contradiction indifferently, but only the true one, even if no one accepts it and it is not reputable. However, a dialectician, who uses arguments on both sides [of an issue], *will* assume either part of a contradiction, even if it is reputable but not true and even if only the person he is conversing with accepts it. For this reason it is with a view
  - 5 to the dialectician that he says 'either', and with a view to the person who demonstrates that he says 'one of them', 'whichever' may be 'true'.

72a11-12 A proposition is either part of a contradiction.

Consider how he proceeds from the more specific to the more universal: from premise to proposition, from proposition to contradiction,

and from contradiction to opposition. What, then, does he say? 'A 10 proposition' is 'either part of' a 'contradiction', namely, either the negative or the affirmative. For both are equally called a proposition. This is why we said in *De Interpretatione* that proposition as a genus is divided into affirmation and negation as species.<sup>184</sup> For species are like parts of genera.

72a12-14 A contradiction is an opposition in which per se there is no intermediate. [The part of a contradiction [that predicates] one thing of another is an affirmation, and the part [that denies] one thing of another is a negation.]

A contradiction admits no third thing between it[s two members].<sup>185</sup> Opposition is the genus of contradiction. For there are four ways in which opposites are opposed: in respect of possession and privation, as contraries, as relatives, and as things that involve contradiction.<sup>186</sup> 20Now the other three species of opposition are not without an intermediate (for between white and black is grey; between right and left that which is neither right nor left; between sight and blindness<sup>187</sup> either that which is not receptive of these at all or that which is receptive, but has not vet received them, like a puppy<sup>188</sup>), but only the species of opposition involving contradiction is without an intermediate, dividing the true and the false in all things that are and are not. 25He adds 'per se' either to contrast this species of opposition with the others or since one can take what is either grey, for example, or black or something else of that sort to be non-white. Therefore 'per se', to prevent us from taking 'non-white' in relation to something else, but as a negation only of white. The parts of a 'contradiction' are simply 34.1'affirmation' and 'negation'. For it has been said that a contradiction is a conflict of affirmation and negation that divides the true from the false.

72a14-16 Among immediate deductive principles I call a thesis one that cannot be proved and that a person does not need if he is going to learn anything no matter what.

Now<sup>189</sup> that he has said generally what an immediate premise in every demonstration is (that it is the absolutely primary principle of the subject of demonstration), since 'immediate premise' has different meanings, he now makes a division of it and says that of immediate premises some are theses and others are axioms and common 10notions.<sup>190</sup> Axioms are those that we know<sup>(o)</sup> from within ourselves and without demonstration, some of which contribute to every science<sup>(e)</sup>, as has been said, others [contribute] to several – for example, those concerned with quantity - and some to one. I have given examples.<sup>191</sup> A thesis too is indemonstrable or needs very little expla-

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- 15 nation for example, that the 'straight lines extending' from the centre 'to the circumference of a circle are equal to one another',<sup>192</sup> 'to draw a straight line from any point to any point',<sup>193</sup> that a point is without parts, and that every triangle is contained by three straight lines.<sup>194</sup> These are self-guaranteeing axioms<sup>195</sup> because they are evident, but they need some attention because they are not [evident] without qualification.<sup>196</sup>
- 20 And so a thesis differs from an axiom in this way, but it differs in another way too, because we put forward axioms or common notions from within ourselves, as was said, but the theses we take from the teacher of each science.<sup>197</sup> For the arithmetician posits that the unit is indivisible, the geometer [posits] the things previously mentioned,
- 25 the doctor [posits] that bodies are composed of four elements, and the natural philosopher that all natural things are composed of matter
- 35,1 and form and that nature is a principle of motion and rest. These are the species of thesis: hypothesis and definition. A definition is one that gives the being of the thing, for example 'man is a mortal rational animal',<sup>198</sup> while a hypothesis is one that predicates
  - 5 or denies something of something.<sup>199</sup> Clearly of course, predicating one thing of another is not a characteristic of definitions, since they do not predicate mortal rational animal of man, but say what the subject is. Definitions state the essence of the thing, not its attributes, for what is predicated must be different from the subject, since
  - 10 nothing is predicated of itself: no one says that man is man.<sup>200</sup> But the definition<sup>201</sup> is not different from the definiendum, for mortal rational animal is nothing different from man. 'Mortal rational animal' is an explanation and explication of man. Therefore definitions are not predicated of the definienda, but determine what the definiendum is, while genera and differentiae are predicated, because
  - 15 they are different from the species. For it is not the same thing to say man and animal or man and rational; when we say that man is an animal or rational, we are predicating them of man as being things that are different from man. On the other hand, hypotheses and generally every affirmation and negation say things that belong or do not belong to the substance<sup>202</sup> per se or accidentally.<sup>203</sup>
  - 20 Hypothesis in turn is divided into two species,<sup>204</sup> of which one is called an hypothesis homonymously with the genus,<sup>205</sup> and the other [is called] a postulate. Something that every hypothesis has in common is that it is not based on a natural notion<sup>206</sup> but is posited by the teacher. For example, 'motion occurs in things', 'nothing comes to be from what in no way or manner is', 'to draw a straight line<sup>207</sup> from any point to any point',<sup>208</sup> and 'to describe a circle with any centre and distance',<sup>209</sup> But all that are not clear or known<sup>(g)</sup>, but although they
- distance'.<sup>209</sup> But all that are not clear or known<sup>(g)</sup>, but although they
   need proof are taken from the teacher without demonstration, are called postulates. For example, '[straight lines] produced from less than two right angles meet',<sup>210</sup> which is taken from the geometer

without demonstration, even though it needs a good deal of argument for its demonstration. In fact Ptolemy devoted a whole monograph to 5 its proof.<sup>211</sup>

And while at this point he stops with this division, further down<sup>212</sup> he divides postulates into those known<sup>(g)</sup> in neither way and those [known] contrarily. What do I mean? That when the geometer says that right angles are equal to one another, the student who does not know geometry does not have an opinion in either way, either that right angles are equal or that they are unequal; however, the geometrometer takes this as something that has been granted. Further, when the geometer says 'two straight lines do not enclose a space',<sup>213</sup> the student will think the contrary, that they will enclose some narrow area. Also concerning a point, he believes that it is not without magnitude, and concerning a line he has the opinion that it has breadth.<sup>214</sup>

Some also want to divide axioms into proper and common.<sup>215</sup> For some axioms are specific to some sciences<sup>(e)</sup>, as 'things that coincide' 15 with the same thing are also 'equal to one another'<sup>216</sup> belongs to geometry alone, and 'contraries are cures of contraries' to medicine alone, while others are common to all, such as the [law of] contradiction.

He says 'immediate deductive principles' to mean 'demonstrative'. For an immediate premise is found in no deduction that is not demonstrative.<sup>217</sup> [He does] well [to say] 'which cannot be proved', for the thesis is assumed, not proved, even if it is demonstrated by another person.<sup>218</sup>

**72a16-17** But one which a person does need if he is going to learn anything at all [I call] an axiom.

He does not mean by this, as one might suppose, that the axioms must be the same in every science<sup>(e)</sup>, but that in every science<sup>(e)</sup> the things 'a person' if he is going to learn' must have from within 25 himself are called axioms.<sup>219</sup>

**72a17-18** For there are some things of this kind, [for it is 37,1 especially to these things that we are accustomed to apply the name.]

He calls 'of this kind' the things which the learner puts forward from within himself<sup>220</sup> in each science<sup>(e)</sup>. To these things, he says, 'we are accustomed' to apply the 'name' axiom.

**72a18-24** [An hypothesis is a thesis that assumes either part of a contradiction, for example that something is or that something is not. One that does not do this is a definition.] For a

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definition is a thesis; since the arithmetician posits that a unit is that which is indivisible in quantity. But it is not an hypothesis; for what a unit is and that there is a unit are not the same.

He shows in these [words] that 'a definition is a thesis' but not an hypothesis. That it is a thesis is clear, since in fact we posit, for example, man as a mortal rational animal, and a unit as 'that which is indivisible in respect of quantity. But it is not an hypothesis'. For if we say 'let this be a unit', then we state an hypothesis.<sup>221</sup> However, in definitions we declare only what the thing is. And it is different for it to be posited that there is a unit and, once the unit has been hypothesized in respect of its being, to say precisely what it is.

72a25-34 But since it is necessary to be convinced of and know<sup>(0)</sup> a thing by having the kind of deduction we call a demonstration. 15and this deduction [occurs] because the [premises] on which the deduction is based are these.<sup>222</sup> [we must not only have prior knowledge<sup>(pg)</sup> of the primary things – either all or some of them -but also [know them] more, for it is always the case that when an attribute belongs to one thing by virtue of another, it belongs to that other thing more. For example, that on account of which we love [something] is dearer to us [than that thing]. And so if in fact we know<sup>(0)</sup> and are convinced by virtue of the primary things, we know<sup>(o)</sup> them and are convinced of them more, because it is through them [that we know and are convinced of] the posterior things. But it is impossible to be more convinced of [anything] than of the things one knows<sup>(0)</sup> unless in fact one knows<sup>(0)</sup> them or is in a better condition than if he happened to know<sup>(0)</sup> [them].]

Since he said that the things employed in demonstrations must be better known<sup>(g)</sup> and more convincing<sup>223</sup> than the conclusion, he now proposes to establish this very point. He says that when there are two things and something belongs to one of them on account of the other, it is necessary for it to belong more to the one through which it is said to belong to the other. For example, if we love the teacher on account of our son, we love our son more. And so if it is through the premises that we are convinced of the conclusion, it is of course necessary for the premises to be much more convincing<sup>224</sup> than the conclusion. For if we are convinced of the conclusion before we obtain conviction in

- 25 the principles, this will not be demonstration, but rather deception. And so, if someone says that so-and-so has said that this person is good, and we are convinced that he is good even if we do not know<sup>(0)</sup> whether the one who said it is true or not, clearly if that person is not
- 38,1 trustworthy, neither will a person bearing witness<sup>225</sup> know that he is good. This is why when Polus said that Archelaus was happy, Socra-

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tes answered quite safely when he said 'I do not know<sup>(0)</sup>', 'because I have not yet associated with the man' and I do not 'know<sup>(0)</sup>' 'how he stands' 'in relation to education' 'and justice'.<sup>226</sup>

But some are puzzled at this, saying 'Why? Since it is on account 5 of wine that drunkenness belongs to a man, is drunkenness more in the wine? Or since it is on account of the sword that the man is dead. does being dead belong more to the sword? And if being heated belongs to a person in motion on account of his motion, is the motion hotter than the person who is in motion?' And myriads of such [examples]. We solve the puzzle by saving that when the same thing belongs to two things, and belongs to one of them on account of the 10 other, of course it will belong to the latter prior and to a greater degree by far. For example, if being warm belongs to the water on account of the fire, clearly the fire is hot to a greater degree. Likewise if cold belongs to a body on account of snow, of course it will belong to the snow to a much greater degree. Hence he says obscurely that this very thing 'belongs more to that', as being that through which 15such a thing also belongs to that (I mean to the first). But drunkenness does not belong to wine at all, [as it would have to] in order for us to say that it must belong more to it than to the person who drank it, nor does being dead belong to the sword or heat to the motion.

But the solution of the puzzle does not seem to me to be sound. For it does not solve the difficulty but dismantles the problem and begs 20the question. For it was proposed to prove that the premises employed in demonstrations must be known<sup>(pg)</sup> not only previously to what is proved 'but also more'. For, he says, 'it is necessary not only to have previous knowledge<sup>(pg)</sup> of the primary things – either all or some of them – but also [to know them] more'. And so he proposes to prove both - that it is necessary for them both to be known<sup>(pg)</sup> previously and to be known<sup>(g)</sup> more. But if we solve it this way, he will 25be taking as granted that it is necessary to recognize the premises and he will only be investigating whether it is also necessary for them 39,1to be previously known<sup>(pg)</sup> more than what is being demonstrated, so that the problem is only comparative. But the passage does not mean this. And besides, the argument that the premises must be known<sup>(pg)</sup> previously to the conclusion needs explanation.

'But since it is necessary to be convinced of and know<sup>(0)</sup> the thing 5 by having the kind of deduction we call a demonstration', etc. For if we are convinced of the conclusion on account of the deduction – I mean the *demonstrative* deduction – and if every deduction is based on premises, it is necessary not only for all the premises to be known<sup>(pg)</sup> previously to the conclusion, but rather also to be more convincing than 10 it. For if they are not convincing, we cannot be persuaded of the conclusion.<sup>227</sup> So, 'it is necessary not only to have previous knowledge<sup>(pg)</sup> of the primary things – either all or some of them – but also' [to know] the primary things, i.e., the premises, 'more'.

It is worth investigating why he says 'either all or some of them'. For of course it is necessary to have previous knowledge<sup>(pg)</sup> of and to have acquisition of  $a^{ll}$  the promises. For if a parameter dispute

- 15 have conviction of *all* the premises. For if a person were to dispute one, the conclusion would not be true (or at least granted) either.<sup>228</sup> Now it is possible to say that he does not mean that it is necessary to be ignorant of some of the premises,<sup>229</sup> but that either some or all [must be] self-guaranteeing, and that the rest get their confirmation through demonstration.<sup>230</sup> For in non-demonstrative deductions, we sometimes grant the conclusion even though we are ignorant of some or all the premises.
- 20 The deduction in the *Meno* is of this sort. It deduces that virtue is teachable as follows: virtue is knowledge<sup>(e)</sup>, knowledge<sup>(e)</sup> is teachable, therefore virtue is teachable.<sup>231</sup> In this deduction the major premise, that knowledge<sup>(e)</sup> is teachable, is clear. But then the conclusion is [clear] too, for indeed virtue is teachable. But we do not yet have conviction of the minor [premise], since from where [do we know that]
- 25 virtue is knowledge<sup>(e)</sup>? A person who pays attention more precisely may not even grant the major [premise], that knowledge<sup>(e)</sup> is teachable. For if we have proved that one kind of knowledge<sup>(e)</sup> is indemonstrable – the [knowledge] of the common notions – and
- 40,1 another kind comes to be present in us through demonstration, whereas the common notions are not teachable,<sup>232</sup> then it is not true that all knowledge<sup>(e)</sup> is teachable. And so the major [premise] has not been granted either, for it is not generally true. But since it is not, it makes the figure generally non-deductive too even if they are in a stronger condition than [they would be] by virtue of demonstration,<sup>233</sup>
  5 since these [premises] are common notions and axioms.
  - From this it is clear that previously too, where he said 'it is necessary not only to have previous knowledge<sup>(pg)</sup> of the primary things – either all or some of them', he was taking 'to have previous knowledge<sup>(pg)</sup>' in the case of the common axioms to be to have previous knowledge<sup>(pg)</sup> without demonstration, and this is why he added 'some'. For note that there he clearly said that some of the premises
  - 10 we know<sup>(o)</sup> i.e., know<sup>(g)</sup> through demonstration and others [we know] more strongly than by virtue of demonstration. For 'in a better condition than if he happened to know<sup>(o)</sup>' means knowing<sup>(g)</sup> them in a stronger way than by virtue of demonstration.<sup>234</sup>

**72a34-7** But this is what will happen unless someone who is convinced through demonstration has previous knowledge<sup>(pg)</sup>, [for it is necessary to be more convinced of the principles – either all or some of them – than of the conclusion.]

15 What is 'this'? The contrary of what he said. He said that it is not possible to be more convinced of the premises than of the conclusion unless one has knowledge<sup>(pg)</sup> of the premises previous to the conclu-

sion. Now this is impossible, namely, for a person who does not have previous knowledge<sup>(pg)</sup> of the premises to be more convinced of them than of the conclusion. For it will follow that one who does not have previous knowledge<sup>(pg)</sup> of the premises but says he knows<sup>(o)</sup> the conclusion is saving contrary things. For because he knows<sup>(0)</sup> the conclu-20sion he must know<sup>(o)</sup> the premises too. But since in fact he knows<sup>(o)</sup> the premises neither through demonstration nor in a stronger way than by virtue of demonstration, and it is otherwise impossible to know<sup>(0)</sup> anything in the strict sense, he will not know<sup>(0)</sup> the premises. But in fact it is necessary for him to know<sup>(0)</sup> the [premises] through which he says he knows<sup>(0)</sup> the conclusion. Therefore he will both know<sup>(0)</sup> and not know<sup>(0)</sup> the same [premises], and he will both know<sup>(0)</sup> 25and not know<sup>(0)</sup> the conclusion. He will know<sup>(0)</sup> it because we grant that he knows<sup>(0)</sup> it, but he will not know<sup>(0)</sup> it because he is ignorant of the premises. For if he says that he is convinced of the conclusion without having previous knowledge<sup>(pg)</sup> of the premises, it is obvious that he does not know<sup>(g)</sup> the conclusion either. Now if this is impossible, it is impossible for a person to know<sup>(0)</sup> the conclusion unless he has previous knowledge<sup>(pg)</sup> of the premises.

Alexander says that by 'unless someone who is convinced through 41.1demonstration has previous knowledge<sup>(pg)</sup>' he means '[unless someone has previous knowledge] of the things of which he is convinced', 235 in order that the meaning be as follows: unless someone has previous knowledge<sup>(pg)</sup>, sc. of the premises of the things of which he is convinced through the demonstration, i.e., the conclusions. But even if we understand 'who is convinced',<sup>236</sup> the passage is close to this kind  $\mathbf{5}$ of thought: unless someone who is convinced through demonstration will have previous knowledge<sup>(pg)</sup> of the premises.

72a37-9 But a person who is going to have the knowledge<sup>(e)</sup> [that comes] through demonstration [must not only know the principles better and be more convinced of them than of what is being proved.]

This means that the premises employed must be more convincing not 10 only than the conclusion, but also than their opposites. For example, if someone were to establish something by virtue of assuming that nothing comes to be from what in no way or manner is, this claim, that nothing comes to be from what in no way or manner is, must be more convincing not only than the conclusion, but also than its opposite, namely, that something does come to be from that which in no way or manner is. For if this is such that it can sometimes also be 15otherwise, clearly the conclusion inferred through this cannot be unchangeable.<sup>237</sup> But we said that knowledge<sup>(e)</sup> is such that it cannot be otherwise.

**72b1-3** But neither can anything be more convincing or better known<sup>(g)</sup> to him from among the opposites of the principles, on which the deduction of the contrary deception will be based, [since one who knows<sup>(e)</sup> must be unqualifiedly unpersuadable to the contrary.]

- He does not mean that nothing 'else' is more 'convincing', but that 42,1 none 'of the opposites of the principles' is more 'convincing', on which (namely, the opposites) it will follow that the false deduction is based. For if a true deduction has occurred from assuming that nothing must come to be from that which in no way or manner is, clearly a false deduction will be inferred from the contrary of this.<sup>238</sup>
  - 5 **72b5-7** Since it is necessary to know<sup>(e)</sup> the primary things, some think that there is no knowledge<sup>(e)</sup>,<sup>239</sup> [while others [think that] there is, but that there is demonstration of everything. Neither of these views is either true or necessary.]

 $A^{240}$  person discussing demonstration must not only teach everything that contributes to the study of it but also refute the [arguments] of those who maintain the contrary. This is why after saying precisely

- 10 what demonstration is, Aristotle now here proposes to refute those who maintain the contrary of the definition of demonstration. These include both those who say outright that 'there is no' demonstration 'at all'<sup>241</sup> and those who hypothesize that everything is demonstrable; but to speak more truly, these people too eliminate demonstration through the [arguments] in which they say that everything is demonstrable, as we will learn. For of course there must be demonstration
- 15 either of nothing at all, or of everything, or of some things but not of others. So after refuting both those who say that there is no demonstration at all and those that say that everything is demonstrable, and leaving the truth, that there is demonstration of some things but not of others, he will later show of what there is demonstration and of what there is not.

Why on earth did he not investigate this at the beginning? If in 20 problems the [question] 'if it is' is prior to the [question] 'what it is',<sup>242</sup> he should first have demonstrated whether demonstration is and then have taught what it is. But he first taught 'what it is' and now has changed to the [question] 'if it is'. Now we declare that just as in his investigation concerning the void he first teaches the notion of void – precisely what we understand the void to be – and then on that

25 basis investigates whether or not it is,<sup>243</sup> here too he first teaches the notion of demonstration and on that basis investigates whether there is or is not such a manner of demonstration. For in cases where we do not have any notion at all about what the sought is or what it

43,1 signifies, or where we have a vague image of what it means, unless

we know<sup>(0)</sup> the notion of the thing that is the subject we will not be able to know<sup>(g)</sup> whether or not it is.

However, in cases where it is evident precisely what the word signifies, the investigation of the [question] 'if it is' will come first. For example, a centaur. For it is clear precisely what the myths  $\mathbf{5}$ intend such an animal to be. So if this is what the inquiry is about, the [question] if such an animal is should be investigated first. Now if it is proved that it is not, no inquiry about the remaining problems will be left for us. But if it is proved that it is, then we next conduct the inquiry about the [question] 'what it is' on a more scientific<sup>(e)</sup> basis. But if we have a vague notion of the sought - of precisely what 10 the word wants to indicate - how is it possible to investigate about it whether it is or not? Now since the notion of demonstration was not clear or not altogether clear, it was reasonable for him first to teach precisely what we suppose demonstration to be -a deduction of such and such a kind – and on that basis he investigates whether there is or is not such a deduction.

Of course there must certainly be demonstration either of nothing 15or of everything or of some things but not of others. Now they all both those who say that there is demonstration of nothing, those [who savl that everything is demonstrable, and those [who say] that some things are demonstrable but others are not – uses this conditional in common: if there is demonstration, the primary things must be 20known previously<sup>(pg)</sup>. This is true and also he has already taught it to us in the definition of demonstration, that demonstrations must be based on things that are primary and better known<sup>(g)</sup>. However, those who say either that everything is demonstrable or that there is demonstration of nothing add 'through demonstration' to the consequent, thus: if there is demonstration, it is necessary to know<sup>(0)</sup> the primary things through demonstration. This additional specification produces the cause of their error.

By using this conditional, those who posit that there is no demon-25stration establish this by using the second hypothetical [syllogism]<sup>244</sup> in this way: 'if there is demonstration it is necessary for the primary 44.1things to be known previously<sup>(pg)</sup> through demonstration; but it is impossible for the primary things to be known previously<sup>(pg)</sup> through demonstration; therefore there is no demonstration'. Why is it not possible to know<sup>(g)</sup> the primary things through demonstration? Because it must proceed ad infinitum. For if the things are infinite, the 5 primary things must be demonstrated through some things that are prior; but the infinite cannot be got completely through; and so there will not be demonstration of the primary things; but if the primary things are not known<sup>(g)</sup>, it is impossible for demonstration to occur. But if things do not go ad infinitum but we end up at something that is ultimate and a primary principle, it is of course necessary for that thing not to be demonstrable since there is nothing prior to it, if in 10

fact we say that the primary things must be previously known<sup>(pg)</sup> through demonstration, and every demonstration must be based on certain things that are primary and known previously<sup>(pg)</sup>. But if the primary thing has not been demonstrated, neither can the secondary things be demonstrated. And so it remains that there is no demonstration at all. This is how those who eliminate demonstration [argue].

- On the other hand, those who say that everything is demonstrable establish this in the following way. 'If there is demonstration, it is necessary to know<sup>(0)</sup> the primary things through demonstration; but in fact it is possible to know<sup>(0)</sup> the primary things through demonstration; therefore there is demonstration'. But clearly they do badly to assume the minor premise. For they posit the consequent, and so infer the antecedent, although to the contrary they should have inferred the consequent in the first of the hypothetical [syllogisms]<sup>245</sup>
- 20 by positing the antecedent. For if I were to say as follows: 'if he is a man, he is also an animal', and then use the consequent as a minor premise: 'but in fact he is an animal', it is not true to infer 'and therefore he is a man'. By using the minor premise badly they inferred a false conclusion. But they established the minor premise, namely, 'but in fact it is possible to know<sup>(0)</sup> the primary things through demonstration', in the following way: even if it is not possi-
- 25 ble, they say, to demonstrate these through some primary things, in any case it is possible to demonstrate them by means of a circular proof.

A circular proof occurs when we assume the conclusion, convert one of the premises, and establish the remaining one. For example in the deduction 'man is capable of laughing, that which is capable of laughing is receptive of intelligence and knowledge<sup>(e)</sup>, therefore man

- 30 is receptive of intelligence and knowledge<sup>(e)</sup>, if we want to establish one of the premises, namely, 'man is capable of laughing', by a circular proof, we say as follows: 'man is receptive of intelligence and
- 45,1 knowledge<sup>(e)</sup>, what is receptive of intelligence and knowledge<sup>(e)</sup> is capable of laughing, therefore man is capable of laughing'. And since we have ended up where we began from at the beginning, namely, the premise 'man is capable of laughing', using it as a conclusion
  - 5 this is why such a thing is called a circular proof: because it uses the same thing as both beginning and end.<sup>246</sup> Thus, by refuting both those who say that everything is indemonstrable and those who hypothesize that everything is demonstrable, he indicates the truth, that there is demonstration of some things but not of others. And he teaches what things are not demonstrable the immediate premises which we call axioms, which are stronger than [things known] in
  - 10 virtue of demonstration. For if there is demonstration, it is necessary for the primary things to be known previously<sup>(pg)</sup>; however, it is not necessary for them to be known previously<sup>(pg)</sup> through demonstra-

tion; those that are not immediate must be known previously<sup>(pg)</sup> through demonstration, but those that are immediate and are common notions need not be known previously<sup>(pg)</sup> through demonstration, but we must know<sup>(o)</sup> them directly more strongly than in virtue of demonstration.

**72b7-10** For those who hypothesize that there is no knowledge<sup>(e)</sup> at all postulate that there is an infinite regress, [supposing that people cannot know<sup>(e)</sup> the posterior via the prior when there is nothing primary.]

Those,<sup>247</sup> he says, who have hypothesized that demonstration does not occur at all unless the primary things are previously known<sup>(pg)</sup> through some other things that are prior, 'those' 'postulate' that those who say that there is demonstration proceed ad infinitum if they establish the primary things through some other things that are prior. For it is otherwise impossible to know<sup>(g)</sup> the posterior things if the prior things are not known<sup>(g)</sup>. But if the infinite cannot be got completely through, demonstration is eliminated. They said this either hypothesizing that things truly do proceed ad infinitum or assuming it hypothetically, namely, that it is always necessary to know<sup>(g)</sup> the primary things through other prior demonstrations.

**72b10-11** Speaking correctly. For it is impossible to traverse things that are infinite.

Why 'speaking correctly'? Because if the primary things are not previously known<sup>(pg)</sup>, the secondary things cannot be known<sup>(g)</sup>. For 46,1 this they did speak 'correctly', and he himself posited this in the definition of demonstration. However, they did not hypothesize correctly that these things must be known<sup>(g)</sup> through demonstration.

**72b11-13** But<sup>248</sup> if they stop<sup>249</sup> and there are principles, these [must] be unknown<sup>(g)</sup> if there is no demonstration of them, [which is the only thing these people declare to be knowledge<sup>(e)</sup>.]

If, he says, things do not proceed ad infinitum but there is something that is absolutely first, it is necessary to know<sup>(o)</sup> this through demonstration. But demonstration is through certain things that are prior. Therefore it is not possible to know<sup>(e)</sup> this. But if this is not known<sup>(g)</sup>, neither will demonstration be able to know<sup>(g)</sup> anything subsequent to it.<sup>250</sup>

**72b13-15** [Otherwise, it is possible to know<sup>(o)</sup> the primary 10 things, but not to know<sup>(e)</sup> the things based on them without

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qualification or in the strict sense,] but only on the hypothesis that the other things are.  $^{\rm 251}$ 

For, he says, there will not be demonstration 'without qualification' because of what was said previously, but it is possible to establish something 'hypothetically',<sup>252</sup> which is not demonstration 'in the strict sense'. For example, if two is five, then five will be two, and if the earth is winged, of course it will also have wings.

15 **72b15-18** The others agree about knowing<sup>(e)</sup>, for [they hold] that it exists only through demonstration. But [they hold] that nothing prevents there being demonstration of everything, [since circular demonstration can occur and [things can be demonstrated] from one another.]

These people, he says, 'agree' that there is demonstration, but [hold that there is] demonstration of the primary things, which are previously known<sup>(pg)</sup> through demonstration. The primary things are not established through some other prior things, but demonstration proceeds circularly, establishing the prior from the posterior in the way we said.<sup>253</sup>

47,1 **72b18-22** But we say that not all knowledge<sup>(e)</sup> is demonstrative, but that of the immediates is indemonstrable. That this is necessary is evident. [For if it is necessary to know<sup>(e)</sup> the things that are prior and on which the demonstration depends, but these stop at some point at the immediates, these latter must be indemonstrable.]

From what he had previously said he obtains the result that there is demonstration. For the very proof that there is no demonstration has ended up in knowing<sup>(g)</sup> [that there is] demonstration, for it was through demonstration that they proved that there is no demonstration. For, they say, if there is demonstration it is necessary to know<sup>(0)</sup> the primary things through demonstration. But in fact, the consequent is false; therefore the antecedent [is false] too. But this very thing is a demonstration.<sup>255</sup> And so by the very [act of] dismantling demonstration they establish demonstration.

- 10 And so, having obtained from them the result that there is demonstration, he proves that it is impossible to know<sup>(o)</sup> everything through demonstration in this way. For if we always establish the extremes through some middle term, in cases where it is not possible to take any middle term but the procedure arrives at some ultimate things, which are immediate, of course 'these' 'must' 'be' 'indemonstrable'. And so in fact there is demonstration on account of what
- 15 these people have said, and there is not demonstration of everything

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because not every premise is mediate,<sup>256</sup> but there are some immediate premises too, of which there is no demonstration because they are immediate, but there is knowledge<sup>(e)</sup> because they are self-guaranteeing and we have an understanding of them that is stronger than that which is due to demonstration. And this is why we said at the beginning that knowledge<sup>(e)</sup> is different from demonstration, in that 20 knowledge<sup>(e)</sup> extends more widely than demonstration.

**72b23-4** We say that this is  $so,^{257}$  and  $^{258}$  declare that there is not only knowledge<sup>(e)</sup> but also some principle of knowledge<sup>(e)</sup> by which we recognize the limits.<sup>259</sup>

The<sup>260</sup> Philosopher<sup>261</sup> gives the explanation of the present passage, taking intelligence as the principle of knowledge<sup>(e)</sup>, to be not our 25[intelligence] but the [intelligence] that is divine and above us, and the limits to be the intelligible and divine forms. They are called limits because they are the boundaries of all things. For as plurality begins from the unit and is resolved into the unit,<sup>262</sup> and, for example, tens are limits of hundreds and hundreds [are limits] of thousands,<sup>263</sup> but the unit is [the limit] of all universally, so also if we were to speak 48.1of the limits of things, the celestial bodies [are the limits] of perceptible things, the divine substances [are the limits] of them, and the first principle [is the limit] universally of all. He might be saying this against those who eliminate demonstration by an infinite regress, because we say that 'there is' 'not only' demonstration but that things 5 do not proceed ad infinitum either. 'but' that 'there is' 'also' a 'principle' of demonstration by which we know<sup>(g)</sup> 'the limits' of things when we get illumination from that source. This is what the Philosopher [says].

But Themistius<sup>264</sup> seems to explain the thought of the present [words] more naturally and in a way that naturally fits the passage, saying that our intelligence is the principle of demonstration and the limits are the things of which the axioms are composed, i.e., the 10 subject and the predicate, for example, 'in everything either the affirmation or the negation'. We do not know<sup>(g)</sup> the limits through demonstration, but as perception knows<sup>(g)</sup> perceptibles without demonstration and knows<sup>(g)</sup> them more strongly than if it knew<sup>(g)</sup> them through demonstration, so also intelligence, intuiting them with simple intuitions, grasps without demonstration the nature of the 15things it combines [to form] the axioms. So he might say that things must not proceed ad infinitum, but that there is indeed a principle of demonstration: that very intelligence that intuits things and does not need demonstration but is itself the principle of [demonstration].

72b25-8 But<sup>265</sup> that it is impossible to demonstrate without qualification by circular [proof] is clear, since in fact demonstration must be based on things that are prior and better known<sup>(g)</sup>. [For it is impossible for the same things to be simultaneously prior and posterior to the same things.]

It<sup>266</sup> is clear from this, he says, that it is 'impossible' for there to occur demonstration in the strict sense if the primary things are proved by a circular proof, i.e., from posterior things. We said in the definition of demonstration that demonstration must be based on things that are primary: primary in nature.<sup>267</sup> However, circular proof proves primary things through posterior things. Therefore it is impossible to employ circular proof in the demonstration of primary things.

Now, he says, perhaps we did not do well<sup>268</sup> to give the definition of demonstration saying that it is based on things that are primary in nature, since in fact there are two ways of demonstration, one based on things prior in nature and one based on things prior to us, as we said that the spherical [shape] of the moon is established through things that are primary to us.<sup>269</sup> But this, he says, is false,

- 5 and our definition was given well. For establishing prior things through posterior things is not always necessary,<sup>270</sup> except in cases where the posterior things are irrefutable signs,<sup>271</sup> such as 'since there is ash, fire was once here', or 'since the moon is illuminated in this way, it is spherical'. However, if from the fact that a woman is pale it is established that she has given birth, since the indicator is
- 10 refutable, such [an argument] would not be called a demonstration in any way. And in the case of irrefutable signs, we will not say that such [a demonstration] is demonstration in the strict sense, but that this whole thing is a demonstration from a sign, since it is necessary to establish effects from their causes, which is a property of demonstration in the strict sense, and not causes from their effects.
- 15 **72b28-9** Except in a different way, as some things are [prior] in relation to us, while others are [prior] without qualification which is the way in which induction makes [something] known.

For it has been said that 'prior' has two meanings: [prior] in relation to nature and [prior] in relation to us. Now demonstration in the strict sense establishes secondary things from things that are primary in nature, whereas [demonstrations] that infer from signs [establish] prior things from posterior. Of this sort also is proof through induction, which establishes universals on the basis of particulars, i.e., prior things from posterior things. For from what source do we prove that every animal moves its lower jaw? We prove [it] by enumerating the particular animals, and establishing the universal through the particular and the prior on the basis of the posterior.

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72b30-1 But if that were the case, knowing<sup>(0)</sup> without qualification would not have been defined well. [but there [would be] two kinds.1

If we use 'demonstration' in this way, sometimes establishing posterior things through prior and sometimes prior things through posterior, we were wrong to say in the definition of demonstration that 50.1demonstrations must be constructed from things that are prior in nature and causes.

72b31-2 Or rather, the other kind of demonstration, the one that comes to be<sup>272</sup> from what is better known<sup>(g)</sup> to us, is not [demonstration] without gualification.

That is, if the definition of demonstration has been given well by us, 5 that posterior things must be established on the basis of things prior in nature, a [demonstration] that establishes prior things on the basis of posterior things will not be called demonstration in the strict sense, but, as we said, [it will be called] a proof from a sign.

72b32-5 For those who say that there is circular demonstration there follows not only what has now been said. [but that they are saying nothing else than that this is the case if this is the case. But this way it is easy to prove everything.]

After refuting those who say that there is no demonstration of anything, he proposes to refute also those who hypothesize that everything is demonstrable because deductions are able to turn back through what is called circular proof. In fact, he showed one absurd consequence for them – the first – that they prove primary things on the basis of posterior things and universals on the basis of particu-15lars. The second absurd consequence that he shows is that they assume the same things to be both more clear and less clear than the same things;<sup>273</sup> now, as we said, he reduces the argument to another<sup>274</sup> absurdity. For those who assert, he says, that there is circular demonstration, it will follow that 'they are saying' nothing 'other' 'than' that each thing is this on account of this: because it is this. For example, why is the soul immortal? Because the soul is immortal. Why is man an animal? Because man is an animal. And 20this is ridiculous.

Further, he creates unclarity both by making use of his usual brevity and by training the reason on letters alone, not using an example, and third, because although he takes letters and calls them terms, he does not employ them as terms but as premises. For although he takes A, B, and C and calls them terms, he employs each 25to represent a premise, doing nothing strange or unusual for him. For 51.1

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he often employs letters for premises. In the second book of the *Prior Analytics* he makes use of such a practice, namely, employing letters for premises. In fact, he marks it, saying 'I call A not a term but two premises'.<sup>275</sup> Now this is the cause of the unclarity.

But after taking A, B, and C, he uses A to stand for two premises of the deduction instead of one, or for the minor [premise], omitting the major [premise] as understood, and he uses B to stand for the conclusion. And since circular proof, as I said, takes the conclusion

- 10 as the minor premise, converts the other [premise] and so establishes the remaining one, he in turn uses B, which was the conclusion of the first deduction, for the minor premise, with the other [premise] clearly supplied in thought, and thus he uses the remaining one as the conclusion, which was originally A, but he calls it C in order to indicate by the difference that it is the conclusion. That he employs
- 15 C instead of A he himself makes clear. For since he is conscious that from the labelling of the letters nothing absurd seems to be concluded, if B is proved through A and C through B, when he repeats the argument he says 'let it be supposed that A is C,<sup>276</sup> i.e., let us suppose that A is the same as C, and what was previously a premise let it now be supposed to be the conclusion. And so, supposing that if
- 20 *A* is the case then *B* is the case and if *B* is the case then *C* is the case, and *A* is the same as *C*, then it follows that 'if *A* is then *A* is'.<sup>277</sup> In order to make the argument clearer by means of examples, I say as follows: let the premise 'man is capable of laughing' be taken for *A*, and let a major premise 'that which is capable of laughing is
- receptive of intelligence and knowledge<sup>(e)</sup> be supplied in thought along with it; it follows, of course, that man is receptive of intelligence and knowledge<sup>(e)</sup>; and let this conclusion be called *B*. Now *B*, namely, 'man is receptive of intelligence and knowledge<sup>(e)</sup>, follows *A*, i.e., 'man is capable of laughing'. And if someone is to investigate why is it the
- 52,1 case that *A* is, i.e., that 'man is capable of laughing', and we wanted to make use of circular proof in order to establish this, we say thus: 'man is receptive of intelligence and knowledge<sup>(e)'</sup> what was formerly the conclusion, *B*, now is employed as a minor premise<sup>278</sup> and the conclu-
  - 5 sion follows: 'therefore man is capable of laughing' which was originally a premise, A, but now is the conclusion – clearly given that here too we omit the major premise 'that which is receptive of intelligence and knowledge<sup>(e)</sup> is capable of laughing'. But A he originally called C, as I said, wanting to show by the difference that it is the conclusion.
  - Finally, repeating the argument he says that what I called C I originally called A. So supposing that if A is the case then B is the case and if B is the case then C is the case, which is the same as A, therefore, if B is the case then A is the case; but in fact if A is the case then B is the case; therefore, if A is the case then A is the case. Therefore, those who say that something is proved circularly are saying nothing other than that since each thing is the case, because of this it is the case.

It is possible, as I said, to employ A as standing for the two 15premises. But when we say in the conversion of the deduction, 'if Bis the case then C is the case, i.e., A is the case', since we take A not as standing for the two premises, but for one, which we make the conclusion - in order not to seem in the conversion to employ the two premises as one conclusion, it is better to employ each of the letters for one premise, understanding the remaining [premise] in the man-20ner of enthymemes; for example, 'so-and-so is a dandy, therefore he is an adulterer', clearly supplying in thought the major [premise] 'every dandy is an adulterer'. In this way if we say 'man is capable of laughing, therefore man is receptive of intelligence and knowledge<sup>(e)</sup>, we also understand in addition the major [premise], 'that which is 25capable of laughing is receptive of intelligence and knowledge<sup>(e)</sup>, as deliberately omitted.

'For those who say that there is circular demonstration there follows not only what has just been said', i.e., that prior things are proved from posterior and universals from particulars. but that they say nothing other than that this is the case' since<sup>279</sup> 'this is the case', i.e., the same things are both prior and posterior to the same things, 30 and better known<sup>(g)</sup> and less well known,<sup>280</sup> which is absurd.

**72b35** But<sup>281</sup> it is clear that this happens when three terms are 53.1posited.

'This', he says, 'happens' 'for those who say that there is circular demonstration',<sup>282</sup> 'that this is the case if this is the case',<sup>283</sup> 'when three terms are posited'. And it is reasonable [for him to say this], since demonstration too is based on at least three terms; and this is so since every deduction too [is based on at least three terms]. And so  $\mathbf{5}$ circular proof is based on at least three terms and two premises.

72b36-7 For it makes no difference to say that it turns back through many or few, but [it does make a difference to say that it turns back] through few or through two.

For it is of course possible by using a composite deduction<sup>284</sup> to deduce through several terms and 'to turn back' in a circular proof. And 'it 10 makes no difference' whether the terms are more or fewer. However, to say that the turning back takes place through fewer than three terms and two premises is impossible, since a deduction cannot take place through fewer either.

72b37-8 For when, given that A is the case.

That is, either the minor premise or both [premises], as we said.<sup>285</sup> 15

**72b38** Of necessity B is the case.

That is, the conclusion.

**72b38-9** And [given that] this [is the case, of necessity] *C* [will be the case], [then given that *A* is the case, *C* will be the case.]

20 'This', clearly B, which was originally taken as the conclusion, but now [it is taken] as a premise; 'C', as we said, he employs as the conclusion. And so, given that A is the case, of necessity C is the case. But he employs C as identical to A, as he shows next. Indeed, he says as follows:

**72b39-73a2** If, then, given that A is the case it is necessary that B is the case, and that if this is the case [it is necessary that] A [is the case] (for this is what being circular [is]), let it be supposed that A is C.

- 25 You see that previously, saying 'given that A is the case, C will be the case',<sup>286</sup> he employed C instead of A. Note that here he clearly says
- 54,1 that if B is the case, it is necessary that A is the case. And he goes on to say that what he now takes as A, he there called C, saying 'let it be supposed that A is C, as if he were saying 'let A be what C is'.

**73a2** So given that *B* is the case, to say<sup>287</sup> that *A* is the case [is to say that *C* is the case].

Note that he explains this very point again, still more clearly, saying
clearly that, when I make use of circular proof and say that 'given that B is the case', 'A' is the case, I am saying nothing other than what I said before, that given that B is the case, C is the case.

**73a3-6** But this [is to say] that given that A is the case, C [is the case]. [But C is the same as A, and so it follows that those who maintain that there is circular demonstration are saying nothing else than that if A is then A is. In this way it is easy to prove everything.]

'But this', he says, we originally proved of C, that 'given that A is the case' of necessity it is too, since in fact B was proved through A and C through B. But C has been shown the same as A. And so nothing

10 *C* through *B*. But *C* has been shown the same as *A*. And so nothing else is inferred except that 'given that *A* is the case', *A* is the case.

**73a6-7** But in fact this is not possible either, except for things that follow one another, such as properties.

Because in circular proof not even this very thing occurs in all cases - that things are demonstrated through themselves - unless three 15terms are employed that are so related to one another that each converts with the remaining ones, i.e., so that they are coextensive. This is the same as saving that they must be composed of properties like 'man', 'capable of laughing', and 'receptive of intelligence and knowledge<sup>(e)</sup>: each of these converts with the remaining ones. For unless the terms are related in this way, it will not be possible to 20make use of circular proof at all. For it is not possible for the premises to convert if the universal affirmative [premise] does not convert with itself but with the particular affirmative [premise].

**73a7-8** Now it has been proved that when one thing is posited it is never necessary for anything different to be<sup>288</sup> the case.

Since, he said above, that 'this happens when three terms are pos-25ited'.<sup>289</sup> and that it cannot [happen] through fewer, now repeating this very point, he here says that we have proved in the second book of the *Prior Analytics*<sup>290</sup> that if one term or premise is posited, it is impossible for a deduction to take place, for if I say 'man' or 'stone' or 'man is an animal', no conclusion will be inferred from one of these. 55.1since in fact a deduction is 'an argument in which, some things' (not 'thing') 'being posited, something follows that is different from the things posited'.291

73a9 I say 'one', because neither if one term nor if one thesis is 5 posited [is it ever necessary for anything different to be the case].

It should be noticed that he calls the premise a thesis. I say this because above, when dividing immediate premises, he made the division into axioms and theses, and divided theses into postulates and definitions, but now he calls universally every premise a thesis.<sup>292</sup>

**73a10-11** But it is possible from two theses first and fewest, if 10 indeed [it is possible] to deduce.

That is, 'from' at least 'two'. 'First', i.e., simplest, since a deduction composed of more premises is not composed of the first ones, but is composite, being established on the basis of preliminary deductions. However a deduction composed of two premises has its generation 15proximately from these, which are its first [premises]. By 'if indeed [it is possible] to deduce' he means 'since deduction in general is composed of at least two premises, so that circular proof too [is composed of at least two premises]'.

20 **73a11-14** Now if *A* follows *B* and *C*, and these follow one another and *A*, in these circumstances it is possible to prove one from another in the first figure all the things that are requested, [as has been proved in the work on deduction].

That is, if the three posited terms are properties, so that all convert with all, then it is possible to convert the major premise and put this together with the conclusion to prove the remaining one. Likewise it is possible to demonstrate the major [premise] by a circular proof, converting the minor [premise] and in this way connecting the conclusion with it, to infer the major [premise]. This is possible only 'in the first figure', 'as has been proved in the work<sup>293</sup> on deduction'.<sup>294</sup>

**73a15-20** But it has also been proved that in the other figures either there is no deduction or [that there is a deduction] but not about what has been assumed. [Things that are not reciprocally predicated can in no way be proved circularly, and so since there are few such things in demonstrations, it is evident that it is void and impossible to say that there is demonstration [of things] from one other and that for this reason there can be demonstration of all things.]

In the second book of the *Prior Analytics* he makes a long discussion about circular proof<sup>295</sup> in which he proves that if terms are taken that convert with one another, it is possible to deduce each of the premises by circular proof in the first figure, but in the remaining figures this is no longer possible, but either nothing is proved at all or something different from the [claim] in question.

For example, if we were to say in the second figure: 'capable of laughing [is predicated] of every man, capable of laughing [is predicated] of no stone',<sup>296</sup> and wanted to establish each of the other premises by circular proof, the affirmative [premise] we cannot prove at all, since in every deduction the conclusion goes along with the

- 10 weaker premise; for when the negative [premise] is converted and the conclusion is taken as a premise, two negative [premises] occur in the first figure, and so nothing will be inferred. For example, if I were to say 'man [is predicated] of no stone', which was the conclusion, 'stone [is predicated] of nothing that is capable of laughing', the result is that it is not at all possible to prove the affirmative
- 15 [premise]. But if we want to prove the negative [premise], we do not prove *it*, but we can prove its converse, as follows:<sup>297</sup> 'capable of laughing [is predicated] of no stone, capable of laughing [is predicated] of every man'.<sup>298</sup> The conversion is as follows: 'stone [is predicated] of no man, man [is predicated] of everything that is capable of laughing', and 'therefore stone [is predicated] of nothing

that is capable of laughing]' is inferred. But we wanted to prove that 'capable of laughing [is predicated] of no stone'. But if someone were to say that the sought is proved since the conclusion converts (for if stone [is predicated] of nothing that is capable of laughing, clearly also capable of laughing [is predicated] of no stone), we say that the original [sought] is not inferred directly without the conversion.<sup>299</sup>

Note<sup>(o)</sup>, however, that if we do not reduce the deduction to the first figure but keep the property of the second figure, it is possible to prove the negative [premise]. Let the deduction be as follows: 'capable of laughing [is predicated] of no stone, capable of laughing [is predicated] of every man, therefore man [is predicated] of no stone'.<sup>300</sup> Now in this deduction if I take the conclusion and convert the affirmative premise, I keep the second figure and infer the negative premise as follows: 'man [is predicated] of no stone, man [is predicated] of everything that is capable of laughing', and 'capable of laughing [is predicated] of no stone' is inferred.

The Philosopher says that nothing is inferred by circular proof in the third figure because everything inferred in the third figure is particular, and supposing that the conclusion is particular, if we want to prove one of the premises which is universal, it is not possible 35 by a circular proof.<sup>301</sup> For if we assume the conclusion, which is particular, and the particular premise we will infer the remaining 57.1one in this way.<sup>302</sup> But I say that just as in the examples I gave in the first figure - because he takes terms that are coextensive, even though a universal affirmative [premise] does not convert with itself, likewise, as I said, because the terms are coextensive Aristotle grants that the affirmative [premise] converts with itself – it is not absurd 5 that in the third figure too, when the terms are coextensive, it is possible to infer the conclusion as universal and when it has been inferred as universal to demonstrate the premises too by circular proof. For example, 'man [is predicated] of everything that is capable of laughing, that which is receptive of intelligence and knowledge<sup>(e)</sup> [is predicated] of everything capable of laughing, therefore man [is predicated] of everything that is receptive of intelligence and knowl-10 edge<sup>(e)</sup><sup>303</sup> I prove the minor premise by analysis into the first figure, assuming the conclusion and the major [premise].<sup>304</sup> But it is not possible to prove the major [premise] either by reduction to the first figure<sup>305</sup> or through the third [figure] itself.<sup>306</sup>

**73a21-2** Since it is impossible for that of which there is knowledge<sup>(e)</sup> without qualification to be otherwise, that which is known<sup>(e)</sup> by demonstrative knowledge<sup>(e)</sup> must be necessary.

After refuting those who say that there is no demonstration of anything and those who hypothesize that everything is demonstrable, he now, next, returns to his original point, which was to teach

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20 precisely what demonstrative knowledge<sup>(e)</sup> is. And since it is not possible for anyone to know<sup>(o)</sup> this unless he knows<sup>(g)</sup> of what things there is demonstration, he takes up the discussion of these and teaches the material that is foundational to demonstration.

He says that demonstration is not simply knowledge<sup>(e)</sup> of things that are only true, but also of things that cannot 'be otherwise'. But if this is so, demonstration is necessary.<sup>307</sup> And if it is necessary, it is of course necessary for it to be based on necessary premises too. For it is not possible to demonstrate something

- 25 premises too. For it is not possible to demonstrate something necessary from premises that are not necessary. And so, since demonstration is necessary and is based on necessary premises, we must, he says, grasp what are the necessary problems of which there is demonstration, and what are the premises of the things that are necessary, from which the demonstrative deduction comes to be. But since every premise asserts something of some-
- 30 thing or denies something of something, and this either in every case or in some case, and either per se or accidentally, and since demonstrative premises must either affirm or deny in every case
- 58,1 and per se, not accidentally, we will not know<sup>(g)</sup>, he says, what are the necessary premises that contribute to demonstration until we learn precisely what 'in every case', what 'per se', and what 'accidentally' [are].<sup>308</sup> And next, after going through the things that are previously known<sup>(pg)</sup>, he presents in addition his doctrine about necessary premises and problems.
  - 'But since it is impossible for that of which there is knowledge<sup>(e)</sup> without qualification to be otherwise, that which is known<sup>(e)</sup> through demonstrative knowledge<sup>(e)</sup> must be necessary'. It is clear that 'it is impossible to be otherwise' is the same as that it is necessary to be
  - 10 so. But 'impossible' is clearer to us and presents his thought more plainly. No matter that we say many times that it is necessary for a sick person to undergo venisection, we bring in the word 'impossible' to give greater emphasis to the meaning of necessity, saying that it is impossible to become healthy unless he undergoes venisection. Now this is why he too, taking 'impossible' as clearer, infers 'neces-
  - 15 sary' from this. For if 'that which is known<sup>(e)</sup>' cannot 'be otherwise', of course this will be necessary, he says.

**73a23-4** [Demonstrative [knowledge is knowledge] we have by having a demonstration.] Therefore a demonstration is a deduction based on things that are necessary.

Clearly, 'from necessary' premises, since it is not possible to infer anything that is necessary from things that are not necessary, which he omitted [to state] supposing that it is clear. **73a24-7** Therefore we must grasp *from* what things and *of* what sorts of things demonstrations are.<sup>309</sup> [But let us first determine what we mean by 'in every case', by 'per se', and by 'universal'.]

'From what things' and 'of what sorts of things' are not parallel; 'from what things' amounts to 'from premises', and 'of what sorts of things' amounts to 'of what kinds of problems are there demonstrations', which it is necessary to establish, clearly, through necessary premises.

**73a28-9** Whatever is not [such as to apply] to some cases but 25 not to others, nor at some times but not at others, I say [belongs] 'in every case'.

In the *Prior Analytics*, he defined 'in every case' saving 'when it is not possible to take any instance of the subject of which the predicate is not predicated'.<sup>310</sup> Likewise [he defined] 'in no case' as 'when there is 59.1nothing of the subject of which the predicate is asserted'.<sup>311</sup> Here he says that this must hold for 'in every case' as it is employed in the demonstrative sciences<sup>(m)</sup>, and further that it always belongs to the subject and not 'at one time but not at another'. In the other passage 5 he says that belonging to everything is 'in every case' even if not always. He did not need 'always' there, since he was not discussing demonstrative deductions, but only [deductions] without gualification, in which there is need only for the predicate to belong to all cases of the subject. Here, however, [he demands] both 'to everything' and 'always'. And, he says, that this is the 'in every case' employed in 10 demonstrations is clear from the objections brought against demonstrative premises. For, he says, people who object to a demonstrative premise believe that they refute it not only if they prove that the predicate belongs or does not belong to every case of the subject, but also if it does not always belong or not belong.

**73a29-31** For example, if animal [holds] of every man, then if it 15 is true to say that this is a man,<sup>312</sup> it is true [to say that it is] also an animal.

That is, if it is true that 'animal' belongs to every man, then 'if it is true to say that' so-and-so 'is a man', then 'it is' of course 'true' to say that he is 'also an animal'.

**73a31** And if [it is] now [true to say] the one, [it is now true to say] the other too.

That is, if it is posited that this particular [thing] is a man, [he is] also 20 an animal. For it is not the case that he is sometimes an animal and sometimes not an animal, but he is always said to be both an animal
and a man. But in the case of sleeping, it is not like this, but remaining a man he can sometimes sleep and sometimes not, and sometimes engage in conversation and sometimes not. However, he will not sometimes be and sometimes not be an animal or mortal but he always is.

# 73a31-2 And likewise, if in every line [there is] a point.

That is, a point will not sometimes belong to a line and sometimes not belong, but it will always have this.

60,1 **73a32-4** An indication [of this] is that when we are asked [to believe that something holds] 'in every case', this is in fact how we bring objections, [if [it does] not [hold] either in some case or at some time.]

'An indication' of the fact that 'in every case' is as we said, is that 'being asked' to grant demonstrative premises, for example 'if every

- 5 man is an animal' (if every man is being discussed), we bring forward 'objections', not only investigating if the predicate belongs to every [such] subject, but also if [it belongs] to every one, but not always. For example, we grant the [premise] that every man is an animal, because it belongs both to every [man] and always; but the [premise] that every man is engaging in conversation we do not grant nor will we say that the predicate belongs to every [instance of the] subject,
- 10 because it does not always belong. For clearly what [holds] 'in every case' will not belong to every [instance] unless the predicate will always be [predicated] in every case of the subject.

**73a34-7** All the things that belong<sup>313</sup> [to something] in 'what it is' [I say belong] per se, as line [belongs per se] to triangle and point to line. [Their essence depends on these and these are predicated in the account that states what those things are.]

- 15 After determining what is 'in every case' he turns to 'per se'. He gives four meanings of 'per se' of which the first thing he declares is said per se is that which is predicated of something in 'the "what it is", i.e., what is employed in the definition of that thing. For example, we say that animal belongs per se to man and figure to triangle [and
- 20 point to line].<sup>314</sup> For animal, being predicated per se of man, is employed in the definition of that thing. For he says that man is a mortal rational animal. Likewise triangle is a figure contained by three straight lines. He also says that point is predicated per se of line; for we say that a line is the flow of a point<sup>315</sup> or a line is that
- 25 which lies 'evenly with the points on itself'.<sup>316</sup> Note<sup>(0)</sup> that the claim does not strictly speaking hold of line: it seems not to have been

stated very appropriately. For a point does not belong in a line. A more appropriate definition of line would be that which says 'magnitude in one dimension'.<sup>317</sup> For the things employed in this definition are constitutive of the essence<sup>318</sup> of line and are predicated in it.

73a37-40 Also [I say] all of the things predicated of them, to which *they* are predicated in the account indicating 'what it is', [belong to them per se], as straight and circular belong to line, and odd and even to number.

This is the second meaning of 'per se'. For we also say [things belong] per se whose subjects are employed in their definitions; for example, 5 when defining snubness we employ in its definition the subject, namely, nose, saving that snubness is concavity in a nose. Likewise also, when we define straight we employ line, saying that straight is an affection of a line 'which lies evenly with the points on itself',<sup>319</sup> or [a line] 'whose middle [points] are in front of the ends'.<sup>320</sup> or however 10 else it is defined. Likewise also we say that 'circular' or circumference<sup>321</sup> is an affection of a line [which is such that] 'all the straight lines extending to it from one of the points lying within' it 'are equal to one another'. And clearly a segment of a circle is not itself called a circumference, but it should rather be called bent rather than a circumference in the strict sense. But a circle as the geometer defined 15it, is a circumference. Likewise also we say that a number that can be divided into two equal parts is even, and a number that cannot be divided into two equal parts is odd, and likewise in similar cases. This is the second meaning of 'per se'.

But the passage contains some unclarity, which we will settle in the following way. He says 'all of the things predicated in them, to 20which they are predicated in the account indicating what it is'. The word 'them' creates the unclarity. Therefore, let us employ 'certain things'322 instead, and the statement becomes clear, thus: 'all' of the things belonging accidentally in certain things, 'to which they are predicated in the account indicating what it is', i.e., the very subjects to which the accidents belong, are employed 'in the account' of the 25accidents 'indicating' the 'what it is', i.e., their being, in their definitions – that they are a whole of this kind. Of things that have their being in others (he says), the ones in whose definitions their subjects are employed, I say [belong] per se.

# 73a40-b1 And prime and composite, and equilateral and oblong.

In fact these, he says, belong per se to number, because in the definition of each of them we employ their subject, namely, number. 62,1Note<sup>(0)</sup> that Alexander understands by prime number here not what is prime per se, but prime to another.<sup>323</sup> A number measured by a unit

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alone is prime,<sup>324</sup> for example, 5, 7, 11, 17. These are not measured by the number 2 or by any other number, only by the unit. Numbers measured by the unit and also by one or more other numbers are called composite,<sup>325</sup> for example 6. It [is measured] by the number 2, the number 3, and the unit. Likewise 9 is measured by the unit and the number 3. Numbers that are measured only by the unit as a common measure are called prime to one another,<sup>326</sup> for example, 6 and 11: they are measured only by the unit as a common measure.

But that he does not employ [numbers] prime to one another here as Alexander says, but [numbers] prime without qualification, is evident from the fact that Aristotle does not say 'prime numbers' in the plural, but 'prime'.<sup>327</sup> Likewise Alexander takes 'equilateral and

- 15 oblong' [to belong] not to numbers but to figures, <sup>328</sup> which was indeed reasonable for him to think. However, Aristotle has not applied these to figures, but to numbers. For in fact we say that square numbers are equilateral, <sup>329</sup> for instance 9, because it comes to be when 3 is multiplied by itself. Those that result from unequal numbers when they are multiplied, [we call] oblong. For example we call 15 oblong
- 20 because it is composed of 5 multiplied by 3.<sup>330</sup> That he does not take 'equilateral and oblong' [as belonging] to figures but to numbers, he makes clear by what he goes on to say.

**73b1-4** And of all these there are predicated in the account stating 'what is' line in the one case and number in the other. [Likewise in other cases too I say that such things [belong] per se to each thing.]

- 25 That is, in the definitions of all the previously mentioned things, their subjects are predicated: in some, line [is] clearly [predicated] – in the definition of circular and straight; in some, number [is predicated] – in all the rest. But it is clear that we do not employ line as
- 63,1 subject in the definition of equilateral and oblong. For the subject of these is not line but figure, and they are affections not of line but of figure. And so he clearly means number to be the subject of these.

**73b4-5** While all that belong in neither way [I call] accidents, [as musical or white [are accidents] of animal.]

- 5 That is, I call 'accidents' all that neither take the subject in their own definition nor are employed as a predicate in the definition of the subject. For example, 'musical or pale [are accidents] of animal', which are of a nature<sup>331</sup> also to be separated from it. Now 'what about this', someone might enquire, 'do we also call per se those accidents
- 10 that are not separated, the way black [belongs] to crow? By no means. For he determined which accidents he says belong per se to the subjects as well. And so if accidents are inseparable, but do not

contribute to the definition of their subjects or do not employ the subjects in their own definition, they will not belong per se to their subjects.<sup>332</sup>

And how will we know<sup>(g)</sup> which inseparable accidents should be 15 employed in the definition of their subjects or [ought] to employ those [subjects] in their own definition, and which ought not? I say that all inseparable accidents that belong determinately to one and the same nature<sup>333</sup> and to no other, belong in them per se, and all that do not belong to some determinate nature but can belong to more as well, even if they are inseparable, are not said to belong to their subjects 20 per se.<sup>334</sup>

**73b5-9** Also [I call per se] that which is not said of any other subject, as the walking [thing] is *something else* that is walking, and [likewise for the] white [thing].<sup>335</sup> [But a substance and everything that signifies a particular, are what they are, without being something else. I call per se those things that are not [said] of a subject, and accidents those that are [said] of a subject.]

This is the third meaning of 'per se' – that which is not one thing that is predicated of something else, as was the case for the two previous ways, but simply that which does not have its being on account of something else or in something else, as accidents do, but what exists all by itself, as substance [does]. For its accidents need it for their being, but it needs nothing. This is the third way of 'per se'.

'Also that which is not' 'said' 'of any other subject', i.e., that which is not in any in other subject, for example 'walking'; for something 30 must be a man and then walk, and walking is in the subject man.

The things that are 'not' [said] 'of a subject', i.e., are not in a 64,1 subject: for he employs 'of a subject' to mean 'in a subject'.<sup>336</sup>

**73b10-14** In yet another way [I call] per se what belongs to something because of itself, and what does not [belong] because of itself an accident. For example, if there was lightning while someone was walking, it was an accident, [since it is not because of his walking that there was lightning, but we say that this just happened. But if [it occurs] on account of itself, [I call it] per se.]

This is the fourth meaning of 'per se', that which proves to be the 5 cause of something not accidentally. For if 'there was lightning while he was walking', he says, we do not say that there was lightning because of the walking per se, but accidentally. For even if he were not walking, there would have been lightning. Nor if someone discovered a treasure while digging do we say that the digging was the cause of the discovery of the treasure per se, but accidentally. For he 10

did not dig on account of this. However, if someone died when his throat was cut, we say that the cut was per se the cause of his death. For the death was not incidental to the cut, but the cut was the cause of the death.

He gives these [meanings] in order for the division to be complete, but not all these meanings of 'per se' contribute to demonstrative science<sup>(m)</sup>. Only the first two ways of [being] per se are useful for the present topic, since they are characteristic of things that belong of necessity and always. For it is not possible not to employ 'nose' in the definition of snubness, nor is it possible for the things employed in the definition of certain things not to belong always to all [instances of] the subject, as animal [belongs] to man. The third way is especially concerned with individuals, for these are [predicated] of

- nothing else and 'signify a particular',<sup>337</sup> but there is no demonstration of individuals, as will be proved in what follows. The fourth way is not useful for demonstration either. For a cut is not the only cause of death, nor is it certainly [a cause of death] unless it happens to be fatal, and so it is not always, nor is sailing in the spring the only cause
- 25 of safety, nor [is it] always [a cause of safety]; but demonstration naturally has the [property of holding] 'always' as well. This is why this is not useful for demonstration either.

**73b14-16** For example, if someone<sup>338</sup> died while his throat was being cut and [died] by virtue of the cut<sup>339</sup> [[we say] that [he died] because of his throat's being cut and did not just happen to die while his throat was being cut.]

He necessarily added 'and by virtue of the cut', i.e., on account of the cut; for it is possible that he would have died even if his throat had not been cut, for example if he happened not to have received [the blow] in a fatal place, but the fear and the shock, or even the fated 65,1 time of death caused his death, being present by some chance at the time of the cut, as if someone should die while bathing or eating. For if it happens thus, neither the bath nor eating nor the cut will be per se the cause of death, but it just happened that way.<sup>340</sup>

5 **73b16-18** Therefore the things called per se in the case of things that are known<sup>(e)</sup> without qualification are such as to be predicated in the predicates or to have [the others] predicated in [them] both because of themselves and of necessity.

After enumerating the previously mentioned four meanings of 'per se' in order that the division be complete, as I have already said,<sup>341</sup> he now distinguishes them and says that the two first meanings of 'per se' contribute to demonstrative sciences<sup>(m)</sup>, and the remaining two do not. For the third does not even directly predicate one thing

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of another, but is just a verbal expression signifying some substance, while the fourth, even though it does predicate one thing of another as the cause of an effect, and even though the cause is of necessity the cause of the effect, nevertheless such a thing does not contribute to a premise, but rather to the formation of an entire deduction. For 15example the moon is eclipsed because of occultation by the earth, but we do not employ this in a premise; rather, as I said, the cause of the eclipse contributes to the formation of the entire deduction, being employed in the place of the middle term, as in the following deduction: 'the moon is occulted by the earth, that which is occulted is 20eclipsed, therefore the moon is eclipsed'. Note here that although the cause of the moon's being eclipsed is occultation by the earth, this<sup>342</sup> was not employed in a premise, but it contributed to the formation of the middle term. We will give a more precise examination of this when he himself mentions it.<sup>343</sup>

Thus, only the first two meanings of 'per se' are useful for the 25 demonstrative sciences<sup>(m)</sup>, since they belong of necessity and per se. And that the former meaning of 'per se' belongs of necessity to the subject is evident directly, since in fact the things employed in the definitions of something<sup>344</sup> must belong to those things and [belong] of necessity. This is why Aristotle does not even think it worthwhile to establish the point.

But the second – that which employs the subject in its own 30 definition - seems not to belong of necessity because the predicate does not belong to all [instances of] the subject (for odd does not [belong] to every number, nor does even [belong] to every number). However, he shows<sup>345</sup> that these too belong of necessity to all [instances of the subject because their opposition is immediate and is 35equivalent to a contradiction. For just as a contradiction [holds] in the case of all things that are and are not, dividing both the true and 66.1the false, and belongs or does not belong to all both of necessity and always, not because both of its members apply to all cases, but because certainly one or the other of the two [applies] - in this way also in the present cases, since either even or odd [applies] to every number, this is why we say that they of necessity belong per se and 5 always, because one or the other member of the opposition certainly must apply to those things of which it is of a nature to be predicated.<sup>346</sup> Besides, for the things of which one or the other member of the opposition is predicated, the predicate clearly belongs to all [instances of] the subject,<sup>347</sup> and if to all, then also, of necessity, always.<sup>348</sup> After making this distinction he will turn to his doctrine of 10the universal.

'Therefore the things called per se in the case of things that are known<sup>(e)</sup> without qualification are such as to be predicated in the predicates or to have [the others] predicated in [them] both on account of themselves and of necessity'. Since he has enumerated the

- 15 meanings of 'per se' and has taught that only the first two belong of necessity, he here draws the conclusion that is useful to him for demonstrative sciences<sup>(m)</sup>, inferring the necessity of demonstrative premises from what has been shown. For he says in effect that even if all the things we have enumerated belong of necessity, those employed in premises 'in the case of things that are known<sup>(e)</sup> without
- 20 qualification<sup>7</sup>, i.e., the things known<sup>(e)</sup> in the strict sense, are different, [being] such 'as to be predicated in the predicates or to have' the predicates 'predicated' of them. Here he indicates the two first ways among the meanings of 'per se', which have been shown to be of necessity and to belong per se. Therefore, demonstrations are based on necessary premises.
- 25 As I said, he signifies the first two ways of 'per se' by 'be predicated in' and 'to have predicated in [them]'. The first by 'be predicated in'; for it is because each thing contains its essence in its own definition and is by virtue of it, that he said that the subject 'is predicated in' 'the predicates', as man [consists] in animal, rational, and mortal
- 30 (which are predicated of it), because the essence of man [consists] in them. And it is because the second way is opposite to the first (for in
- 67,1 the first the subject employs the predicate in its own definition, but in the second the predicate employs the subject in its own definition) that after saying 'be predicated in' in the first case, in the second he says 'have' the predicate 'predicated in' the subject. For in this case
  - 5 what is predicated is by virtue of the subject. For it is by virtue of number that even or odd belongs [to a subject], and this is why he said that it is predicated in the subject, i.e., on that depends its being and its preservation.

**73b18-21** For it is not possible [for them] not to belong either without qualification or [as] the opposites [do], [the way either straight or bent [belongs] to line and either odd or even to number.]

- 10 'Without qualification' must be taken as applying to the former way; for it is not possible for the things employed in the definition of something not to belong of necessity to all [instances of] the subject and always. 'The opposites' [must be taken] with reference to the second way. For in this case too it is necessary for the whole opposition to belong to every [instance of] the subject. For every number is
- 15 either even or odd, and every line either bent or straight. However it is possible to take 'without qualification' as applying to the second way too: 'without qualification' when we predicate the whole opposition, for example every number is even or odd, and every body subject to generation is either heavy or light. He says 'the opposites' to mean 'one or the other of the opposites', since, as I already said, taking one
- 20 member of an opposition we predicate it of what is receptive [of it], as [we predicate] even of every number 10, or any such thing.

It is discovered that in the case of some per se accidents there is also some mean – in cases where excess and deficiency are observed, as with snubness and aquilinity. For there is also straightness in between them. But in these cases it is possible to employ the immediate opposition, if we say as follows: that every nose is either straight or bent, just as we also say that every line is divided into these two [kinds]. For clearly 'bent', as applying to a nose is called aquiline if it is convex, and snub if it is concave.

But this should not be taken without qualification to have been said as applying to all per se accidents, only to those that are known<sup>(e)</sup>; these are the things [that are grasped] by abstraction. This is why he said those things 'in the case of things that are known<sup>(e)</sup> without qualification'.<sup>349</sup> But snubness and straightness of the nose are not things that are known<sup>(e)</sup>, for they are not grasped as the result of abstraction.

**73b21-2** For the contrary [of something] is either its privation 68,1 or a contradiction in the same kind, as even is what is not odd *among numbers*, since it follows [that any number that is not odd is even].

Since he said that they belong of necessity 'either without gualification or the opposites', he wants to establish this very point in these [words]. For immediate contraries coincide with privation and pos-5 session, or affirmation and negation. For as in the case of things receptive of sight and blindness, it is certainly necessary for one or the other of the opposites to belong, and likewise it is certainly necessary that one or the other member of a contradiction belong to subjects, so also in the case of immediate contraries it is necessary for one or the other of the contraries to belong to that which is receptive, as even or odd [belongs] to number, life or death to a 10 human, and heavy or light to bodies. This is why a contrary is certainly equivalent either to the privation or to the negation of the member [of the contrariety] contrary to that which has been posited. For example, non-odd is equivalent to even, for in numbers the non-odd is certainly even. Likewise if one were to say un-odd instead 15of non-odd, in the language of privatives, it is equivalent to even. Now since the contradiction [holds] of necessity in every case, i.e., either the affirmation or the negation is true, likewise, in the case of things that are receptive, either the possession or the privation is predicated truly. But we have shown that immediate contraries are equivalent to these. Therefore it is necessary for these too to belong of necessity to the things that are receptive.

By 'the contradiction' he means 'the member [of the contradiction] that contradicts the contrary of what is posited'; for if even is 20 posited, since odd is the contrary of this and non-odd is what contra-

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dicts this, non-odd is of course equivalent to the contrary of odd, which is even.

By saying this, namely, that 'the contrary' 'is' 'either a privation or a contradiction', he might have seemed in this way to be taking privation and possession as coextensive with affirmation and negation. For someone might say that in cases where privation and negation apply, one of the contraries [applies] as well: since a goatstag is not odd, it is therefore even. This is why he pedantically added 'in the same kind', i.e., in cases where both opposites are of a nature to be found together in the same kind. For in these cases the opposites are equivalent to privation and possession and to affirmation

- sites are equivalent to privation and possession and to affirmation and negation. For, he says, 'in' number 'the non-odd' (the negation)
  is 'even', not because, he says, I am identifying the negation with the
- affirmation (for even is an affirmation, and non-odd is a negation), but in this way I say that the even is non-odd, in that in such cases the negation 'follows' the affirmation; for 'non-odd' follows 'even' and
  - 5 'non-bent' [follows] 'straight' because of the immediate opposition of the contraries. And so, he says, I am not in effect calling the negation and the affirmation identical, for they are different one from the other. For if I say 'non-even', I have only eliminated even; but if I say 'odd', I have posited odd. Now these are not identical, but nevertheless they coincide in the case of immediates. For a person who says that some number is not even is saying nothing other than that it is
- 10 odd, and a person who says that a nose is not straight is saying nothing other than that it is bent.

**73b23-4** And so if it is necessary to assert or deny [that any attribute belongs to a given subject], it is necessary also for the per se [attributes] to belong.

That is, if in every case either the affirmation or the negation [is true], in the case of immediates, the contradiction is equivalent with the contraries. Therefore, in the case of such immediates the contraries will of necessity belong to the subjects.

**73b25-7** [Let 'in every case' and 'per se' be determined in this way.] I call universal whatever belongs in every case and per se and qua itself.

After enumerating the meanings of 'per se' and distinguishing those that are useful for every demonstrative science<sup>(m)</sup>, he will turn to his doctrine on the universal. Aristotle knows<sup>(o)</sup> three meanings of 'universal'. One is where the predicate belongs without qualification to all [instances of] the subject, even if it does not belong per se, as we say that black [belongs universally] to every Ethiopian or walking to every human.<sup>350</sup> Second, that which is universal and per se, as we say

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even [belongs universally] to every instance of the number 10.351 Third, that which [belongs] per se, in every case, and primarily; this 25is what he now teaches and employs in demonstrative sciences<sup>(m)</sup>: for example that the three angles of every triangle are equal to two right angles. That its three angles [are] equal to two right angles belongs to every scalene triangle, and [belongs] per se, but not primarily; for it does not qua scalene have its three angles equal to right angles nor [does it] qua isosceles. For even if it is not scalene, nothing prevents 30 its being another triangle that has its three angles equal to two right angles. Now having its three angles equal to two right angles belongs primarily to triangle, because [it belongs] to every triangle, and [belongs] to every [triangle] per se and [does so] primarily, for it belongs to nothing else before triangle. For if it belongs to some figure to have its three angles equal to two right angles, still it does not 70.1belong to every figure or qua figure, but qua triangle.

And he says that this [kind of] universal must be employed in demonstration.<sup>352</sup> But if this is so, it will follow that there is nothing demonstrable that does not convert with the predicate and, to speak briefly, that only definitions and properties are demonstrable be-5 cause they convert with the definienda. However, that man is an animal is not demonstrable, because the predicate does not belong primarily to the subject.

To this Themistius says that genera and differentiae are demonstrable even if they are not coextensive with their subjects, but [they are demonstrable nonetheless because they belong both per se and to all [instances of] the subject.<sup>353</sup> In fact, Aristotle is clearly thinking about the principal and chief [kind of] demonstration, and the kind that is most suitable to the first philosopher, when he says that this is [the kind of demonstration] that demonstrates most universally. So what is employed in the case of genera and differentiae will clearly be a secondary standard for demonstration, whereas the first and chief [standard] is the things that he himself taught.

But in addition to this, some have said the following: that Aristotle 15means by this not that all demonstrable things should convert, but that these are things that contribute to demonstrations. For example, in the demonstration that the triangle has its three angles equal to two right angles, [the theorem] that if a straight line falls on two parallel straight lines, the three alternate angles are equal to one 20another<sup>354</sup> must be employed, and this converts. For in cases where the three alternate angles are equal to one another, a straight line has fallen on two parallel straight lines. But this is false. For Aristotle does not say this, but he is discussing the demonstrable things themselves, as we will note in the passage. Besides, not even all the things employed in demonstrations convert. For to prove that the 25three angles of a triangle are equal to two right angles, [the theorem] that if one side of the triangle is produced, the exterior [angle] is



equal to the interior and opposite [angles] is employed; but it does not convert. For it is not the case that if something has the exterior [angle] equal to the interior and opposite [angles], it is a triangle which has one side produced. For this happens also to quadrilaterals when one side is produced.<sup>355</sup>

- 30 **73b27-32** And per se and qua itself. [Thus it is obvious that everything that is universal belongs to its subject of necessity. Per se and qua itself are the same, as point belongs to line per se and so does straight (for [it belongs to line] qua line), and two right [angles belongs] to triangle qua triangle (for triangle per se is equal to two right [angles]).]
- He employs these in parallel, signifying the same thing, as he says 71,1 in what immediately follows. For, he says, 'per se' 'and qua itself are the same'. After saying first that the universal must be per se and in every case, he next goes on to mention the third difference, namely, that it must belong primarily to the predicates.
  - 5 Note<sup>(o)</sup> that Aristotle says here that 'per se' and 'qua itself' are the same, but Theophrastus and his followers say that they are different, since [they say that] 'per se' is more universal than 'qua itself'. For if anything [belongs to something] qua itself, it also [belongs to it] per se, but it is not the case that if anything [belongs to something] per se, it certainly also [belongs to it] qua itself. Having its three angles equal to two right angles belongs to triangle qua triangle, and also
  - 10 per se, but it belongs to isosceles per se, but not qua itself. For it is not qua isosceles that having its three angles equal to two right angles belongs to it (if this were so, it would not belong to equilateral or scalene, since they are not isosceles), but qua triangle without qualification.

Theophrastus and his followers [say] this.<sup>356</sup> But Aristotle, having discovered that these coincide in some cases, said that both are the same. For example, 'receptive of intelligence and knowledge<sup>(e)</sup>' belongs to man per se and qua itself; for [man] is not receptive of intelligence and knowledge<sup>(e)</sup> qua animal or qua two-footed or ensouled, but qua man. For this seems to be the only animal that is receptive of intelligence and knowledge<sup>(e)</sup>. Also, not being able to be divided into equals belongs to odd number per se and qua itself.

**73b32-9** The universal belongs precisely when it is proved [to belong] to what is chance and primary. [For example, having two right [angles] is not universal to figure even though it is possible to prove of a figure that it has two right [angles], but not of any chance figure, nor does a person who proves this make use of a chance figure (for a quadrilateral is a figure, but it does not have [its angles] equal to two right [angles]), whereas any chance isosceles has [its angles] equal to two right [angles], but [it is not the] primary [subject that does,] but triangle is prior.]

This is the third specification of 'universal'. 'To what is chance' means when the very predicate belongs to a chance [instance] of the things underlying<sup>357</sup> the predicate, as having its three angles equal to two right angles [belongs to] a chance triangle, and not only to a chance 25 [triangle], but to [triangle] as its primary [subject]. For having its three angles equal to two right angles does not belong primarily to scalene but to triangle.

**73b39-74a2** Now that which is shown to be the chance and primary thing that has two right angles or whatever else – it is to this primary subject that it belongs universally, and the demonstration per se is of this universally.

That to which the predicate belongs both as its primary [subject] and to a chance [instance of it], he says, 'of this' that 'the demonstration' 72,1is both 'per se' and 'universal'. 'But of the other things' to which the predicate belongs to a chance [instance of them] but not primarily, the demonstration, he says, is of these things 'in some' 'way',<sup>358</sup> but not in the strict sense or universally. For example, if a geometer proves of every isosceles triangle that its three angles are equal to 5 two right angles, the demonstration is of this 'in some' 'way, but not per se'<sup>359</sup> or universally, because having its three angles equal to two right angles belongs to it not qua isosceles but qua triangle. In this way, then, there is no demonstration of this per se. However, in that the predicate is predicated truly of every isosceles, in this way, according to a secondary standard of demonstration in these cases too 10it can be called a demonstration. Further, consider how clearly he says in these words not that such things are useful for demonstration but, as I said, that they are the demonstrable things themselves. For, he says, 'also demonstration per se is of the universal'.<sup>360</sup>

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**74a2-3** And it is of the others in some way and not per se; nor is it of isosceles universally, but to a wider extent.

In saying 'in some way' he shows that there is demonstration of things that belong per se but not primarily, but not [a demonstration] of this kind; for demonstration is of this kind of things principally and primarily, and of the rest secondarily.

20 **74a4-6** But it must not escape our notice that it often happens that we fail completely and that what is proved does not belong as primary and universal in the way it seems to be proved as primary and universal.<sup>361</sup>

After teaching about the universal, he now wants to teach the causes of deception through which even if we do not demonstrate anything universally according to what has been taught here, nevertheless we

- 25 universally according to what has been taught here, nevertheless we 'often' think we are demonstrating universally. He says that there are three causes of this kind of deception. One is when we construct demonstrations about something unique and particular, for example that the earth lies in the middle of the universe or that the cosmos is spherical, or the attributes that belong to the sun as properties. For in those cases we think we are constructing universal demonstra-
- 30 tions because the things proved belong per se, and belong to nothing 73,1 else but those things. However, this is not universal. For if in fact there were several *cosmoi* or several suns or several earths, the same things would have applied to the others too. For just as if the scalene were the only triangle and we proved in the case of it that it has its three angles equal to two right angles, such a demonstration would
  - 5 not be universal because such [an attribute] would not be proved as belonging to it qua scalene, but qua triangle – so also what is proved in the case of things that exist uniquely will not be universal since these things do not hold of them because there is one earth or one sun, but because it is simply a sun or simply an earth. And so if in fact there were several, the same things would have applied to the others as well. Therefore the things proved in these cases are not proved universally.
  - 10 **74a6-9** [We are deceived in this way when either there is nothing to grasp higher than the particular] or there is, but it is nameless and applies to things that are different in kind.

The second cause of deception is when there is something common, but this is 'nameless', and because they do not have any common name, we are compelled to construct demonstrations for each kind. For example, it is proved in the seventh book of Euclid's *Elements* that if four numbers be proportional, they will also be alternately

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proportional.<sup>362</sup> For example, if 8 is to 4 as 32 is to 16, then 16 is to 4 as 32 is to 8. This same [result] is also proved in the fifth book for magnitudes, that if four magnitudes be proportional, they will also be alternately proportional.<sup>363</sup> But the same thing will also be proved 20for times, that if four times be proportional, they will also be alternately proportional. Since the same proof is given for each of these – there being nothing common in virtue of which all could be demonstrated in a single argument – we do not say that the demonstration of these is universal. For just as if it were proven separately of the isosceles that it has its three angles equal to two right angles, and 25also separately in the cases of the scalene and of the equilateral, such a demonstration is not universal since it does not hold of some common single thing, such as triangle, to which as its primary subject such an attribute belongs – so also in the present case, since there is nothing common to which as its primary [subject] this attribute belongs, such that numbers, times, and magnitudes participate in 30 the attribute because they participate in *this*, we say that the dem-74.1onstration that holds of each of these separately is not universal. But if in these cases too someone were to give some common thing to be predicated, such as quantity, even so the demonstration will not be universal in cases where there is no named common [subject].

But perhaps it is not possible to use such a demonstration for quantity universally, since quantity includes place and speech,<sup>364</sup> 5 which cannot be grasped as the result of abstraction, whereas demonstration is proved in the cases of things that are grasped as the result of abstraction. Besides, even if this attribute belonged to every quantity and it were true to say that if a certain four quantities are proportional they will also be alternately proportional, even so the proof does not hold primarily of quantity. For this attribute does not 10 belong to it qua quantity, since the same proportionality is preserved in the case of qualities too, that if a certain four qualities be proportional, they will also be alternately proportional. This is how Plato in the Gorgias takes lawgiving, judging,<sup>365</sup> sophistic, and rhetoric, and says that sophistic has to rhetoric the same relation as lawgiving has to judging, and alternately that judging [has the same relation] to 15rhetoric as lawgiving has to sophistic.<sup>366</sup> Likewise he takes gymnastic, medicine, the art of preparing delicacies, and cooking, and in turn shows the same proportionality. And so the same proof extends to qualities as well, not quantities alone. But quantity and quality have nothing in common of which it is possible to demonstrate the common attribute of these things.

Also, it is not possible to take the statement as universal only in 20the case of quantities and demonstrate that if four certain quantities be proportional, they are also alternately proportional. For it is not true that all quantities taken at random can be proportional, only those of the same kind.<sup>367</sup> For as I said, speech and place are quanti-

ties and the demonstration will not apply to them. Further, it does not even [hold] universally of magnitudes, unless these are also of the

- 25 same kind. For let there be four magnitudes, such as a line, a surface, a place, and a body. It is impossible in this case to make use of either proportionality or [the property of] alternation. For it is not true that the place is to the body in it as the line is to the surface. For if a body is square, it is not the case that the place of the body is [square] too.<sup>368</sup> But in fact, even if there is a proportion, there is still no [property of]
- 30 alternation. For example, the [perimeter] of a square is to a square as the perimeter of a circle is to a circle,<sup>369</sup> but not alternately; for it
- 75,1 is not possible for the perimeter of a square to have any relation or ratio to the perimeter of a circle, nor for the circle [to have any ratio] to the square.<sup>370</sup> For these magnitudes are not of the same kind.

**74a9-12** Or that of which it is proved is in fact as a whole in a part [to that of which it is proved. For the demonstration will hold of the particulars and will be in every case, but nevertheless the demonstration will not be of this as the primary universal.]

5 The third way is when the universal has in fact been named, but the demonstration does not have that as a subject, but each species separately. The sense of the passage is the following:<sup>371</sup> 'Or', he says, the subject which the demonstration has in the strict sense is not universal but 'as in a part'. For example, if the demonstration has the isosceles as a subject, it belongs 'as a whole in a part' to this triangle, namely, the isosceles, 'of' which it is demonstrated [as a subject]. That is, the common genus, i.e., triangle, in fact belongs to the isosceles 'as a whole

in a part'. For the genus is a whole and the species is like a part.

The passage should be understood either in this way or as follows: 'Or' the more specific, namely, isosceles, 'is in fact' to triangle (which the demonstration has as a subject in the strict sense) as 'a whole in a part', isosceles being some kind of whole to triangle 'as in a part'

- 15 because triangle is employed in the definition of isosceles, and the things employed in the definition of something are parts of it. But the first explanation is more consistent with what is asserted, for he goes on to say, 'for the demonstration will hold of the particulars and will be in every case'. And so what he called a part is not the genus, such as triangle, as becoming a part of the definition, but the species, such
- 20 as triangle, as becoming a part of the definition, but the species, such as isosceles, of which [the attribute] is demonstrated in every case but not [as its] primary [subject].

**74a12-13** But I say that the demonstration is of this as its primary [subject], qua this, when it is of its primary [subject] universally.

He chooses [to say] 'qua this' to mean 'universally'. He uses this meaning of 'qua' to mean that the demonstration is universal for 25 whatever it is proved [to hold of as] its 'primary' [subject] 'universally'. For having its three angles equal to two right angles [holds] in every case of isosceles too, but not [of it] as its primary [subject], but [it holds] of triangle as its primary [subject]. Now demonstration is universally of *this* as its primary [subject].

**74a13-16** So if someone proves that [lines at] right [angles to the same line] do not meet, the demonstration of this would seem to be due to the fact that it holds of all [lines at] right [angles]. [But it is not, since this does not occur because they are equal in this particular way, but because they are equal in any way.]

After saying that deception occurs in three ways, he next sets out 5 examples of the three ways, in these words. Note<sup>(0)</sup> that he does not give illustrations in the order in which he sets out the first, second, and third [ways].<sup>372</sup> The present example is of the third way.<sup>373</sup> It is proved as follows: if a straight line falling on two straight lines make the interior angles on the same side equal to two right angles, the straight lines, if produced indefinitely in both directions, meet on 10 neither side. Now if someone constructs the argument [as applying to] two right angles, he seems to prove it universally, but it is not universal because this attribute does not belong to straight lines restricted [to being] at two right angles,<sup>374</sup> but it happens [to belong] to [straight lines] at two right angles, which are equal. For even if both the one and the other [angle] are half of a right angle, or in whatever other way, it follows no less that the straight lines if 15produced do not meet.

**74a16-17** And if there were no other triangle than isosceles, it would seem to belong qua isosceles.

This is an example of the first way, that if there were only one [kind of] triangle – isosceles for example – this [attribute], having its three angles equal to two right angles, 'would' 'seem' to belong to it in that it is isosceles, and to be universal. But in fact it is not. For it does not belong 'qua isosceles' but qua triangle. And so it is not the demonstration with isosceles [as subject] that is universal, but the [demonstration] with triangle [as subject]. So even if a demonstration were to have some unique thing as its subject, it would not be universal, for in fact if there were several similar things, the same demonstration would have applied to these as well. **74a17-19** And that proportionals alternate,<sup>375</sup> qua numbers, qua lines, qua solids, and qua times.

- 77,1 An example of the second way. What he means is this, that by being proved for numbers that 'proportionals' 'alternate' it seems to belong to them 'qua numbers' and likewise also for lines 'qua lines' and likewise for the rest, because the common [subject] for all these has not been named.
  - 5 **74a19-23** As once it was proved separately, though it can be proved by a single demonstration [to hold] of them all. [But because all these things numbers, lengths, times, and solids are not a single named thing, they used to be taken separately.]

'Once' should not be understood temporally but rather as if [said] roughly and not precisely. He means that it was demonstrated rather roughly in each case because we do not know<sup>(0)</sup> what is the one thing predicated in common in all these cases, whether it is quantity, for example, or something else, in virtue of which numbers, magnitudes

10 and times are one in their common genus. Now since this is unknown<sup>(g)</sup> and since these things are different from one another in their kinds, it is reasonable that it turns out that there is demonstration of each of them separately, and we think we have demonstrated universally even though we have not demonstrated anything universally.

74a23 But now it is proved universally.

15 'Now' in turn should not be understood temporally, but something like 'precisely and in the demonstrative sciences<sup>(m)</sup>'.

**74a23-4** For it did not belong qua lines or qua numbers, but qua this thing which they hypothesize to hold universally.

That proportionals alternate does not belong, he means, to lines qua 20 lines or to the rest qua those things, but qua something belonging to all of them in common, which is nameless. 'They hypothesize' – clearly those who consider the thing that belongs to them in common.

**74a25-32** This is why even if someone proves for each [kind of]<sup>376</sup> triangle by one demonstration or another that each has two right angles, the equilateral separately, [and the scalene and the isosceles as well, he does not yet know<sup>(o)</sup> that *the triangle* has two right angles, except in the sophistical way, nor [does he know that this property belongs to] triangle as a whole, not even if there is no other triangle besides these. For he does

not know<sup>(0)</sup> [that the property belongs to the subject] qua triangle or even that *every* triangle [has it], except numerically, but not that every one has it in virtue of its kind, even if there is no [triangle] that he does not know<sup>(0)</sup>.]

He means that even if one goes through each of the kinds falling under the universal, proving separately for each [that it has a given attribute], and omits none of the kinds, [and supposes] that in this way he demonstrated universally, we say that such a thing is not a demonstration because it does not prove the attribute as holding of some common thing to which it belongs as primary, but this way [of proving it] is like proving in the sophistical way, deducing [conclusions] about universals from particulars and constructing proofs from accidents. For even if, as I said, he goes through all the kinds falling under triangle, he does not know<sup>(o)</sup> that they have their three angles equal to two right angles qua triangles, but [he knows] each of them in turn, but not yet in virtue of their common kind, even if he is ignorant of none of the particular [kinds].

**74a32-3** Now when does he not know<sup>(0)</sup> universally and when 10 does he know<sup>(0)</sup> without qualification?

How, he says, will we characterize when the demonstration turns out to be universal and when it does not? Now he says 'if the essence of triangle and equilateral were the same',<sup>377</sup> as is the case with cloak and coat, if the demonstration held universally of one, it would also hold universally of the other; but when they are not identical, how do we distinguish which of them the demonstration holds of universally 15as its primary [subject]? He teaches the following rule for this. Whatever is the first thing which when it is eliminated the attribute is simultaneously eliminated, this is what the demonstration turns out to be of universally. For example, being bronze belongs to this triangle, as do being isosceles, being a triangle, being a figure, and having limits. But when bronze is eliminated the property of having 20its three angles equal to two right angles is not simultaneously eliminated, nor [is it simultaneously eliminated] when isosceles [is eliminated]; but when triangle is eliminated the attribute is eliminated even though both figure and having limits remain.

If anyone should say, 'What is he saying, then? When figure is eliminated, or having limits, is not the attribute simultaneously eliminated too, namely, consisting of three angles that are equal to two right angles?' Indeed it is, I say, but none of these is the first, but triangle is the first [thing which, when it eliminated, the attribute is simultaneously eliminated]. For it is possible for something to be a figure and to have limits, but not to have its angles equal to two right angles (for example, if it were a quadrilateral). But since triangle too

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is included in figure, it follows that when figure is eliminated the attribute is simultaneously eliminated. Therefore the demonstration
30 is of triangle primarily, because it belongs to any random triangle and belongs to this primarily, not to figure, because [the attribute does] not [belong] to all [figures] nor is this the first thing simultaneously with which, if it is eliminated, [the property] is eliminated.

79,1 **74a33-5** Indeed it is clear that [he would know universally] if the essence of triangle were the same [as the essence] either of equilateral or of each [kind of triangle] or of all [kinds of triangles together]. [But if it is not the same but different, and [the property] belongs qua triangle, he does not know<sup>(0)</sup>.]

'Of each', because if there were one kind of triangle, namely, isosceles, it would be the same thing to say isosceles and [to say] triangle,

- 5 there being no other triangle but only isosceles. 'Of all', because even if he goes through all the kinds and it is the same thing to say all the kinds of triangle and [to say] triangle, the demonstration will not be universal if it has the kinds as its subject, because the nature of the universal depends on the particulars, and the attributes which were proved of the kinds in fact belong to it. For it is not true that if there
- 10 were one [kind of] triangle, e.g., isosceles, the attribute would belong to isosceles qua isosceles, nor does it belong to all of them together in that they are those things, but in that they are triangles without qualification. So it is necessary to construct the demonstration with reference to [the subject] to which it belongs primarily without qualification. This is the sense of what has been said. What follows this passage is something like this.

'Now when does he not know<sup>(o)</sup> universally and when does he know<sup>(o)</sup> without qualification?'<sup>378</sup> The question he is asking [is] the contradiction 'by what will we distinguish when we do not know<sup>(o)</sup> universally according to what has been taught here, and when we do know<sup>(o)</sup>?' He answers the second question first, namely, the affirmation, i.e., 'When does the demonstration prove to be universal?' He says, 'if the essence of triangle were the same [as the essence] either of equilateral or of each [triangle] or of all [triangles]', with 'know<sup>(o)</sup>

- 20 without qualification' understood from before. For if to say triangle and [to say] equilateral were the same thing, like sword and cutlass, and having its three angles equal to two right angles belonged to triangle qua triangle, clearly a person who proved it of an equilateral would have demonstrated it of triangle too. For it is the same thing to say both triangle and equilateral. But if it is not the same thing.
- 25 he says, but the essences of triangle and equilateral are different just as the essences of animal and man are different, and if the demonstration has as its subject equilateral, but not triangle, and the attribute of the demonstration belongs [to it] not qua equilateral but qua

triangle, we do not say that such a person knows<sup>(0)</sup> universally. Now 80,1 having shown in these words when demonstrations are universal and when they are not, he next gives the rule that distinguishes these [cases].

**74a35-7** Does it belong qua triangle or qua isosceles? And when 5 does it belong in respect of this as primary? And of what is the demonstration universally?

After saying 'does it belong qua triangle or qua isosceles' that it is proved universally', in order to avoid seeming to base the demonstration on a particular, he ascends to the more universal, saying 'and when does it belong in respect of this as primary?' In explaining this he goes on to say, 'and of what is the demonstration universally?', i.e., when will we know<sup>(g)</sup> by an argument that holds in common that we are constructing our demonstrations about something 'universally'?

74a37-b2 Clearly, whenever things are being removed and it belongs to [something as its] primary [subject]. [For example, two right angles will belong to an isosceles bronze triangle, but [will belong] also when being bronze and being isosceles are removed, but not when figure or limit [is removed]. But [they are] not the first [things which, when they are removed it fails to belong]. What, then, is the first?]

That is, when several things are predicated of the same thing, as of this triangle [are predicated] 'being bronze', 'isosceles', triangle, and 15 having (for example) a perimeter of four feet, and anything else that belongs to it, and if the property that its three angles are equal to two right angles remains when the other [attributes] 'are being removed' but a certain one is left, it is to the thing that is left that the attribute belongs as [its] primary [subject], and the demonstration is of that thing universally. For when bronze is removed and isosceles and having the perimeter, as long as triangle remains behind, the attribute remains in the triangle. But if this is eliminated, the attribute too is simultaneously eliminated straightaway.

**74b2-4** If then, triangle [is the first, the property] also belongs to the others in virtue of this [and the demonstration is of this universally].

That is, if when triangle is removed, straightaway the attribute too is eliminated simultaneously with this primary [subject], clearly 'the demonstration' 'is' 'of this' 'universally' and it is on account of this that the attribute also belongs to the rest, namely, isosceles, scalene, figure, and the rest.

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 ${\bf 74b5}$  If, then, demonstrative knowledge  $^{\rm (e)}$  is based on necessary principles.

- 30 After showing that what is known<sup>(e)</sup> and demonstrable is necessary and is based on necessary premises, he investigated both what are
- 81,1 the necessary problems of which there is demonstration, and what are the necessary premises from which demonstrative deductions about these things come to be. And since teaching what is 'in every case' and 'per se' and 'universal' contributes to the knowledge<sup>(g)</sup> of these things for him, he first taught about those topics and then
  - 5 subsequently said what the necessary problems are about which there is demonstration. For while he was constructing his doctrine about the universal, he said that demonstrations per se are about such things: namely, those that are primary and universal, and such that when they are eliminated, the attribute which we want to prove as belonging to the subject is eliminated too. He says that demonstration in strict sense is based on these,<sup>379</sup> while it is of other things
  - 10 accidentally in some way.<sup>380</sup> He also added the causes on account of which it often happens that we believe we have demonstrated [universally] when we have not demonstrated universally.

After saying this he now reasonably turns to the remaining part of his doctrine, namely, teaching what are the necessary premises from which demonstrative problems are deduced. He says that de-

- 15 monstrative premises must be per se. He proves this using the following hypothetical deduction: 'if demonstrations are based on things that are necessary and things that are necessary alone are per se, therefore demonstrations are based on things that are per se'. Clearly the two antecedents are assumed in this deduction namely,
- 20 that demonstrations are based on things that are necessary and that things that are necessary alone are per se – and the consequent, that demonstrations are based on things that are per se, follows both of these together. It is not alien to deductions to employ two antecedents, for sometimes the conclusion, i.e., the consequent, does not follow each one of the antecedents but follows both together, as I have shown elsewhere.<sup>381</sup> This is the deduction. He establishes each of the
- 25 antecedents, both that knowledge<sup>(e)</sup> is based on things that are necessary and that things that are necessary alone are per se. How he establishes these we will know<sup>(o)</sup> by going through the passage in detail.

'If, then, demonstrative knowledge<sup>(e)</sup> is based on necessary principles'. This is the first antecedent. After positing this, he immediately goes on to give the proof of it. For he says as follows:

# 30 **74b6** For what he knows<sup>(e)</sup> cannot be otherwise.

For clearly we know  $^{(e)}$  not only the conclusion but also each of the premises through which we know  $^{(g)}$  the conclusion too. For if we were

not to have knowledge<sup>(e)</sup> of the premises, we cannot have knowledge<sup>(e)</sup> of the conclusion either, unless we have the premises on which the demonstration is based. But what we know<sup>(e)</sup> cannot be otherwise; and what cannot be otherwise is necessary; so demonstrations are based on necessary premises; therefore the demonstration is based on things that are necessary.

74b6-9 And the things that belong per se to things are necessary [for some belong in the 'what it is' and the others are predicated of the [subjects] that themselves belong in their 'what it is'].

This is the second antecedent, that 'things' 'that belong per se' 'to 5 things' are 'necessary'. Again, after positing this he goes on to give the proof of it where he says 'for some<sup>382</sup> belong in the "what it is" and the others are predicated of the [subjects] that themselves belong in their "what it is", of which one or the other of the opposites must belong' to the things – namely, in the first ways;<sup>383</sup> for these are the 10 ones that predicate one thing of another. The former are predicated in the 'what it is' of their subjects, as with the things [that are predicated] in the first way of [belonging] per se. For animal is predicated in the 'what it is' of man. The other [predicates] are such that their subject is predicated of its predicate in their own account that indicates 'what it is', as [happens] with the things [predicated] in the second way [of belonging per se].<sup>384</sup> For number is predicated in the definition of even – namely, [something that belongs per se] to number. The things predicated in the 'what it is' of certain things belong to them of necessity; for the definition of each thing belongs of necessity to the definiendum. 'The things', therefore, 'that belong per se are necessary'.

This is how he establishes that the things that are per se are necessary. That in addition the things that are per se are the only 20necessary attributes of things, he proves as follows. 'For' everything, he says, 'belongs' to something 'either in this way'<sup>385</sup> (namely, per se in the first ways of [belonging] per se) 'or accidentally';<sup>386</sup> but what belongs accidentally does not belong of necessity; therefore only things that are per se belong of necessity.

I say again, if everything belongs to something either per se or 25accidentally, and what does not belong accidentally belongs of necessity, and what belongs per se does not belong accidentally, it therefore remains that the things that belong of necessity belong per se. He will infer the present point through a categorical deduction, in this way: every demonstration is based on necessary things; necessary things are per se; therefore, every demonstration is based on 30 things that are per se, which it was proposed to prove.

It is possible to make Aristotle's deduction categorical directly; but

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if it becomes categorical it makes the form in the second figure invalid, since it is based on two affirmative [premises]. This is why he must combine them hypothetically, with two antecedents em-

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ployed and one consequent. The entire deduction is this: 'if demonstrative knowledge<sup>(e)</sup> is based on necessary principles'<sup>387</sup> 'and the things that belong per se to things are necessary', 'it is evident that demonstrative deductions will be based on such things'.<sup>388</sup> For if

- we combine them categorically, as I said, the middle term, 'neces-5 sary', comes to be predicated both of the principles of demonstration and of what belongs per se to things. And note a second figure [deduction] based on two affirmative [premises], and it is invalid. This is why the combination becomes hypothetical, as follows: if demonstrations are based on necessary principles, and it is posited
- 10 that things [that belong per se] are the only necessary things, it therefore follows that demonstrative principles are necessary and per se. But in fact, the former; therefore also the second.

However, he infers a proof of the conditional, namely, that the consequent necessarily follows the antecedent, by saving 'for everything belongs either in this way or accidentally'.<sup>389</sup> For if everything

- belongs either of necessity or accidentally, and the things that belong 15of necessity do not belong accidentally, the things that belong of necessity therefore belong per se. For only the things that are per se are necessary and [only] the things that are necessary are per se. Therefore, if it is given that demonstrations are based on necessary premises, and it is also given that only the things that are per se are necessary, it will also follow as a consequence that demonstrations
- 20are based on things that are per se. For it is the same to say that demonstrations are based on things that are necessary and [that they arel based on things that are per se, if in fact only the things that are necessary are per se and [only] the things that are per se are necessary.

The things that 'belong in the "what it is", i.e., the things predicated of the subject, as are the things [predicated] in the first way [of belonging per sel.

'The others are predicated of the [subjects] that themselves belong in their "what it is". These are clearly the subjects employed in the 25'what it is' of the things predicated of them, as in the definition of even number [is employed], and in fact it is employed as predicated of the even.

74b9-10 Of which one or the other of the opposites must belong.

For it has been proved that in the second way [of belonging per se], since the opposition is immediate, of necessity one or the other of the 30 opposites belongs to the subject.

**74b10-11** It is evident that demonstrative deductions must be 84.1 based on such things.

After positing both of the antecedents and establishing [them], he next infers the consequent as well. By 'is based on such things' he means 'is based on the two just stated ways of [belonging] per se'.

74b11-12 For everything belongs either in this way or accidentally. [and accidents are not necessary.]

In these words he shows that only things that are per se are necessary, which, as I said, becomes a proof of the whole conditional in the way stated.

74b13-18 We should, then, say it this way, or, taking as a 10 starting point that demonstration is something necessary,<sup>390</sup> [and if something has been demonstrated it cannot be otherwise: therefore the deduction must depend on necessary [principles]. For it is possible to deduce from true [premises] without demonstrating, but from necessary premises it is not [possible to deduce] without demonstrating, since this is automatically a characteristic of demonstration.]

He establishes the claim by means of several arguments, of which the present is the second. In the first argument he assumed that it is necessary to know<sup>(e)</sup> demonstrative premises and showed on the basis of this that they must be necessary too, from which in turn he 15inferred that they are based on things that belong per se. He next makes an argument from a different starting point, namely, from the demonstrative problem or conclusion itself - which is rather clearer. For if demonstration is of things that belong of necessity and cannot be otherwise, and things that are necessary are based on things that 20are necessary (for nothing can be necessary unless it is inferred from things that are necessary),<sup>391</sup> therefore demonstration is based on necessary premises. For a true deduction can be based on premises that are true and not necessary, but it is impossible for a demonstrative [deduction to be based on such premises]. For example, 'Socrates is walking, what is walking moves on legs, therefore Socrates moves on legs'. Here the deduction both is based on true [premises] and is 25true, but such a thing is not a demonstration because the conclusion is not necessary nor is it based on necessary premises.<sup>392</sup>

Further, what do I say in cases where the predicate can be separated from the subject, where in fact it is not a case of inseparable accidents, but where they do not belong to a single unique nature – can there be a demonstrative deduction, in view of what we have 30 already said above?<sup>393</sup> In fact, even if the conclusion is necessary,

even so such a thing is not a demonstration; for example, 'Socrates moves on legs, what moves on legs is an animal, therefore Socrates is an animal'.<sup>394</sup> For we must know<sup>(o)</sup> by now that to seem to infer something necessary as a conclusion from premises that can [be otherwisel is not to know<sup>(e)</sup>.

- 74b18-21 An indication that demonstrations are based on things 85.1that are necessary is that this is how we bring objections against those who think they are demonstrating – on the grounds that [a premisel is not necessary – if we think that it can [be] otherwise either generally or at least as far as the argument goes.
  - $\mathbf{5}$ This is the third argument that demonstrations 'are based on things that are necessary'. If something should be proposed to us as a demonstrative premise, we think we refute it, he says, if we show that the predicate does not belong to the subject of necessity. Then, showing that the same [notion] is like a common notion of everyone about demonstration, namely, that demonstration is based on things
  - 10 that are necessary, he says that not only do those who look to the truth dispute premises in which the predicate does not belong to the subject of necessity, but also those who dispute more eristically for the sake of contentiousness, when they want to obstruct an argument, often say that a premise does not belong of necessity even if it is necessary. Thus it is a common notion that demonstra-
  - tive sciences<sup>(m)</sup> must be necessary.<sup>395</sup> 15

**74b21-4** From this it is also clear that it is foolish people who think they do well to assume principles on the grounds that a premise is reputable and true, as the sophists [assume] that knowing<sup>(e)</sup> is having knowledge<sup>(e)</sup>.

If it has been shown, he says, that knowledge<sup>(e)</sup> must be based on 20things that are necessary, people are ridiculous who think that they have demonstrated [something] if they propose premises that are either reputable or true but not necessary, like the sophists. For they ask if the geometer knows<sup>(e)</sup> about geometry, and after obtaining this, they say that 'knowing<sup>(e)</sup>' is 'having knowledge<sup>(e)</sup>', having knowledge<sup>(e)</sup> is knowing<sup>(o)</sup> knowledge<sup>(e)</sup>, and one who knows<sup>(o)</sup> knowledge<sup>(e)</sup> knows<sup>(e)</sup> precisely what this thing is, therefore one who knows<sup>(e)</sup> knows<sup>(o)</sup> what 25knowledge<sup>(e)</sup> is. But the geometer knows<sup>(e)</sup>; therefore the geometer knows<sup>(e)</sup> what knowledge<sup>(e)</sup> is. For at this point since they have obtained a true premise, that the geometer knows<sup>(e)</sup>, and that one who knows<sup>(e)</sup> has knowledge<sup>(e)</sup>, and third, the reputable [premise] that a person who has something knows<sup>(0)</sup> what he has, they think that in this way they have demonstrated that the geometer must know<sup>(0)</sup> precisely what knowledge<sup>(e)</sup> is.

But it has been shown that demonstrations are not based simply 30 on things that are true or reputable, but become demonstrative when they are based on things that are necessary, appropriate, and primary to the subject. And so, if there were some determinate nature of knowledge<sup>(e)</sup> which a knowledgeable<sup>(e)</sup> person certainly must have. 86.1 people who deduce like this would not be said to be demonstrating. But if there is no determinate nature of knowledge<sup>(e)</sup> but [there is only] every knowledge<sup>(e)</sup>, <sup>396</sup> for example, geometry or astronomy or each of the particular ones, it will not be the case that anyone who has knowledge<sup>(e)</sup> will also know<sup>(o)</sup> without gualification what knowledge<sup>(e)</sup> is. And so the geometer has geometrical knowledge<sup>(e)</sup> and he 5 knows<sup>(g)</sup> precisely what this is. But he does not know<sup>(o)</sup> without gualification what is knowledge<sup>(e)</sup>, because there is not even a nature of knowledge<sup>(e)</sup> in general, but it is a homonymous verbal expression predicated of things different in kind, or, rather, different in genus.

Some explain this passage more sophistically, as follows. If 'knowing<sup>(e)'</sup> is 'having knowledge<sup>(e)'</sup> and having knowledge<sup>(e)</sup> has knowledge<sup>(e)</sup>, 10 therefore knowing<sup>(e)</sup> has knowledge<sup>(e)</sup>, with the argument sophistically changing from meanings to verbal expressions. For the person who knows<sup>(e)</sup> has knowledge<sup>(e)</sup>; that, I say, is indicated by the verbal expression 'knowledge<sup>(e)'</sup>. But to say 'having knowledge<sup>(e)</sup> has knowledge<sup>(e)'</sup> is typical of those who do not stay with the meaning, but change to the verbal expressions and all but say that the very verbal expression that says 'having knowledge<sup>(e)'</sup> has knowledge<sup>(e)</sup> in itself – the very word 'knowledge<sup>(e)'</sup>. Nevertheless, the first explanation seems to me more naturally fitting.

**74b24-6** [For what is a principle for us is not what is reputable,] but the primary [fact] in the genus which the proof concerns; and not everything true is appropriate.

For it is true that every isosceles triangle has its three angles equal 20 to two right angles; but it is not appropriate for knowledge<sup>(e)</sup> because the demonstration does not proceed [to demonstrate the attribute as belonging] to that of which such [an attribute] is proved [to belong] as its primary [subject].

**74b26-7** That the deduction must be based on things that are necessary is evident from the following too.

Another argument that demonstrations are based on things that are 25 necessary. Now if, he says, we think we know<sup>(e)</sup> when we know<sup>(o)</sup> the reason and the cause through which the conclusion is of necessity, and a person who is ignorant of the reason and the cause is not knowledgeable<sup>(e)</sup>, and the premises are the cause of the conclusion, it is of course necessary that they belong of necessity. For if the conclu-

- 30 sion is necessary but the premises can [be otherwise], and what can
- 87,1 [be otherwise] can also not be, clearly, therefore, he will know<sup>(0)</sup> the conclusion as belonging of necessity,<sup>397</sup> but will not know<sup>(0)</sup> the reason and cause of this, if indeed the premises through which it is proved can also not belong. But a person who is ignorant of the reason is not knowledgeable<sup>(e)</sup>. Therefore demonstrations cannot be based on
  - 5 premises that can [be otherwise]. And so there is every necessity [for it] to be based on necessary [premises].

**74b27-8** For if a person who does not have an account of the 'why', when there is a demonstration, is not knowledgeable<sup>(e)</sup>.  $^{398}$ 

He is precise in adding 'when there is a demonstration'. For there is knowledge<sup>(e)</sup> of axioms and we are said to be knowledgeable<sup>(e)</sup> of them,
but we do not have an account of them, because – since there is nothing prior to them and more basic – there is no demonstration of them. So we are called knowledgeable<sup>(e)</sup> of them before we know<sup>(g)</sup> their account.<sup>399</sup>

**74b28-32** It would result that *A* belongs of necessity to *C*, but *B*, the middle through which it was demonstrated, does not [belong] of necessity; he does not know<sup>(o)</sup> why [*A* belongs to *C*], for this is not [a demonstration] through the middle. [For it can fail to be, but the conclusion is necessary.]<sup>400</sup>

That 'A' 'belongs of necessity' 'in every case' 'of C is taken as the conclusion which is posited [to hold] of necessity; B, the middle term which generates the premises, is that through which the conclusion is proved. Now suppose someone thinks that man is of necessity an animal, and thinks that the cause of this is that man walks about or philosophizes, and [suppose that he] deduces as follows: 'man philosophizes, that which philosophizes is an animal, therefore man is an animal'. Since he takes a middle term that can [be otherwise], and what can [be otherwise] can also not belong, if this is hypothesized as not belonging, he will know<sup>(0)</sup> that the man is of necessity an animal, but he will not know<sup>(0)</sup> the reason why he is an animal, since the middle term has been eliminated.<sup>401</sup> But a person who does not know<sup>(0)</sup> the reason does not know<sup>(e)</sup> why this very thing lis the casel. Therefore the same person will both know<sup>(e)</sup> and not know<sup>(e)</sup> the same thing – know<sup>(e)402</sup> it by hypothesis, but not know<sup>(e)</sup> it because he assumes premises that can [be otherwise].

**74b32-6** Further, if someone does not know<sup>(0)</sup> [something] now, even though he has his account [of it] and is still alive and the thing still exists, [and he has not forgotten it, then neither did

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he know<sup>(0)</sup> before. But the middle term might perish if it is not necessary, and so he will have his account and the thing still exists, but he does not  $know^{(0)}$  it. Therefore neither did he  $know^{(0)}$  before.]

Another argument that establishes the same thing. What he says is in effect this. There are three connected things, he says: the knower<sup>(g)</sup>, 88,1 the knowledge<sup>(g)</sup>, and the known<sup>(g)</sup>. It happens that a person who is first knowledgeable<sup>(e)</sup> is later not knowledgeable<sup>(e)</sup> when one of these three things has ceased to be. For if the knowledge<sup>(g)</sup> and the knower<sup>(g)</sup> still exist but the thing ceases to be, it happens that the person who formerly was knowledgeable<sup>(e)</sup> is no longer knowledgeable<sup>(e)</sup>, [and likewise] if he has ceased to be but the thing still exists, or if he has not ceased to be but forgetting has occurred.<sup>403</sup>

Now supposing that someone says that demonstrations can be based on things that can [be otherwise], then, since demonstrations cannot be otherwise and it is possible for what can [be otherwise] not to be, if we hypothesize the thing that can [be otherwise] as not being.<sup>404</sup> it will happen that the person who formerly knew<sup>(e)</sup> is not knowledgeable<sup>(e)</sup> even though he has not ceased to be or forgotten and 10 although the thing has not perished – which is ridiculous, as I already said. For example, if someone were to deduce as follows: 'man does geometry, that which does geometry is an animal, therefore man is of necessity an animal' – suppose a person who deduces in this way thinks that he has a demonstration because man cannot be otherwise, but must be an animal, but [suppose] he thinks he has this knowledge<sup>(e)</sup> through the middle term 'does geometry'. Since we 15hypothesized that doing geometry is something that can [be otherwise] and what can [be otherwise] can also not be, let doing geometry be eliminated. For what can [be otherwise] is that which is not necessary, and if it is posited nothing impossible follows.<sup>405</sup> If, then, doing geometry is eliminated, it will happen that even though the thing (namely, the fact that man is an animal) still exists and that 20which knows<sup>(g)</sup> this very thing (namely, the knowledgeable<sup>(e)</sup> person) [still exists] and has not forgotten that man is an animal, he no longer knows<sup>(0)</sup> demonstratively that man is an animal, since the cause has been eliminated. And so, he says, if he does not now know<sup>(e)</sup> demonstratively that man is an animal, when the cause is eliminated because the cause of the thing can [be otherwise], 'therefore neither did he know<sup>(0)</sup> before', since in fact knowing<sup>(e)</sup> is knowing<sup>(0)</sup> the cause 25and that it cannot be otherwise.<sup>406</sup>

**74b36-9** But if it has not ceased to be but can cease to be, the result will be possible and can [occur]; but it is impossible for a person<sup>407</sup> in that condition to know<sup>(o)</sup>.

- Since he proved the absurdity by hypothesizing that what can be 30 otherwisel changes, someone might say 'but even if the demonstra-
- tion is based on things that can [be otherwise], let it be posited that 89.1 that which can [be otherwise] still exists and has not been eliminated'. Confronting this he says that even if now it has not vet been eliminated, still it can be eliminated because that is the nature of what can [be otherwise]. Now even if this absurdity which we have stated did not first occur now – namely, that the knowledgeable<sup>(e)</sup>
  - person still exists and the thing still exists and no forgetting has 5 occurred, but he is no longer knowledgeable<sup>(e)</sup> because the thing that can [be otherwise] no longer exists - it is in any case possible for this to happen afterwards, even if we hypothesize that the thing that can [be otherwise] has not been eliminated. If, then, when the thing that can [be otherwise] is eliminated the absurdity follows - namely, that [the knower] does not know<sup>(e)</sup> even though 'the thing still exists', and
  - the knower<sup>(g)</sup>, and the knowledge<sup>(g)</sup> too neither, therefore, did he 10 know<sup>(e)</sup> before the thing that can [be otherwise] ceased to be. For it is impossible to change from knowing<sup>(e)</sup> to not knowing<sup>(e)</sup> unless one of the three ceases to be – either the knower<sup>(g)</sup>, or the known<sup>(g)</sup>, or the knowledge<sup>(g)</sup>.

Besides, if we said that we know<sup>(e)</sup> only when we know<sup>(o)</sup> the thing and its cause and that it cannot be otherwise, and if the premises are

the causes of the conclusion, it is therefore impossible for them to be 15otherwise. But it is necessary for what cannot be otherwise to be as it is; therefore the premises of the deduction must be necessary, as has been demonstrated through several [arguments].

'But if it has not ceased to be but can cease to be, the result will be possible'. He says 'the result', i.e., the absurdity that follows the stated hypotheses, which is to know<sup>(e)</sup> something and then to change to not knowing<sup>(e)</sup> it even if neither the knower<sup>(g)</sup> nor the known<sup>(g)</sup> nor the knowledge<sup>(g)</sup> has ceased to be. Now if this is impossible, it is impossible, then, to know<sup>(e)</sup>, on the supposition that knowledge<sup>(e)</sup> is based on premises that can [be otherwise]. For the absurdity was a consequence of this.

75a1-7 Now when the conclusion is of necessity, nothing pre-25vents the middle through which it was proved from being non-necessary. [For it is possible to deduce something necessary from non-necessary [premises] just as [it is possible to deduce] something true from non-true [premises]. But when the middle is of necessity, the conclusion is of necessity too, just as from true [premises the conclusion is] always true. (Let A hold of B of necessity, and this of C. Thus it is necessary that A belong to C.]

Since he proved that demonstrations must be based on necessary premises, lest anyone think that he recited those [arguments] super-

fluously and claim that it is not at all doubtful whether – given that a conclusion of a demonstration is of necessity – the premises that imply it must be necessary too (for how could a conclusion be necessary if it is not drawn from necessary premises?), this is why he now wants to prove that he did not state them superfluously. For everyone will grant that conclusions of demonstrations are necessary, but that what is necessary is not in all cases based on necessary premises, is not easy to see.

It is possible to infer necessary [conclusions] 'from non-necessary [premises] too'. For 'just as' a 'true' conclusion results 'from' premises 5 that are 'not' 'true', so also necessary [conclusions result] from nonnecessary [ones]. For if we should say as follows: 'today there is rain, when there is rain the heaven is moving, therefore today the heaven is moving', we have inferred a necessary conclusion (for it is not possible for the heaven not to move), but from premises that can [be otherwise]. So it is possible to infer a necessary conclusion from 10 premises that can [be otherwise], as we have shown, just as [it is] also [possible to infer a] true [conclusion] from [premises that are] nontrue. However, it is impossible that a conclusion based on necessary premises be non-necessary. But what can [be otherwise] is opposite to what is necessary; for when premises can [be otherwise], a necessary conclusion can follow, as we just said. However, when a conclusion can [be otherwise], it is impossible unless the premises 15can [be otherwise].

Now if it is also possible to infer something necessary from things that can lbe otherwisel, it was reasonable for us to prove that conclusions of demonstrations must certainly be based on premises that are necessary as well. This is why he discussed 'per se' earlier, which is the only [relation] that we must employ in premises of demonstrations. Clearly both when we say that we infer true [conclu-20sions] from non-true [premises] and when [we say] that [we infer] necessary [conclusions] from non-necessary [premises] we are not saving that the conclusion is inferred on account of the nature of the premises, but because the relation of the extreme [terms] to one another is of a certain sort, as in the present deduction. For it is not because it is raining that the heaven is moving, but because raining occurs when the heaven is moving (because it is always moving, but 25it rains sometimes) - it is through this [sc. as a minor premise] that the conclusion was drawn. Likewise if we were to say 'man is a stone, stone is a substance, therefore man is a substance', it is not inferred that man is a substance because he is a stone, but because of the nature<sup>408</sup> of the extreme [terms]. However, if the premises are of necessity, there is every necessity for the conclusion to have its necessity for no other reason than on account of the premises.<sup>409</sup> For if man is of necessity an animal and animal is of necessity a sub-30 stance, it is of course necessary that man be a substance too.

But if anyone is puzzled about how Aristotle himself, who in defining deduction says that it is discourse 'in which, some things 91,1 being posited, something different from the things posited follows of necessity'<sup>410</sup> (as though every conclusion were necessary), says here that some conclusions too can [be otherwise], let the person who is puzzled about this note<sup>(o)</sup> that it is not the same for something to follow of necessity and to be necessary. For what is necessary is that

- 5 which is unvarying in virtue of its own nature, while what can [be otherwise] is that which is different at different times; on the other hand, what is said to follow of necessity is that which follows of necessity when something is hypothesized, for example that a person in water is wet. For it is not necessary for him to be wet, since, if a person comes to be in water it is certainly necessary for him to be wet, but if he is on a boat, he is not of necessity wet. And that which follows of necessity extends more widely than that
- 10 which is necessary. For if something is necessary, it certainly follows of necessity from something, unless it is an individual. For example, animal is necessary; but if man is hypothesized, [animal] follows of necessity.<sup>411</sup>

I said 'unless it is an individual'<sup>412</sup> because Socrates is some thing necessarily (for he is always unvarying in that he is a man, but not in that he is coloured or in respect of any of his other accidents), but he does not follow anything of necessity. For Socrates is not predicated of anything. Therefore we did well to say that if something is

necessary it certainly follows something of necessity unless it is an individual. However, it is not the case that if something follows something of

However, it is not the case that if something follows something of necessity, it is also necessary. For it follows of necessity that when a person eats he is moving his jaws, but moving his jaws does not belong [to him] of necessity. In this way every conclusion belongs of necessity,<sup>413</sup> because if the premises are hypothesized it is certainly necessary for it to follow. However this [does not entail] that every conclusion is also necessary.

**75a8-11** But when the conclusion is not necessary, neither can the middle be necessary [for let A belong to C not of necessity, and [let A belong] to B and B to C of necessity; therefore A will belong to C of necessity; but it was posited [that A does] not [belong to C of necessity].]

25 For if the conclusion can [be otherwise], we then say that the premises that imply it are not necessary, since it has been proved that a conclusion that follows necessary [premises] is certainly necessary. But it will turn out that this<sup>414</sup> holds of necessity because the premises can [be otherwise]; for this was posited.

**75a12-16** [Since if someone knows<sup>(e)</sup> demonstratively, [the conclusion] must belong of necessity, it is clear that he must have the demonstration through a middle that is necessary too.] Or he will not know<sup>(e)</sup> either why or that it is necessary for it to be, but either he will think [that he knows] even though he does not know<sup>(o)</sup> (if he supposes what is non-necessary to be necessary), or he will not even think [that he knows].

What he means is this: if the conclusion of a demonstration, he says, is necessary even if the premises are not necessary but can [be otherwise], then if he does not know<sup>(0)</sup> that the premises can [be otherwise], 'he will think' that he knows<sup>(0)</sup> [the conclusion] even though he does not 'know<sup>(0)</sup>'; but if he knows<sup>(0)</sup> that they can [be otherwise], 'he will not even think' that he has demonstrated [the conclusion] at all since the middle term through which the demonstration took place can be otherwise.

'Either why or that', i.e., he will not have demonstrated either the 10 'why' or the 'that'. For, as he will next say, some deductions establish the 'that' and others [establish] the 'why', and of those that establish the 'that' some are based on immediate premises while others are based on mediate [premises]. Likewise also for those [that prove] the 'why'. For example, if I say 'the moon is not casting shadows, since it not casting shadows it is eclipsed, therefore the moon is eclipsed', I have established that it is eclipsed from premises that are not 15immediate. For 'since it is not casting shadows it is eclipsed' is not sufficient for a demonstration that it is eclipsed. For what if it is in conjunction<sup>415</sup> or under the earth<sup>416</sup> and is not casting shadows because it is not illuminating the region around the earth? This is why it needs a middle term that establishes that the moon is eclipsed, for example 'the moon is full, but although it is full it is not casting 20shadows, if it is not casting shadows at the time of full moon it is eclipsed; therefore the moon is eclipsed'. Here the deduction is immediate if it no longer needs another middle [term] but has [the moon's] being eclipsed demonstrated through the stated terms. Likewise in the case of the 'why' the following kind of deduction would be mediate: 'the moon is diametrically opposite the sun, when it is diametrically opposite it is eclipsed, therefore the moon is eclipsed'. 25

Note that in this we state the cause of the eclipse, but not the immediate [cause]. For what if someone says, 'from where [do we know] that the diametrically opposite position is the cause of the eclipse?' For not even this is the principal cause of the eclipse. So there is need of another middle term which says that it is occulted by the earth, in order that the deduction may be this: 'the moon is occulted by the earth when it is diametrically opposite [the sun]; being occulted it is eclipsed; therefore the moon is eclipsed'. This is immediate since it contains the basic cause of the eclipse. So in

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general, when we employ in a deduction the proximate middle [term] which connects the extreme terms, and there is no other [middle]
93,1 that is more of a cause, we call this deduction immediate. We will learn about this more accurately in what follows when he expounds it,<sup>417</sup> but we mentioned it now as an explanation of the present passages since they were set out in this way.

**75a16-17** Likewise if he knows<sup>(0)</sup> the 'that' through middle [terms] or if [he knows] the 'why' and [knows it] through immediates.

He means the following: that he will know<sup>(0)</sup> neither the deduction that establishes the 'that' nor the [deduction that proves] the 'why' if the middle term through which the demonstration takes place can [be otherwise]; for 'either' 'he will think'<sup>418</sup> that he knows<sup>(e)</sup> though he does not know<sup>(e)</sup>, being ignorant that the middle term can [be otherwise], or, knowing<sup>(0)</sup> that it can [be otherwise] 'he will not even think'<sup>419</sup> that he knows<sup>(e)</sup>. In what follows, as I said, he speaks of the mediate and the immediate both in the case of the 'that' and in the

- case of the 'why'. But here he makes a distinction and connects the immediate with the [deduction] that establishes the 'why' and the mediate with the [deduction] that [proves] the 'that'.
- But the passage is unclear because it employs the preposition *dia* in one place in its complete form and in another with elision of the alpha. For when he says 'likewise' if 'he knows<sup>(o)</sup> the 'that" through middle [terms]',<sup>420</sup> the preposition *dia* is in its complete form; for this reason we must make a slight pause at the alpha, i.e., 'through mediates'<sup>421</sup>; but when he says 'or if [he knows] 'the "why" and [knows it] through immediates',<sup>422</sup> we must make an apostrophe at the iota, the preposition *dia* being understood with elision of the alpha, and the alpha privative being employed with 'middle',<sup>423</sup> i.e., as if the premises that prove the 'why' are immediate.

**75a18-21** But there is no demonstrative knowledge<sup>(e)</sup> of accidents that are not per se according to the way things that are per se were distinguished. [For it is not possible to prove the conclusion [to hold] of necessity. For the accident may not belong – this is the kind of accident I am talking about.]

After proving that demonstrations are necessary and are based on premises that are necessary and per se, since the second way of things that are per se referred to accidents that are inseparable,<sup>424</sup> lest anyone think as a result that there is demonstration of inseparable accidents in general, in this passage he specifies this very point, that there is demonstration without qualification not of all inseparable accidents,<sup>425</sup> even if they always belong to their subject, but only

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of those that belong per se to their underlying substances.<sup>426</sup> These are the ones that belong to some single determinate nature.<sup>427</sup> For the other accidents are not demonstrable even if they are inseparable and always belong to their subjects, since they do not belong per se to the things (for black can be separated in thought from Ethiopians and from crows without their underlying nature being harmed).<sup>428</sup> And besides, even if black belongs inseparably to Ethiopians and crows, even so it is of a nature to come to belong and cease to belong to other things. This is why, since the nature of these things can [be otherwise] and does not belong per se to things, there is no demonstration of such things, because it is not possible to prove the predicate to belong of necessity to the subject. 10

'Of accidents that are not per se in the way things that are per se were determined', i.e., of accidents that are not per se and do not have the kind of nature we determined that per se accidents have – of these things, he says, there is no demonstration.

**75a22-3** Although someone might wonder why [we] need to ask 15 these questions about these things, if it is not necessary for the conclusion to be.

Since he said that there is no demonstration of accidents, which is the same as saying of things whose nature<sup>429</sup> is such that they can [be otherwise], he here poses a puzzle and says if there cannot be demonstration of accidents because they can be otherwise, and if a conclusion that can be otherwise does not follow of necessity, why are we proposing a premise from accidents at all and deducing and saying that the conclusions follow such premises, which we have proved the conclusions do not follow of necessity?

In solving this puzzle he says that 'necessary' has two meanings: what is due to the very nature of the things and what is due to logical 25consequence. For given premises of whatever sort they may be, the conclusion will follow of necessity even if the [subject] matter is not necessary.<sup>430</sup> In fact this is how he defines deduction, saving that it is discourse in which, the premises being posited, the conclusion follows on account of them, <sup>431</sup> – not on account of their nature. Now the necessity of logical consequence must be a characteristic of every deduction; however [it is] the necessity in accordance with nature 30 [that characterizes] demonstrations, both on account of logical consequence and on account of the subject matter. Now in other deductions when we ask the people we are conversing with [to grant] the premises and they grant them, we infer the conclusion as following 95.1of necessity the premises granted by them. However, in demonstrations we must not simply ask or posit things that the interlocutors accept, but we must take the premises from the very nature of the things.

<sup>5</sup> 'Why [we] need to ask these [questions] about these things'. He says 'these' to mean 'premises that can [be otherwise]',<sup>432</sup> and 'about these things' to mean '[about] the conclusions that follow them'.

**75a24-5** For it makes no difference if someone were asked anything at random and then asserted the conclusion.

- 10 Asking<sup>433</sup> [the interlocutor to grant] premises that can [be otherwise] and drawing a conclusion from them, he says, is like joining together random and unconnected premises and inferring a random conclusion from them. For example, 'a man is walking about, a horse is whinnying, therefore a man is a substance'. For if in the case of deductions that can [be otherwise] the conclusion does not follow the premises of necessity but nevertheless we ask [the interlocutor to manth each manning have.
- grant] such premises and in this way think that we are inferring, how does it differ if we ask [the interlocutor to grant] any other premises at all and draw a random conclusion? For in neither of these cases does the conclusion follow on account of the premises.

**75a25-7** But [we] need to ask [the interlocutor to grant non-necessary premises] not on the grounds that [the conclusion] is necessary on account of what has been asked,<sup>434</sup> but because it is necessary for a person who asserts them to assert [the conclusion] and to assert [the conclusion] truly, if they truly belong.

The solution of the puzzle comes from this. This is how, he says, we 'need' 'to ask [the interlocutor to grant]' premises that can [be otherwise], not on the grounds that the nature of the conclusion is necessary on account of the premises, 'but because' 'for a person who asserts them' 'and' asserts [them] 'truly', -i.e., for the one who posits the premises and posits them truly – it will follow that he 'asserts' the conclusion 'truly'. 'Not on the grounds that [the conclusion] is necessary on account of what has been asked' does not mean that the conclusion is not necessary on account of the premises (for the conclusion must certainly follow if the premises are true and the figure is valid), but that the cause that the conclusion is the case is

- 30 figure is valid), but that the cause that the conclusion is the case is 96,1 not in the premises – which must be the case in demonstrative deductions. For it is completely necessary for the cause of the conclusion to be manifest in the premises. For example, 'the moon is occulted, what is occulted is eclipsed, therefore the moon is eclipsed'. Note in the premises the cause of eclipse – occultation. Again, 'man
  - 5 exists per se, what exists per se is a substance, therefore man is a substance'. Again the cause of the conclusion is in the premises -i.e., the middle term. For the cause of man's being a substance is that he exists per se; for what exists per se is a substance.

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However, if I say as follows: 'man laughs, that which laughs is an animal, therefore man is an animal', the premises are true and if the 10 premises are posited the conclusion must follow too on account of what has been posited. But the premises are not the causes of the conclusion, since it is not because he laughs or because he is in general capable of laughing that he is an animal; rather, his being an animal follows his being capable of laughing, but his being capable of laughing is not the cause of his being an animal, just as his walking or his capability of walking, or his reading or any such thing, even if 15it certainly follows them [is not the cause], but the cause is his capacity of perceiving. So if his capacity of perceiving is employed as the middle term, in that case the conclusion both necessarily follows the premises and is due to the premises.

For this way [of speaking]<sup>435</sup> has two meanings: [it means] either that the conclusion certainly follows if they are posited, or that in addition the cause of the conclusion is observed in the middle term. 20For it is not the case that if one thing follows another, that which the former follows is certainly the cause of what follows it. For fire follows smoke and being spherical follows this pattern of phases, but smoke is not the cause of fire nor are the phases [the cause] of being spherical. So since there are some things which others certainly follow, and therefore do not seem to be able [to be otherwise], it is possible to deduce truly from such things, even if not demonstratively.

**75a28-31** Since everything that belongs to each genus per se and qua itself belongs of necessity, it is evident [that scientific<sup>(e)</sup> demonstrations are concerned with things that belong per se and are based on these].

Here the Philosopher seems to repeat himself, for what he said above<sup>436</sup> he says here too, namely, that demonstrations cannot be based on premises that can [be otherwise], and he uses the same proofs again. However, he does not do this to no purpose, but [he does 97.1so] because he wants to teach us here that demonstrations must be based on things that are appropriate to each genus with which the problem is concerned and that we must take the premises [from such things] and not demonstrate a geometrical theorem, for example, by taking premises from arithmetical [premises] or [demonstrate a theorem] having to do with natural philosophy [taking premises] from geometrical [premises]. This is why he said above that 'not 5 everything' 'true' 'is appropriate' to demonstration, 'but the primary [fact] in the' appropriate 'genus which the' demonstration 'concerns'.<sup>437</sup> He proves this by assuming in advance that demonstrations are based on things that are per se. This is why he first reminds us of what has been proved, that demonstrations are based on things that are per se and of necessity.
## Translation

- 10 'Since everything that belongs to each genus per se and as itself belongs of necessity, it is evident'.<sup>438</sup> The things that belong per se to each genus, he says, 'belong of necessity', since these are the only things that belong of necessity, as was proved above.439 But if demonstrations are necessary and are based on things that are necessary, demonstrations are therefore based on things that are per
- se and 'are concerned with things that belong per se'.<sup>440</sup> But these 15same things have been proved above, as I said.

75a31-3 For accidents are not necessary, so that it is not necessary to know<sup>(0)</sup> why the conclusion holds or if it always is, but is not per se, as in deductions through signs.

- 20Because everything that does not belong per se belongs accidentally and things that belong accidentally can also not belong, therefore demonstration cannot be based on such things. For even if such accidents are never separated from their subjects, he says, unless they belong to them per se there will not be a demonstration based
- on them, for reasons that have been stated many times. As an 25example of this he gives deductions 'through signs', which deduce causes from effects. For it is from the moon's phases that we infer that it has a spherical body, and from smoke's appearing [that we infer] that there is a fire. For even if this belongs ten thousand times always to the things that have been proved, there is no demonstration in these cases because they do not deduce effects from causes or
- secondary things from primary [a feature] which demonstration in 30 the strict sense must have - but the other way round.
- 98.1**75a34-5** For neither will he know<sup>(e)</sup> per se that which is per se, nor [will he know] the 'why.' [To know<sup>(e)</sup> the 'why' is to know<sup>(e)</sup> by virtue of the cause.]

Since the moon is spherical per se, a person who deduces this via its phases will not have per se knowledge<sup>(e)</sup> of this -i.e., he will not know<sup>(0)</sup> the effect from the cause – but [he will know it] accidentally

 $\mathbf{5}$ in some way.

> **75a35-7** Therefore the middle must belong because of itself to the third, and also the first to the middle.441

For if the first belongs of necessity to the third, and if it belongs through the middle, 'therefore the middle must' 'belong' per se 'to the

third' and must be the subject of the first, so as in this way to prove 10 that the first belongs per se to the third 'through' itself.

**75a38-9** Therefore it is not possible to prove by crossing from another genus, for example [to prove] a geometrical [fact] by means of arithmetic.

After proving that demonstrations are necessary and are based on things that are necessary, and that only things that are per se are 15 necessary, he next, as I said, infers as a corollary the [point] he is now proving, i.e., that demonstrations that apply to one science<sup>(e)</sup> cannot also apply to another. He means that it is impossible by means of the same demonstration with which we demonstrate a geometrical theorem, for example, to demonstrate an arithmetical [theorem].

In order to prove this he first makes a division of the things 20employed in demonstrations, as he did at the beginning as well.<sup>442</sup> For, he says, there are 'three things' employed 'in demonstrations':<sup>443</sup> the things from which the conclusion is proved (these are the axioms), also both the subject term and the predicate [term] of the conclusion.<sup>444</sup> There being these three things in demonstrations, it is possible, he says, to use the same axioms in different sciences<sup>(e), 445</sup> For 25 both the geometer and the arithmetician will say that 'things which are equal to the same thing are also equal to one another'. However it is not possible to use the same subject or predicate term in two sciences<sup>(e)</sup>, since the subjects of different sciences<sup>(e)</sup> are different. Now he says rather roughly that it is possible to use the same axioms in 30 different sciences<sup>(e)</sup>. However, later on he will refine his account and show that not even different sciences<sup>(e)</sup> will use the same axioms. For 99.1when the geometer says that things which are equal to the same thing are also equal to one another, he will not be employing without qualification everything that is equal, but things that are equal to the same magnitude. Likewise the arithmetician will say numbers which are equal to the same number are also equal to one another.<sup>446</sup>

**75a39-40** For there are three things in demonstrations, one is the conclusion being demonstrated.<sup>447</sup>

That is, the predicate term in the conclusion, which the demonstration proves either to belong or not to belong to the subject.

75a40-1 This is that which belongs to some genus per se.

He calls the subject the genus, as is his frequent custom.

**75a41-b2** [One is the axioms (axioms are [the premises] from which [the conclusion is demonstrated]).] The third is the subject genus whose affections and per se accidents the demonstration reveals.

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That is, the subject term in the conclusion whose 'per se' attributes 'the demonstration' aims to prove.

15 **75b2-3** Now the things on which demonstrations are based can be the same.

That is, the axioms, which are the major premises in the deductions.

**75b3-6** As to things whose genus is different, like arithmetic and geometry, [it is impossible to apply an arithmetical demonstration to the accidents of magnitudes, unless magnitudes are numbers.]

20 Sciences<sup>(e)</sup>, he says, whose subject is different cannot use the same premises, namely, minor [premises]. For these very reasons it is not possible to take the same subject term in the conclusion, since the subject term in the conclusion is the same as the subject [term] in the minor premise. Now if different sciences<sup>(e)</sup> do not have the same

- 25 subjects (for magnitudes are the subjects of geometry and numbers 100,1 of arithmetic and magnitudes and numbers are different), neither the subject term nor the predicate [term] will be the same since the genera are different. For it is not possible for the same thing to be predicated universally and per se of each one of the different genera, as was taught above.<sup>448</sup>
  - 5 **75b6** How this is possible and in what cases will be said later.

'This' – he means that in some sciences<sup>(e)</sup> it is possible to take minor premises that are the same – we will speak of afterwards.<sup>449</sup> For it will be proved that in the subalternate sciences<sup>(e)450</sup> it is possible to take the same premises in the more specific science<sup>(e)</sup> as in the more

- 10 universal [science] as well, as in the case of geometry and optics. For the geometer too will take the premises of optics because the subjects [of the two sciences] are in common; for example, taking straight lines, whether they meet or are parallel, and angles and triangles and such like. Because there are certain common subjects in these [sciences], it is possible for the same premises that are employed in the more specific science<sup>(e)</sup> to be employed in the more universal
- 15 [science] too, namely, those employed as minor premises. However, it is not certain that the more specific [science] will employ the [premises employed] in the more universal science<sup>(e)</sup>. Geometry is more universal and more basic than optics.<sup>451</sup> For geometry is concerned with lines without qualification and with figures without qualification, without considering what subject they are in, but it
- 20 contemplates lines themselves, angles themselves, and figures themselves in abstraction, while optics specifically contemplates lines in

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sight, and the angles and figures based on these. This is why the optician will not employ all the geometer's premises, for example that the [straight lines] from the centre are equal, and the like, for none of these will be useful to the optician.

Likewise for the case of medicine and natural philosophy. For both the doctor and the natural philosopher will consider breathing and will assume in a premise that this person is breathing; but the natural philosopher considers breathing without qualification – what it is and from what causes it has its origin – while the doctor will consider only human breathing and this only so far as it is contrary to nature and is obstructed – what the cause of the obstruction is and how it will be cured. This holds too also for music and arithmetic and all the subalternate sciences<sup>(e)</sup>.

**75b7-9** But arithmetical demonstrations always have the genus 10 with which the demonstration is concerned and the other [sciences] similarly. [And so it must be the same genus either without qualification or in some way if the demonstration is to cross.]

He establishes here that it is impossible to apply in one science<sup>(e)</sup> the premises employed in another. For, he says, in every demonstration employed in this science<sup>(e)</sup>, one and the same genus, i.e. the subject  $\mathbf{5}$ [genus], is employed. Now if, for example, in every arithmetical demonstration the same subject is employed - numbers - and likewise in turn in every geometrical demonstration the same subject [is employed] by geometry – magnitudes – it is impossible for sciences<sup>(e)</sup> not concerned with the same subject to use the same premises; for 10 the middle term is in the same genus as the extremes, since the premises are of necessity and per se; but the middle term generates the premises; therefore different sciences<sup>(e)</sup> will not use the same premises, and so neither [will they use] the same subject and predicate. So if it is necessary, he says, to use the same demonstrations in 15different sciences<sup>(e)</sup>, they should have 'the same genus' 'either without qualification' 'or in some way'. Without qualification the same: in the same science<sup>(e)</sup>, such as geometry, for the earlier theorems always become principles and premises of the later ones, since what is proved in an earlier theorem is employed in the demonstration of a later one, and it is like this in all cases. Somehow the same: in the 20subalternate sciences<sup>(e)</sup>, as we said.

'But arithmetical demonstrations always have the genus with which the demonstration is concerned'. 'Always' is employed to mean 'generally', i.e., the same genus is employed generally in every arithmetical demonstration. 25

101,1

25 **75b10-12** It is clear that otherwise it is impossible; for the extremes and the middles must be from the same genus. [For if they are not per se they will be accidents.]

He proves here in another way that it is impossible for demonstrations to cross from one science<sup>(e)</sup> to another. If three terms are employed in a demonstration, two extremes and one middle, the 30 three, he says, 'must be' employed 'from the same genus' – in arithmetic from numbers, in geometry from magnitudes, and likewise in the other [sciences]. For it has been assumed in advance that the 102,1 extremes must be predicated per se of one another, and that the middle must be the subject of one and be predicated of the other; and so unless they are taken from the same genus, they will not belong to one another per se but accidentally.

**75b12-16** This is why it is not possible to prove by geometry that there is one science<sup>(e)</sup> of contraries, nor that two cubes are a cube, [or [to prove] by one science<sup>(e)</sup> what belongs to another, except for those that are so related to one another that one is subordinate to the other as the facts of optics are to geometry and the facts of harmonics are to arithmetic.]

For proving that 'there is one science<sup>(e)</sup> of contraries' is proper not to geometry, because the terms are not taken from the subjects of geometry, but rather to dialectic, which imitates first philosophy and attempts to demonstrate all things as if all things were its subjects.<sup>452</sup> Likewise 'nor' is it the task of geometry to demonstrate 'that two cubes are a cube', but rather of stereometry; for geometry is concerned with planes and stereometry with solids.<sup>453</sup>

By<sup>454</sup> 'that two cubes are' one 'cube' he means this: how is it possible to make two cubes one cube? In fact, he is alluding to the famous story. When the Delians had the plague,<sup>455</sup> the god told them in an oracle that they would be rid of the plague if they duplicated the altar, which was a cube. They took another equal cube and put it upon the altar. But when the plague did not stop, the god told them in an oracle that they had not done what they had been ordered, for he had ordered them to duplicate the altar, but they had put a cube on a cube. And they went to Plato asking how they could duplicate

20 the cube. He said to them 'it seems that the god is reproaching you for disregarding geometry'. He said that the duplication of the cube will be found if two mean proportionals are found to two straight lines,<sup>456</sup> and he proposed this problem to his students.

Some of the students wrote about the discovery of these. For the geometer proves<sup>457</sup> that if three straight lines are in proportion,<sup>458</sup> the square described on the first is to the [square constructed] on the second as the first is to the third.<sup>459</sup> However, he does not teach a

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method for how two mean proportionals can be found to two straight 103,1 lines. He simply proves that in plane [figures] the square on the first is to the [square] on the second as the first [line] is to the third.<sup>460</sup> For example, let there be three straight lines in proportion: 8, 4, and 2; for as the [line] of 8 is to the [line] of 4 (it is double) so is the [line] of 4 to the [line] of 2. For it is double too. And this is why as the first is to the third, the [line] of 8 to the [line] of 2 (it is four times), so is the square on the first, which is 64, to the [square] on the second, which is 16. Now the [square] of 64 has to the [square] of 16 the ratio of four times, for the first [line] is four times the third (8 to 2). 10

This is how he proves [the theorem] for planes. But for solids the more general [theorem is] that so is the square on the first, that is given, to the [square] on the second as the first is to the third. Now since this is so, if two mean proportionals are found to two straight lines, the [square] on the first will be to the [square] on the second as the first is to the third.<sup>461</sup> They are found in this way.

Let it be required to find two mean proportionals of two given straight lines. Let AB and BC be the given two [straight lines] and let AB be the double of BC. It is necessary to find their two mean proportionals.<sup>462</sup> Let BA and BC be produced to F and G, let rectangle BD be completed, and let diagonal AC be drawn. On AC let semicircle ADEC be described, and through point D let straight line FG be drawn such that FD is equal to EG. I say that the two [straight lines] CG and AF [which are equal]<sup>463</sup> are the mean proportionals of AB and BC.



DC is equal to AB; therefore CG is to FA and FA is to BC as AB is to CG. For since FD is equal to EG and DE is common, FE is therefore equal to DG. Therefore the [rectangle contained] by DG and GE is equal to the [rectangle contained] by EF and FD. But the [rectangle contained] by DG and GE is equal to the [rectangle contained] by BG

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and GC, as has been demonstrated for semicircles.<sup>464</sup> But<sup>465</sup> the [rectangle contained] by EF and FD is equal to the [rectangle contained] by BF and FA.<sup>466</sup> And since it has been proved in *Elements*,

- 30 Book 6, [Proposition] 14 that in <equal><sup>467</sup> and equiangular parallelograms the sides about the equal angles are reciprocally proportional, CG is to AF as BF is to BG. But FA is to AD and CD is to CG as BFis to BG. And therefore CG is to AF and FA is to BC as CD is to CG.
- 35 Therefore, of the two given straight lines, AB and BC, two mean proportionals, CG and FA, have been found.
- 104,1 Alternative proof. We will set out the text of Apollonius of Perga,<sup>468</sup> which is more logical,<sup>469</sup> as Parmenion<sup>470</sup> says.<sup>471</sup> Let AB and BC be the given straight lines and let AB be the double of BC. It is necessary to find their two mean proportionals. Let the rectangular parallelo-
  - 5 gram AC be completed, let diagonals AC and BD be drawn, let BA and BC be produced to F and G, and through point D let straight line FG be applied such that EF becomes equal to EG.<sup>472</sup> I say that CG and AF are two mean proportionals of straight lines AB and BC.



For let straight line EH be drawn from E to BC parallel to AB. 10 Since EBC is an isosceles triangle and EH is at right angles to BC, BH is therefore equal to HC. Now since BC is bisected at H and CG is added to it in a straight line, the [rectangle contained] by BG and GCtogether with the [square contained] by HC is therefore equal to the [square contained] by HG. Let the [square contained] by EH be added in common. Therefore the [rectangle contained] by BG and GC together with the [squares contained] by CH and by HE are equal to the [squares contained] by EH and HG. But the [square contained] by CE is equal to the [squares contained] by CH and HE, and the [square contained] by EG is equal to the [squares contained] by EH and HG. Therefore the [rectangle contained] by BG and GC together with the [square con-

tained] by CE is also equal to the [square contained] by EG.

For the same reasons, also the [rectangle contained] by BF and FA together with the [square contained] by AE is equal to the [square contained] by EF. But EF is equal to EG. And therefore the [rectangle contained] by BG and GC together with the [square contained] by CE is equal to the [rectangle contained] by BF and FA, and to the [square contained] by AE. But the [square contained] by EC is equal to the 20[square contained] by EA, for they<sup>473</sup> are equal. Therefore, then, the [rectangle contained] by BG and GC is equal to the [rectangle contained by BF and FA. And since it is proved in [Book] 6. [Proposition] 14 that in <equal>474 and equiangular parallelograms the sides about the equal angles are reciprocally proportional, therefore CG is to AFas BF is to BG. But FA is to AD and CD is to CG as BF is to BG. And 25therefore CG is to AF and AF is to AD as DC is to CG. And AB is equal to DC and BC is equal to AD. And therefore GC is to AF and AF is to BC as AB is to CG. Therefore, of two given straight lines, AB and BC, two mean proportionals, CG and FA, have been found.

But how must we multiply a solid by a solid? Let A and B be two straight lines and let A be the double of B, and let C and D, two mean proportionals of A and B, be taken, so that C is to D and D is to B as A is to C. I say that the [cube contained] by A is double the [cube contained] by C, since A has to B a ratio that is triplicate that of [the ratio which] A [has] to C;<sup>475</sup> for similar solids are to one another in a triplicate ratio to that of their corresponding sides. Therefore the [cube contained] by A is to the [cube contained] by C as A is to B. But A is the double of B; therefore also the [cube contained] by A is also the double of the [cube contained] by C.

**75b17-20** Nor [is it possible to prove by geometry] anything that 5 belongs to lines but not qua lines and qua [following from] the proper principles [of geometry], [for example if the straight line is the most beautiful line or if it is contrary to the circular line. For [these attributes] do not belong qua their proper genus, but qua something common.]

For 'if', he says, 'the straight line' were called 'the most beautiful of lines', since beauty does not belong to it in that it is a line (for it belongs to many other things too), it is not the task of the geometer to make distinctions about this. He calls the straight line the most 10 beautiful line as an example, for they say that the circular line is the most beautiful line because it is uniform and every part of it fits onto every other part. Likewise it is not the task of the geometer to consider whether the circular line is called contrary to the straight line. For neither beauty nor contrariety belongs to them qua lines, since they belong to many other things too, and so demonstrative science<sup>(e)</sup> will not employ such things since they are not appropriate and are not in the subject genus as primary.<sup>476</sup>

**75b21-2** It is also evident that if the premises on which the deduction is based are universal, the conclusion too must be eternal.

- 5 Here he wants to prove that there cannot be demonstration of anything perishable. He proves this from what he has demonstrated previously. For if demonstrations are based on things that belong per se and of necessity, it is impossible for anything that is perishable to be demonstrated; for things that are perishable do not belong of necessity but [belong] at some times and not at others. So if it has
- 10 been proved that demonstrations are based on necessary premises, and conclusions that follow necessary [premises] are completely necessary (for if the conclusion is necessary it has been proved that it is possible that the premises can [be otherwise]; however if the premises are necessary it is not possible for the conclusion not to be necessary), so that if demonstrations are based on necessary prem-
- 15 ises and conclusions that follow necessary premises are completely eternal, therefore it is not possible for anything that is perishable to be demonstrated.

For if what is demonstrated is something perishable, since it is wholly necessary for the subject term in the conclusion or problem<sup>477</sup> to be the same as in the minor premise, if the problem is perishable, of course the subject term in it is perishable too – the same, in fact,

- 20 as must be the subject in the minor premise. But the predicates of things that are perishable do not belong to them of necessity or per se, because they can also not belong;<sup>478</sup> and so the minor premise too will be neither per se nor universal. For it is completely necessary for the major [premise] in every deduction to be universal.<sup>479</sup> But if the
- 25 problem is perishable, as I said, the minor premise must be perishable too, and for this reason the predicate does not belong to it<sup>480</sup> per se or universally, since it can also not belong at some time. So since the minor premise turns out to be particular and not necessary, the conclusion too is particular and not necessary. Therefore there can-
- 30 not be demonstration of things that are perishable but, as has been said, demonstrations are of things that belong of necessity and universally.

75b23 Of such a demonstration, i.e., demonstration without qualification.

'Such', i.e., one whose premises are taken universally. Then, since of 107,1 every demonstration the premises must be universal, which the conclusion follows as completely eternal, he adds, 'i.e., demonstration without qualification', i.e., in the common account of every demonstration without qualification, the conclusion is eternal. **75b24-6** Therefore there is no demonstration of things that are perishable and no knowledge<sup>(e)</sup> without qualification, but [there is] as if accidentally, because they are not [demonstration and knowledge] of it universally,<sup>481</sup> but at a time and in a way.

He does well to say not 'accidentally', but 'as if accidentally'. For there will not be a demonstration that Socrates is an animal, because Socrates is something perishable: but there could be said to be a demonstration of that accidentally, in a way, because the subject of 10 the demonstration in the strict sense belongs to Socrates, namely, 'ensouled thing that is capable of perceiving', which is per se and primarily an animal. But this does not belong accidentally to Socrates 'but at a time'; this is why Socrates is not accidentally in the strict sense an animal, but accidentally in a way, 482 because the demonstration in the strict sense applies to something else, of which animal is 15predicated proximately, namely, that which is capable of perceiving, and on account of that, as long as Socrates is, it will be said that it is demonstrated that he is an animal. But that which is not always, would in a way be like things that are accidentally.

The text is transmitted in two ways. Most of the manuscripts have because [they are demonstration and knowledge] of the universal itself', while some [have] 'because they are not [demonstration and knowledge] of it universally'.<sup>483</sup> The second text would be clearer, i.e., 20since it is not universal that Socrates is an animal. For that which belongs to the subject primarily and to every instance and always is universal, and demonstration is of this kind of things.<sup>484</sup> 'But at a time and in a way', i.e., that animal is predicated of Socrates at a time - as long as Socrates is. But [it is also predicated] 'and in a way' because Socrates is not primarily or per se an animal, but since every man is an animal and every animal is capable of perceiving, and 25Socrates is both a man and capable of perceiving, for this reason Socrates is an animal. But demonstration per se must belong primarilv to the subject.

The other text, which says 'because [they are demonstration and knowledge] of the universal itself', means either the universal in the sense of 'in every case', i.e., since every man is an animal, this is why Socrates too is an animal, for animal [belongs] to every man; alternatively, if it says 'the universal', according to what is being taught here it would mean that of which 'animal' is primarily predicated, which is that which is capable of perceiving. For 'animal' [is predicated] 'in every case' of this. Now it is because in the strict sense the demonstration that something is an animal holds of *this* that it would be said also to be proved of Socrates that he is an animal. 5 'At a time and in a way' are to be understood as in the other text, i.e., that animal does not [hold] of Socrates universally, 'but at a time and in a way'.<sup>485</sup>

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'But as if accidentally'. It is possible to take the perishable premise as truly accidental, as if we said 'Socrates is pale'. But it was in order to employ perishable premises that are closer to the demonstration that he employed those that have as their predicate something substantial, like 'Socrates is an animal' or something of that sort. And this is why, when he took such premises, he said 'as if accidentally'.

**75b26-30** But when it is such,<sup>486</sup> the second premise must be non-universal and perishable [– perishable because the conclusion will be [perishable too if it is], non-universal because one of the things to which [it applies] will be, but not another<sup>487</sup> – so that it will not be possible to deduce universally, but [only] that [it holds] now.]

- 15 When, he says, we deduce something that is perishable, of the two premises the minor must be both 'perishable' and 'non-universal'. 'Perishable', because 'the conclusion too' is perishable, since nothing perishable can be inferred from necessary [premises]; 'non-universal, because one of the things to which [it applies] will be, but not
- 20 another', i.e., since the minor premise must be perishable, it must also be particular. For of the things of which it is true, one of them will be and another will not be; all of them that have not yet ceased to be will be, and all that have ceased to be will not be; but in cases where one is and another is not, what is predicated truly of them must be particular. For example, if someone said that every man is
- 25 an animal, since every man is perishable it is necessary that some have ceased to be and some are. But if this is so, it is not universal that every man is an animal; for those who have ceased to be are not animals. And so it is true rather that some are animals. But if the minor premise is particular, a demonstrative conclusion does not result.

Since this is so, it will 'not be possible', he says, 'to deduce a 30 universal' from such premises, 'but that [it holds] now'. For in the strict sense what is universal is 'in every case' and primarily and not sometimes so and sometimes not so, but always. But that every man

- 109,1 is an animal is not universal, for it is now universally true to say not that both men who were and men who will be are animals (for neither those who were nor those who will be are), but that all men who are now are animals. For this is how the universal is true in the case of
  - 5 perishables not, indeed, without qualification. But what contributes to universal demonstrations is not this kind of thing, but the fact that it holds without qualification for the things of which it is predicated, and that it is not sometimes so and sometimes not so. Therefore there is no demonstration of perishables.<sup>488</sup>

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**75b30-2** It is similar with definitions, [since in fact a definition is either a principle of demonstration or a demonstration differing in position, or a conclusion of a demonstration.]

Just as there is no demonstration of perishables, he says, neither can 10 there be definition of them. For, he says, every 'definition is either a principle of demonstration' 'or a conclusion' 'or a demonstration differing' only 'in position'. It is said in the De Anima<sup>489</sup> that there are three kinds of definitions. Some are from the matter, some from the form, and some from both together; for example, defining anger from the matter you will say that it is boiling of the blood around the heart, [defining it] from the form, [you will say that it is] desire to cause grief 15in return for grief, and [defining it] from both together [you will say that it is boiling of the blood around the heart due to a desire to cause grief in return for grief. Now it is definitions from the form that are the principles of demonstrations, for demonstrations deduce effects from causes, and the form is the cause of the matter.<sup>490</sup> For a certain kind of matter is due to a certain kind of form. So for a demonstration of anger one would use in the place of a principle the definition from 20the form, in the following way: 'so and so desires to cause grief in return for grief, the blood boils around the heart of a person who desires to cause grief in return for grief, therefore the blood around so and so's heart is boiling'.

Note that in these words I used the definition from the form as a principle of the demonstration, and I made the [definition] from the matter the conclusion of the demonstration. For it is impossible for a person who is demonstrating to make the [definition] from the matter a principle of demonstration and the [definition] from the matter a principle of demonstration and the [definition] from the form the conclusion, because demonstrations do not confirm causes from effects but, vice versa, [confirm] effects from causes. However, the definition from both together is the same as the demonstration, differing only 'in' its 'position', because in defining we begin from the blood around the heart due to desire to cause grief in return for grief, while in the demonstration we use [them] in the opposite order, beginning from the form and ending up at the matter.

Now if every 'definition' 'is' 'either a principle' 'of a demonstration' 'or a conclusion of a demonstration' 'or a demonstration differing' only 110,1 'in position', and it has been proved that there is no demonstration of perishables, it will have been demonstrated simultaneously that it is not possible to give a definition of perishables either.<sup>491</sup> For if someone were to say that Socrates is a mortal rational animal,<sup>492</sup> he is not defining Socrates, but man without qualification, since definitions 5 naturally convert with the definienda,<sup>493</sup> but *it* does not convert with Socrates. 'Mortal' is employed in the definition of 'man' (the universal) as having a nature to die in respect of individuals, but not in

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respect of the defined form. For just as it is not of the defined form that, for example, capable of laughing is [predicated], two-footed and terrestrial are also said [of man] in the same way.<sup>494</sup>

- 10 **75b33-6** Demonstrations and knowledge<sup>(e)</sup> of things that occur repeatedly, such as eclipses of the moon, clearly hold always in that they are of this kind,<sup>495</sup> but are partial in that they are not always. And as eclipses are, likewise for the others.
- Since he says that there is no demonstration of perishables, he proceeds to investigate things that occur eternally but cease to be in respect of particulars, such as eclipses. For if each eclipse is perishable, how do we say that there is demonstration of them? He says that each particular eclipse is not demonstrable, since in fact it is subject to generation and perishing; but the demonstration does not take place as if for this particular eclipse occurring at this particular
- 20 time, but with respect to the common kind [that holds] of eclipses all that fall under the same cause. But we do not construct demonstrations as if there is one moon, but as if there were ten thousand [moons] being eclipsed because of the earth's screening. Now this is what we say is the demonstration in the strict sense of the eclipse of both the sun and the moon, because we do not construct demonstra-
- 25 tions as if for this particular eclipse or as if there were one sun and one moon. And so the demonstration is not of this particular eclipse but without qualification of eclipses that occur through the same causes, even if there are ten thousand things that are eclipsed. However, there is no demonstration of the [eclipse] that is occurring at this particular time, except in the way we said there is demonstra-
- 111,1 tion of other perishables, by being demonstrated universally in these cases. The same thing [holds] in similar cases.

## Notes

**1**. I avoid translating *telos* as 'end' here, since the point is not that the *An*. *Post.* is the last of Aristotle's logical works. 'Goal' also misses the mark; the other works are not aiming at the doctrine of demonstration.

**2**. 'Without qualification', like 'at all', renders *haplôs*. Philoponus (hereafter 'P.') employs the same examples in making the same point at *in An. Pr.* 5,4-14, cf. *in DA* 227,14-17.

**3.** An. Pr. 24a22 distinguishes dialectical premises from demonstrative premises, but makes no reference to sophistical ones. Top. 100a25-101a5 speaks of 'eristic', not 'sophistical', deductions. Top. 100a25 defines a demonstration as a deduction whose premises are either true and primary or themselves have true and primary premises as the starting point from which they are known. It defines a dialectical deduction as one whose premises are reputable (see n. 7). Eristic deductions have premises that appear reputable but are not, or, alternatively, they are invalid deductions from what is, or is only apparently, reputable.

4. Int. 17a36-7.

5. P. makes this point also at in An. Pr. 4,15-18.

6. The same example is found at 154,29-30 and in An. Pr. 3,22-5.

7. 'Reputable' (*endoxos*) propositions are those that an interlocutor accepts as true (whether or not they are in fact true), or those that are held by 'everyone, or most people, or the wise', and among these latter, 'either all or most of them or those who are best known and most esteemed' (*Top.* 100b21-3).

**8**. *autopistos*, a word not found in Aristotle. For the idea, see 72a25-b4.

**9**. P. occasionally uses the word *heterokinêtos* to describe those who lazily accept the opinions of others without investigating for themselves (*in Cat.* 133,4; 156,9). The word is not found in Aristotle, but P. uses it several times of those entities (which he once identifies as 'bodies') whose motion depends on a self-mover (*in Cat.* 50,23-6; *in Phys.* 770,33-771,3; 889,18-22).

**10**. For this Aristotelian division, see, e.g. *Metaph.* 1025a25, *Top.* 145a15, *EN* 1139a27-8.

11. cf. EN 1139a25-31 for the thought that true and false in theoretical matters correspond to good and bad in practical matters.

12. homologoumenos. Granted by whom? Presumably by those with the relevant kind of knowledge<sup>(e)</sup>, but certainly not by everyone (cf. 72a1-5, 76b28-34).

**13**. i.e. the *Posterior Analytics*.

14. This is probably a reference to a lost commentary of P.'s on the *Topics*. See Sorabji 1987, 232.

**15**. 71a1-2.

16. P. here (as at 3,20) omits 'that involves reasoning'  $(diano \hat{e}tik\hat{e})$  from his quotation. He first takes up the claim that all teaching and learning is derived from pre-existing knowledge (3,19-4,29) and then explains the importance of the qualification 'that involves reasoning' (4,29-6,6).

17. cf. 3,22-3. Aristotle speaks of common principles (koina) in the sense that

they are used as principles in (hence, are common to) more than one science (e.g. 76a36-b3, b14-15) but never of common notions (koinai ennoiai), which is a term found in Euclid's *Elements* for the kind of geometrical starting point that corresponds most closely to Aristotle's *koina*, which he also calls axioms (axiômata) (e.g. 76a14). P. is influenced by Euclid's usage – unfortunately so, because despite the fact that Euclid's third Common Notion (if equals are subtracted from equals the remainders are equal') is identical with one of Aristotle's frequently cited examples of a common principle, his fifth Common Notion ('things that coincide with one another are equal to one another') is a purely geometrical principle. This consideration leads P. to conclude that some common notions apply in only one science. See 10.27-11.3. In addition, although P. here seems to say that all scientific principles are common notions, at 34,6 ff. he identifies the common notions with axioms, which he there recognizes are only one kind of scientific principle. There could also be some connection with the Stoic common principles, whose nature is, however, disputed. They are said to be criteria of truth (Alexander, Mixt. 218,10-12) and are either universally held notions (Sextus Empiricus, Adv. Math. 1.50) or generalizations derived on the basis of preconceptions (prolepsis) (Aetius 4.7.3-4).

18. On the translation I have adopted P. is pointing out that in order to form a demonstration we must select which of the common notions to use as premises. Another translation would be 'if we have not previously acquired admitted premises from the common notions'. But this would introduce a distinction between common notions and demonstrative premises that conflicts with the previous sentence and many other passages which identify common notions with (a class of) indemonstrable principles, i.e. ultimate premises.

**19.** This expression is inexact. It is probably equivalent to the claim made above, that 'demonstration too is obtained from pre-existing knowledge<sup>(g)</sup>'.

20. Plato, Meno 81D2-3.

**21**. This passage of P. is given as fr. 1 in the fragments of Alexander, *in An. Post.* (Moraux 1979).

22. An. Post. 2,19.

**23**. P. holds that our knowledge of common notions (by which he here means scientific principles) is immediate in the sense that it does not depend on more secure knowledge of other facts; it is in a different way that perception gives immediate knowledge of the facts it reports. I suppose that P. subscribes to the view that the reports of perception are incorrigible. His point here is that if something is immediately known, there can be no need to investigate it.

**24**. P. does not deny this claim generally, since that would risk contradicting Aristotle's claim at 71a17-18 that in some cases we can know things simultaneously with recognizing them. He is simply saying that learning and knowledge cannot happen simultaneously if learning requires a prior instance of learning.

**25**. P. means that any instance of teaching is also an instance of learning, and vice versa; both have to do with the same activity of the same people (the teacher and the learner). This is an odd use of the term 'substrate'.

**26**. This thesis is important for Aristotle's view on how we acquire knowledge. See especially 99b35-100a11.

**27**. Note that P. holds that perception teaches us facts ('that this is white'). Here it is not a matter of the special object of sight (colour), as at *DA* 418a11-13. Aristotle speaks similarly in *An. Post.*, where he speaks of perceiving that the moon is now eclipsed (88a1). Note, though, that the two examples P. brings have to do with a special object of sight (white) and what *DA* calls an incidental object of sight (418a20-3; the example there is 'the son of Diares').

28. This sentence is false, since deductions, even valid deductions, may have

false premises, may have premises that are not known in advance, and may have premises that are not granted. It cannot be improved by supposing that P. here is thinking only of demonstrative deductions, since the examples that follow are not demonstrations.

29. Namely, the art of deduction.

**30**. In this case a 'particular' is a proposition like 'humans move their lower jaw'.

**31**. P. explains the technical term *enthumêma* as coming from the more common word *enthumeisthai*.

**32.** This argument seems to be purely *exempli gratia*, and not to correspond closely with historical events. The characters involved are Pisistratus the sixth-century Athenian tyrant and (presumably) Aeschines the fourth-century Athenian orator and opponent of Demosthenes. According to Herodotus 1.59 and Aristotle (*Ath. Resp.* 14.1), Pisistratus became tyrant of Athens not after taking money, but after contriving to be given a bodyguard. Aristotle offers a somewhat similar argument at *Rhet.* 1357b30, where, however, it is Dionysius of Syracuse, not Aeschines, who is compared to Pisistratus.

**33**. P.'s lemma has *perainontai* ('proceed') where Ross has *paraginontai* ('are acquired') (71a4).

**34**. 71a1-2.

35. For the argument, see Plato, Phdr. 245C5-8.

36. The lemma has hôsautôs de where Aristotle has hôs d'autôs.

37. 71a1-2.

38. Plato, Gorg. 454E-455A.

**39**. 71a1-2.

**40**. 'Problem' (*problêma*) is a technical term prominent in the *Topics*. At *Top.* 101b28-36 problems are said to be identical with (dialectical) premises (*protaseis*) except for the manner in which they are expressed. 'Is animal the genus of man?' is a premise, whereas 'Is animal the genus of man or not?' is a problem. In the present passage, P. applies the term 'problem' to the initial statement in a proof of the conclusion to be proved. This is adapted from mathematical terminology. In his *Commentary on the First Book of Euclid's Elements*, Proclus distinguishes between theorems and problems, specifying that a theorem requires us to prove that a given geometrical object has a certain attribute, while a problem requires us to construct a certain geometrical object given certain other geometrical objects (*in Prim. Eucl.* 81,5-22). See also below, 32,20-3.

**41**. The terminology of 'given' and 'sought' is not Aristotelian, but is found frequently in Proclus, *in Prim. Eucl.*, notably 203,5-12.

42. P. here refers to the two basic kinds of demonstrations. The first is the kind of proof which Aristotle has mainly in mind in *An. Post.* 1, which proves that a certain attribute belongs per se to a certain subject. The various types of per se relations are defined and discussed at 73a34-b24. The second kind of demonstration is implicit in *An. Post.* 1 (especially 76a33-6). In this kind of demonstration the existence of one subject is shown to follow from the existence of others that are already known to exist. This corresponds to what we find in geometry. For example, the first theorem of Euclid's *Elements*, which P. cites just below (8,21-8), proves (as Aristotle would put it) that equilateral triangles exist and does so by showing how an equilateral triangle can be constructed on a given straight line, where the existence of straight lines is postulated, together with the ability to make certain other constructions needed to produce an equilateral triangle.

**43**. P.'s attempt to extend Aristotle's claim to the case of existence proofs is less than successful.

44. I construe hekastês as a genitive of characteristic.

**45**. According to P.'s idiosyncratic interpretation (36,23-5), the axioms without which nothing can be demonstrated (72a16) are not restricted to such general principles as the principle of non-contradiction and the law of the excluded middle, that hold in every science; they are the basic facts of the science. For examples, see 8,24-8.

**46.** The sequel of this passage makes it clear that P. is thinking of a syllogized version of geometrical proofs, where some of the steps consist in applying a general principle, such as 'things which are equal to the same thing are also equal to one another', to particular cases, for example, the straight lines A, B, and C. A, B, and C are an arbitrary set of lines that instantiate the principle, and there is an infinite number of other lines that would instantiate it just as well. Further, the particular lines in a diagram drawn in connection with the proof are unique. P.'s point holds for proofs by *ekthesis*, which are typical of geometry. It also holds for arguments that show that an individual has an attribute already known to hold of a universal under which it falls, or that a species has an attribute already known to hold of a genus under which it falls, but these types of proofs do not include the proof that an attribute (such as having its angles equal to two right angles) holds universally of a subject (such as triangle, as opposed to isosceles triangle).

47. An unusual application of the notion of potentiality.

48. Euclid, Elements, Book 1, C.N. 1 (tr. Heath).

**49**. P. does not express this thought well. While the minor *term* ('man') is included in the major *term* ('animal'), the minor *premise* justifies the application of the major premise to the special case of the minor term.

50. See the appendix for Euclid's statement and proof of this theorem.

**51**. I render *prosullogismos*, usually translated 'prosyllogism', as 'preliminary deduction' to conform to my rendering *sullogismos* as 'deduction'.

**52**. pros tên tou kuklou periphereian. Heiberg deletes these words in his edition of Euclid.

53. Euclid, Elements Book 1, Def. 15.

**54**. A paraphrase of Euclid, *Elements*, Book 1, Def. 20. It thus appears that P. considers definitions to be axioms, but not so: axioms include propositions that assert definitional properties of their subjects, but for P. these propositions are distinct from the definitions themselves. See below, 35,2-17.

**55**. P. refers to Aristotle's remark (76b16-21) that definitions are not always supplied for cases where they are obvious. Euclid defines straight line and equilateral triangle (*Elements*, Book 1, Def. 4, 20). He speaks of finite straight lines (*Elements*, Book 1, Post. 2), but does not define the term (nor does he for the terms 'base', 'coinciding', and 'equal').

**56**. But the given is a term (e.g. soul, animal), not a proposition (above, 7,20-7).

**57**. If the sought is a cause or principle, we have to do at best with a proof by a sign, not a strict demonstration. See below, 31,8-17.

**58**. P. elsewhere calls this claim an axiom of medicine (36,16-17), but it is hard to see how it is relevant to determining why someone has fever.

**59**. P.'s point is that all sciences employ axioms and terms, not that they employ the same axioms and terms. In fact, P. does not believe that the same terms and axioms are found in every science. The terms a science employs in its demonstrations come from the science's subject genus, which is different for each science. For Aristotle, axioms are principles that are common to all sciences or at least more than one, but P. holds that some axioms are specific to each science (10,27-11,3 and elsewhere). On the other hand, the given and

the sought are typically the subject and predicate term in the conclusion of a demonstration, which are not the only terms used in the proof.

**60**. This perplexing sentence is prompted by the reference to medicine in the previous paragraph. There medicine was said to be like the other sciences<sup>(e)</sup>; here it is said to be different from them. I suppose P. is thinking of the example he used above, which (unlike sciences<sup>(e)</sup>) in the strict sense) concerns a particular person who has fever, the determination of what kind of fever it is, and of its cause. The reference to the study of nature (*phusiologia*) as an art as opposed to a science<sup>(e)</sup> is unexpected, but see following n.

**61**. P. does not explain in what way the arts are indefinite. I suppose that it is because they are essentially concerned with individual cases: the doctor does not just deal with the disease; he treats a patient. Moreover, the individuals in question are typically material, enmattered objects, and matter is something indefinite (*Metaph.* 1037a24-7). Cf. *GA* 778a4-9: 'It is the aim, then, of nature to count the coming into being and the end of animals by the numbers of these higher periods, but nature does not bring this to pass accurately because of the indefiniteness of matter and because there prove to be many principles which hinder natural generation and decay and often cause things to fall out contrary to nature' (tr. adapted from Barnes 1984).

62. For Euclid's statement and proof of this theorem, see the appendix.

**63**. Euclid, *Elements*, Book 1, Prop. 14 (tr. Heath). See the appendix for Euclid's proof of this theorem.

64. Euclid, Elements Book 1, Def. 4 (tr. Heath).

65. P. has meizous where Euclid has meizones.

66. Euclid, Elements, Book 1, Prop. 20 (tr. Heath).

**67**. This theorem is not in Euclid. It is an elementary theorem of the sort now used in introductory courses in geometry, and might well have been a school exercise in P.'s day.

**68**. To judge by his examples in this passage, P. probably means that the existence of a primitive subject of a science, whose existence is hypothesized as a principle of the science, is never a subject for investigation. Circles are primitive subjects for plane geometry but not for stereometry, so their existence is not in question in the former science but can be in the latter. However, there are reasons to suspect some confusion on P.'s part, since many theorems in Euclid call for the construction of a straight line or circle that satisfies certain conditions. For example, *Elements*, Book 4, Prop. 5: 'About a given triangle to circumscribe a circle' (tr. Heath).

**69**. Clearly, a thing identified as given will never be sought, but P. does not explain how this shows that 'magnitude' is never sought.

**70**. P. does not justify this claim. If we set out to construct a sphere equal to a given cube, is not the sphere the sought?

**71**. This sentence appears desperately muddled. Things grasped by perception are better known 'to us', not better known 'in nature', (cf. 71b33-72a5, see below, 29,1-14) and so are precisely the things a science needs to investigate.

**72**. Recall that talk of the given and the sought is not Aristotelian. See above, n. 41.

**73**. P. interprets Aristotle's distinction between the kinds of prior knowledge in terms of his own distinction between given and sought, and in terms of Euclid, *Elements* Book 1, Prop. 1.

**74**. The shift from 'what it is' to 'what it signifies' is significant, and undermines P.'s interpretation. See 92b4-8. See below, n. 76.

**75.** P. here apparently contradicts what Aristotle says at 71a14, but cf. 71b31-3 and P.'s comment ad loc. (28,21-9).

**76.** P.'s misunderstanding continues. At 92b5-8 Aristotle denies this claim. He says there that (a) anyone who knows what something is must also know that it is (exists), so that (b) it is impossible to know what a goat-stag is (because goat-stags do not exist); on the other hand (c) it is possible to know what 'goat-stag' signifies.

**77**. A slip for 'we have previous knowledge<sup>(pg)</sup>'. Axioms are self-guaranteeing and so cannot be investigated.

**78**. Recall that at 10,16-18 P. saw no difficulty in the idea that we know what an axiom signifies.

79. Closing the quotation before epi.

80. Euclid, Elements, Book 1, C.N. 3 (tr. Heath).

**81**. For examples of how 'music' employs such common axioms, see the *Division of the Canon*, attributed to Euclid.

**82**. Euclid, *Elements*, Book 1, C.N. 7 (in Heiberg's numbering, 5 in Heath's) (tr. Heath). See n. 17.

83. P. omits Aristotle's esti (71a13).

84. P. has de amphô for Aristotle's d'amphô.

85. Namely, the law of the excluded middle.

86. The lemma has tode where Aristotle has todi.

87. Euclid, Elements, Book 7, Prop. 15.

**88**. 71a1-2.

**89**. I translate *epharmossein* as 'apply', but whereas P. speaks of applying a particular case to a universal, we tend to speak the other way round.

**90**. The example that follows makes it clear that P. is thinking of demonstrations in the same way as at 8,6-19 (see notes ad loc.). The 'more universal' theorems are what we regard as theorems. The theorems to which we are 'attending to for the first time' are considered as represented by the diagrams used in the proof. The proof consists in applying the previously known theorems to the particular triangles ABC and ADC.

**91**. This result is not a theorem in Euclid, but it is proved in the course of the proof of *Elements*, Book 1, Prop. 12.

92. Euclid, Elements, Book 1, Prop. 5.

93. Euclid, Elements, Book 1 Prop. 4 (tr. Heath).

94. P. gives more information than is needed to yield the desired conclusion.

**95**. This application of the word 'universal' stretches its meaning almost beyond recognition – apparently for the sole purpose of generalizing the claim made in the previous paragraph.

96. Plato, Meno 71D.

97. Plato, Meno 79E.

98. Plato, Meno 81D.

99. Plato, Meno 80D.

100. Plato, Meno 82A.

101. Plato, Meno 84D-85B.

**102.** In this paragraph *merikon* and *katholou* (translated 'particular' and 'universal' as in the preceding paragraph) have the sense of 'specific' and 'generic' or 'general'.

103. P. has meizous where Euclid has meizones.

104. i.e. that there are no whole numbers m and n such that m times the side is equal to n times the diagonal. This result is equivalent to the fact that the square root of 2 is irrational.

**105**. Nothing in Aristotle corresponds to this discussion (which is apparently based on P.'s interpretation of 'and how' (71b8) at 19,18-20,2), and it is questionable whether Aristotle would accept it. See below, n. 117.

106. The lemma has egnôrise where Aristotle has egnôrisen.

**107**. This statement can hardly be correct; the connection that Aristotle here asserts holds between perception and induction requires a richer explanation, of which many attempts are available in the scholarly literature.

**108**. See above, 15,27-16,2. The description of the figure in the semicircle in the next sentence as 'the unnoticed triangle' will be due to the influence of this previous passage.

**109**. That is, recognition that the figure is a triangle is not the result of discursive reasoning, but it results from perception.

110. P. paraphrases Euclid, *Elements*, Book 1, Prop. 32.

111. This statement presupposes P.'s (mis)interpretation of 71a21 as identifying perception with induction. P. then understands 'the learning of some things occurs in this way' to mean that we learn some things by perception (rather than by performing an induction immediately upon perceiving a particular instance).

112. 71a1.

113. P's. lemma has tina sullogismon where Aristotle has sullogismon.

114. P. is confusing his examples. It is not the triangle in the semicircle but the triangle in the hand that is concealed.

**115**. The contrast between two different proofs of the same conclusion (for which, cf. above 16,19-25) is out of place here. What is at stake is not whether you know something *in a certain way*, but whether you know it at all.

**116**. At this point the Aldine text adds the following: 'Sometimes he is ignorant that it is and sometimes he is ignorant of what it is. Also, a person learning astronomy knows that [there are] stars, but is ignorant whether they are like this or like that. For he learns afterwards that a triangular formation is of such and such a sort, the following reveals. [The text of this sentence is corrupt.] But knowledge<sup>(e)</sup> and knowing<sup>(e)</sup> are different from demonstration, for knowledge<sup>(e)</sup> is the very disposition about facts which occurs in us, while as to demonstration, it is the procedure in virtue of which the knowledge<sup>(g)</sup> of these things occurs. Also, the word "knowledge<sup>(e)</sup>" is more general than "demonstration," since a person is not able to demonstrate just because he is said to know<sup>(e)</sup>. However Aristotle now uses "know<sup>(e)</sup>" to mean "demonstrate" since the word is more familiar.'

**117**. This interpretation of 'and how' is undermined in P.'s own paraphrase: 'i.e. in respect of the way of learning', which is indistinguishable from the way Aristotle here characterizes the distinction between learning in respect of the universal and learning in respect of the particular. See above, 16,20-5.

118. P. seems here to understand 'common' to mean 'found in every science', although elsewhere he tends to take it in the sense of 'accepted by everyone' (e.g. 21.5; 85.8).

119. i.e. the law of the excluded middle.

120. P. is speaking somewhat loosely here; elsewhere (especially 23,22-5) he is more precise. The preceding sentence shows that he understands that demonstration is not identical with knowledge<sup>(e)</sup>, but is the way in which knowledge<sup>(e)</sup> comes to be. Here he stresses their connection: demonstration always produces knowledge<sup>(e)</sup>, but there are cases of knowledge<sup>(e)</sup> that are not produced by demonstration.

**121**. P. interprets this claim as meaning that *the cause* cannot be otherwise: if we know<sup>(e)</sup> X, then we know that Y is the cause of X and that Y cannot fail to be the cause of X. Cf. 22,15-17. Most modern interpreters take Aristotle to mean that Y is the cause of X and we know that X cannot fail to be the case.

122. That is, they cannot fail to cause the phenomenon in question.

**123.** P. elsewhere recognizes (some) arguments of this kind as constituting an inferior kind of proof. See below, n. 175.

 ${\bf 124}.$  The usual translation of this word, 'white lead', would lead to confusion here.

**125**. The example is strained. P. presupposes that motion is an accident of an object that is moved and that time is accident of motion.

**126**. And therefore, time is not an accident of any particular motion.

127. P. offers different accounts of sophistical arguments at 30,3-4 and 32,18-19.

**128**. P.'s lemma has *auto* where Ross, following most of the Aristotle MSS, has *autoi*, which gives the meaning: 'the former think that they are in this condition', viz. of knowing the cause and that it cannot be otherwise. Ross's MS C agrees with the lemma.

129. Laoi, connected by folk etymology with laas, a word for stone.

130. Aristotle calls our knowledge of immediate scientific principles 'undemonstrated knowledge' (*anapodeiktos epistêmê*) at 72b19-20 and 88b36. He discusses the nature of scientific principles immediately following the present passage, beginning at 71b20.

131. 71b17.

132. 71b10-12.

**133.** P.'s attempt to state the relation between knowledge<sup>(e)</sup> and demonstration 'more precisely' leaves room for further improvement.

**134**. Prior to this sentence the Aldine edition adds the following sentence: 'After saying that demonstration is based on things that are true, primary and immediate, he teaches what is "true" and what is "primary" and "immediate".'

135. P. seems to be taking 'primary' (*prôtos*) to mean 'prior' (*proteros*); otherwise it is hard to understand why he thinks that something that requires demonstration could be primary.

136. The Aldine text begins the comment on this passage with the following sentence: "causes of the conclusion" instead of "proximate causes, not more remote ones"; for he goes on to say that in this way the principles will be appropriate to what is proved'.

137. Aristotle's point in calling the principles prior to the conclusions is not simply that they occur earlier in a demonstration than the conclusion does; they are prior in that they are more fundamental both epistemologically and onto-logically.

138. 71b22-3. P. gives houtôs where Aristotle has houtô.

**139.** P. here refers to the view commonly held in his own day, that the body is constituted of the four humours (blood, phlegm, yellow bile, and black bile). This theory is prominent in the Hippocratic writings (notably *The Nature of Man*), which largely antedate Aristotle, and was taken up by Galen. However, it is not found in Aristotle, who held (with Galen) that the four elements (fire, air, water, earth) are the simplest forms of material substance, and these are blended into compounds, which in turn may form more complex entities. The body of an animal is composed of homogenous compounds (e.g. bone, flesh) and heterogeneous compounds (e.g. face, hand) (see *PA* 2.1).

**140**. See *Phys.* 194b30-1 for the father as cause of the child, and 192b21-2, 200b12, and other passages cited in Bonitz 1870, 836a1-34.

141. viz. 'prior ... and causes'.

142. 71b22.

143. 71b22-3.

144. See 93a30-1 for a similar analysis of lunar eclipse.

**145**. The word order in P.'s lemma varies from Aristotle's by placing *ouk estin* after *to mê on*.

146. 71b20-1.

147. There is a slight anacolouthon here.

148. P.'s word order here coincides with Aristotle's.

**149**. 14,25-15,19.

150. For example, in Diagram 3 (p. 27) square ABGH is double triangle ABH.

**151.** Emending to apo tês diametrou to ho diametros in 27,3. The text as given by Wallies contains the contradiction that the square on the diagonal is both double the square on the side and incommensurable with it.

**152**. This elementary result in number theory is not found in the arithmetical books of Euclid.

**153.** The Aldine text begins the comment as follows: 'He says "based on primary indemonstrables" because if the things assumed for the demonstration are not indemonstrable but demonstrable, he will not know the problem unless he has a demonstration from these [namely, the primary indemonstrables]. For if he does not securely know<sup>(o)</sup> the demonstrations of the premises, he needs to seek again for demonstrations'.

154. 71b21.

155. 'We' refers to Aristotle.

**156.** I leave *bouletai* untranslated, since the nicety it conveys is hard to render. 'Are wont to proceed' would do, if it were not somewhat archaic.

157. 71b27.

**158**. 20,22-3.

**159**. The examples that follow distinguish between per se and per accidens *facts*, not between per se and per accidens *knowledge*.

**160**. The Aldine text begins the comment as follows: "In that we understand", that is, knowing<sup>(0)</sup> what it signifies or what it is. But also knowing<sup>(0)</sup> that it is the case [reading *hoti* for *ho*, *ti*]. And notice that he now speaks of knowing<sup>(0)</sup> the axioms in the two ways'.

**161**. Since the conclusion of a demonstration is eternal (75b21-3), the sense in which scientific principles 'pre-exist' the conclusions cannot be temporal. This must be a way P. uses to express the ontological priority ('in nature') of the principles.

**162**. 71a14.

163. 10,15-20 (in the comment on 71a11). However, in the earlier passage Aristotle was speaking of what he calls axioms or common principles, whereas in the present passage he is speaking of scientific principles in general. P.'s mistaken identification of Aristotle's common principles with common notions as he understands that term (as including far more scientific principles than Aristotle intended, cf. n. 17) leads him to interpret the claim made at 71a11 ff. in terms of what is asserted here (which applies rather to definitions than to the other kinds of principles).

164. The Aldine text begins the comment as follows: 'What is prior. For after speaking of the minor premise he comes to the major. For example, man is an animal; this is the minor. Then the major: every animal is a substance. Notice that it is from the things prior in nature, viz. animal and substance, that he proved the ultimate, viz. man, which is a substance. In any case ...'.

**165**. Top. 141a26-142b19; Phys. 184a16-b14; An. Pr. 68b35-7; Metaph. 1029b3-12; EN 1095b2-4.

166. The lemma has *tauton* where Aristotle has *tauto*.

167. P. substitutes legô ('I say') for esti ('is').

**168**. P. offers a different account of sophistical deductions at 21,28-9; at 32,18-19 he makes homonymy, not falsity, their distinguishing feature.

**169.** I translate *oikothen* 'from within ourselves' (similarly at its other occurrences: 30,22; 34,10; 34,21; 36,24; 37,2). The alternative is to read P. as claiming that they have their confirmation from within *themselves*, that is, in their own right, without need for external support. However, a review of the other occurrences of the word in P. (especially *in An. Post.* 354,5) convinced me to adopt the 'subjective' reading. There are problems, however, mainly due to Aristotle's opposition between what is prior to us and what is prior in nature, and his belief that the principles are prior in nature but least recognized 'by us'. When P. speaks of the principles as having their confirmation 'from within ourselves', then, the 'we' of whom he is speaking will be not the laymen, but those who have achieved knowledge<sup>(e)</sup>, who have succeeded in making what is prior in nature also prior to them. See n. 174.

**170**. The closest Aristotle comes to making such a statement is DA 430a17, where he describes the active intellect as 'separate, impassive, and unmixed, since in its essence it is activity'.

171. For 'exists per se' see 73b5-9. At 73b7-8 substance (*ousia*) is identified as 'whatever signifies some *this*' (*hosa tode ti sêmainei*), a description of substance repeated at *Metaph*. 1017b24-5, where it is identified with the property of being 'separable' (*kai ho an tode ti on kai khôriston êi*). In that substances are separable from items in the other categories, they are standardly taken to exist independently of them. For this word of *authupostatos*, see P., *in Cat.* 46,16-20.

**172**. P. omits mention of hypotheses, the third kind of principle identified at 72a14-24. For P. the principal difference between axioms and hypotheses is that axioms are believed by all people on their own account, whereas hypotheses are accepted on the teacher's authority and require a certain amount of explanation. See 34,19-35,2; 35,17-36,13; 127,9 ff.

**173**. 29,2-14.

**174.** The *An. Post.* account of priority and intelligibility 'in nature' and 'to us' (71b33-72a5) does not suggest that what is prior and better known in nature can be prior and better known to us as well. In the *Metaphysics*, however, Aristotle says that 'it is our work to start from what is more intelligible to oneself and make what is intelligible by nature intelligible to oneself' (1029b5-8). When we complete this work, we have become experts and have attained knowledge<sup>(e)</sup>.

175. The discussion of proofs by irrefutable signs corresponds to nothing in the Aristotelian passage. Aristotle discusses deductions based on 'signs'  $(s\hat{e}meia)$  at *An. Pr.* 2.27, and mentions 'signs' at 75a33, but does not develop the idea into what it becomes in P.: a recognizable though inferior kind of demonstration. The subject of such proofs is well discussed in Morrison 1998.

**176.** P.'s point is that only part of the moon is illuminated as long as it is waxing, but when it reaches opposition to the sun, its entire hemisphere is illuminated.

**177.** In fact, Aristotle does not elsewhere characterize a premise as 'either part of a proposition (*apophansis*)'. At *Int.* 20b24 he calls it 'a part of a contradiction (*antiphasis*)' – which has led some to suppose that the text at 72a8 is corrupt. See Barnes 1994 ad loc.

178. Int. 17a20-34.

**179**. 17a34-7, following a definition of affirmation at 17a25 that is almost identical with the one given here.

**180**. cf. *Rhet.* 1404b37-8: 'homonymous words are useful to enable the sophist to mislead his hearers' (tr. adapted from Barnes 1984). However, in the *Sophistical Refutations* homonymy is only one among many sources of fallacy. P. characterizes sophistical deductions differently at 21,28-9 and 30,3-4.

**181**. See *Top.* 101b28-36, where Aristotle says that problems and premises differ only in 'manner' (*tropos*), and n. 40.

182. Wallies prints ho ti where Ross prints hoti. Ross's text is translated 'because it is true'.

**183.** The Aldine text begins the comment as follows: 'A dialectical premise asks both: is a man an animal or not an animal. But a demonstration does not ask anything else, but assumes a single premise, the true one'.

**184**. *Int.* 17a23-6, but Aristotle does not there speak in terms of genus and species.

**185**. This is how Aristotle characterizes contradictions at *Metaph*. 1055b1-2, b7-8, and 1057a34-6. In *Int*. he discusses them (17a33-7, 17b16-18a12) but does not use the expression 'nothing between'.

**186.** This list of kinds of opposition is taken from *Metaph*. 1018a20-1. See also *Cat.* 10, *Top.* 2.8, 5.6, *Metaph*. 1054a23, etc.

187. White and black are contraries, right and left are relative terms, sight and blindness are examples of possession and privation. The notion of 'between' involved in some of P.'s examples is not entirely clear.

**188.** P.'s treatment of this example is less nuanced than Aristotle's at Cat. 13a3-16.

189. The Aldine text begins the comment as follows: 'He calls a thesis one which cannot be proved and which a person does not need if he is going to learn, because it teaches something. A thesis is different from an axiom because a thesis is not self-guaranteeing to the learner, but it comes to be present [in him] from the teacher (while the learner possesses and puts forward an axiom from within himself) and because a thesis requires a little explanation even if it is indemonstrable. For example, all the lines from the centre to the circumference are equal to one another. But axioms do not; for there is no need [to prove that] twice two are four. In any case ...'.

**190**. See above, n. 17.

**191**. Above, 10,27-11,3.

**192**. Euclid, *Elements*, Book 1, Def. 15 (tr. Heath). P.'s text includes the words *pros tên periphereian tou kuklou* ('to the circumference of a circle'), which Heiberg omits.

193. Euclid, *Elements*, Book 1, Post. 1.

194. These definitions are not found in Euclid.

**195.** P. here contradicts his (correct) observation just above (34,8-10) that the present passage contradistinguishes axioms from theses. His examples, which include one of Euclid's construction postulates and (in effect) the definition of triangle, seem to place under the heading of axioms all of Euclid's principles and arguably all of Aristotle's as well. No other passage shows more clearly how far P.'s 'psychological' interpretation of axioms leads him from a straightforward reading of Aristotle's text.

196. P.'s tendency to characterize the types of scientific principles in psychological terms (we know axioms 'from within ourselves' because they are evident, whereas theses require some explanation because they are evident, but not evident without qualification) has some basis in Aristotle (cf. 76b23-34), but is muddled, and does not give sufficient weight to the different roles that the different kinds of principles play in scientific demonstrations. The present Aristotelian passage contains no such psychological description.

**197**. Aristotle does refer to a situation of teaching and learning in connection with hypotheses at 76b27-34, but not in the passage being commented on. In the present Aristotelian passage, hypotheses are theses, and therefore inde-

monstrable principles; in the later passage, they are not principles, but are explicitly said to be provable (*deikta onta*, 76b27). One of the greatest faults in P.'s presentation of Aristotle's view of scientific principles is his conflation of these two passages.

198. Aristotle never defines man in this way, or as 'rational animal'. The present definition, found several times in the commentators, supplies 'mortal' in order to differentiate man from god (assuming that god is an animal, something that Aristotle might doubt).

**199**. P. interprets Aristotle's characterization of a hypothesis at 72a18-20 to mean 'a thesis that assumes either of the parts of a contradiction (i.e. I mean, that something is or is not the case)'. He takes it to be describing quite generally an assumption that a given predicate does or does not belong to a given subject. On the more commonly accepted view, the passage means 'a thesis that assumes either of the parts of the contradiction (i.e. I mean, that something exists or does not exist)'. On this account hypotheses are existence claims for the basic subjects of a science's subject genus. See Barnes 1994 ad loc. P. adopts something like the more common view at 37,10-13.

**200**. At this point the Aldine text adds the following: 'In any case, of immediate premises some are theses, others are axioms. Which are axioms is clear. Of theses, hypotheses are one kind and definitions are the other. Of hypotheses the species are postulate and hypothesis (named homonymously [with the first sense of hypothesis]). The common feature of every hypothesis is that it does not depend on a natural notion but is posited by the teacher. All the hypotheses that are known<sup>(g)</sup> and which the learner admits at the same time as he hears them are called hypotheses, while those that are not clear or known<sup>(g)</sup>, but although they require supporting argument are taken without demonstration from the teacher, are called postulates. Postulates are divided into those that are known<sup>(g)</sup> moderately well and those whose contraries are believed. For example, if the geometer says that right angles are equal [I omit *oudeteras*] the student who does not know geometry believes neither that they are equal nor that they are unequal. But [as to the claim that a point has no size] he believes the contrary, supposing that the point is not without size'.

201. Here 'definition' has the sense 'definiens'.

**202.** We would expect P. to say 'subject' (*hupokeimenon*) rather than 'substance' (*ousia*). Perhaps he is under the influence of his preceding example, where the subject in question (man) is indeed a substance.

**203**. P. makes a useful point here, but it is not in accord with the Aristotelian text. P. implies that definitions are not scientific principles, although in the present passage Aristotle says that definitions and hypotheses are theses, and that theses are scientific principles.

**204**. Aristotle does not make this division of hypotheses in the present chapter. P. is importing material from 76b27-31, where the hypotheses in question are not principles (cf. *deikta onta*).

**205**. That is, the genus 'hypothesis' has two species, 'hypothesis' (where the word in used in different sense) and 'postulate'.

**206**. P. does not speak of 'natural notions' elsewhere. However, the context shows what he means. He is here contrasting hypotheses in the generic sense with axioms. Axioms we know 'from themselves' and are 'evident' and 'self-guaranteeing' (34,10-11; 18), but hypotheses are not evident without qualification, but require some attention for their truth to be seen (34,19) and are posited by the teacher (34,21-2). The axioms, then, will be natural notions in the sense that we have them naturally. For the idea cf. *in An. Pr.* 49,18-20.

**207**. Euclid, *Elements*, Book 1, Post. 1, with the addition of *grammên*.

**208**. At this point MSS R and V add the following: 'But all the hypotheses that are known and which the learner admits at the same time as he hears them are called hypotheses, for example, "to draw a straight from any point to any point." [There are slight differences between R and V, and I follow V.]

209. Euclid, *Elements*, Book 1, Post. 3 (tr. Heath).

**210**. An abbreviated version of Euclid, *Elements*, Book 1, Post. 5: 'that, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles' (tr. Heath).

211. Proclus reports Ptolemy's proof at in Prim. Eucl. 365,7-367,27.

**212**. The reference is to 76b30-1, but Aristotle does not there distinguish two different types of postulates, but merely says that contrary to hypotheses, which the learner believes and also accepts without proof, postulates are claims that the learner accepts without believing them, that is, either he disbelieves them or he simply has no opinion.

**213**. Euclid, *Elements*, Book 1, C.N. 9 in Heiberg's edition; rejected by Heath 1925, vol. 1, 232). I have given Heath's tr.

**214**. cf. Euclid, *Elements*, Book 1, Def. 2: 'A line is breadthless length' (tr. Heath).

**215**. This seems to be a reference to Proclus. See *in Prim. Eucl.* 184,12-22. It seems to admit that this view of axioms is not Aristotelian, although P. elsewhere (notably 10,27-11,3) adopts it as an interpretation of Aristotle.

**216**. cf. Euclid, *Elements*, Book 1, C.N. 7 (C.N. 4 in Heath's numbering): 'things which coincide with one another are equal to one another' (tr. Heath).

**217**. In this sentence P. justifies Aristotle's use of the word 'deductive': the notion of immediate premise is applicable only in the context of a demonstrative science, in which the distinction between immediate principles and non-immediate provable facts is at home.

**218**. P. overlooks the fact that this passage makes it clear that hypotheses being spoken of are immediate principles, and imports the use of hypothesis found at 76b27-31.

**219**. This implausible interpretation is motivated by P.'s belief (adapted from Euclid's practice) that some axioms are applicable in only one science. See above, 11,2-3. In his attempt to maintain his interpretation P. here is driven to tactics of desperation.

**220**. Nothing in the Aristotelian passage suggests that we put forward the axioms from within ourselves. *Oikothen*, the word I translate as 'from within himself' is not found in Aristotle. In fact, Aristotle says little about how we come to have knowledge of the most fundamental axiom, the principle of non-contradiction. For one suggestion, see Wians 2006, 333-53.

**221**. This example fits Euclid's practice better than it fits P.'s own account of hypotheses, on which they predicate something of a substance (35,17-19).

**222**. The lemma has *tad*' where Aristotle has *tadi*.

**223.** Aristotle says that they must be better known<sup>(g)</sup> (71b21, b29), but not that they must be more convincing.

**224**. Aristotle says only 'more' (*mallon*). P.'s addition of 'much' (*pollôi*) seems merely rhetorical.

**225**. Someone who does not have any opinion on whether the person in question is or is not good other than so-and-so's assertion.

226. Plato, Gorg. 470D9, E6-7.

**227**. This claim is acceptable, but it does not warrant the desired conclusion, that they are *more* convincing than the conclusion.

**228**. P. is careless here, since a valid argument with one or more false (let alone merely disputed) premises may nevertheless have a true conclusion.

229. In fact the interpretation which P. here rejects, is quite implausible.

**230**. At this point the Aldine text adds the following: 'For example: the soul is impassive in respect of its essence, what is impassive in respect of its essence is immortal, therefore the soul is immortal. Notice here the major premise, which states that what is impassive in respect of its essence is immortal, is self-guaranteeing and indemonstrable, but the minor premise needs a demonstration: that the soul is simple in respect of its essence, what is simple in respect of its essence is impassive in respect of its essence, therefore the soul is impassive in respect of its essence. And so this deduction, the one just stated, has a major premise which we stated, which is self-guaranteeing, and a minor premise that requires demonstration'.

231. The reference is to Plato, Meno 87B-C.

**232**. This claim is probably to be seen as a consequence of P.'s view that the axioms are known 'from within ourselves'. See n. 220.

**233.** i.e. we are convinced of the common notions more strongly than we are of things we know through demonstration.

**234.** This interpretation of 72a33-5 is dubious. Aristotle there does not say that we *do* know the principles in a stronger way than by virtue of demonstration, but makes a general claim about cases where we know one thing (A) and know it qua following from something else (B): in such a case we must either know B or have some grasp of B that is stronger than knowledge.

**235.** Alexander takes *pisteuontôn* in the lemma (translated 'who is convinced') to mean *pisteuomenôn* ('of the things of which he is convinced'). This passage appears as fr. 6 in Moraux 1979.

236. That is, even on the most natural interpretation of the passage.

**237**. At this point the Aldine text adds the following: 'To proceed so as not to be able to be otherwise. Not only must we be more familiar with the principles, we must, he says, not only know<sup>(0)</sup> the premises and the conclusions clearly but we must not consider any of their contraries more trustworthy than these pre-examined things. For if he considers the contraries of the principles more trustworthy, he will have the deduction of the contrary deception, and instead of saying that good is beneficial, he will say that evil is beneficial'. [MS U gives all of this except for the first sentence.]

**238**. This sentence is desperately unclear. First, what are true and false deductions? Are they valid and invalid deductions, respectively, or are they valid deductions with conclusions that are, respectively, true and false. Further, since for Aristotle deductions require more than one premise, what are we supposed to assume about the remaining premises? It would be absurd to suppose that P. is claiming here that if a true (or a false) proposition is a premise of a deduction then the deduction is valid (or invalid, respectively), and it would be ungenerous to suppose him to be saying that if a proposition is true (false). all conclusions of valid deductions which have that proposition as a premise are true (false). Note that Aristotle does not talk in terms of true or false deductions, but says '... the deduction of the contrary deception'. If we have a demonstration of the form 'A belongs to all B, B belongs to all C, so A belongs to all C', and take the contrary of the major premise, we get the deduction 'A belongs to no B, B belongs to all C, so A belongs to no C', in which the conclusion is false and contrary to the true conclusion of the demonstration. Whether P. recognized this and whether he attempted to express it in the present sentence are not clear.

239. Wallies incorrectly identifies this line as 72b4.

Notes to pages 50-54

**240**. The Aldine text begins the comment as follows: 'Because it is fitting to know<sup>(0)</sup> the primary things, i.e. premises that are derived from things that are demonstrated and self-guaranteeing, some think that there is no such thing as demonstrative knowledge<sup>(e)</sup>. For who, he says, can find all things to be self-guaranteeing and demonstrated? In any case ...'.

**241**. 72b8.

242. For this claim, see 89b38-90a1.

**243.** Aristotle discusses the void at *Phys.* 4.6-9. After a preliminary discussion (4.6) he proceeds as P. says, determining what 'void' means (4.7, 213b30-214a16), examining arguments for the existence of void (4.7, 214a16b11), and finally proving that void does not exist (4.8-9).

**244.** This corresponds to the second of what the Stoics called 'indemonstrable' syllogisms – arguments in which the premises are a conditional and the contradictory of the conditional's consequent, and whose conclusion is the contradictory of its antecedent, thus: If P then Q, but not Q, therefore not P (see e.g. Sextus Empiricus PH 2.157). The terminology 'hypothetical' seems to be Peripatetic, cf. Aristotle, An. Pr. 50a39-b2; P. speaks of treatments of the subject by Theophrastus and Eudemus (in An. Pr. 242,14-245,1 = Text 111B in Fortenbaugh et al., 1992). It falls under the heading of the first kind of hypothetical argument ascribed to Theophrastus by Alexander (in An. Pr. 390,3-4), 'He would be referring to arguments which are hypothetical through a connection, which is also called a conditional, and an additional assumption', discussed in Barnes 1985.

**245**. This corresponds to the first of what the Stoics called 'indemonstrable' syllogisms – arguments in which the premises are a conditional and the conditional's antecedent, and whose conclusion is its consequent, thus: If P then Q, and P, therefore Q. It falls under the heading of the first kind of hypothetical argument ascribed to Theophrastus by Alexander. See the previous n.

**246**. The property of having its end identical with its beginning, associated with circles as early as Heraclitus (DK 22 B 103), in fact holds of any closed plane figure.

**247**. The Aldine text begins the comment as follows: 'For those who hypothesize that there is no such thing as demonstration say that if demonstration is through things that are prior, then those things that are prior in turn need to have things that are prior. And if they do, those in turn are through things that are prior. But if they do not have things that are prior, neither will there be demonstration. In any case ...'.

**248**. The lemma has *ei de* where Aristotle has *ei te*.

**249**. The lemma has *histantai* (plural) where Aristotle has *histatai* (singular).

**250.** The Aldine text here contains the following: "But if it is not possible to know<sup>(o)</sup> the primary things, neither" is it possible "to know<sup>(e)</sup> the things that depend on them, neither without qualification nor in the strict sense; only on the hypothesis that those things are." But if it is not possible to know<sup>(o)</sup> the primary things of the prior things, neither [is it possible to know] the things subsequent [to them]. And there will not be demonstration, but all things are known<sup>(g)</sup> hypothetically. For the hypothesis posits something [to be predicated] of something, and compels us to be confident that it is so, and does not bring a demonstration.'

251. The lemma has ekeina estin where Aristotle has ekeina éstin.

**252**. *ex hupothese*ôs, translated 'on the hypothesis' in the lemma.

253. 44,26-45,5.

254. The Aldine text continues the comment as follows: "But nothing"

prevents "there being demonstration of everything." But those who "agree" that there is demonstration and say that all things are demonstrated, [hold that] nothing prevents there "being" "circular" proof, and that universals are proved from particulars and particulars from universals. For anyone who knows<sup>(0)</sup> that Socrates and Plato are humans knows<sup>(0)</sup> also that a human is Socrates and [a human] is Plato. And anyone who knows<sup>(0)</sup> that twice two is four knows<sup>(0)</sup> that four is twice two."

**255**. This is a deduction (although not a syllogistic deduction), but is not a demonstration as it stands, since it is not embedded in the context of a science.

256. I use this word for *emmesos*, which applies to premises which can be demonstrated through middle terms.

257. The lemma has *houtôs* where Aristotle has *houtô*.

258. The lemma has te where Aristotle has t'.

259. horos, except in the present passage translated 'term' or 'definition'.

**260**. The Aldine text begins the comment as follows: 'He says that the intellect is the principle of knowledge<sup>(e)</sup>. For it is by means of this that we recognize the [principles] that are most basic, and so to speak limits. But those who suppose that the divine is now a principle do not suppose well. He says that knowledge<sup>(e)</sup> is of two kinds: knowledge<sup>(e)</sup> in the case of problems that comes through the axioms, and [knowledge<sup>(e)</sup>] of the axioms itself'.

**261**. The reference is to Ammonius, whose lecture notes were the basis of P.'s commentary.

262. cf. Plotinus, Enn. VI 6[34].

263. See Iamblichus, in Nic. 88,15-89,27.

264. Themistius, in An. Post. 9,9-10.

**265**. P.'s lemma, agreeing with the second hand of two Aristotle MSS (C and n) has *d*' where Ross, following most of the Aristotle MSS, has *te*.

**266**. The Aldine text begins the comment as follows: 'If indeed demonstration must be based on things that are prior and better known. If circular proof is employed in demonstrations as necessary, on the grounds, he says, that nothing prevents demonstration from coming to be from things that are prior to us, we did not do well to define knowing<sup>(0)</sup> in the strict sense as being based on causes and things that are prior in nature. For it is possible to know<sup>(0)</sup> from things that are not of this sort as well. But if we did do well to define [it that way], then the other kind of demonstration is not demonstration in the strict sense. But if this is what he says about things that are prior in nature but posterior to us, it [i.e. the result of such a demonstration] is not knowing<sup>(0)</sup> without qualification, but the statement is ambiguous and has another meaning. In any case ...'.

**267**. At 71b33-72a5 Aristotle makes the distinction between two ways of being prior. He does not explicitly say there in which way scientific principles are prior, but it is clear enough that he means that they are prior, indeed primary, in nature. In any case, the present passage (72b26-32) removes any possible doubt that this is his view.

268. Aristotle's tone at 72b30 ff. is not so apologetic as P.'s.

269. 31,17-32,7.

270. That is, such arguments are not always valid.

271. For proofs by signs, see n. 175.

**272**. The lemma has *hê ginomenê* where Aristotle has *ginomenê* g'.

**273.** P. refers to 72b32, but Aristotle there speaks of things better known<sup>(g)</sup>, rather than things that are more and less clear. Cf. 52,26-31.

**274.** Reading *heteron* with MSS R and a, where Wallies adopts *deuteron* ('second').

275. An. Pr. 53b23-4.

276. 73a1-2.

**277**. 73a5.

**278**. At this point the Aldine text adds the following: 'understanding in thought the converse of the major premise, that that which is receptive of intelligence and knowledge<sup>(e)</sup> is capable of laughing'.

**279**. P. has *epeidê* where Aristotle has *ei*.

**280**. The reference is to 72b25-32, but nothing was said there about proving universals through particulars.

**281**. The lemma has de where Aristotle has d'.

282. 72b32-3.

283. 72b34.

**284**. See below, 55,13-14.

285. 51,5-52,25.

286. 72b38-9.

287. The lemma has legein einai where Aristotle has einai legein.

**288**. The lemma has *einai ti* where Aristotle has *ti einai*.

289. 72b35.

290. An. Pr. 53b16-20.

291. An. Pr. 24b18-19.

**292.** The reference is to 72a14-21, but in that passage theses are divided into hypotheses and definitions. Postulates are introduced only at 76b23-34, where they are counterdistinguished from hypotheses.

293. P. has tôi where Aristotle has tois.

294. 73a14, cf. An. Pr. 2.5.

295. An. Pr. 2.5-7.

296. P. omits the conclusion, 'man is predicated of no stone'; see below, 56,12-13.

297. Aristotle makes this point at An. Pr. 58b22-5.

**298**. The conclusion of the argument, which P. omits, is 'stone is predicated of no man'.

**299.** P. here shows greater concern for rigor than does Aristotle, who converts the conclusion without comment (An. Pr. 58b25).

300. Aristotle treats this case at An. Pr. 58b18-22.

301. An. Pr. 58b39-59a3.

**302**. That is, as a particular, not a universal.

**303**. Aristotle does not consider this case, which is in fact a fallacious inference; as P. has said, third-figure syllogisms cannot have universal conclusions.

**304**. The syllogism goes as follows: 'Receptive of intelligence and knowledge<sup>(e)</sup> is predicated of every man (converse of conclusion), man is predicated of everything capable of laughing (major premise), therefore receptive of intelligence is predicated of everything capable of laughing (minor premise)'.

**305**. Since P. is willing to accept the (illegitimate) moves required to make the proof of the major premise go through, he should be willing to accept the similar moves required to make the proof of the minor premise go through as well: 'receptive of intelligence belongs to every man (converse of conclusion), man belongs to everything capable of laughing (major premise), therefore receptive of intelligence belongs to everything capable of laughing (minor premise).

**306**. This is so because the minor premise is universal and third figure syllogisms must have particular conclusions.

**307**. That is, the conclusions of demonstrations are necessary.

**308**. The present passage does not mention 'accidentally'; it promises to

define 'in every case', 'per se', and 'universal' (73a26-7), and that is exactly what Aristotle does in the remainder of the chapter. However, he does define 'accidentally' in the course of the chapter (73b4-5, b9-10, b11-13).

309. The lemma has eisi where Aristotle has eisin.

**310**. This is a paraphrase of *An. Pr.* 24b28-30.

311. An. Pr. 24b28-30.

312. The lemma has tonde where Aristotle has tond'.

313. The lemma has huparkhei where Aristotle has huparkhei te.

314. Wallies deletes this example.

**315.** cf. Proclus, *in Prim. Eucl.* 97,7 for this alternative definition (*rhusis sêmeiou*), with discussion in Heath 1925, vol. 1, 159.

**316**. This is a quotation of part of Euclid's definition of *straight* line, *Elements*, Book 1, Def. 4.

**317**. For this alternative definition, see Proclus, *in Prim. Eucl.*, 97,7, discussed by Heath 1925, vol. 1, 158.

**318**. Adopting Wallies's addition *ousias tês*. Without this addition the text would be translated 'constitutive of line'.

319. Euclid, *Elements*, Book 1, Def. 4.

**320**. This definition is given in Proclus, *in Prim. Eucl.* 109,21, and practically verbatim in Aristotle, *Top.* 6.11, 148b27.

321. The words in Greek are peripheres and periphereia.

**322**. tisi.

323. This passage is fr. 9 in Moraux 1979.

**324**. This definition is essentially identical with the definition given by Euclid (*Elements*, Book 7, Def. 11) and Theon (Theon of Smyrna, *Expositio rerum mathematicarum ad legendum Platonem utilium*, 23,10).

**325**. This definition is different from Euclid's (*Elements*, Book 7, Def. 13): 'that which is measured by some number' and Theon (24,16-17): 'those measured by a smaller number' in that it implies that the unit is a number: the number 1.

**326**. This definition is identical with Euclid's (*Elements*, Book 7, Def. 12) and almost so with Theon's (24,8-10).

327. prôton, a singular form.

**328**. This passage is fr. 10 in Moraux 1979.

**329**. The term 'equilateral' (*isopleuros*) is not applied to numbers by Euclid. Nicomachus (Intro. Arith. 2.6.1) mentions equilateral numbers along with other kinds of 'figured' numbers, and notes that 'the tradition concerning [these kinds of numbers] is properly given in the Geometrical Introduction' (tr. D'Ooge 1926, 236). This last mentioned work of Nicomachus has not survived. At Intro. Arith. 2.15.1, after completing his discussion of pyramidal numbers (2.13-14), which are the simplest 'solid' numbers, Nicomachus proceeds to his treatment of other 'solid' numbers as follows: 'while the origin, advance, increase, and nature of the equilateral solid numbers of pyramidal appearance is the foregoing, ... there is another series of solid numbers of a different kind, consisting of the so-called cubes, "beams",' etc. (D'Ooge 1926, 252). It seems that equilateral numbers are solid numbers, in which the lengths of the sides of the corresponding geometrical solids are equal. This is clear for the case of the pyramidal numbers, the only ones that Nicomachus explicitly calls equilateral. The base of these figures is a polygonal number, corresponding to a regular polygon all of whose sides are equal in length, and whose height is equal to the length of one of the sides of the base. I assume that the term also applies to cubic numbers (such as 1, 8, 27) which correspond to cubes, whose sides are, of course, equal. The present passage shows that the term was also applied to polygonal numbers as well.

**330**. For Pythagorean 'figured numbers,' see discussion in Heath 1921, vol. 1, 82-3, with references.

**331**. 'To be of a nature' (*pephukenai* used in this way, see also 66,6; 94,6; 110,7. See also n. 429.

**332**. P. here fails to acknowledge the existence of 'per se accidents' (*kath'* hauto sumbebêkota) (75a27-31, b1), which are the conclusions of demonstrations and therefore can be known<sup>(e)</sup>. They are not definitional attributes and therefore not scientific principles or per se attributes in the senses given at 73a34-b5, but neither are they accidental in the sense that they are capable of not belonging to their subject. There can be no knowledge<sup>(e)</sup> of accidents of this latter kind (75a18-21). However, he does recognize 'per se accidents' below, 93.23-94.10.

**333**. By 'one and the same nature' P. here in effect means 'a single unequivocal subject qua such'. The property of having its angles equal to two right angles belongs to triangle qua triangle. See n. 429.

**334**. Nothing in the definitions of the two kinds of per se relations that play a role in knowledge<sup>(e)</sup> (73a34-b5) implies this result, which in fact conflicts with Aristotle's view that man is per se mortal (though there are other mortal things than man). See n. 428.

**335**. The lemma has *leukon*. The Aristotle MSS have *to leukon* ('the white"). Ross inserts a second occurrence of this word immediately afterwards: *to leukon* ('... and the white thing [is something that is] white').

**336**. P. chides Aristotle for failing to make use of the distinction between a predicate's being 'said of' its subject and being 'in' it (*Cat.* 2).

337. 73b7-8.

**338**. The lemma has *tis sphattomenos* where Aristotle has *ti sphattomenon* ('something died while *its* throat was being cut').

339. The lemma has kata sphagên where Aristotle has kata tên sphagên.

**340**. It is difficult to believe that Aristotle would accept that the fated time of death could be a cause.

**341**. 64,12-16.

**342**. Namely, the proposition 'the cause of the moon's being eclipsed is occultation by the earth'.

**343.** The middle term in the deduction is either 'occulted by the earth' or 'occulted'. The statement 'the cause of the moon's being eclipsed is occultation by the earth' is not a premise of the deduction, but, as P. says, it contributes to the formation of the middle term. Aristotle discusses related matters in *An. Post.* 2.8, but I do not find anything in P.'s comments on that chapter that fulfills his promise to give a more precise examination of the matter.

**344**. After the plural of 'definitions' the singular here is unexpected.

**345.** Aristotle does not show this result. Indeed, some of his examples (notably 'even and odd') are consistent with it, but not all of them are. The definition of the second kind of 'per se' relation (the subject appears in the definition of the attribute) does not entail that such attributes must come in contradictory pairs. In fact, not all of them do. The example of 'equilateral' and 'oblong' is a case in point. For equilateral numbers, see n. 329. Oblong numbers are sometimes defined as numbers of the form m(m+1) and sometimes as any non-square composite number. On any of the accounts of equilateral numbers and either account of oblong numbers, the terms are not contradictory. See Barnes 1994, 118 and McKirahan 1992, 89-90.

**346**. P. is following Aristotle (73b16-24) in holding that predicates which belong per se to their subjects in this way always come in pairs, even though the definition of this per se relation does not require them to do so. The case of

'equilateral', 'isosceles', and 'scalene' in relation to 'triangle' seems to be a counterexample.

**347**. P. here changes from speaking of, say, 'even' as a predicate to speaking of 'even and odd' as a predicate. See 65,31-2.

**348.** Note that Aristotle holds that only 'per se' attributes are necessary attributes, but he does not say in *An. Post.* that things that hold in every case are per se.

349. 73b16.

**350**. This is the basic sense of 'universal'. See, for example, *An. Pr.* 24a18 and *An. Post.* 71a17, 96a8-9.

**351**. This point is nicely made at 99a31-5. See also 84b22, 86b31.

**352.** At 74a1-2 Aristotle says that 'demonstration per se is of this [kind of] universal', which I take to mean that the conclusions of proper demonstrations are universal in this way. However, he does not say that this kind of universal is the only kind of relation found in demonstrations. Indeed, the way he has defined the 'per se' relation makes it difficult to suppose that he believed that the premises of demonstrations are all universal in this sense.

353. Themistius, in An. Post. 13,5-9; 12,20-3.

**354.** A close paraphrase of Euclid, *Elements*, Book 1, Prop. 29. (See the appendix for Euclid's statement and proof of this theorem.) I have adapted Heath's tr. But P.'s mention of three alternate angles is a slip; there are only two. In the diagram, the parallel lines are AB and CE, the line that 'falls on' them is AC, and the alternate angles are ABC and ECD.

**355.** In fact the sum of the three angles in question is greater than the exterior angle by two right angles, and it is also false that any one or two of the interior angles is equal to the exterior angle. It is hard to imagine how P. arrived at this false belief.

356. This passage is given as fr. 116 in Fortenbaugh et al. 1992.

**357**. The phrase *tôn hupo to katêgoroumenon* must refer to the predicate's subject.

358. 74a2.

359. 74a2.

**360**. P. inserts tou before katholou.

361. The lemma has prôton katholou where Aristotle has katholou prôton.

**362**. Euclid, *Elements*, Book 7, Prop. 13 (tr. Heath). See the appendix for Euclid's statement and proof of this theorem.

**363**. Euclid, *Elements*, Book 5, Prop. 16 (tr. Heath, except that P. has *esontai* where Euclid has *estai*). Although the theory of proportion developed in Book 5 was recognized in antiquity as applying generally to arithmetic, geometry, and other mathematical sciences, the definitions of ratio, proportional, etc. are stated in terms of 'magnitudes'.

**364**. For speech (*logos*) and time as quantities, see *Cat.* 4b23-4 and 5a8-14, where it is the quantitative aspects of both that are of interest.

**365**. At Gorg. 464B ff. Plato talks of justice (*dikaiosunê*), not judging (*dikastikê*).

**366.** The latter of these two claims is found at *Gorg.* 464B, but Plato does not make the former claim, nor does he explicitly apply the law of alternating proportions to the analogies in question. He may believe that sophistic has the same relation to rhetoric as lawgiving has to judging, but he does not say so, and he certainly does not say anything of the form A is to B as C is to D, *therefore* A is to C as B is to D. The analogies he employs are used heuristically, not as the ingredients of a deduction.

367. According to Euclid's definition of 'proportional' (Elements, Book 5, Def.

6, cf. Def. 4), only things that are capable, when multiplied, of exceeding one another can be proportional. P.'s point is that, for example, a magnitude three feet long cannot be proportional to a volume of five cubic feet, since volumes and lengths cannot be compared in such a way that one exceeds the other.

**368**. This is a consequence of Aristotle's doctrine of place (*Phys.* 3.1-5, esp. 212a7-21).

**369**. It is hard to see what P. means by this claim. If he means that ratio between the perimeter and the side of a square is equal to that between the perimeter and radius (or diameter) of a circle, he is simply wrong. His previous remarks (74,21-2) exclude that he means the ratios between the perimeters and areas of the two figures. So either he is wrong here, or he is speaking not of the quantitative ratio between perimeters and sides (or radii), but is thinking more simply that in the case of a square, what corresponds to the perimeter of a *circle* will be its own perimeter: each is a line (or distance) around the edge of the figure.

**370.** P. seems to be conflating (or confusing) two different thoughts. First, that lengths and areas have no ratio to one another because they are incomparable ('not of the same kind'). Second, that the diameter and circumference of a circle have no ratio in the sense that there is no whole-number ratio between them (no whole numbers m and n such that m times the diameter is equal to n times the circumference) – a consequence of the irrationality of the number  $\pi$ .

**371.** P. expounds two possible interpretations of this passage and gives a reason to prefer the first. Consider a proof that isosceles triangles have angles equal to two right angles. On the first interpretation the subject of the proof, isosceles triangle, is a genuine whole, but it is not the subject to which the attribute belongs universally. It is a species of that subject, and stands in relation to that subject as a part. On the second interpretation, the genus, triangle, is considered a part of isosceles triangle because 'triangle' occurs in the definition of isosceles. P.'s comment makes it clear that he finds the expression 'as a whole in a part' (*hôs en merei holon*) difficult to understand.

**372.** I translate Wallies' conjecture (in app. crit.) of  $h\hat{e}iper$  exetheto ta tou prôtou for hoisper exetheto hupodeigmasi ta tou prôtou. The text as printed would be rendered: 'he did not give illustrations in the same order in the illustrations in which he set out'.

**373**. Translation adopted from Heath's tr. of Euclid, *Elements*, Book 1, Post. 5.

374. Literally, 'limited in two right angles': P.'s expression is loose.

375. The lemma has hoti enallax where Aristotle has hoti kai enallax.

**376**. The lemma has *hekaston trigônon* where Aristotle has *hekaston to trigônon*.

**377**. 74a33.

378. 74a32-3.

**379.** That is, on premises that are universal in the sense defined at 73b25-74a3.

**380**. 74a1-2.

**381**. I have been unable to find the passage to which P. refers.

**382**. P. has *ha* where Aristotle has *ta*.

**383**. That is, the first two ways of belonging per se. See 73a34-b5, b16-18.

**384**. P.'s description of the second kind of per se relation is even more obscure than Aristotle's characterization at 73a37.

385. 74b11.

386. 74b11-12.

**387**. 74b5.

388. 74b10-11.

389. 74b11-12.

**390**. The lemma has *anankaion* where Aristotle has *anankaiôn*: 'demonstration is *of* things that are necessary'.

**391**. In fact, deductions with necessary conclusions can be constructed whose premises are not both necessary (they may even be false) (*An. Pr.* 1.8). In those cases the conclusions are *inferred* from things that are not necessary, but they are not *based on* them. Further, P.'s claim here does not apply to principles, which are necessary but not demonstrable.

**392**. Even if we consider the second premise necessary, the first premise is obviously not so.

393. See 63,5-20 and n. 334.

**394**. This example, with a singular term for a subject, seems inappropriate as an example of the point Aristotle is making.

**395**. 71b13-16 give P. good reason to suppose that this is a common notion in the sense that it is shared by all. See n. 118.

**396.** It is tempting to translate  $epist\hat{e}m\hat{e}$  here as 'science', a choice which becomes inevitable in the commentary on *An. Post.* 1.7.

**397**. P. takes this as given, which is a reasonable interpretation of 74b26-32. **398**. Wallies cites this lemma as 73b27.

**399.** This is an apparent slip. Since there is no demonstration of axioms, there can be no account of them, in the sense of 'account' apparently in question. **400.** Wallies cites this lemma as 73b28.

**400.** Wantes cites this femina as 75020.

**401**. Since by hypothesis, the minor premise is false. **402**. Note that P. here substitutes know<sup>(e)</sup> for know<sup>(o)</sup>.

**403**. That is, the knowledge no longer exists.

**404**. That is, the minor premise is false.

405. A paraphrase of An. Pr. 32a19-20.

**406**. A paraphrase of 71b10-12.

**407**. The lemma has *ton houtôs ekhonta* where Aristotle has *houtôs ekhonta*, which would call for the translation 'it is impossible to know<sup>(o)</sup> things that are in that condition'.

**408**. An anonymous referee of this translation suggested emending *phusin* (nature) to *skhesin* (relation), which would accord with the use of that word in 90,22.

**409**. P. appears to neglect the requirement that demonstrations be based on principles that are prior in nature to the conclusions. In *An. Post.* 1.13 Aristotle discusses cases in which the premises and conclusion of a demonstration can be rearranged to form a deduction whose conclusion is one of the indemonstrable premises of the demonstration and one of whose premises is its conclusion (78a22-b13). In such cases, we may suppose, the conclusions of both deductions are shown to be necessary, but only in the demonstration does the conclusion have its necessity on account of the premises.

410. An. Pr. 24b18-19.

**411.** The example could be clearer. I suppose that P. has in mind the fact that every man is an animal. If we hypothesize that Socrates is a man, then it follows of necessity that Socrates is an animal. Further, every man is necessarily an animal, but the deduction does not yield *this* conclusion.

**412.** I translate *atomon* here and elsewhere as 'individual'. In P. this word usually refers to concrete particulars, such as Socrates, as opposed to *infimae species*, although in certain contexts it refers to the latter as well. An example of the latter practice is found at 403,34-404,1, where P. distinguishes between things that are *atomon* in number, such as Socrates, and things that are *atomon* in kind (*eidos*), such as man.

**413**. That is, it is a necessary consequence of the premises that the predicate term in the conclusion is predicated of the subject term.

**414**. Given that the syllogism is valid, the fact that its premises (more strictly, at least one of its premises) can be otherwise entails that the conclusion can be otherwise too.

**415**. sc. with the sun. P. is referring to the period just prior to the new moon, when the moon is invisible.

416. i.e. during the time of the day between moonset and moonrise.

417. Aristotle takes up this issue at 78b13-31 in Book 2, chs 17-18.

418. 75a15.

419. 75a16.

420. dia mesôn.

421. dia emmesôn.

422. di'amesôn.

423. mesôn.

424. 73a37-b3.

**425**. Aristotle does not here specifically mention inseparable accidents.

**426**. P. does not always take account of this property of per se accidents. See 63,18-20, 94,17-18.

**427.** For this phrase see 63,19, and compare 'one and the same nature' (63,18) and 'single unique nature' (84,29). For the thought, see nn. 333 and 429.

**428**. This claim begs the question about what is the underlying nature of the entities in question. Further, Aristotle is comfortable about there being different explanations for a single attribute belonging per se to different subjects (99a30-b7). See also 63,16-20 and n. 334.

**429.** This sentence speaks of things whose nature (*phusis*) is such that they can be [otherwise], and seemingly equates such things with things that can be otherwise. This might suggest that 'the nature of a thing' here is simply a paraphrase for 'a thing'. However, the following paragraph makes it clear that this is exactly not what P. has in mind. In contrasting *necessitas consequentiae* from *necessitas consequentis* he distinguishes between a conclusion that follows because of logical consequence and one that follows from the very nature of things. In any deduction the consequence follows of necessity from the premises, but in demonstrations we also have 'necessity in accordance with nature'. The premises come from 'the very nature of the things', and this is 'necessity in accordance with nature'. In this context, then, the nature of a thing has to do with its modality: whether it is necessary or contingent. This will depend on the thing. Consider the proposition 'man is an animal'. The entities involved (man, animal) are by nature such as to determine that the proposition is necessary.

**430**. P. presupposes that the deduction in question is valid.

431. P. here gives a loose paraphrase of An. Pr. 24b18-20.

**432**. Ross 1949, 528 adopts this interpretation, paraphrasing the text as 'One might ask why such premisses should be sought', and saying in his commentary, 'The word *erôtan*, as well as the substance of what Aristotle says, shows that the reference is to dialectical arguments' (530).

**433.** In this comment, P. expounds the objection, which as he sees it is founded on the failure to distinguish the necessity of logical consequence from the necessity of the conclusion.

434. Namely, the non-necessary premises.

435. P. refers to the expression 'necessarily follows'.

**436**. 74b5-75a17.

**437**. 74b25-6.

438. P. has kath' hauto where Aristotle has kath' hauta.
**439**. 74b6-12.

440. P. has kath' hauto where Aristotle has kath' hauta.

441. Wallies indicates that the lemma begins at 75a36.

**442.** At 72a14-24 Aristotle makes a division of deductive principles into axioms, definitions, and hypotheses.

**443**. 75a39.

**444**. P.'s understanding (which he explains in his comments ad 75a39, a40, and a42) of Aristotle's list of the three ingredients of demonstrations is quite strained.

445. 75b2-3.

**446**. P. refers to 76a38-b2.

**447**. The lemma has to apodeiknumenon sumperasma where Aristotle has to apodeiknumenon, to sumperasma.

448. 75a28-42, with P.'s commentary, 96, 26-99, 14.

**449**. The reference is to 78b32-79a16. The relevant part of P.'s commentary is 178,14-179,12.

**450**. Aristotle discusses the subalternate sciences in the present chapter and also at 76a4-15 and 78b32-79a16. Subalternate sciences are pairs of related sciences of which one is subordinate to the other in a particular way. In a sense these pairs of sciences constitute exceptions to the rule that each science has its own unique field of study (subject genus). Geometry and optics form one such pair. Both sciences study lines. Geometry studies lines in general, and does so without reference to their material nature, while optics studies geometrical properties of visual lines, and optical properties, such as how large different objects appear, depend on geometrical properties, such as how large an angle they subtend in the visual field. See McKirahan 1978 and 1992, ch. 5.

**451**. These two properties are explained, respectively, in the next two sentences. Geometry is more universal because it considers all lines, not just some lines; it is more basic because optics takes over some of its premises from geometry (and not vice versa).

452. See Metaph. 1004b17-26.

**453.** P. is wrong to think that Aristotle is referring to the problem of duplicating the cube (an interpretation that in any case is hard to get out of Aristotle's phrase 'two cubes are a cube'). The reference is to the arithmetical property that the product of two cube numbers is a cube number, which Euclid proves at *Elements*, Book 9, Prop. 4.

**454**. The definitive discussion of P.'s treatment of the problem of the duplication of the cube is to be found in Knorr 1989, chs 1, 3. See also Knorr 1986, 17-24, 188-190, 305-8.

**455.** This account concerning the Delians is only one of several stories associated with the problem of duplicating the cube. The principal ancient text is Eutocius, *Commentary on Archimedes On the Sphere and the Cylinder*, 2.1. For a brief account, see Heath 1921, vol. 1, 246-70.

**456.** If we have two quantities, *A* and *C*, then the mean proportional between them is defined as the geometrical mean of *A* and *C*, that is, the middle term *B* in the sequence *ABC*, such that *A* is to *B* as *B* is to *C*, in the sense that if A = mB (where m is a number) then B = mC. It follows that  $A = m^2C$ . Correspondingly, the problem of finding two mean proportionals between two quantities *E* and *H* amounts to finding the two middle terms *F* and *G* in the sequence *EFGH* such that for some number n, E = nF, F = nG, and G = nH, so that  $E = n^3H$ . In the present case, the volume of one cube is double the volume of the other: E = 2H. Therefore  $n^3H = 2H$ , and therefore n = the cube root of 2.

457. In place of the following stretch (102,24-105,4) the Aldine text has: 'He

sets out the demonstration [of the theorem:] given two straight lines, to find a mean proportional. Likewise, in Porism 33 of the first book on solids as well [i.e. Euclid, *Elements*, Book 11, Porism to Prop. 33], that if four straight lines are serially proportional, the solid parallelepiped on the first is to that on the second (supposing it is similar and similarly constructed) as the first is to the fourth. [See the appendix for Euclid's statement of the theorem and porism.] However, the demonstration of this by Apollonius of Perga, as Parmenion says, is the one we will set out. It goes as follows. [The following construction is very different from the one Eutocius attributes to Apollonius (see n. 471). It is closer to the construction Eutocius ascribes to Philo of Byzantium (see n. 462).] Given two



unequal straight lines, to find two mean proportionals. Let AB and AC be two unequal straight lines and let them be placed so as to enclose a right angle ABC. Complete the parallelogram BD and draw its diagonal AC. About triangle ACD circumscribe semicircle ADEC. Extend straight lines BA and BC to F and G. Join FG through point D so that FD is equal to EG. This is assumed as an undemonstrated postulate. It is evident then that FE is equal to DG. Now since point F has been taken outside circle ADC and two straight lines FB and FE extending from F intersect the circle at points A and E. Therefore the rectangle with sides BF and FA is equal to the rectangle with sides EF and FD. For the same reasons, then, the rectangle with sides BG and GC is equal to the rectangle with sides DG and GE. But the rectangle with sides DG and GE is equal to the rectangle with sides *EF* and *FD*. For each is equal to each: *FE* to DG and FD to EG. And therefore the rectangle with sides BF and FA is equal to the rectangle with sides BG and GC. Therefore GC is to FA as FB is to BG. But FA is to AD and DC is to CG as FB is to BG because the triangles are similar. But *DC* is equal to *AB* and *AD* to *BC* and *FA* is to *AD* as *AB* is to *CG*. But CG is to FA as  $\overline{FB}$  is to BG, i.e. AB to GC. And therefore GC is to FA and FA is to BC as AB is to GC. Therefore the four straight lines AB, GC, FA, and BC are serially proportional. Therefore the cube on AB is to the cube on GC as AB is to BC. So if AB is hypothesized the double of BC, the cube on AB will be the double of the cube on GC. [I print Wallies' diagram, but note that according to it BC = 2AB, whereas the present text states that AB = 2BC.] The appendix to the Aldine text agrees with the text Wallies prints.

**458**. Namely, if they are in geometrical proportion. See n. 456.

459. 'The geometer' is Euclid, and the reference is to *Elements*, Book 8, Prop.

11, although that theorem is stated in terms of numbers, not straight lines. In Book 8, Prop. 12, Euclid proves the analogous result for cube numbers, but as P. remarks, he does not provide a method of determining the how to find the mean proportionals for magnitudes. The case of (whole) numbers is easier, since it is trivial to determine the cube root of a cube number, but the matter ceases to be trivial when the theorem is applied to (continuous) magnitude. See the appendix for Euclid's statements and proofs of these theorems.

**460**. This property follows from the definition of mean proportional (above, n. 456). Since A = mB and  $A = m^2C$ , it follows that A is to C as  $A^2$  is to  $B^2$ ; the ratio between the quantities in both cases is  $m^2$ .

**461**. This is a mistake. P. here repeats the property of plane figures. In the case of solids there are four lines, not three, and they are related in such a way that as the first is to the fourth, so is the cube of the first to the cube of the second. He gives the correct formulation below, 104,31-105,4.

**462.** The construction and proof that follow closely resemble those of Philo of Byzantium as found in Eutocius (Eutocius, *in Sph. Cyl.* 60,28-64,14 (Heiberg)). On the basis of Philo's construction I reconstruct P.'s version of the construction as follows. Let the given lines AB and BC be placed so as to contain a right angle at B. Draw AD perpendicular to AB and CD perpendicular to BC. [*ABCD* is therefore a rectangle.] Join *AC*. Describe semicircle *ADEC*. Extend *BA* and *BC*. At *D* apply a moving straightedge intersecting *BA* extended at *F* and *BC* extended at *G*, and let it revolve around *D* until *FD* is equal to *EG*.

**463**. This is a mistake. CG and AF cannot be equal, since they are precisely the two mean proportionals being sought, as P. says just below and also at 103,33-5.

**464**. This result follows from Euclid, *Elements*, Book 3, Prop. 36, according to which each of the two rectangles in question is equal to the same thing, namely, the square of the tangent to the circle from point G. See the appendix for Euclid's statement of this theorem.

465. By a similar application of Euclid, *Elements*, Book 3, Prop. 36.

**466.** P. omits the obvious consequence of the foregoing, that the rectangle contained by BF and FA is equal to the rectangle contained by BG and GC.

**467**. That is, equal in area. Wallies inexplicably adopts an alternative MS reading *isopleurôn* for *isôn*, which misquotes Euclid and makes nonsense of the claim. I adopt the reading *isôn*, on which P. is quoting verbatim the first half of Euclid, *Elements*, Book 6, Prop. 14.

**468**. The construction which P. gives is identical with that of Hero (*Mechanica* 1.11); Eutocius (*in Sph. Cyl.* 64,15-66,7) credits Apollonius with a different construction. See Knorr 1989, 12-24.

469. organikôteran, translated 'more instrumental' by Knorr.

**470**. Identity uncertain. The architect Parmenion associated with the Serapeum (early third century BC) is possible, but the chronology is difficult. See Knorr 1989, 53-4 and notes ad loc.; also 28 n. 34.

**471.** P. provides a simplified version of Apollonius' construction as given by Eutocius. Again, Eutocius presents the construction more clearly, as follows. (I adapt the labelling to conform to P.'s account.) Let the two straight lines [i.e. AB and BC] between which it is necessary to find two mean proportionals contain right angle ABC. Describe circle KDL with centre C and radius AB, and describe circle MDN with centre A and radius BC, intersecting circle KDL at D. Join DB, DC, and DA. AC [i.e. figure ABCD] is a parallelogram with diagonal DB. Bisect DB at E. Describe a circle with centre E intersecting the extensions of BA and BC at F and G respectively, in such a way that line FG contains D, which will occur if a straightedge rotating around D and intersecting BG and

BF [more precisely, intersecting the extensions of BD and BA] is brought to where EG [where G is its point of intersection with the extension of BC] is equal to EF [where F is its point of intersection with the extension of BA] (Eutocius, in Sph.Cyl. 64,15-66,7 (Heiberg)).

**472.** P. neglects to specify that point E is the point of intersection of diagonals AC and BD, which is clear in Eutocius' account. See the previous n.

473. sc. EC and EA.

474. Emending Wallies' isopleurôn to isôn. See n. 467.

**475**. That is, if A = nC, then  $A = n^3B$ .

476. That is, their proper subject genus is broader than that of geometry.

477. For the meaning of the word 'problem', (problêma), see n. 40.

**478.** Socrates is not always a man because Socrates does not always exist; however, whenever Socrates exists, he is a man. In this way 'man' belongs to Socrates in a different way from that in which 'healthy' does. Socrates can fail to be healthy but he cannot fail to be a man. If he stops being a man, he ceases to exist, so there is no Socrates who is not a man. P., then, is claiming not that Socrates is a man only accidentally and that sometimes he may be not a man, but that sometimes (namely, when Socrates does not exist) the predicate 'man' does not belong to Socrates. However, in another sense Socrates is necessarily a man: as long as he exists he cannot fail to be a man. P. recognizes this necessity in other passages (91,13-14; 107,7-17).

**479.** That is, the subject of the major premise must be a universal: 'man', not 'Socrates'. Unlike particulars, universals are not subject to generation and perishing, so P. concludes that if the conclusion is perishable, it is because the subject term of the minor premise is perishable. A counterexample would be a demonstration that the sun (which is eternal) is eclipsed.

**480**. Namely, to the subject of the minor premise.

481. The lemma has *katholou autou* where Aristotle has *kath' holou autou*.

**482**. What Aristotle says is 'as if accidental' is not, for example, the fact that Socrates is an animal, but the demonstration and knowledge<sup>(e)</sup> of that fact.

**483.** The difference between the two readings is that the first has *tou katholou* and the second has *ou katholou*. None of the MSS cited by Ross contains the first reading. Ross prints *ou kath' holou*. See Ross 1949, 534.

**484**. Modern editors agree with P.'s preference of this reading.

**485**. I punctuate with a full stop; Wallies prints a comma.

**486**. The lemma has *hotan d' \hat{e}i toiautê* where Aristotle has *hotan d' \hat{e}i* ('but when it is').

**487**. 75b29. At 108,18-19, P. along with some Aristotle MSS, has to men estai to de ouk estai where Ross, following other Aristotle MSS, reads tôi men estai tôi d'ouk estai ('it will [apply] to one thing but not to another').

**488**. P. leaves the impression that he believes that the fact that each man is perishable prevents there being a proper demonstration that every man is an animal. On Ross's emendation (see above, n. 487), this problem does not arise.

**489**. *DA* 403a26-b6.

**490**. cf. *Metaph*. 1041b7-8: 'what we seek is the cause, i.e. the form, by reason of which the matter is some definite thing'. The claim is not (as P. indicates) that the form is the cause of the matter.

**491**. This argument proves that if there is definition of perishables it cannot be either a conclusion of a demonstration or a demonstration differing only in position; it does not prove that such a definition cannot be a principle, though P. may have considered this view too absurd to merit discussion.

492. This is intended as an example of the conclusion of a possible demonstration.

. See *Top.* 1.4-5.

. That is, not in respect of the defined form. I translate the received text, which Wallies obelizes.

. The lemma has *toiaide* where Aristotle has *toioud*', which would be translated 'in that they are of this kind of thing' – namely, things that occur repeatedly.

# Appendix: Theorems from Euclid's *Elements*

### Book 1, Prop. 1

On a given finite straight line to construct an equilateral triangle.



Let AB be the given finite straight line.

Thus it is necessary to construct an equilateral triangle on straight line AB. With centre A and distance AB let the circle BCD be drawn, and with centre B and distance BA let the circle ACE be drawn, and from point C at which the circles intersect, let straight lines CA and CB be joined to points A and B.

Since point A is the centre of circle CDB, AC is equal to AB. Again, since point B is the centre of circle CAE, BC is equal to BA. But it was proved that CA is also equal to AB. Therefore CA and CB are both equal to AB. But things that are equal to the same thing are also equal to one another. Therefore the three straight lines CA, AB, and BC are equal to one another.

Therefore triangle ABC is equilateral, and it has been constructed on the given finite straight line AB.

Which it was necessary to do.

#### Book 1, Prop. 29

[The result Philoponus refers to is only one of three claims made in this Proposition. I omit the statement and proof of the other claims.]

A straight line falling on parallel straight lines makes the alternate angles equal to one another [...].

Let straight line EF fall on parallel straight lines AB and CD. I say that it makes the alternate angles AGH and GHD equal [...] For if angle AGH is unequal to angle GHD, one of them is greater. Let angle AGH be greater. Let angle BGH be added to each. Therefore angles AGH and BGH are greater than angles BGH and GHD. But angles AGH and BGH are equal to two right angles. Therefore angles BGH and GHD are less than two right angles. But straight lines produced indefinitely from angles less than two right angles intersect. But they do not intersect because it was hypothesized that they are parallel. Therefore angle AGH is not unequal to angles GHD. Therefore it is equal [...].



Therefore a straight line falling on parallel straight lines makes the alternate angles equal to one another [...].

### Book 3, Prop. 36

If a point is taken outside a circle and two straight lines from the point fall on the circle, and if one of them cuts the circle and the other is a tangent, the rectangle contained by the whole of the straight line that cuts it and the exterior part of straight line between the point and the convex circumference is equal to the square on the tangent.

For let a point D be taken outside the circle ABC, and from D let two straight lines DC and DB fall on the circle ABC, and let DCA cut the circle ABC and BD be a tangent. I say that the rectangle contained by AD and DC is equal to the square on DB.



#### Book 5, Prop. 16

If four magnitudes are proportional, they will also be proportional alternately. Let A, B, C, D be four proportional magnitudes: as A is to B so is C to D. I say that they will also be so alternately: as A is to C so is B to D.

Let equimultiples E and F of A and B be taken, and G and H, other chance equimultiples of C and D.

Since E is the same multiple of A that F is of B, the parts have the same ratio as the same multiples of them. Therefore as A is to B, so E is to F. But as A is to B so is C to D. And therefore as C is to D so is E to F. Again, since G and H are equimultiples of C and D, therefore as C is to D so is G to H. But as C is to D, so is E to F. And therefore as E is to F so is G to H. But if four magnitudes Appendix

are proportional and the first is greater than the third, also the second will be greater than the fourth, and if equal, equal, and if less, less. Therefore if E exceeds G, F also exceeds H, and if equal, equal, and if less, less. And E and F are equimultiples of A and B, and G and H are other, chance, equimultiples of C and D. Therefore, as A is to C so is B to D.

Therefore, if four magnitudes are proportional, they will also be proportional alternately.

Which it was necessary to prove.

#### Book 6, Prop. 14

In equal and equiangular parallelograms, the sides about the equal angles are reciprocally proportional [...].

Let AB and BC be equal and equilateral parallelograms with the angles at B equal and let DB and BE lie in a straight line.



Therefore FB and BG are also in a straight line.

I say that in AB and BC the sides about the equal angles are reciprocally proportional: that as DB is to BE so is GB to BF.

Let the parallelogram FE be completed.

Therefore since parallelogram AB is equal to parallelogram BC, and FE is another parellelogram, as AB is to FE so is BC to FE. But as parallelogram AB is to parallelogram FE so is line DB to line BE, and as parallalogram BC is to parallelogram FE, so is line GB to BF. And therefore in parallelograms AB and BC, the sides about the angles are reciprocally proportional [...].

Therefore, in equal and equiangular parallelograms, the sides about the equal angles are reciprocally proportional [...].

Which it was necessary to prove.

## Book 7, Prop. 13

If four numbers are proportional, they will also be proportional alternately.

Let A, B, C, D be four proportional numbers: as A is to B so is C to D. I say that they will also be proportional alternately: as A is to C, so is B to D.

Since as A is to B so is C to D, A is a part or parts of B, and C is the same part or parts of D. Therefore alternately whatever part or parts A is of C, B is the same part or parts of D. Therefore as A is to C so is B to D.

Which it was necessary to prove.

#### Book 8, Prop. 11

There is one mean proportional of two square numbers, and the square has to the square the duplicate ratio of that which the side has to the side.

## Appendix

Let A and B be square numbers, and let C be the side of A and B the side of D. I say that there is one mean proportional of A and B, and that A has to B the duplicate ratio of that which C has to D.

For let C multiplied by D make E, and since A is a square with side C, C multiplied by itself has made A. Then for the same reason, also D multiplied by itself has made B. Therefore since C multiplied by C makes A and C multiplied by D makes E, as C is to D so is A to E. Then for the same reason also as C is to D so is E to B. And as A is to E so is E to B. Therefore there is one mean proportional number to A and B.

I say, then, that A has to B the duplicate ratio of that which C has to D. For since A, E, and B are three numbers in proportion, A therefore has to B the duplicate ratio of that which A has to E. But as A is to E so is C to D. Therefore A has to B the duplicate ratio of that which side C has to side D.

Which it was necessary to prove.

### Book 8, Prop. 12

There are two mean proportional numbers of two cube numbers, and the cube has to the cube the triplicate ratio of that which the side has to the side.

Let A, B be cube numbers and let C be the side of A and D the side of B. I say that there are two mean proportional numbers of A and B, and that A has the triplicate ratio to B of that which C has to D.

For let C multiplied by itself be E, and multiplied by D be F, D multiplied by itself be G, C multiplied by F be H and D multiplied by F be I.

Since A is a cube whose side is C, and C multiplied by itself has made E, therefore C multiplied by itself has made E and multiplied by E has made A. For the same reasons, also D multiplied by itself has made G and multiplied by G has made B. And since C multiplied by C is E and multiplied by D is F, therefore as C is to D so is E to F. For the same reasons, then, also as C is to D, so is F to G. Again, since C multiplied by E has made A and multiplied by F has made H, therefore as E is to F so is A to H. But as E is to F so is C to D. And therefore as C is to D so is A to H. Again, since C multiplied by F has made H and D multiplied by F has made I, therefore as C is to D so is H to I. Again, since D multiplied by F has made I and multiplied by G has made B, therefore as F is to G so is C to D. And therefore as C is to D so is A to H and H to I and I to B. Therefore H and I are two mean proportionals of A and B.

I say, then, that A has the triplicate ratio to B of that which C has to D. For since four numbers A, H, I, B are proportional, therefore A has the triplicate ratio to B of that which A has to H. But as A is to H so is C to D. And A has the triplicate ratio to B of that which C has to D.

Which it was necessary to prove.

### Book 11, Prop. 33

Similar parallelepipedal solids are to one another in the triplicate ratio of their corresponding sides.

### Porism to Book 11 Prop. 33

From this it is evident that if four straight lines are proportional, as the first is to the fourth so is the parallelepipedal solid on the first to the similar and similarly described parallelepipedal solid on the second, since the first line has to the fourth the triplicate ratio of that which it has to the second.

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# English-Greek Glossary

absolutely first: prôtistos absolutely primary: prôtistos abstraction: aphairesis absurd: atopos absurdity: atopon accident: sumbebêkos accidental, accidentally: kata sumbebêkos account: logos accurate: akribês activity: energeia actually: energeiâi (dat.) ad infinitum: eis apeiron, ep' apeiron add: prostithenai, be added: proskeisthai additional specification: prosthêkê adjacent: ephexês admit: epidekhesthai affection: pathos affirm: kataphaskein affirmation: kataphasis affirmative: kataphatikos all by itself: auto kath' hauto alternate: enallax alternately: enallax alternation: to enallax always-moving: aeikinêtos analysis: analusis angle: gônia angle itself: autogônia antecedent: to hegoumenon apex: koruphê apply: didonai, epharmozein, epiphêmizein, harmozein, tithenai appropriate: oikeios area: embadon arguably: eikotôs argue: epikheirein argument: epikheirêma, epikheirêsis, kataskeuê, logos arithmetic: arithmêtikê arithmetical: arithmêtikos arithmetician: arithmêtikos around the earth: perigeios art: tekhnê ascend: anatrekhein, anerkhesthai, anienai ask, ask questions: erôtan assent to: sunkhôrein assert: kataphaskein, legein, phanai assume: lambanein assume in advance: prolambanein, proüpolambanein astronomy: astronomia attempt: epikheirein attend to: epiballein attention: epistasis

attribute (n.): huparkhon, sumptôma, sumbebêkos attribute, be an accidental a. of: sumbainein automatically: êdê axiom: axiôma

base (n.): basis base (v.): poiein based on, be: ginesthai ek, sunistasthai basic: arkhoeidês, kurios beg the question: aitêsis tou zêtoumenou begin: arkhesthai beginning: arkhê being: ousia, to einai belong: huparkhein, sumbainein, prosêkein bent: kampulos better known<sup>(g)</sup>: gnôrimoteros bind together: sundeein bisect: dikha temnein, dikhêi temnein book: biblion boundary: *peras* breadth: platos bronze: khalkos (n.), khalkous (adj.) can be otherwise: endekhesthai allôs ekhein cannot be got completely through: adiexitêtos capable of laughing: gelastikos capable of perceiving: aisthêtikos capacity of perceiving: to aisthêtikon categorical: katêgorikos cause: aitia, aition cease to be: phtheirein cease to belong: apoginesthai celestial: ouranios centre: kentron change: metaballein, metabainein characteristic (n.): idion characteristic, be a c. of: hepesthai characterize: kharaktêrizein circle: kuklos circular: kuklôi, periphereia, peripherês circular line: periphereia circular proof: kuklôi deixis circumference: periphereia clear: saphês, dêlos clearly: dêlos, dêlon hoti, dêlonoti, saphôs coextensive, be: exisazein coincide: epharmozein, suntrekhein combination: sumplokê combine: sumplekein come to be present: paraginesthai

## English-Greek Glossary

commensurable: summetros common: koinos common name, by the: koinôs common usage: sunêtheia complete (adj.): plêrês complete (v.): sumplêroun complete form, in its: entelês composed of, be: sunkeisthai composite: sunthetos conclude: sumperainein, sunagein conclusion: *sumperasma* condition, be in a: diakeisthai conditional: sunêmmenos confirm: pistoun confirmation: pistis, to piston conjunction: sunodos connect: sunagein, sunaptein connected: ephexês consequence: to hepomenon consequence, as a: akolouthôs consequence, be a c. of: akolouthein consequent: to hepomenon, epagomenon consider: episkeptesthai, epitheôrein, skopein consistent: akolouthôn, sumphônos consistent, be: akolouthein constitutive: sumplêrôtikos construct: poiein, sunistasthai contain: ekhein, emperiekhein, emperilambanein, periekhein contemplate: theôrein contradict: antiphaskein contradiction: antiphasis contrariety: enantiotês contrary: enantios contrary to nature: para phusin contrast (n.): antidiastolê contrast (v.): antidiairein, antidiastellein contribute: sumballein, sunteinein, suntelein converse: antistrophos converse with: prosdialegesthai conversion: antistrophê convert: antistrephein convex: kurtos conviction: pistis, to piston conviction, that creates: *pisteutikos* convincing: pisteuomenos, pistos corollary: porisma crescent: mênoeidês cross (v.): metabainein cube: kubos culmination: telos cut: temnein

deceive: apatan, exapatan deception: apatê deduce: sullogizesthai deduction: sullogismos deductive: sullogistikos deficiency: elleipsis define: horizein defined: horistos definiendum: horistos definition: horismos, horos, logos demonstrable: apodeiktikos, apodeiktos demonstrate: apodeiknunai demonstrate previously: proapodeiknunai demonstrate simultaneously: sunapodeiknunai demonstrated: apodeiktos demonstration: apodeixis demonstration, of: apodeiktikos, apodeiktos demonstration, that involves: apodeiktikos demonstrative: apodeiktikos, apodeiktos deny: apophaskein descend: katerkhesthai describe: anagraphein, graphein determinate: hôrismenos determine: aphorizein, diorizein diagonal: diagônios, diametros dialectic: dialektikê dialectical: dialektikos dialectician: dialektikos diametrically opposite: kata diametron difference: diaphora, heterotês differentia: diaphora dimension: diastaton direct: ep'eutheias direct [proof]: hê ep' eutheias [deixis] direction: meros directly: autothen, ep'eutheias discover: exeuriskein, heuriskein discovery: heuresis discuss: dialegesthai, logon poieisthai, legein discussion: logos disk: diskos dismantle: anaskeuazein dispute: antilegein dissolution: dialusis dissolve: analuein distance: diastêma distinguish: aphorizein, diakrinein, diorizein distinguishes, that: diakritikos divide: diairein divine: theios division: diairesis do: poiein doctor: iatros doctrine: didaskalia draw: agein, ekteinein, epizeugnunai, lambanein, sunagein draw a conclusion: sunagein duplicate: diplasiazein duplication: diplôsis earlier: proteros

earthe: proteros earth: gê eclipse: ekleipsis eclipsed, be: ekleipein, eklimpanein ecliptic: zôidiakos kuklos effect: aitiatos efficient: poiêtikos element: stoikheion eliminate: anairein elision: ekthlipsis employ: khrêsthai, paralambanein enclose: periekhein end: akron, peras, telos end in: katalêgein end up: ginesthai, lêgein engage in conversation: dialegesthai engage in: energein enquire: zêtein ensouled: empsukhos enthymeme: enthumêma entitle: epigraphein enumerate: aparithmein, katarithmein equal: isos equally: homoiôs equiangular: isogônios equilateral: isopleuros equivalent, be: isodunamein, exisazein eristic: eristikos error: planê essence: ousia, einai, ên einai, to einai establish: kataskeuazein establishes, that: kataskeuastikos eternal: aidios even: artios evenly: ex isou every case, in: kata pantos evident: phaneros, prophanês, enargês examination: exetasis example: paradeigma excess: huperbolê exist: huphistanai explain: epexêgeisthai, exêgeisthai explanation: exêgêsis, paramuthia explication: anaptuxis expound: didaskein expression, as a single: huph'hen extend: prospiptein extend more widely: epi pleon exterior: ektos extreme: akros

failure to notice: anepistasia fall on: empiptein false: pseudês, pseudos falsehood: to pseudes, to pseudos falsity: to pseudos familiar: gnôrimos figure itself: autoskhêma figure: skhêma find: heuriskein, proseuriskein, peperasmenos first: prôtos first philosophy: prôtê philosophia fit on: epharmozein flow: rhusis follow: akolouthein, hepesthai, sumbainein, sunagein for the most part: hôs epi to polu forget: epilanthanein, lêthê mesolabein forgetting: lêthê form: eidos, skhêma formation: genesis found together, be: sunistasthai foundational: hupobeblêmenos foundations, be in the: hupoballesthai fraction: morion from a sign: tekmêriôdês from within oneself: oikothen full moon: panselênos

general: katholikos, koinos generally: katholou, koinôs, holôs generate: gennan generates, which: gennêtikos generation: genesis genus: genos genus, as a: *genikos* genus, in the same: sungenês geometer: geômetrês geometrical: geômetrikos geometry: geometria, geometrikê geometry, do: geômetrein get through to its end: dianuein gibbous: amphikurtos given: dedomenos, dotheis, to dedomenon gnomon: gnômon go along with: hepesthai go on to investigate: *epizêtein* go through in detail: epexienai go through: dierkhesthai, eperkhesthai, epexerkhesthai goat-stag: tragelaphos grant: sunkhôrein, didonai, homologein granted: homologoumenos grasp: hairein, lambanein greater: meizôn

half moon: dikhotomos have a nature: phuein heaven: ouranos heavy: barus hemisphere: *hêmisphairion* hold out: proteinein holds in common, that: koinos homonymous: homônumos homonymy: homônumia how many meanings has: posakhôs legetai human (adj.): anthrôpeios human (n.): anthrôpos hypothesis: hupothesis hypothesize: *hupotithenai* hypothetical: *hupothetikos* hypothetically: *ex hupotheseôs* 

idea: nous
identify: eis tauton agein
if it is: ei esti(n)

## English-Greek Glossary

ignorance: agnoia ignorant. be: agnoein illegitimate inference: paralogismos illuminate: phôtizein illumination: ellampsis illustration: hupodeigma image: phantasia imitate: mimeisthai immediate: amesos immediate cause: prokatarktikon aition immediately: euthus immortal: athanatos impassive: apathês implies, that: sunaktikos imply: sunagein impossible, it is: adunaton impossible: adunatos in effect: dunamei in fact: tôi onti in front of, be: epiprosthein in general: holôs, katholou in turn: ana meros incidental, be: sumbainein include: anagein, lambanein, periekhein incommensurable: asummetros indefinite: aoristos indefinitely: ep'apeiron indemonstrable: anapodeiktos indicate: dêloun indication: sêmeion indicator: sêmeion indifferently: homoiôs individual: atomos indivisible: adiairetos induction: epagôgê infer: epgaein, episunagein, sumperainein, sunagein, suneisagein infinite: apeiros infinite regress: to eis apeiron ienai inquiry: skepsis inseparable: akhôristos instrument: organon intelligence: nous intelligible: noêtos interior: entos interlocutor: ho prosdialegomenos intuit: epiballein intuition: epibolê invalid: asullogistos investigate: zêtein investigating: zêtêsis investigation: zêtêsis involve: ekhein irrefutability: to aluton irrefutable: alutos isosceles: isoskelês join together: episunaptein

kind: *eidos, genos* kind of knowledge<sup>(e)</sup>: *epistêmê* kind of proof: *pistis*  know<sup>(e)</sup>: epistasthai know<sup>(g)</sup>: ginôskein know<sup>(o)</sup>: eidenai knower<sup>(g)</sup>: ho ginôskôn knowing<sup>(e)</sup>: to epistasthai knowledge<sup>(e)</sup>: episteme, to epistasthai knowledge<sup>(e)</sup>-producing: epistêmonikos knowledge<sup>(g)</sup>: gnôsis knowledge<sup>(g)</sup>: to eidenai knowledge<sup>(g)</sup>: to eidenai knowledge<sup>(b)</sup>: epistêmôn known<sup>(e)</sup>: epistêtos known<sup>(g)</sup>: gnôrimos known previously<sup>(pg)</sup>, be: proginôskesthai kosmos: kosmos

labelling: onomasia law of contradiction: hê antiphasis lead: anagein learn: manthanein learn previously: promanthanein learning: mathêsis leave: kataleipein less clear: asaphesteros less well known<sup>(g)</sup>: agnôstoteros letter: stoikheion lie (v.): keisthai limit: horos, peras line: grammê line from angle to angle: diagônios line itself: autogrammê logic, of: logikos logical: logikos, organikos logical consequence: akolouthia lunar: selêniakê

magnet: lithos, magnêtis magnitude: megethos maintain: diatattein major: meizôn major [premise]: meizôn make: poiein make a contrast: antidiastellein make a difference: diapherein make a distinction: diastellein, diorizein, dialambanein make the deduction: sullogizesthai man: anthrôpos manner: tropos manuscript: antigraphon mark: episêmainein material (adj.): hulikos material (n.): hulê mathematical: mathêmatikos matter: hulê mean (n.): mesotês mean (v.): legein, phanai, sêmainein mean proportional: mesê analogon meaning: to legomenon, sêmainomenon, sêmasia measure (n.): metron measure (v.): metrein

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measure, that serves as a: metrêtikos mediate (adi.): emmesos medicine: iatrikê meet: apantan, sumpiptein member: morion memory: mnêmê mention: legein, mimnêskein, phanai method: *methodos* middle: mesos middle [term]: mesos minor: elattôn minor premise: proslêpsis, elattôn monograph: monobiblon month: meis moon: selênê more of a cause: aitiôteros more scientific<sup>(e)</sup> basis, on a: epistêmonikôteros more specific: merikôteros motion: kinêsis move: kinein moved by something else: heterokinêtos multiply: pollaplasiazein music: mousikê

name (n.): onoma name (v.): onomazein nameless: anônumos natural: phusikos natural philosopher: phusikos natural philosophy: phusikê natural philosophy, having to do with: phusikos naturally: thelei naturally fitting: prosphuês nature: phusis nature, be of a: *phuein* nature, in: têi phusei nature, in relation to: pros tên phusin nature, the study of: phusiologia necessary: anankaios necessity: anankaion, anankê necessity, of: ex anankês negation: apophasis negative: apophatikos non-being: to mê on non-deductive: asullogistos not knowing geometry: ageômetrêtos not of the same kind: anomoeidês note (v.): episêmeiousthai, sêmeioun note<sup>(0)</sup> (v.): eidenai notice (v.): prosballein notion: ennoia number: arithmos

object: enistanai objection: enstasis oblong: heteromêkês observe: theasthai, theôrein obtain confirmation: pistoun obvious: prodêlos occultation: epiprosthesis occulted, be: epiprosthesthai odd: perittos omit: paraleipein opinion: ennoia opinion, have an (or the): doxazein oppose: antikeisthai opposite: apenantios, antikeimena opposition: antithesis optician: optikos optics: optikê orator: rhêtor ordinary: koinos origin: genesis original: ex arkhês parallel: parallêlos parallelogram: parallêlogrammon part: meros, morion part, in a: en merei participate in: metekhein particular: kath' hekasta, merikos, ta kata meros, tode ti, epi merous, kata meros, ta en merei pass beneath in its course: hupotrekhein passage: khôrion, lexis, rhêtos passing (n.) underneath in its course: hupodromê pattern of phases: phôtismos pay attention: ephistanai pedantically: akribologoumenos per impossibile: di'adunatou per se: kath' hauta and kata with other forms of the reflexive pron. perceptible: aisthêtos perception: aisthêsis perceptual: aisthêtikos perimeter: *perimetros* perish: apollunai perishable: phthartos perpendicular: kathetos, isos perpendicularly below: kata katheton person who demonstrates: apodeiktikos phase: phôtismos philosopher: philosophos philosophize: philosophein philosophy: philosophia place: topos, khôra plainly: enargôs plane: epipedos plausible: *pithanos* plumb-line: kathetos plural, in the: plêthuntikôs plurality: plêthos point: sêmeion, stigmê pointed: oxurunkhos pose a puzzle: aporein pose an additional puzzle: epaporein posit: tithenai posited, be: hupokeisthai, keisthai positing: thesis position: thesis possess: ekhein

## English-Greek Glossary

possession: hexis possible: dunatos posterior: husteros postulate (n.): aitêma postulate (v.): axioun potentially: dunamei power: dunamis practical: praktikos precede: proüparkhein, proêgeisthai preceding point: to prosekhes precise: akribês precisely what: ti pote predicate (adj): katêgoroumenos predicate (n): to katégoroumenon predicate (v.): katêgorein, legein predicated, be: katégoreisthai predicated in, be: *enuparkhein* predicated in, have: enuparkhein predicated of, be: huparkhein, katêgoreisthai predicated truly, be: alêtheuein pre-established: proüpokeimenos pre-established, be: proüpokeisthai pre-exist: proüparkhein preliminary deduction: prosullogismos premise: protasis preposition: prothesis present (n.): prokeimenos present (v.): paradidonai, tithenai preserve: sôzein presuppose: proüpokeisthai presupposition: *proüpokeimenon* previous knowledge<sup>(pg)</sup>, have: proginôskein previous: proteros previously: anô, proteron previously granted: proômologêmenos previously known<sup>(pg)</sup>: proegnôsmenos, proginôskomenos previously known<sup>(pg)</sup>, be: proginôskesthai previously mentioned: eirêmenos primary: prôtos prime: prôtos principal: kurios principle: arkhê prior: proêgoumenos, proteros prior assumption: proeilêmmenon prior knowledge<sup>(pg)</sup>: *prognôsis* prior knowledge<sup>(po)</sup>, have: *proeidenai* privation: sterêsis privative: sterêtikos privatives, in the language of: sterêtikôs problem: problêma procedure: hodos, tropos proceed: exienai, ienai, perainesthai, proerkhesthai, proienai proceed in detail: epexienai produce: ekballein, prosekballein, poiein progression: proodos promote: proballein proof: deixis, kataskeuê, pistis proof per impossibile: di'adunatou deixis proper: idios property: *idion* proportion: analogon, summetria proportional: analogon proportionality: analogia propose: proballein, proteinein, protithenai proposed, be: prokeisthai proposition: apophansis, logos, protasis prove: deikununai proximate: prosekhês pursue: hepesthai put around: *peritithenai* put forward: proballein put together: suntithenai putting together: sunthesin poiêsamenon puzzle: aporia puzzled, be: *aporein* qua: hêi quadrilateral: tetragônon, tetrapleuron quality: poion, poiotês quantity: poson question (n.): erôtêsis question (v.): erôtan random: tukhon, at random: hôs etukhe rather roughly: holoskherês ratio: logos rational: logikos reason (n.): aitia, logos reason illegitimately: paralogizesthai reasonable: eikôs reasoning, that involves: dianoêtikos receive: dekhesthai, lambanein, paralambanein receive the name: onomazesthai ekhein receptive: dektikos reciprocally proportional, be: antipaskhein recognition: gnôrisis recognize: gnôrizein recognizing: gnôrisis rectangle: orthogônion rectangular: orthogônios reduce: anagein, apagein reductio ad impossibile: eis adunaton apagôgê reduction: anagôgê refer: anagein refine: diarthrôsein refutable: lutos refutation: elenkhos refute: dielenkhein, elenkhein region: topos related: keimenos relation: logos, skhesis relative: pros ti relevant, be: khôran ekhein remain: leipein remainder: ta kataleipomena remaining: loipos remove: aphairein

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reputable: endoxos reservation: sôzein resolve: analuein rest (n.): êremia restricted: hôrismenos result: to sumbainon result from: ginesthai ek reveal: dêloun revolution: peridinêsis rhetoric: rhêtorikê rhetorical: rhêtorikos ridiculous: geloios right: orthos right angle: orthê road: hodos rule standard: kanôn same kind, of the: homoeidês scalene: skalênos science<sup>(e)</sup>: epistêmê science<sup>(m)</sup>: *methodos* scientific<sup>(e)</sup>: epistêmonikos screen (v.): antiphrattein screening (n.): antiphraxis script: tupos section: tomê seek: zêtein segment: tmêma self-constituted: authupostatos self-guaranteeing: autopistos self-moving: autokinêtos semicircle: hêmikuklion sense: dianoia separate: khôrizein separately: *idiâi* (dat.) set out: ektithenai shadow: skia shape: skhêma shine on: katalampein show: apophainesthai, deiknunai, dêloun side: pleura, meros sight: opsis sign: sêmeion, tekmêrion signify: dêloun, sêmainein signifying: *sêmantikos* simple: haplous simultaneously: hama simultaneously eliminated, be: sunanairein slight pause: hupodiastolê snub: simos snubness: simotês solar: hêliakos solid: stereos solution: epilusis, lusis solve: epiluein, estin epilusis, luein sophist: sophistês sophistic: sophistikos sophistical: sophistikos sought: *zêtoumenos* sought, the: to zêtoumenon soul: psukhê

sound, be: hugiôs ekhein space: khôrion species: eidos specific: eidikos, idikos specific sense, in a more: eidikôteron legomenos specification: prosdiorismos specify: prosdiorizein speech: logos sphere: *sphaira* spherical: sphairikos, sphairoeidês square (adi.): tetragônos square (n.): tetragônon standard: metron starting point: arkhê state (n.): hexis statement: logos stationary, be: histasthai stereometry: stereometria still exist: sôzein stone: lithos straight: euthus straight line: eutheia, ep' eutheias straight line, in a: ep'eutheias straightaway: euthus straightness: to euthu, euthutês strict sense, in the: kuriôs strictly speaking: kuriôs student: akroatês, mathêtês study: theôria subalternate: hupallêloi subject (adj.): hupokeimenos subject (n.): hupokeimenon subject, be the: hupokeisthai subject, have as a: ginesthai epi subject to generation: en genesei, genêtos subject to perishing: phthartos subsequently: akolouthôs substance: ousia substantial: ousiôdês substitute: antimetalambanein. metalambanein substitution: metalêpsis substrate: hupokeimenos subtend: hupoteinein subtract: aphairein superfluously: perittôs, perissôs supply in thought: prosupakouein, sunupakouein suppose: hupolambanein, huponoein, keisthô supposed, be: keisthai surface: epiphaneia systematically: hodôi take: apolambanein, eklambanein, lambanein, paralambanein take place: ginesthai teach: didaskein, paradidonai teaches, that: didaskalikos

teachable: didaktos

teacher: didaskalos, ho didaskôn

## English-Greek Glossary

teaching: didaskalia temporally: khronikôs term: horos, onoma text: graphê 'that', the: to hoti that it is: to hoti esti(n) theorem: theôrêma theoretical: theôrêtikos theory: theôria thesis: thesis think: dokein, epinoein, nomizein, oiesthai think about: diaskopein think of: enthumeisthai think something worthwhile: axioun thought, dianoia, epinoia time: khronos topic: theôrêma treat: dialambanein treatise: pragmateia treatment: pragmateia triangle: trigônon true: alêthês trustworthy: axiopistos truth: alêtheia, to alêthes turn: neuein turn back: anakamptein turning back: anakampsis two ways, in: dittôs

ultimate: eskhatos unchangeable: ametaptôtos unclarity: asapheia unclear: asaphês, adêlos unconnected: asunartêtos underlying: hupokeimenos understand: akouein, entheôrein, hupakouein, hupolambanein, noein, sunepinoein, sunienai unequal: anisos uniform: hoimoiomerês unique: monadikos, idios unit: monas universal (adj.): genikos, katholikos, katholou universal (n): katholou universe, the: to pan unknown<sup>(g)</sup>: agnôstos un-odd: aperittos unrecognized: agnooumenos

valid: errômenos verbal expression: phônê visible: horatos void: kenos

wandering: planê what is not: to mê on what it is: ti esti(n) what it signifies: ti sêmainei what precisely: ti pote whole: holos, plêrês why, the: to dioti without an intermediate: amesos without demonstration: anapodeiktôs without magnitude: amegethês without parts: amerês without qualification: haplôs word: onoma, onomasia work: sungramma write: graphein

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\* indicates the occurrence of a word in the lemmata, as opposed to Philoponus' commentary.

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