

The Supposed Material Cause in *Posterior Analytics* 2.11

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Abstract

Aristotle presents four causes in *Posterior Analytics* 2.11, but where we expect matter we find instead the confusing formula, ‘what things being the case, necessarily this is the case,’ and an equally confusing example. Some commentators infer that Aristotle is not referring to matter, others that he is but in a non-standard way. I argue that *APo.* 94a20-34 presents not matter, but determination by general features or facts, including facts about something’s genus. The closest connection to matter is Aristotle’s view that the relation between genus and species is analogous to that between matter and a hylomorphic compound.

Keywords

Aristotle; causation; matter; demonstration

1. Introduction

Posterior Analytics 94a20-35, which presents four causes (*aitiai*), has a well-known and stubborn problem: where we expect the material cause to be discussed, we find what looks like something else, though it is not clear exactly what.¹ The causes are listed as (1) ‘the what-it-is-to-be’, (2) ‘what things being the case, necessarily this is the case’, (3) ‘what first brought about the change’, and (4) ‘that for the sake of which’. All of these are recognizable descriptions of the canonical four causes except the second. Nor does the example Aristotle gives in the passage clarify matters: we are given a sample demonstration concluding that an angle inscribed in a semi-circle is a right angle, in virtue of the fact that it is ‘half of two rights’, where this feature is supposed to be the middle term, hence

¹ For ease of reading, I will sometimes translate *aitia* in what follows as ‘explanation’ rather than the more traditional ‘cause’, without wishing to imply that Aristotle means to indicate something epistemological as opposed to something metaphysical. Where I do mean to refer to something like a pattern of explanation as opposed to what it cites, I say so explicitly. Nothing in what follows turns on what one takes to be a preferable or acceptable translation of *aitia*.

the cause in this second sense, in virtue of which the angle is right. To the extent that this passage is unclear, so also is the early history of the concept of matter, especially since, if *APo.* is earlier than the *Physics* and the *Metaphysics*, as is generally agreed, it may well be the first passage in which Aristotle draws a fourfold distinction among causes.

Commentators split between those who argue that Aristotle is describing the canonical material cause, ‘that out of which something comes to be, and which is present in it (*enuparchontos*)’ (*Physics* 2.3, 194b24), but in a non-standard way, and those who argue that this presentation cannot be referring to matter as it appears in the rest of the corpus.² The former seems in one way to be the simplest hypothesis: we do not have a clear alternative that might occupy the place of matter here, nor is there any mention of a fifth *aitia* who quit before the others got famous. Since the formula is vague and the example Aristotle gives is puzzling in its own right, commentators understandably look for ways in which they may be interpreted as referring to a kind of material explanation after all. There is, they note, a well-known passage in the *Physics* (2.3, 195a18-19 = *Metaphysics* 5.2, 1013b20) which states that hypotheses are the matter of a conclusion, which has usually been interpreted to mean more generally that the premises of a syllogism may be regarded as the matter for their conclusion. Further, they suggest, by looking at the geometrical proofs to which Aristotle is indirectly referring, we might see a way to think of the inscribed angle as ‘constituted’ by half of two right angles.³

Those who argue against identifying this cause with matter point out that the text does not actually indicate the premises (or hypotheses) of the conclusion as the cause: the cause in the example is stated to be the middle term, ‘half of two rights’, not the premises taken together, nor any more basic proposition about the term. The claim that the hypotheses are the matter of their conclusion is in any case obscure, and it is unfortunate if we must interpret Aristotle as intending to use such an out-of-the-way example to introduce a general notion, and then in fact naming something quite different as the cause.⁴ Indeed, as Malink 2017 has persuasively argued, Aristotle’s

² Those who hold that Aristotle is describing matter include: ps.-Philoponus (*In APo.* 376.19-21 Wallies), Balme 1992, 83-4 and 1994, 227, Leunissen 2010, 184-6, and Malink 2017, 190; for further references see Malink 2017, 190 n. 83. Those who argue that this cannot be matter include: Ross 1949, 638-42, Dancy 1978, 373-7, Graham 1987, §6.1, and Goldin 2009, 167.

³ The proofs and their interpretation are discussed further below.

⁴ Commentators all the way back to Alexander have found the use of hypotheses as an example of matter perplexing; see Simplicius, *In Phys.* 320.1-11 Diels. The efficient and final causes are illustrated with straightforward examples of aggression bringing on a counter-attack and health, respectively; the illustration of the formal cause remains somewhat baffling, partly because it is evidently tied to the presentation of the

claim in the *Physics* is referring to the hypotheses (i.e. indemonstrable premises) of demonstrations, not to the premises of conclusions for syllogisms generally, so commentators are mistaken to find that view appealed to here by the bare reference to entailment.⁵ Further, they argue, the proofs alluded to do not actually construct the angle in the semi-circle out of ‘half of two rights’ or two halves of two right angles.⁶ Finally, and perhaps most importantly, Aristotle is quite clear that the cause presented here necessitates its conclusion, whereas matter as elsewhere described does not necessitate what it causes, but is rather necessitated by formal or final causes.⁷ So, since ‘matter’ (*hylē*) does not appear anywhere else in the *Organon*, we should be open to the possibility that he is not referring to it here either, perhaps because he had not yet developed the concept.

Neither option is especially satisfying. If Aristotle is describing matter, we do not have a convincing account of why he would describe it this way; if he is not, we lack a clear alternative candidate for what he is describing.⁸ Certainly the only reason to interpret the passage as referring to matter is that the fourfold schema everywhere else in the corpus includes the above (1), (3), (4) and matter, but the proposed interpretations are strained. We are stuck, it seems, between a reading of the passage which makes little textual or philosophical sense on its own, and an equally unappealing interpretation to the effect that what we are being given is something that is not matter, but is not clearly anything else, and which is quietly dropped and replaced by matter in the physical and metaphysical works for unspecified reasons and without comment.

One option which has not been explored in interpreting this passage is the connection Aristotle sees between the material cause and the notion of a genus, considered as an underlying subject (*hupokeimenon*) of differentiae, a connection he makes several times in the *Metaphysics*.⁹ In

‘material’ cause (see Ross 1949, 641-2; Barnes 1994, 227-8).

⁵ See esp. 190 n. 83. The interpretation of this passage as referring to the premises of the conclusion is not improved, however, by taking it to refer only to indemonstrable principles, nor does Malink claim that it does.

⁶ See Ross 1949, 641. For criticism of Barnes’ attempt to see such construction as implicit in the proof alluded to, see Dancy 1974, 377 n.

⁷ Balme 1992 argues that while matter does not in general necessitate, Aristotle has chosen for this context an area in which it does, so that necessitation is incidental to the mode of causation being presented here (84), but other commentators have not followed him in this.

⁸ Ross suggests, assuming the reference is indeed to the premises of a syllogism, the ‘eternal ground’ of an eternal truth, or more accurately, the cause of its being known (640-1, against which see Barnes 1994, 226); Graham 1987 follows Ross to the extent of interpreting Aristotle as referring to the ‘logical ground’. Dancy 1978 does not speculate, but rather argues that, even though Aristotle must have meant to indicate matter, what we are given in this passage simply is not matter (377).

⁹ Aristotle refers to the genus as matter in several passages of the *Metaphysics*: 5.6, 1016a24-8, 5.28,

one way, this is not surprising, since the text itself does not mention the notion of a genus or really contain other obvious indications that Aristotle has genera in mind. In another way, though, it is very surprising: it is not as though the text contains any clear resonances with other key concepts associated with the core notion of matter (such as subject, *hupokeimenon*, constituent, *to ex hou*, part, *meros*, or potentiality, *dunamis*), and the passage must be stretched in perplexing ways to integrate them as well. Further, if this passage does represent an earlier stage in Aristotle's understanding of material causes, or an earlier way of describing them, the connection to the concept of *genos* – which resonates with Platonic and early Academic discussions of definition, and with Aristotelian dialectic as presented in the *Topics* (also agreed to be early) – would be a prime candidate, at least as plausible and worthy of attention as any of the other options that have been proposed.

I think, in fact, that this connection is what Aristotle is indicating, at one remove. Aristotle is referring, in effect, to the fact that something may bear a given property for generic or universal reasons, i.e. for reasons that are not specific to it as an individual or to its specific nature or subtype, and that when this is the case, we need to pick out what general facts or features entail that it does indeed have that property. This is a sensible and common way of explaining a thing's properties, one which is congenial both to proofs like the one in the text, and to explanations that derive from the genus of a natural species: this type of triangle has angles summing to $2R$ because all triangles do; humans are mortal because all animals are. Indeed, Aristotle frequently elucidates proper explanatory and demonstrative practice in the *Analytics* with the former example: we must, he says, explain the fact that isosceles triangles have angles summing to $2R$ by reference to the fact that they are triangles, not insofar as they are isosceles.¹⁰ This is a form of explanation that would also have been familiar to anyone with knowledge of the Academy – it is, after all, a marked commitment of Platonism, familiar from the central books of the *Republic*, that understanding ultimately depends on ascending to a grasp of higher, more basic principles, which must eventually terminate in something 'unhypothetical'. For the sake of having neutral but informative terms (and to avoid constant use of scare-quotes) I shall refer to this type of explanatory relationship as 'general

1024a29-b9, and 7.12, 1038a3-9 are the most prominent, and are discussed below. How, and how literally, to view this connection is discussed by Rorty 1973 and 1974, Grene 1974, and White 1975, as well as, less directly, Balme 1992, though Grene, n. 10, 68-9 includes further correspondence with Balme on the question directly. See also Granger 1984, 19-20.

¹⁰ He mentions or develops this point at *APr.* 48a33-36, as well as *APo.* 73b38, 74a17, 74a25-32, 85a27-8, 85b5-15, 85b39-86a2, 86a26, and 91a4.

determination' and to such causes as 'general causes', but without presuming anything as to how such determination might ultimately relate to matter.

It is a further step from this notion of something's holding because of generic or universal reasons to the idea that it holds because of a thing's genus, which would seem to be only one type of such determination, and yet another step from this to the notion of a thing's matter. To make the case plausible, we need to have reason to think that this sort of explanation might indeed be at issue, both in this passage itself and the example of the inscribed angle (Section 2 below), and that it is an important type of explanation for Aristotle, at least in the *Posterior Analytics* (Section 3). We must, further, have a reasonable account of how the notion of general determination might be transformed, either conceptually, developmentally, or both, into the material cause of the physical works, which will then allow us to assess how strong or weak the connection really is (Section 4).

If this is correct, what *APo.* 94a20-34 presents is not the canonical material cause, but a form of explanation by appeal to general features or facts, which include something's genus. The most direct route from this text to Aristotelian matter as presented in the physical works is therefore by way of Aristotle's view that genus and matter are both less determinate subjects (*hupokeimena*) of more determinate forms (*eidē*). This form of explanation is not at all inconsistent with material-causal explanation, and indeed is ultimately congenial to it in many respects, but it does not require or directly pertain to the notion of an inherent, underlying subject for change, or an enduring constituent out of which something comes to be. The balance of evidence thus suggests that what is being presented in the *APo.* is distinct from but analogically related to the material cause of the physical works, and is either logically or developmentally prior to it, or both.

2. General Determination in 2.11

APo. 2.11, 94a20-34, presenting the types of cause, runs as follows:

Since we think we understand whenever we know the cause, and there are four causes – one being 'what it is to be', one being 'what things being the case, necessarily this is', another being 'what first brought about the change', and fourth 'for the sake of what' – all of these are proven through the middle term. For 'that which, being the case, necessarily this is', cannot be derived from one premise, but rather from at least two; and this is the case, whenever they have one middle term. It is also clear in this way: Why is the [angle] in the semi-circle right? What being the case, is it right? Let what is right be A, half of two rights B, the [angle] in the

semi-circle C. The cause of A, right, belonging to C, the [angle] in the semi-circle, is B. For this, on the one hand, is equal to A, while C is [equal] to B; for it is half of two rights. So, since B is half of two rights, A belongs to C (and this is the angle in the semi-circle's being right).¹¹

The form of explanation being offered thus runs, sparsely: 'Certain things being the case, necessarily, something is [F].' The example is introduced by a question, which is then shifted into this form from a 'why' question: 'Why is the [angle] in the semicircle right? What being the case, is it right?'¹² It then shows that an angle inscribed in a semi-circle is a right angle because, evidently, it is equal (or at least equivalent) to 'half of two rights', and 'half of two rights' is equal to 'right'.

Syllogistically, the demonstration runs:

1. *Right* (A) belongs to *half of two rights* (B).
2. *Half of two rights* (B) belongs to *the angle in the semi-circle* (C).
3. Hence, *right* (A) belongs to *the angle in the semi-circle* (C).

The reasoning in the passage itself is summed up with the same 'something's being the case, this is' phrasing as in the initial formula: 'Since B is half of two rights (τοῦ Β οὖν ὄντος ἡμίσεος δύο

¹¹ ἐπεὶ δὲ ἐπίστασθαι οἰόμεθα ὅταν εἰδῶμεν τὴν αἰτίαν, αἰτίαι δὲ τέτταρες, μία μὲν τὸ τί ἦν εἶναι, μία δὲ τὸ τίνων ὄντων ἀνάγκη τοῦτ' εἶναι, ἑτέρα δὲ ἢ τί πρῶτον ἐκίνησε, τετάρτη δὲ τὸ τίνος ἕνεκα, πᾶσαι αὐταὶ διὰ τοῦ μέσου δείκνυνται. τὸ τε γὰρ οὗ ὄντος τοδὶ ἀνάγκη εἶναι μιᾶς μὲν προτάσεως ληφθείσης οὐκ ἔστι, δυοῖν δὲ τοῦλάχιστον· τοῦτο δ' ἔστιν, ὅταν ἐν μέσον ἔχωσιν. τούτου οὖν ἐνὸς ληφθέντος τὸ συμπέρασμα ἀνάγκη εἶναι. δῆλον δὲ καὶ ὧδε. διὰ τί ὀρθή ἢ ἐν ἡμικυκλίῳ; τίνος ὄντος ὀρθή; ἔστω δὴ ὀρθή ἐφ' ἧς Α, ἡμίσεια δυοῖν ὀρθαῖν ἐφ' ἧς Β, ἢ ἐν ἡμικυκλίῳ ἐφ' ἧς Γ. τοῦ δὴ τὸ Α τὴν ὀρθὴν ὑπάρχειν τῷ Γ τῇ ἐν τῷ ἡμικυκλίῳ αἰτίον τὸ Β. αὕτη μὲν γὰρ τῇ Α ἴση, ἢ δὲ τὸ Γ τῇ Β· δύο γὰρ ὀρθῶν ἡμίσεια. τοῦ Β οὖν ὄντος ἡμίσεος δύο ὀρθῶν τὸ Α τῷ Γ ὑπάρχει (τοῦτο δ' ἦν τὸ ἐν ἡμικυκλίῳ ὀρθὴν εἶναι). All translations are mine. The quotation marks in my translation of this passage are meant to preserve the fact that the passage presents each cause with a definite article, which often has a quotation-like function, and an interrogative pronoun. This differs from the canonical presentation in the *Physics* (2.3, 194b23-35, = *Metaph.* 5.2, 1013a24-34), in a way which may indicate a closeness with the kind of question and answer context of Aristotelian dialectic. For example, in the *Physics* the efficient cause is simply 'The primary principle of change or rest' (ἡ ἀρχὴ τῆς μεταβολῆς ἢ πρώτη ἢ τῆς ἡρεμῆσεως, 194b29-30), and the final cause is simply 'the end, and this is that for the sake of which' (τὸ τέλος· τοῦτο δ' ἔστιν τὸ οὗ ἕνεκα, 194b32-3). In this passage, by contrast, they are ἢ τί πρῶτον ἐκίνησε and τὸ τίνος ἕνεκα, respectively.

¹² The move from plural to singular suggests that a plurality of conditions is not required for the explanatory relationship as such, but rather for it to be proven syllogistically (further weakening the case for seeing a reference to the premises of a syllogism as causes). The reference to a plurality of premises seems driven rather by the general claim that all the types of cause are proven through a middle term, since the point that the general cause cannot be derived from one premise alone is presented as a reason in support of it.

ὀρθῶν), A belongs to C (and this is the angle in the semi-circle's being right' (94a32-4).

What follows from the fact that the B term is 'half of two rights,' or, to slide from mention to use as Aristotle is wont to, from what half of two rights is? Aristotle presents the reasoning in terms of equivalence claims (perhaps, as Barnes 1994, 227 suggests, because this is how the geometers would do it), which amount to two general truths:

1. $R = \frac{1}{2} \cdot 2R$

2. An angle inscribed in a semi-circle = $\frac{1}{2} \cdot 2R$

So, because half of two rights is equivalent to right, and applies to any angle inscribed in a semi-circle, any such angle is right.

This much is uncontroversial, and constitutes all the explicit reasoning Aristotle presents in the passage. What, though, is actually being asserted about causation or explanation, and how does it relate to the material cause?

Some difficulties with taking the example to be referring to the premises of the syllogism have been noted above, including perhaps most importantly that it is the middle term, 'half of two rights', which is named as the cause. It is preferable, on the whole, to assume that Aristotle's examples are exhibiting something his audience would have recognized without recourse to such an obscure example, and without having to interpret his own words as explicitly but incorrectly naming as the cause something other than that what he is supposed to mean.

It is unclear, however, how the middle term, 'half of two rights' could indicate a more standard example of matter either, and so, besides citing the example of the hypotheses as matter, commentators have turned to the Euclidian-style proofs to which Aristotle may be referring as background. Two primary candidates for the background proof are typically cited: Euclid 3.31, and a different proof for the same conclusion indicated by Aristotle himself at *Metaphysics* 9.9, 1051a24-9.¹³ Euclid 3.31 does not specify any particular inscribed angle (see Fig. 1), whereas the proof mentioned in the *Metaphysics* specifies the inscribed angle which is formed at the point on the semi-circle where it intersects the radius perpendicular to the diameter, which thus divides it in half (see Fig. 2).

¹³ Barnes 1994 favors Euclid's proof, for the steps of which see Heath 1908, 63; Ross 1949, 641 favors the one from the *Metaphysics*, also described by Heath (ib.), of which Dancy 1978 offers a somewhat different version. Leunissen's reconstruction differs somewhat from both (2010, 185).

The proofs are similar, but not the same. Euclid’s proof works by showing that the inscribed angle must be equal to the adjacent angle on the line formed by extending BA through F, and by appealing to the definition of a right angle (1.10), which states that if a line set on a straight line makes a pair of equal adjacent angles on it, both angles are right. The proof in the *Metaphysics* works by showing that, since this particular inscribed angle may be divided into two isosceles triangles, the divided angle must be equal to half the angles of the whole triangle formed with the diameter, which is equal to $2R$. We then generalize to reach the conclusion on the basis of the prior principle that all inscribed angles in the same segment are the same (Ross and Heath, as cited in n. 13 above, appeal to Euclid 3.21 for this).

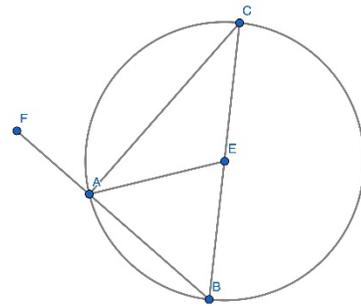


Figure 1 (following Heath 1908)

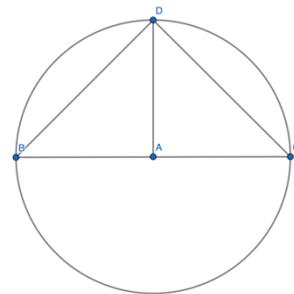


Figure 2 (following Ross 1949)

Now, Aristotle’s canonical descriptions of matter take two forms: something’s matter is (a) ‘that out of which something comes to be, which is present in it (*enuparchontos*)’ (*Phys.* 2.3,

194b24 = *Metaph.* 5.2, 1013a24-5), and (b) that which is capable of being or not being [some F].¹⁴ It is difficult to see, though, on either proof, how ‘half of two rights’ could be either the enduring subject out of which the inscribed angle’s being right comes to be, or that by which the inscribed angle is capable of being or not being right: the fact is eternal, so it does not come to be at all; it is necessary, so the angle can only be right, nor can *half of two rights* be anything but *right*. One might argue that the angle is wholly constituted by (i.e. has as ‘intelligible matter’) an angle, the same size as itself, which is half of two right angles, i.e. a right angle – but this an odd thing to say, and does not correspond to any step in either proof or in Aristotle’s reasoning in the passage.¹⁵ Nor, if we think of the process of constructing a proof, is it helpful to think of the angle as being made ‘out of half of two right angles, or the halves of two different right angles. The details of the background proof, then, do not make for a promising interpretation of ‘half of two rights’ as matter. If that is nevertheless the way in which Aristotle is intending to illustrate material constitution, he is giving a poor example and a bizarre explanation of it.

If instead Aristotle is simply saying that the inscribed angle is half of two rights because it is equivalent to one of two equal halves of a line (= 2R) intersected by a perpendicular (Euclid’s proof), or equal to half the angles of a whole triangle (the *Metaphysics* 9 proof), he is saying something clear and accurate. The background reasoning, whichever proof we think is being alluded to, concerns, of course, basic features of circles, triangles, the sums of their angles, and in general depends on the whole axiomatic structure of geometry as it was being developed. Both rely on the fact that a triangle formed from the inscribed angle and the diameter will be divided into isosceles triangles formed from radii, and hence will have equal base angles, and, as triangles, will follow the

¹⁴ (a) is perhaps better known given its presence in the canonical statement of the four causes in *Physics* 2, but (b) seems to be equally basic, if not more so. See, e.g. *Metaph.* 7.7, 1032a20: ‘All things that come to be either by nature or by craft have matter; for each of them is capable both of being and of not being, and this capacity is the matter in each’; and *GC* 335a32: ‘So then, that which is able to be and not be is the cause as matter, for the things that come to be.’ The latter passage is describing generation and destruction, but the former passage is discussing change in any category (1032a14-15). On the relative importance of this description of matter, see Henry 2019, ch. 4.

¹⁵ Since the example and the reasoning about it are reasonably clear, commentators have few good options when it comes to saying how half of two rights might nevertheless be the matter of the conclusion. Barnes 1994 states: ‘as the proof itself indicates, the angle in the semicircle is constructible out of the halves of two right angles, which are thus its “matter”’ (227). But Aristotle cites being ‘half of two rights’ as the cause, not ‘two halves of two rights’. Further, as Dancy 1978 points out, Euclid 3.31 does not construct the angle in this way, and in the alternative proof the fact that it may be construed as composed of two halves of two right angles (which are not actually constructed in the proof) plays no role. Leunissen 2010, differently, glosses the proof as yielding a notion of matter because ‘The angle in a semicircle is by necessity a right angle *given that it is two rights – divided in half*’ (186, original italics).

2R rule. As noted above, this fact is mentioned frequently in the *Analytics* – enough that the audience need not be reminded of it explicitly.¹⁶ Euclid’s proof also relies on the previously established definition of a right angle, whereas the *Metaphysics* proof relies on a prior proof that all inscribed angles on the same segment are the same. Further, though the proofs make use of triangles, the question and the explanation explicitly concern angles, not triangles. So it is fair to say, though it perhaps seems too obvious to be worth mentioning as a step in the reasoning, that the example also involves reasoning from general and in some cases antecedently established facts about triangles to facts about a particular class of angles.

The explicit reasoning in the passage, then, along with the background knowledge it presumes, would thus constitute a clear example – if that were the author’s intent – of showing that something holds because it follows necessarily from certain general principles, including, in particular, facts about more general kinds than the ones being discussed. This is a straightforward type of explanation: A holds of C because of certain general facts that do not pertain to C directly or as such, i.e. as being whatever individual or type of individual that it is. I take it that something like this would be the default analysis of the passage, were there not strong reasons to seek some reference to underlying matter, in spite of the needless obscurity – even by Aristotle’s standards – this would involve.

The primary drawbacks of this interpretation are therefore just that (1) this kind of reasoning appears to be very different from the explanatory roles ascribed to matter as described in the physical works, nor is it obvious how this difference could turn out to be merely apparent; (2) it is not clear why Aristotle would include general determination among his four basic types of *aitia* in this passage of the *APo*. However, the costs of trying to find the material cause in this passage are high enough that we should prefer an interpretation which makes sense of the explanatory relationship being described in the text, such that this relationship might be transformed by plausible steps into something that does resemble the Aristotelian material cause.¹⁷

¹⁶ See above, n. 10.

¹⁷ General facts would certainly include the hypotheses Aristotle names as the matter of conclusions in the *Physics* (195a15-16) – which he presents as an instance of matter, not as an analogical extension. So we might push further to argue that our passage in *APo* is, after all, indicating matter. However, the example of hypotheses is presented as falling under the general heading of *to ex hou*, which indicates constitution. And while Aristotle may well have included indemonstrable principles among his general determinants, it is hard to justify the thought that in this passage he is indicating the relevant sense of composition – which in the *Physics* also applies to the relation between material parts and their wholes, and between letters and syllables – by describing the way in which general features of triangles necessitate certain features of more determinate

3. Explanation from prior to posterior in *APo*.

If we take the phrases ‘what things being the case, necessarily this is’, and ‘that which, being the case, necessarily this is’, on their face, they seem to indicate nothing more (nor less) than entailment of one thing by something that is, as implied by the genitive absolute (τινων ὄντων) in some sense prior to what is entailed. It indicates, that is, that if we take something to be true, it fixes or determines something else that might otherwise be open. It is true, as Ross and others have pointed out, that this formula resembles the definition of a syllogism given at *APr.* 24b18-20: ‘A syllogism is an account in which, some things being laid down, something other than the things stated follows of necessity by their being the case.’¹⁸ However, there are differences between the two formulas, including the fact that the definition of the syllogism refers to things being ‘posited’ or laid down (τεθέντων τινῶν, τῶν κειμένων), whereas the mode of explanation described in our text simply speaks of certain things being the case (τίνων ὄντων / τίνοϛ ὄντοϛ – as noted above, n. 12, Aristotle uses both the plural and the singular form). Moreover, similar phrases appear numerous times in the *Topics*, where they bear no obvious connection to the formal notion of a syllogism, and instead simply mean that something is the case because it follows from something else that is being taken as antecedently established, or as held fixed for the sake of dialectical examination. For example (111b16-24):

Look whether, concerning what is proposed (τοῦ προκειμένου), what is proposed holds when something is the case (τίνοϛ ὄντοϛ τὸ προκείμενον ἔστιν), or if something is the case by necessity (ἐξ ἀνάγκηϛ) if what is proposed holds. In wishing to establish something, on the one hand, [look whether] if something is the case (τίνοϛ ὄντοϛ), what is proposed will be the case (for if the former is shown to

subtypes of triangles or of inscribed angles. If there is a shared background understanding of a specific sort of constitution relation applying to all these examples, on which see Malink 2017, Aristotle’s presentation does nothing to evoke it. By contrast, Balme 1992, arguing that this passage in 2.11 is referring to the premises as matter for the conclusion, claims: ‘What is common to every kind of matter is that it is that out of which the product is produced’ (84); but if this is all there is to the claim, then it is hard to avoid the conclusion that it is better off as a metaphor.

¹⁸ συλλογισμὸς δὲ ἐστὶ λόγος ἐν ᾧ τεθέντων τινῶν ἕτερόν τι τῶν κειμένων ἐξ ἀνάγκηϛ συμβαίνει τῷ ταῦτα εἶναι.

hold, what is proposed will have been shown); on the other hand, in wishing to overthrow something, what is the case if what is proposed is the case; for if we have shown that what follows from what is proposed is not the case, we will have refuted what is proposed.¹⁹

This phrasing then, does not directly evoke the notion of a syllogism, and still less the obscure thought that the premises of a syllogism might be taken as its matter. In general, at least, it seems only to indicate necessary consequence from something taken to be fixed antecedently.²⁰

In the context of the *Posterior Analytics*, however, this notion of necessary consequence is not as thin as it sounds. In a demonstrative science like geometry, the only relevant notion of ‘antecedence’ is what Aristotle would call unqualified priority – i.e. logical or metaphysical priority – and hence we move right away from the idea of showing that something holds necessarily in virtue of some antecedent fact, to showing that it holds necessarily in virtue of more basic, and so more general facts.²¹

It is, indeed, crucial to the project of a demonstrative science, as Aristotle is clearly aware, that propositions be explained appropriately, and that this requires them to be explained at the right level of generality, as the example of isosceles triangles’ following the 2R rule is used to show. This point about appropriate generality is, further, explicitly related by Aristotle to the demands of giving a correct explanation (*aitia*) of the sort required by demonstration. Someone who showed of each type of triangle that it follows the 2R rule would not have understanding of the fact that triangles

¹⁹ Another example comes at 113a24-5: ‘Or, [see whether] if something of this sort is said of something, such that if this is the case, necessarily, contraries belong [to the same subject]’ (ἢ εἴ τι τοιοῦτον εἴρηται κατά τινος, οὗ ὄντος ἀνάγκη τὰ ἐναντία ὑπάρχειν). At 153b29-30 Aristotle also uses the genitive absolute construction for something agreed to be true (ἐνός . . . ὁμολογηθέντος) in order to derive necessary consequences, though without the τίς ὄντος phrase.

²⁰ Outside the *Topics*, the phrase is occasionally used, mainly without any obvious reference to a pattern of reasoning, syllogistic or otherwise, but just to represent antecedent conditions (as e.g. at *GC* 320b18, *GA* 723a1, *Metaph.* 1018b36). In a passage from the *PA* (677a18), τίνων ὄντων is used to indicate just that when some things are the case about bodies, other things follow necessarily, meaning apparently that certain bodies will just produce certain kinds of residue because of the way they function, and we do not need to seek any further reason for their production such as a final cause. Barnes (1994, 226) cites this in favor of the view that matter can after all necessitate its effects (and so in defense of reading this passage as referring to material causation), but Aristotle is clearly describing the results of certain causal processes, not necessary effects of having a certain type of matter.

²¹ Canonically, *APo.* tells us that the premises of a demonstration must be prior (*protera*) and unqualifiedly more intelligible (*gnōrimōtera haplōs*), rather than relative to us (71b20-72a6).

follow the 2R rule, either as such or universally, even if there were no other types of triangle left out – only someone who knows it to hold of triangles *qua* triangles knows this (74a25-32). A ‘demonstration’ of this fact which applied to isosceles triangles as such would be an explanation (*aitia*) only to the audience at best (85b22) – that is, merely apparently.

Aristotle examines the issue more closely in *APo.* 1.24, when discussing a dispute over whether universal (*katholou*) or particular (*kata meros*) demonstrations are better. He concludes that universal demonstrations are superior for several reasons. Invoking the point about isosceles triangles and the 2R rule, he claims that ‘the person who knows each thing *as* each thing belongs knows it better’ (85b9), hence, in a case like this, where *triangle* applies synonymously to many subtypes, and 2R holds of them *qua* triangles, it belongs to isosceles *qua* triangles, not *qua* isosceles, so this is better known universally (85b9-13).

A further, related reason in favor of the same conclusion connects this point even more explicitly to the causal requirement for the premises of a demonstration (85b23-7):

Further, if a demonstration is a syllogism that reveals explanations (*aitias*) and the reason Why, the universal is more explanatory (*aitiōteron*) (for that in virtue of which something belongs in itself, this is the cause for itself; but the universal is primary; therefore, the universal is the cause). So too the [universal] demonstration is better: for it more than [particular demonstration], is of the cause and the Why.²²

Thus, at least for cases like this, Aristotle argues firmly for the conclusion that universal demonstrations are better, using the same example of the isosceles, because it is only through universal demonstrations that we know why a given predicate actually holds.²³ The point, then, is a general one, given in explicitly causal-explanatory terms. Though he argues here for the superiority of universal demonstrations over particular ones, the core of his argument depends rather on the idea of appropriate generality – it would also be a mistake to try to give a universal proof from facts that are too general or merely analogous across kinds.²⁴ We must rather find the most universal term

²² ἔτι εἰ ἡ ἀπόδειξις μὲν ἐστὶ συλλογισμὸς δεικτικὸς αἰτίας καὶ τοῦ διὰ τί, τὸ καθόλου δ’ αἰτιώτερον (ᾧ γὰρ καθ’ αὐτὸ ὑπάρχει τι, τοῦτο αὐτὸ αὐτῷ αἴτιον· τὸ δὲ καθόλου πρῶτον· αἴτιον ἄρα τὸ καθόλου)· ὥστε καὶ ἡ ἀπόδειξις βελτίων· μᾶλλον γὰρ τοῦ αἰτίου καὶ τοῦ διὰ τί ἐστίν.

²³ The point is also made in *APo.* 1.5, with the geometrical references but without the causal language.

²⁴ *APo.* 1.9, 75b37-76a3 makes this point; cf. 2.17, 99a5-16, and 2.18.

to which the relevant property belongs as such, and that term will then be the one that has explanatory value.²⁵

The same kind of explanatory pattern is described in *APo.* 2.14, after Aristotle has (in 2.13) described the role and use of division in seeking and establishing definitions. In dealing with ‘problems’, Aristotle says, we should set down the common genus (e.g. animals), stating what holds of all its members, and then proceed to each next term of the divided genus, extracting what follows (*hepetai*) each term. For, when we do so, ‘it is clear that we shall be immediately able to state why the things that follow hold of the things under what is common, for example, why they belong to man or horse’ (98a7-9). Thus, he says, if B represents the properties that follow from being an animal, and C, D and E are all species of animal, it is clear, he thinks, why B belongs to a given species, e.g. D – namely, because of A (98a9-11). Thus, to take the stock example, if *mortal* follows *animal*, then *animal* is the cause, i.e. the middle term, in virtue of which *mortal* applies to *dog*. So, one way of finding solutions to problems posed – problems being questions of the form ‘Is A B or not?’ – is to show that a given property follows from a higher-level kind.²⁶ The example differs, and the emphasis is on the methodological point, but the explanatory pattern is the same as in the case of isosceles triangles and the 2R rule.²⁷

In the context of the *Posterior Analytics*, then, Aristotle needs and wishes to preserve the notion that we must explain some facts as necessitated by more general ones, including facts which pertain to a thing’s genera, since it answers to a key requirement of demonstrative science. It is not clear, though, where such explanations would fit within the traditional schema of causes. The efficient and final causes are not necessarily more general than their effects, besides being otherwise inadequate. The way in which something (e.g. a species) necessarily bears the properties that

²⁵ Lennox 1987 refers to this type of explanation as ‘A-type’ explanation, which is based on ‘the realization that different *eidē* of a *genos* have certain features in virtue of those features belonging primitively to that *genos*’ (92), in contrast to ‘B-type’ explanations, which show that a given feature belongs to a kind primitively. He discusses it not only with respect to *APo.*, but argues that this explanatory distinction is of crucial importance to the *Historia Animalium*.

²⁶ Commentators on this chapter differ as to how to understand the statement of the goal (ὁ ἔχειν τὰ προβλήματα, 98a1) and the initial recommendation (ἐκλέγειν δεῖ τὰς τε ἀνατομὰς καὶ τὰς διαιρέσεις, 98a1-2), which appears to refer to lost compilations of divisions and anatomical descriptions (see Barnes 1994, 250). Ross 1949, 662 follows Zabarella in thinking that the goal is properly formulating problems rather than finding solutions to them, while Barnes (*loc. cit.*) appears not to. It is clear, though, that Aristotle is modeling a kind of correct explanation, and that the explanation is of this form.

²⁷ The issue of finding the explanatory connection at an appropriate level of generality is also raised in 2.16-17, also discussed by Lennox 1987, §II.

constitute its essence is also peculiar: it is not really a case of something's being the case because something *else* makes it so, and is thus not subject to demonstration, a point which Aristotle also makes in the *APo.*²⁸

Sometimes, then, scientific explanations need to be given in terms of antecedent facts, which in this context are more general facts, and none of the other causes will do. Given this context, Aristotle's sample explanation with the inscribed angle is a sensible way of alluding to general determination relations, and would naturally evoke his standard example of this sort of determination, namely the fact that the 2R rule applies to all types of triangle because it applies to triangles as such. It is reasonable to conclude, then, that the formula 'certain things being the case, necessarily this is', in *APo.* 2.11, refers in the first instance simply to a general explanatory pattern by reference to something prior: it specifies a way of arguing to a conclusion or answering a Why-question familiar from dialectic, rather than a kind of entity or a metaphysical-explanatory role something may play, which is more characteristic of Aristotle's references to causal types in the physical works. In the particular context of delineating the types of explanation that may be given in a demonstrative science, it indicates necessitation of a lower-level fact by something more basic, and hence more general.

4. From General Determination to Material Explanation

So much may then seem plausible: that explanation by appeal to more general facts is a recognizable and important form of explanation for Aristotelian science as described in *APo.*; that one important subspecies of this sort of explanation would be by reference to a thing's genus; and that Aristotle associates the genus with matter. To this extent, the claim that the cause being presented in this passage is a notion of general determination has at least as much plausibility as any of the other interpretations that have been offered. Still, if we are to accept that what is presented here is not really the material cause, it would be best to be able to show a reasonable degree of continuity between such general determination and the natural-scientific conception of matter as the underlying constituent out of which something is generated, and the source of a thing's capacities for change.

One might worry, in turn, that the connection suggested is at best superficial or tenuous,

²⁸ This is part of the problem discussed from *APo.* 2.3-9, whether and in what sense a definition can be known through demonstration, culminating in the point (2.8) that some definitions can be revealed through a demonstration, but still not proven demonstratively.

even if it is one Aristotle himself makes explicit, since the relationship between genus and matter is itself rather unclear.²⁹ So, we might think, unless we can find a clear account of this association, that general determination and matter must involve two sharply different types of causal explanation, and so our interpretation commits Aristotle to making a serious philosophical oversight in moving from one to the other, or at best to making a dramatic change to his explanatory schemata without noting it, which is perhaps worse than convicting him of just using an opaque formula and an obscure example.

The most prominent passages which refer to genus as matter have in common the notion of a genus as the subject (*hupokeimenon*) of which contrary differentiae are predicated.³⁰ Two of them are from the ‘Lexicon’ of *Metaphysics* 5. In 5.6, the chapter on ‘one’ (*hen*), Aristotle states that one sort of unity is that had by things which share a genus but bear contrary differentiae: ‘these are all said to be one because the genus underlying the differentiae is one (for example, horse, man, and dog are some one thing because they are all animals), and so in about the same way as the matter is single’ (τρόπον δὴ παραπλήσιον ὥσπερ ἡ ὕλη μία, 1016a28). Likewise, and more fully, the passage in 5.28, on ‘genus’, after mentioning uses of the term as referring to an enduring kind such as humans, and with reference to an original progenitor (e.g. ‘those descended from Ion’), states (1024a36-b9):

Further, the way in which the plane is the genus of plane figures and the solid of solids; for each of the figures is either this sort of plane or that sort of solid; and this is the subject (*hupokeimenon*) of the differentiae. Further, in the way that the first constituent (*to prōton enuparchon*) in definitions, which is stated in the formula of what something is, this is the genus, of which the qualitative differentiae are said. Genus, then, is spoken of in these many ways: with respect to the continuous generation of the same form, with respect to the first mover of the same form, and as matter; for that to which the differentia, i.e. the quality, belongs, this is the

²⁹ For the debate about how literally or strongly a thing’s genera ‘mirror’ its underlying matter, see references given above, n. 9. Most commentators seem to side with the view that relationship is analogical; I agree, but will not attempt to pursue the matter here. Rorty 1973 and 1974, as well as Balme 1992, take a stronger view; cf. Lloyd 1962, 86-7. Even if the stronger claim were justified, however, facts about a thing’s genus only represent one type of general determinant, so this would not entail that the two passages are indicated the same relationship.

³⁰ The examples of matter given in *Physics* 2.3 are collectively referred to as *to hupokeimenon* (195a15-20).

subject (*hupokeimenon*), which we call matter.³¹

Matter is thus invoked to sum up what appear to be two senses of ‘genus’, as referring to a kind which is divided into species, and as referring to the first constituent in a definition by genus and differentiae.³²

The passage in 7.12, finally, states that a definition is ‘an account made out of the differentiae’, whether the genus does not exist at all apart from the species, or whether it does but as matter (*hōs hulē*) (1038a5-9):

So if the genus in an unqualified way is not apart from the species insofar as they are of the genus, or if it is, it is as matter (for voice is the genus and [‘i.e.’] matter, while the differentiae make the forms, i.e. the sounds, out of it), it is evident that the definition (*horismos*) is the account (*logos*) made out of the differentiae.³³

The comparison rests, then on the manner in which both genus and matter are taken to be subjects of contrary predicates or properties: the genus in relation to the differentiae that characterize a definable species-form (*eidōs*), and the matter insofar as the material subject is the bearer of contrary properties in ranges such as place or quality, or insofar as certain substances such as humans and dogs have the same sort of (non-proximate) matter.³⁴ The idea of a subject as something ‘laid down’, i.e. as somehow antecedent, also evokes the way in which a general cause is presented as something antecedently holding, while the connection to the notion of definition by

³¹ ἔτι δὲ ὡς τὸ ἐπίπεδον τῶν σχημάτων γένος τῶν ἐπιπέδων καὶ τὸ στερεὸν τῶν στερεῶν· ἕκαστον γὰρ τῶν σχημάτων τὸ μὲν ἐπίπεδον τοιονδί τὸ δὲ στερεὸν ἐστὶ τοιονδί· τοῦτο δ’ ἐστὶ τὸ ὑποκείμενον ταῖς διαφοραῖς. ἔτι ὡς ἐν τοῖς λόγοις τὸ πρῶτον ἐνυπάρχον, ὃ λέγεται ἐν τῷ τί ἐστὶ, τοῦτο γένος, οὗ διαφοραὶ λέγονται αἱ ποιότητες. τὸ μὲν οὖν γένος τὸσανταχῶς λέγεται, τὸ μὲν κατὰ γένεσιν συνεχῆ τοῦ αὐτοῦ εἶδους, τὸ δὲ κατὰ τὸ πρῶτον κινήσαν ὁμοειδέες, τὸ δ’ ὡς ὕλη· οὗ γὰρ ἡ διαφορὰ καὶ ἡ ποιότης ἐστὶ, τοῦτ’ ἐστὶ τὸ ὑποκείμενον, ὃ λέγομεν ὕλην.

³² Ross 1924, 343 does not separate them, and states that ‘according to the Greek idiom this [sc. the second] must mean not ‘the first constituent which is stated in the *ti esti*’ but ‘the first constituent, which is stated in the *ti esti*’. Kirwan 1971 and Reeve 2016, *ad loc.*, do take it as referring to an element in a definition, and separate the two senses; the separation, at any rate, is justified by the ‘Further’ (*eti hōs*) at 1024b4.

³³ εἰ οὖν τὸ γένος ἀπλῶς μὴ ἔστι παρὰ τὰ ὡς γένους εἶδη, ἢ εἰ ἔστι μὲν ὡς ὕλη δ’ ἐστὶν (ἢ μὲν γὰρ φωνὴ γένος καὶ ὕλη, αἱ δὲ διαφοραὶ τὰ εἶδη καὶ τὰ στοιχεῖα ἐκ ταύτης ποιούσιν), φανερόν ὅτι ὁ ὀρισμὸς ἐστὶν ὁ ἐκ τῶν διαφορῶν λόγος. See also *Metaph.* 8.6, 1045a23, which concerns the unity of the definition.

³⁴ See esp. Balme’s communication to Grene, given in her 1974, n. 10.

genus and differentia, i.e. definition by division of a genus, strongly suggests that the association relates to debates with and within the Academy, and so to an early date.³⁵ Even if the connection is ultimately only analogical, therefore, it is not a superficial one for Aristotle: the genus of the species and the matter of the individual hylomorphic compound are both indeterminate subjects made determinate by differentiae constitutive of form. Schematically, a pattern of explanation citing a genus marked out by differentiae will have much in common with one citing matter determined by contraries.

Perhaps the primary difficulty for drawing the connection in this way, then, is the same one that prompts some commentators to argue that Aristotle cannot be referring to matter in *APo.* 2.11: namely, that matter does not necessitate, whereas the kind of cause presented here clearly does. Indeed, when Aristotle talks about the notion of a genus (especially in the *Topics*), he usually treats necessity as running from species to genus rather than the other way around.³⁶ If so, then the type of cause presented here would still be strongly discontinuous with the notion of matter-as-constituent, which would be an unfortunate result.

However, in the *Topics*, there are also two important ways in which Aristotle claims that necessity runs from genus to species. The first is the same as the familiar point about triangles, i.e. that ‘necessarily, the accounts that are predicated of the genera are also predicated of the species, and the things sharing in the species’ (122b9-10). The other principle, which picks up the comparison of genus to matter as being the subject of contraries, is that anything that participates in a genus necessarily participates in ‘one of the species of the first division’ (122a26). That is, necessarily, if something is a member of a genus, it falls into one of the species into which a genus is divided.

Both points are made together in *Topics* 2.4: we can show that a subtype admits of certain properties by a ‘demonstration from the genus concerning the species’ (111a14-20), and we can test whether a general term applies to a given subject by examining whether any of its differentiated subspecies applies. For example, we can test whether the soul is moved by examining whether any of the species of motion apply, since ‘by necessity, of those things of which the genus is predicated, one of the species is also predicated, and [since] whatever things have the genus or are spoken of

³⁵ As does the example of voice (genus/matter) and spoken sounds (species) in the passage from 7.12, which also appears in the discussion of division in the *Philebus* (17b-18d).

³⁶ As, e.g. at *Topics* 124b18, 141b33 and 142b15.

paronymously by reference to the genus, are also had, necessarily, by one of the species, or are spoken of paronymously by reference one of the species' (111a33-6).³⁷

Some terms (though not all: 111a25-6) which apply to the genus, therefore, may be proven to apply to the species, and anything which is a member of or has a genus-related term applied to it is, necessarily, a member of one of its differentiated species, or has a corresponding species-related term applied to it.

Both of these principles about what a genus necessitates are shared in a way by what a thing's matter explains. Though Aristotle of course rejects reductive materialism, material compounds nevertheless inherit some properties from their matter. Anything made predominantly of earth will tend to fall to the center of the universe, anything made predominantly of air will tend to float on water.³⁸ Further, a body's specific material composition, i.e. its proximate matter, determines the range of changes it can undergo along various ranges of contraries.³⁹ Indeed, a thing's matter is, in the physical works, relative to the different sorts of change. Strictly speaking, that is, Aristotle treats the material subject of a qualitative change as different (in definition at least) from that of growth, even if the substance undergoing the changes is the same, and the subject of generation and destruction is of course different again.⁴⁰ Matter, thus, is relative to a determinate range of potentiality, and if a thing is currently capable of undergoing change between contraries within a given range, it necessarily already has a property within that range. So, for example, if a thing is capable of growth or motion in place, it necessarily has one or another location and size already.⁴¹

³⁷ ἐπεὶ δ' ἀναγκαῖον, ὃν τὸ γένος κατηγορεῖται, καὶ τῶν εἰδῶν τι κατηγορεῖσθαι, καὶ ὅσα ἔχει τὸ γένος ἢ παρωνύμως ἀπὸ τοῦ γένους λέγεται, καὶ τῶν εἰδῶν τι ἀναγκαῖον ἔχειν ἢ παρωνύμως ἀπὸ τίνος τῶν εἰδῶν λέγεσθαι.

³⁸ The general point is made at *Meteor.* 4.4, 381b24-7, and again at 382a5-6. Cf. *De caelo* 3.2, 301b22-6 (something's ability to be moved up or down by force is due to its containing air); 4.2, 308b13-15 (fire is always light and moves up, earth and earthy things always move down); more generally at 4.5, 320a22-3. Likewise, the hardness of certain animal parts is generally proportional to the amount of earth in their composition, as at *PA* 655a24-8 (softness of fish spine as due to lack of earthy material), 674b2-5 (the hardness of a camel's palate), 690a4-9 (the hardness of hooves).

³⁹ The *Meteorology*, especially 3.9, contains some of the clearest applications of this principle: the basic sorts of capacities things have for change (such as being boiled, hardened, bent, stretched, burnt etc. are explained as due to specific features of their material composition (its degree of moisture/dryness, whether it has pores and of what sort, and so on).

⁴⁰ *GC* 1.5 320a2-4; b12-14.

⁴¹ This follows from the main premise in the argument justifying taking contraries as principles of natural things at *Phys.* 1.5, 188a31-b26: necessarily, things which change to or from some F, do so from or to a

Thus, material causation in the physical works shares the two senses in which Aristotle thinks of genera as necessitating: (a) certain primary features of the matter transfer to the compound, just as features of the genus transfer to its species; and (b) matter determines a thing's capacity for changes within ranges of contraries, one of which the subject must occupy already, just as a genus determines a range of species into which anything must fall if it is to be a member of the genus.

In natural science, then, an analogous role to the genus is occupied by matter, which determines various features and capacities of natural, changeable substance at a level of specification which is less determinate relative to descriptions of a given individual as such or of its fully determinate form. Explanations citing them will share a common pattern of presenting a subject which is made determinate by various contrary differentiae, so it makes sense for Aristotle to use the same explanatory schema that works for general determination, but they cite different types of entity and refer to different types of explananda.

There is a genuine shift, then, between this four-causal schema and the one we find elsewhere in the corpus. The four-causal schema as a whole being presented here is encapsulating a variety of ways one can answer a question of the form: 'Why is A B?' They are: (1) by showing that A is essentially (primitively) B; (2) by showing that A is derivatively B on the basis of more general facts that apply to it; (3) by showing that A came to be B because something prompted a change by which it became B; and (4) by showing that A is B for the sake of some further G. Between general determination and material causation as presented elsewhere, there is a shift from role to occupant, and from one type of indeterminacy to another.⁴²

I am not inclined to speculate whether the shift is contextual, developmental, or a combination of the two, but there are plausible reasons of both sorts one might give for it. Some of them would indicate that the shift is a subtle one, others argue for something more dramatic, though most of them work best if we continue to assume that the *Posterior Analytics* is earlier than the other presentations of the four causes.

Contextually, it makes sense for Aristotle to move from referring to the explanatory role in

contrary (or intermediate) in the same range as F – e.g. degrees of light or dark. Cf. *Meteor.* 4.2, 382a10: if something is a compound of wet and dry, necessarily it is either hard or soft. Likewise, anything bodily must have perceptible contraries – light or heavy, cold or hot (*GC* 329a10-12).

⁴² This is not to imply that Aristotle is only concerned here with forms of explanation rather than types of causal or explanatory relation, but rather that his emphasis here is on the former.

the context of demonstration to referring to the occupant of the role (or an analogous role) in natural science. Because of the importance natural science ultimately has for Aristotle's thinking about causation and explanation, it makes sense for the occupant of the role in the study of nature to become the focal point for describing that form of explanation, when the concern is not with the formal requirements for displaying one's results. Because the term for matter is itself relatively flexible insofar as it can indicate underlying subjects of various sorts and can be used analogously, the bland role-descriptor used in *APo.* has no real use in that context. In natural science, after all, general determination will in any case mainly proceed from genera – they will no longer be a special case, as perhaps they are in geometry. Further, metaphysical concerns about explanation are more salient in the context of natural science than in Aristotle's philosophy of science – with its paradigm of geometrical proof, its focus on the formal features of demonstration, and its connection with dialectical patterns of argument – and so there is more demand for clarity about the occupant as opposed to the role. There are thus good contextual reasons for which this fourth cause might be absorbed by the material cause in the natural scientific context – to the point where in the *Metaphysics* Aristotle compares the genus to matter rather than the other way around – which do not require us to assume that Aristotle only 'discovered' matter after he wrote the *Organon*.

Philosophically, we can also see a motivation for giving matter priority in the schema. If we start with a maximally determinate description of an individual as *this* individual, of this form or species (*eidōs*), with these properties at this time, there are a variety of ways in which we might wish to explain its features by reference to less determinate levels of description. Relative to the individual, there are of course the features that belong to the species, and those that belong to each of the higher genera may apply to both the lower species and the individual. There is also, though, relative to the contingently described hylomorphic compound as it is right now, the less determinate subject which constitutes the grounds of its being subject to generation and destruction, and by which it may come to have contrary properties at another time. In the context of natural science, however, the metaphysical dependence of the genus on its more determinate species diminishes its explanatory value: the species form, especially in light of *Metaph.* 7.12's arguments about differentiae and definition, can shoulder any burden the genus might play, while the importance of the indeterminate substratum determined by form is correspondingly greater. Moreover, matter already occupies, in a way, a fully general explanatory role with respect to natural, changeable substance, since it is what accounts for things' ability to come into being, change, and perish. Philosophically, then, the metaphysical role of matter is more important to natural scientific explanation than other ways in which natural kinds share common features.

There is also at least good reason for Aristotle to drop the mention of necessity when we shift to explanation in a natural-scientific context. The matter of a hylomorphic compound is itself a hylomorphic compound (e.g. bronze), and its explanatory properties as matter belong to it in virtue of whatever sort of compound it is, i.e. in virtue of its form (until we get to prime matter, if we do). Similarly, it is often more informative, in the natural-scientific context, to indicate matter's role as the source of a thing's potentialities, than to point out that as such it necessitates certain ranges of properties, and that it makes it necessary for the compound to bear properties within the ranges over which it is capable of change. After all, one of the primary burdens Aristotle takes up in the physical works is to establish principles for the scientific study of nature, i.e. of substances that are subject to change, in the face of both radical challenges to the very notion of change (such as the Eleatic challenge as Aristotle understands it) as well as more subtle problems raised by reductionists and Platonists. Matter as the source of potentiality is thus more important in addressing concerns about the foundations of natural science, even though something's matter is nevertheless a determinant in its own right.

This does not mean that Aristotle was after all describing matter in *APo.*, only that in some way matter occupies much the same explanatory role with respect to natural beings that genera and general facts do with respect to determinate species. It may for all that be true, as some have thought, that Aristotle had simply not 'discovered' matter when he wrote the *APo.* and the other works of the *Organon*, and that the contextual shift is accompanied by conceptual discovery or invention. Less radically, it may be that as Aristotle's understanding of natural science developed and changed – as he developed his views about the relationship between genus, species and differentiae, for example, and came to appreciate the implications of making universals metaphysically posterior to species – the sense in which general facts might truly explain more determinate facts became correspondingly weak, and the importance of an underlying determinable subject correspondingly more important.⁴³ A developmental story of either sort would suggest that the introduction of the concept of matter into Western philosophy and science owes as much to Aristotle's ongoing engagement with the Academy as it does to his reactions to earlier attempts at explaining natural phenomena, and to his response to Eleatic challenges to the concept of change.

Finally, a dialectical motivation, which seems to me to be neither squarely contextual nor squarely developmental, but may ultimately be either, both, or neither. Aristotle wishes to maintain

⁴³ For the relationship between genus, form, and differentia, see especially *Metaph.* 7.12 and *PA* 1.2-4.

that persisting matter is a joint cause of the things that come to be (ἡ μὲν γὰρ ὑπομένουσα συναίτια τῆ μορφῆ τῶν γιγνομένων ἐστίν, *Physics* 1.9, 192a13-14), nearly and in a way substance (ἐγγύς καὶ οὐσίαν πως, 192a6). This is, he states, in contrast to the Platonists, who he thinks treat their closest equivalent to the material cause, the Great and the Small, in the same way as non-being (οἱ δὲ τὸ μὴ ὄν τὸ μέγα καὶ τὸ μικρὸν ὁμοίως, 192a7) or, what probably comes to the same thing, as indefinite (*apeira*).⁴⁴ (It is also in contrast to Plato's Socrates, in the *Phaedo*, who famously claims that what Aristotle would seem to consider material causes are mere necessary conditions of something's being a cause, rather than genuine causes: 99a-b.) Aristotle, that is, wishes to assign to matter an explanatory value that he thinks others, especially Platonists, have denied it. One can imagine an objector asking how matter is supposed to be truly explanatory, rather than something determined by form or the passive material on which an agent acts: what kind of explanation is this? It is not the mover, or the goal, or the essence; but if we have already recognized a sense (e.g. in the practice of dialectic) according which antecedent and less determinate conditions may be genuinely explanatory, the way a genus can be, then Aristotle can use that schema to distinguish material causes as explanatory antecedent conditions and joint causes rather than mere necessary conditions, or something thoroughly indeterminate. At other times or in other contexts, as suggested above, material causation and its metaphysical characteristics might then come to overshadow the dialectical role into which it was originally placed.

The analogy between general determination and material causation is not perfect, so perhaps none of these points of contact is enough by itself to explain the shift perfectly. On balance, however, it is more textually and philosophically plausible that the gaps are to be explained along these lines than that this passage is referring to material or quasi-material causes.

5. Conclusion

APo. 2.11 presents a familiar interpretive problem of balancing overall consistency across works with textual and philosophical plausibility, along with the fact that sometimes minds change. There are, I have argued, good textual and philosophical reasons to interpret Aristotle as referring here, not to the material cause, but to what I have called general determination. They are related in that

⁴⁴ *Physics* 3.4, 203a15-16; 3.6, 206b28. He is also critical of the 'receptacle' described in the *Timaeus* (*GC* 2.1, 329a13-24), even though Plato there does make natural processes a joint cause (*sunaitia*, 46c-d). (But see Johansen 2004, 103-6 for an argument that what are there called joint causes are not simply the same things as what Socrates denies are causes in the *Phaedo*.)

explanation by reference to a thing's matter or material properties is, like general determination in the context of a demonstration-based approach to science, or explanation by reference to a thing's genus, a way of explaining something's features by appeal to something that holds of it antecedently, in the sense of holding of it relative to a less determinate level of specification. Aristotle in *APo.* 2.11 is thus not giving an instance of the material cause; if anything, material explanation is an instance of the pattern of answering Why-questions described here. However, the relevant concept of generality or determinability is arguably different between the two types of case, in which case the explanatory relation itself being indicated in 2.11 is only analogically related to the explanatory role of the matter in a changeable hylomorphic substance. In a logical context, being less determinate amounts to one thing, in a natural-scientific context, it often amounts to something else.

We can, on this interpretation, interpret Aristotle in *APo.* 2.11 as meaning what he says, and as presenting a sensible and contextually-appropriate form of explanation. We are also relieved of the burden of trying to say how 'half of two rights' is somehow the underlying matter of an inscribed angle's being a right angle. To insist on any further sort of identification between these two types of explanation seems only to add obscurity, and any gains in consistency between *APo.* and the physical works are insufficient to justify it, since we can make decent sense of the shift from one to the other either developmentally, contextually, or both.⁴⁵

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