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Why did Aristotle invent the material cause ? The early development of the concept of *hê hylê*

I will present a developmental account of Aristotle's concept of *hê hylê* (usually translated « the matter »)¹, focused the earliest developments². I begin by analyzing fragments of some lost early works and a chapter of the *Organon*, texts which indicate that early in his career Aristotle had not yet begun to use *hê hylê* in a technical sense. Next, I examine *Physics* II 3, a chapter in which Aristotle conceives of *hê hylê* not as a kind of cause in its own right, but merely as an example of the so-called « out of which » cause : the material is the cause *out of which* an artifact is made. Next, I examine *Physics* II 7, a chapter in which Aristotle names « the material » as one of the four kinds of cause in its own right. But Aristotle's model of « the material » remains the material out of which an artifact is made.

Later, Aristotle began applying the term *hê hylê* to his predecessors, and also to problems in his own theoretical philosophy. No doubt Aristotle conceived of « the material » as one of the four kinds of cause fairly early in his career. And since most (but not all) of the chapters in our Aristotle Corpus were written in this later stage,

¹ The other studies of the development of Aristotle's theory of the material cause that I have been able to consult include Skemp 1960, Solmsen 1961, Jones 1974, Dancy 1978, and Graham 1984. Graham's 1987 monograph is focused on articulating the two different systems that Graham perceives Aristotle developed before and after discovering the concept of « matter » and demonstrating the incommensurability of these systems. Here I do not comment on the verisimilitude of Graham's accounts of the earlier and later systems of Aristotle, but I do find useful and intend to support his effort to work out the ramifications of Aristotle's introduction of the material cause into his natural science and metaphysics.

² Dancy sketches the following chronology: (1) *Categories* and *Analytica Posteriora*; (2) *Physics* I; (3) *Metaphysics* Z-Θ. I am in basic agreement with this but, as he admits, he is « not operating with a detailed scheme in which every chapter, or even every book, has its place » (1978, 383). In particular, he does not discuss the chronology of *Physics* I-II. Graham, who in general offers a much fuller account of Aristotle's development, asserts that « *Physics* II itself at 3, 194b23f. presupposes *Physics* I 9, 192a31f. and the background argument of *Physics* I 7-8. Thus *Physics* I antedates *Physics* II and both seem to have been written before Aristotle left the Academy and began the *Met.* (cf. Jaeger 1948 : 296, 299 ; Ross 1936:7-9) » (1987, 119n2). But, as I will argue below, *Physics* II 3 does not present a concept of *hylê* as a cause in its own right or as a cause of natural things, two developments presupposed in *Physics* I 7-9. My own conclusion is thus that *Physics* II was composed before *Physics* I. I cannot defend this view here, but the evidence that Graham cites does not by itself support the priority of *Physics* I to II, and Jaeger and Ross group *Physics* I-II together and do not discuss their relative priority. However, I do not think that the priority of *Physics* II to I is relevant to Graham's overall argument, and I do not intend my alternative account of their chronology to be a criticism of his view.

including the entirety of *Metaphysics* and most or all of the biological works³, it is reasonable that most of the commentary on Aristotle's theory of the « material » cause focuses on the later developments. By contrast, I focus today on the earlier developments in order to inform speculation about why Aristotle invented the technical term *hê hylê*, and why he began applying this term to his predecessors⁴, a term they never used and which at first glance does not seem a fitting term for that kind of cause.

Despite how he is customarily translated, Aristotle never uses the term *hylê* to mean matter (or the equivalent in other languages) ; in his usage *hylê* never refers to a free-standing and independent substance as the term “matter” does in post-Cartesian natural philosophy and modern physics. Rather *hê hylê* in Aristotle is always a relative term, meaning the material out of which something is made and, paradigmatically, *the material out of which some artifact was made* : the *bronze* of a statue, the *gold* of a cup, the *iron* of a saw, the *stone* of a wall, the *wood* of a ship or house. It was only later that Aristotle began using the term *hê hylê* with reference to *natural* things, including the « parts » of animals, and also generically, with reference to the « substrate » that persists through any change, artificial or natural.

Given its root meaning, the term *hylê* at first glance seems an odd name for a concept that will later be used to refer to the organic parts not just of plants but especially of animals and humans, and even to a generic substrate of all change. It is furthermore a surprising choice because Aristotle's earliest examples of « the

³ *Metaphysics* A 3 refers to the enumeration of four causes in *Physics* II as being earlier : « Although these have already been theorized by us sufficiently in the works on physics (τεθεωρηται μὲν οὖν ἱκανῶς περὶ αὐτῶν ἡμῖν ἐν τοῖς περὶ φύσεως), let us now gain assistance also from those of our predecessors who choose to investigate about beings and philosophized about the truth » (983a30). And the whole lexicon entry on *aition* in *Metaphysics* Δ 2 (1013a24-1014a21) is a doublet of *Physics* II 3 (194b23-195b21). The *Metaphysics* version omits the epistemological introduction which in *Physics* II 3 (194b16-23 ; cf. *Post. An.* II 11, 94a20) precedes the enumeration of the four causes, and it also omits the concluding remarks in *Physics* II 3 (195b22-30) on how inquiry into the causes should proceed. Whether the excerptor was Aristotle or a later editor, it is understandable that this material was left out, since in *Metaphysics* V the goal to provide a definition of the various senses of the term cause, and not to discuss why or how inquiry into the causes should proceed. *De generatione animalium* I 1 asserts that the entire series of biological works has been organized methodologically according to the four causes, including « the material » cause. Whether or not this is true, the term *hê hylê* is used throughout the biological works as the name for one of the four kinds of cause.

⁴ Solmsen 1961 speaks of it as « one of Aristotle's philosophical inventions or discoveries » (Solmsen 1961), while Graham 1984 prefers to speak of Aristotle's « discovery » of matter. I prefer « invention » rather than « discovery » because I think *hê hylê* is an artificial byproduct of Aristotle's analysis, and not a natural thing like an island or chemical element that was all along out there waiting to be discovered. The fact that the concept was invented and not discovered is what makes it possible to identify Aristotle as the originator of the technical concept *hê hylê*, and to investigate the reasons why he invented it.

material » are often metallic. But the term *hylê* originally meant timber or wood suitable for building ships and houses, and Aristotle frequently uses just these wooden artifacts as model examples. The term *hê hylê* in fact is perfect for Aristotle's purpose, given that the material cause is conceived on the basis of an artifactual model⁵. The crucial philosophical point is that the artifact model governs Aristotle's entire conception of the « material » cause in both earlier and later stages of his development. He applied the term to his predecessors as part of a criticism that, by referring only or mostly to « the material » out of which a substance is made, they neglected the other kinds of cause ; their mode of explanation is insufficient, just as an explanation of a saw or a house referring only to iron and wood materials would be insufficient. If true, this would be a devastating criticism of Aristotle's predecessors who are nowadays, following Aristotle, typically called "materialists" (such as Democritus).

But, as we know from several outstandingly important studies, the terminology used by Aristotle to describe his predecessors' theories in natural science often carries implications that they did not intend and would probably not welcome⁶. I argue that this critique applies to the very term *hê hylê*. Although, at first glance, "the material" appears to be a primitive, neutral, and innocuous term, an examination of its use in the history of philosophy shows that it was conceived as a cause in such a way as to expose a shortcoming in Aristotle's predecessors' views.

⁵ Solmsen 1961, 396f. Solmsen sagely notes that Aristotle could just as easily have chosen « bronze » as the name for this cause instead of « wood ». Theophrastus distinguishes two major kinds of *hylê* by reference to its use in artifacts : « we must endeavor to say in a general way, distinguishing the several uses, for which purposes each kind of timber is serviceable, which is of use in ship-building, which for house-building ; for these uses extend far and are important » (*Enquiry into Plants* V 7, 1, tr. Hort). The English word « timber » (meaning : « wood prepared for building and carpentry ») which Hort uses for *hylê*, captures the meaning of Aristotle's term much better than the English word « wood », since it is important for Aristotle that *hylê* implicitly suggests material suitable for an artifact. Theophrastus' account of the literal notion of *hylê* thus helps explain why ships and houses are among his key examples used to illustrate the relationship between *hylê* and forms or ends as causes. Other terms, including *xylon* are used by Aristotle to indicate materials, including wood, processed to a different extent, so as to be suitable for carpentry, etc. Curiously, Solmsen does not note the support for his interpretation in Aristotle's own reference to two kinds of art dealing with *hê hylê* : « the arts produce their material, some simply, others so that it works well » (ποιούσιν αἱ τέχναι τὴν ἕλην αἱ μὲν ἀπλῶς αἱ δὲ εὐεργόν) » (*Physics* II 2, 194a35-36). This appears to be a reference to different degrees of processing materials so that they are useful in the production of artifacts.

⁶ Cherniss 1935 especially chapter three; on Democritus see p. 223 and on Aristotle's interpretation of Democritean necessity, p. 248-250; cf. Cherniss' discussion of Aristotle's artificial model of natural processes at p. 253, and criticism of Democritus' account of the shedding of teeth at p. 256-257 and 264. Cherniss does not, however, scrutinize the term « matter » itself, and regularly employs the term « material » (as in the expression « material monist ») as a neutral description of the views of Presocratic philosophy (e.g. p. 54). For Democritus in particular see Mourelatos 2005.

SOME LOST WORKS

All attributions of theories of « matter » to Aristotle's predecessors depend ultimately on Aristotle's own dialectical representations of them (such as those in *Physics* I and *Metaphysics* A), and the subsequent doxographic tradition that stems from it. These representations are purely dialectical as opposed to historical. There is no evidence in Aristotle or any other source that any of his predecessors ever used the term *hê hylê*, or any other term, in the sense of « the material »⁷. This technical point can be shown not only by pointing to the absence of the term *hylê* in any genuine fragments, but also by comparing Aristotle's abstract definitions of *hylê*⁸ with reconstructions of his predecessor's views—including Plato⁹.

The most detailed study of the concept of *hylê* is Happ's¹⁰, and it remains valuable. But although Happ correctly observed that the technical concept of *hylê* was invented by Aristotle, he was convinced that (almost) no chronological arrangement of Aristotle's works can be discerned, and that Aristotle used the term in the same sense throughout his writings ; thus he concluded that « it is no longer possible to trace within Aristotle individual stages of the development of its meaning »¹¹. Against this, the present study is precisely an attempt to show that it is possible to trace within

⁷ Cencillo 1958, 27-31.

⁸ The most explicit definitions are these: « by *hylê* I mean the first substrate of each thing, from which something comes to be, such that the substrate persists in it not in an accidental way » (*Physics* I 9, 192a31-32, translation following Graham, 1984, 49); « *hylê*, in the most proper sense of the term, is to be identified with the substrate which is receptive of generation and destruction » (*GC* I 5, 320a3-4); « by *hylê* I mean that which, not being a this actually, is potentially a this » (*Metaphysics* H 1, 1042a25-26). *Physics* II does not contain a definition of *hylê* as such, only examples of *hylê*. This is a further indication that *Physics* II is prior to these other texts in which *hylê* is explicitly defined in specialized contexts.

⁹ Attempts to show that Plato (or Speusippus) had already employed *hê hylê* in a technical sense are worth exploring but beyond the scope of this paper. Plato definitely used the word *hylê* in a couple of relevant discussions, and Aristotle claims that the *chora* or receptacle of Plato's *Timaeus* plays the role of *hylê*. But even if it could be shown that Plato or Speusippus had used the term *hylê* in some technical way, nothing could rule out the possibility that it was nevertheless Aristotle who invented the concept, and then transmitted it to them. Attempts to make a case either that Plato and Speusippus had already used the term earlier, or that they took it over from Aristotle and developed it, have not, in my view, been successful, although I will not argue the point here. Instead, my plan is to make it clear that Aristotle himself did not always use the technical concept of *hê hylê*, and that he later developed the concept in several directions. See further Skemp 1960 ; Somsen, 1961, 395-396.

¹⁰ *HYLE : studien zum aristotelischen Materie-Begriff* (1971).

¹¹ « Aristotle thus found the word in the sense of wood, and then used it extensively for matter, or for what one might call in his philosophy the manifestations of the second principle. Since, as already mentioned above, p. 58 *hylê* has almost the same scope of meaning in all places where it occurs, and chronological differentiation is not possible, it is no longer possible to trace within Aristotle individual stages of the development of meaning » (Happ 1971, 276).

Aristotle individual stages in the development of the meaning of *hylé*, including a stage before he had invented it as a technical concept. Happ does not believe that is possible because he focuses on texts in which the term *hylé* appears, but neglects those texts in which it should appear but it does not. Happ perceives Aristotle using the concept throughout all his works, even works in which there is literally no evidence that the term *hylé* appeared. Happ followed the reasoning of Düring according to which the presence of a distinction between *dynamis* and *energeia* in Aristotle's *Protrepticus* implies that Aristotle must already have made a distinction between *hylé* and *eidos* at the early date of that work's composition. Happ accepts Düring's (uncontroversial) dating of the *Protrepticus* to about 350, thus treating it as one of Aristotle's earliest works. Happ concludes, then, that in Aristotle the concept of matter « appears from the earliest to the latest passages »¹².

But Düring's reasoning about the mutual implicature of the concept pairs *dynamis-energeia* and *hylé-eidos* is flawed¹³. The argument from *Protrepticus* cited by Düring and Happ¹⁴ can easily be interpreted without any reference to the concept of matter whatsoever. In *Metaphysics* Θ, Aristotle distinguishes between two senses of the concept pair: (1) as *dynamis* is to movement (*kinésis*) ; and (2) as *hylé* is to substance (*ousia*)¹⁵. The

¹² « Although we have pointed this out many times, it must again be stated here: there are a few parts of the text in Aristotle where the word *hylé* does not appear, although it would have been in fact necessary (e.g. *Met.* Γ 4, 64). Otherwise it appears from the earliest to the latest passages, perhaps even in the *Protrepticus* (before 353 BC), if *dynamis-energeia* (fr.14 Ross = B79 Düring) is allowed to refer back to *hylé-eidos*. Düring, *Gnomen* 27 (1955, 156) rightly thinks that hardly a stage of development of Aristotelian thought can be imagined, in which Aristotle had developed the concept of *dynamis-energeia*, but not yet *hylé-eidos*. Evidently, one does not come even earlier (Düring, loc. cit.); see Solmsen, <1961> 397 » (Happ 1971, 276 n. 1008). The reference to Solmsen does not support Happ's argument, but merely asserts that « we must assume that he has made his choice at a very early stage of his philosophical activity. The least we can do is to place this choice in his Academic period ». Solmsen's claim in no way excludes the possibility that several works of Aristotle did not refer to *hylé* at all.

¹³ « In the *Protrepticus*, fr. 14 Walzer, Aristotle operates with the conception of *dynamis-energeia*. I doubt whether it is possible to imagine a stage in Aristotle's philosophical development when he had formulated his conception of potentiality-actuality, but not his conception of *hylé-eidos* » (Düring 1955, 156).

¹⁴ « The word 'living' seems to mean two things, one with reference to a capacity and the other with reference to an activity, for we call all those animals 'seeing' who have sight and are naturally capable of seeing (even if they happen to have their eyes shut), as well as those who are using the capacity and are casting their sight. And similarly, with knowing and cognizing we mean, in one case, using and observing and, in the other case, possessing the capacity and having the knowledge » (φαίνεται διττῶς λέγεσθαι τὸ ζῆν, τὸ μὲν κατὰ δύναμιν τὸ δὲ κατ' ἐνέργειαν· ὁρῶντα γὰρ εἶναι φαμεν ὅσα τε ἔχει τῶν ζῶων ὄψιν καὶ δυνατὰ πέφυκεν ἰδεῖν, καὶ μύοντα τυγχάνη, καὶ τὰ χρώμενα τῇ δυνάμει καὶ προσβάλλοντα τὴν ὄψιν. ὁμοίως δὲ καὶ τὸ ἐπίστασθαι καὶ τὸ γινώσκειν, ἐν μὲν τὸ χρῆσθαι καὶ θεωρεῖν λέγομεν, ἐν δὲ τὸ κειτῆσθαι τὴν δύναμιν καὶ τὴν ἐπιστήμην ἔχειν.» Aristotle, *Protrepticus*, apud Iamblichus, *Protr.* XI, 56, 15-22).

¹⁵ *Metaphysics* Θ 6, 1048a31-b8 ; Graham 1984, 38.

latter sense developed out of, and after, the former¹⁶. And in the *Protrepticus* passage, Aristotle uses the former, not the latter, distinction. He distinguishes merely possessing a power from exercising the power (the examples are : seeing, thinking, knowing). That distinction in no way requires the distinction between *hylê* and *eidos*. Thus, Düring and Happ were wrong to suggest that *Protrepticus* contains evidence that Aristotle all along employed the concept of *hylê*¹⁷.

Düring and Happ ignore other passages attributable to Aristotle's *Protrepticus* in which the *dynamis-energeia* distinction also appears, but the term *hylê* does not : in the discussion of the soul ruling the body and using it as a tool or *organon* (VII 41, 19-20). In this context, Aristotle refers to *energeiai* (42, 10) and *dynameôn* (42, 17) of the soul, but never to *hylê*. This is also true in the other passages in which soul and body are discussed together (e.g. VIII 48, 2-9), but it is most surprising when Aristotle discusses the priority of soul to body, again treating the parts of the body as *organa* (37, 4). Here again, Aristotle never uses the term *hylê*, even though he mentions prior and posterior causes in the natural sciences :

Similarly for the natural sciences as well, for it is necessary to be intelligent about the prior of the causes and the elements (τῶν αἰτίων καὶ τῶν στοιχείων) before the posterior ones; for they are not among the highest things, nor do the primary things naturally grow out of them; rather, it is out of the former and because of the latter that the other things come into being and are evidently constituted. For whether it is fire or air or number or any other natures that are causes of and primary to other things (εἴτε γὰρ πῦρ εἴτ' ἀήρ εἴτε ἀριθμὸς εἴτε ἄλλαι τινὲς φύσεις αἰτίαι καὶ πρῶται τῶν ἄλλων), it would be impossible to be mistaken about these things and understand any of the other things ; for how could anyone either recognize speech and be mistaken about syllables, or be knowledgeable about them without knowing any of their elements (τῶν στοιχείων)¹⁸ ?

The *Protrepticus* thus contained an explicit discussion of causes in natural science in which Aristotle mentioned « primary things », « the elements », « fire » and « air » (which are compared to the « letters » of syllables), but not *hylê*. Nor does that term appear in the extensive passage in which Aristotle distinguishes between things which come to be « from a certain intention or art », « because of nature », « because of luck », or « out of necessity » (*ex anankês*)¹⁹. In the *Protrepticus*, Aristotle repeatedly argued that things that come to be « from some intention and art » (*apo tinos dianois kai technês*) imitate things that come to be « because of nature » (*dia physin*), a point that

¹⁶ Menn 1994.

¹⁷ The argument is very well made by Graham 1984.

¹⁸ Aristotle, *Protrepticus*, *apud* Iamblichus, *Protr.* VI, 38.22-39.8.

¹⁹ *Protrepticus*, *apud* Iamblichus, *Protr.* IX, 49.3-51.7.

is reiterated in the *Physics* with reference to *hylé*²⁰. But in the earlier work no reference to *hylé* is made in any of these passages.

The same result follows from an examination of the fragments of Aristotle's *De Philosophia*. There are numerous places one might expect *hylé* to appear, including fragments on first principles and Plato's indefinite dyad²¹; on destructible substances and whether the world is destructible²²; on composite substances and their dissolution into elements, on the natural places and mixture of these components²³; on the generation of animals in the ecological niches of earth, water, air and fire²⁴; and on the existence of a fifth element in addition to the Empedoclean four²⁵. None of these fragments, however, contain any mention of *hylé*²⁶.

I will briefly mention one more lost work in which one might expect to find Aristotle invoking the concept of *hylé*: *On Democritus*, an extensive fragment of which is quoted by Simplicius, who tells us that according to Aristotle, Democritus considers « the nature of the eternal things » (*tên tôn aidión physin*) to consist of « small substances infinite in number » (*mikras ousias pléthos apeirous*, 295.2). Democritus referred to this substance by three technical terms, apparently all neologisms (*tôi te*

²⁰ « Looking to the ancients it would seem to be the material [...] but if art imitates nature, and it is part of the same science to know the form and the material up to a point [...] (εις μὲν γὰρ τοὺς ἀρχαίους ἀποβλέψαντι δόξειεν ἂν εἶναι τῆς ὕλης [...] εἰ δὲ ἡ τέχνη μιμεῖται τὴν φύσιν, τῆς δὲ αὐτῆς ἐπιστήμης εἰδέναι τὸ εἶδος καὶ τὴν ὕλην μέχρι του) » (*Physics* II 2, 194a18-22; cf. II 8, 199a15-17; *Meteorologica* IV 3, 381b6; *PA I* 5, 645a10-15; *Metaphysics* Z 9, 1034a33-34; *Pol.* VII 17, 1337a1-3; cf. [Ar.] *De mundo* 396b11-12; see further Johnson 2005, 81, 148 and Johnson 2012, 120-124, 128-134). See also, by comparison, in the *Protrepticus*: « for nature does not imitate the skill, but it imitates nature, and it exists to help by filling in even what nature has omitted (μιμεῖται γὰρ οὐ τὴν τέχνην ἢ φύσις ἀλλὰ αὐτὴ τὴν φύσιν, καὶ ἔστιν ἐπὶ τῷ βοηθεῖν καὶ τὰ παραλειπόμενα τῆς φύσεως ἀναπληροῦν) » (IX, 49.27-50.2); ἡ τέχνη μιμεῖται τὴν φύσιν (50.12); cf. X, 54.22-23.

²¹ Fragment 11 Ross = Alexander, *Met.* 117.23-118.1.

²² Fragment 19a Ross = Philo, *De Aeternitate Mundi* 5.20-24.

²³ Fragment 19b Ross = Philo, *De Aeternitate Mundi* 6.28-7.34.

²⁴ Fragment 21 Ross = Cicero, *ND* II.15.42+16.44.

²⁵ Fragment 27 Ross = Cicero, *Acad.* I.7.26; *Tusc.* I.10.22 ; 17.41 ; 26.65-27.66.

²⁶ Aristotle's own reference to the *De philosophia* in *Physics* II.2, although it touches on the issue, also does not imply that *hylé* was discussed in the dialogue: « Indeed, the arts produce their material, some simply, others so that it works well, and we use all of their constituents for our sake (for we are somehow also an end; for *the for the sake of which* is twofold; but this was discussed in the books *De philosophia*). » ἐπεὶ καὶ ποιούσιν αἱ τέχναι τὴν ὕλην αἱ μὲν ἀπλῶς αἱ δὲ εδεργόν, καὶ χρώμεθα ὡς ἡμῶν ἕνεκα πάντων ὑπαρχόντων (ἔσμεν γὰρ πῶς καὶ ἡμεῖς τέλος· διχῶς γὰρ τὸ ὄν ἕνεκα· εἴρηται δ' ἐν τοῖς περὶ φιλοσοφίας). (194a33-36 = *De philosophia*, fr. 28 Ross). What is said about the arts producing their own « material » is not said to have been discussed in the *De philosophia*: what was discussed there was the fact that there are two different senses of the expression *to hou heneka*. This tells us that *that* key causal term was used and analyzed in early works. This is not surprising, however, because that term was also used in the *Protrepticus* and in the *Organon*. What we do not find, however, is any mention of *hylé* in any of these works.

den kai tōi nastōi kai tōi ontī, 295.5) : (1) *to den* or « the thing », a made-up term formulated by contrast to the term *ou-den* which means « no-thing » (a term Democritus used for void); (2) *to nastos* or « the stuff »²⁷; and (3) *to on* or « the being ». The substance exists in all sorts of different shapes and configurations *and sizes* (πάσχοι δὲ αὐτοῖς παντοίας μορφᾶς καὶ σχήματα παντοῖα καὶ κατὰ μέγεθος διαφορᾶς, 295.7-8) *out of which* other substances are generated « just as *out of elements* » (*kathaper ek stoicheiōn*, 295.8) : the substance when compounded generates « the sensible masses » (*tous aisthētous onkous*, 295.9). The compounds, or as Aristotle begins calling them, « the bodies » (*tōn sōmatōn*, 295.16) are held together because they have interlocking shapes, which keep the compounds together until they are overcome by some greater « necessity » (*anankē*, 295.19). This is how all of « the perceptible bodies » (*tōn aisthētōn sōmatōn*, 295.22), such as plants and animals and even entire worlds, are generated and destroyed according to Aristotle's account of Democritus.

It is remarkable that Aristotle does not mention the term *hylē* either with reference to Democritus' own terminology, or in his own representation of Democritus' theory, especially since in this passage Aristotle is commenting on the novel technical terminology used by Democritus. At this point in his engagement with Democritus Aristotle does not represent the Abderite as someone who made *hylē* the primary cause of everything. This is as clear indication as one could expect that Democritus himself never used the term *hylē* in the way Aristotle eventually did. Only considerably later, in works such as the *Metaphysics* and biological works does Aristotle connect Democritus' causes with *hylē*, although even then he does not directly attribute to Democritus himself use of the term *hylē* but instead says that his causes function « as material » (*bōs hylē*)²⁸.

THE ORGANON

Turning now to the *Corpus*, it is a well-known fact that the term *hylē* nowhere appears in the *Organon*. We certainly expect to find it, as for example in *Categories* 5,

²⁷ The LSJ (s.v. *nastos*) and Ross translate « solid » here; but in light of the root meaning « close-pressed or firm », and Aristotle's use of a different term for « solid » (στερεός, e.g. *Cat.* 5a23), « stuff » seems a better translation. Thanks to DSH for the suggestion.

²⁸ *Metaphysics* A 4: « Leucippus and his associate Democritus say that the full and the empty are elements (στοιχεῖα μὲν τὸ πλήρες καὶ τὸ κενὸν εἶναι), and that of these the full and solid is the being, but the empty is the not-being (for this reason as well they say that being exists no more than non-being, because the body is no more than the void). But these are causes of the things that exist *as material* (αἴτια δὲ τῶν ὄντων ταῦτα ὡς ἕλην) » (985b4-10). *De generatione animalium* V.8: « But Democritus, neglecting to mention that for the sake of which, reduces to necessity all the things which nature uses (Δημόκριτος δὲ τὸ οὐ ἔνεκεν ἀφείξας λέγειν πάντα ἀνάγει εἰς ἀνάγκην οἷς χρῆται ἡ φύσις) – there are things like this ... but these things are causes as movers and as instruments and *as material* (ταῦτα δ' ὡς κινουῦντα καὶ ὡς ὄργανα καὶ ὡς ἕλην αἴτια) (789b2-8).

where Aristotle discusses a defining feature of substance: while remaining numerically one, substance is able to admit contrary qualities²⁹. But of all the passages it is most surprising not to find the term in *Posterior Analytics* II 11, because that chapter contains an enumeration of the four kinds of cause :

And since we think we have knowledge when we know the cause, and causes are fourfold, all of these are indicated through the middle term : <1> one is *the what something was to be*; <2> one is *the what things being <true> it is necessary for this to be <true>*; <3> one is *the what first moved it*; and <4> a fourth is *the for the sake of which*.

Ἐπεὶ δὲ ἐπίστασθαι οἴομεθα ὅταν εἰδῶμεν τὴν αἰτίαν, αἰτίαι δὲ τέτταρες, μία μὲν τὸ τί ἦν εἶναι, μία δὲ τὸ τίνων ὄντων ἀνάγκη τοῦτ' εἶναι, ἑτέρα δὲ ἣ τί πρῶτον ἐκίνησε, τετάρτη δὲ τὸ τίνος ἕνεκα, πᾶσαι αὐταὶ διὰ τοῦ μέσου δείκνυνται³⁰.

I have translated names of the causes here as literally as possible in order to represent the jargon-ladenness and awkwardness of the Greek. Still, three of the causes named here are easy to recognize: <1> « the what something was to be » is an expression used throughout Aristotle's theoretical works and corresponds to what Aristotle elsewhere calls the form or definition or account—the school term is the formal cause ; <3> « the what first moved it » is also a frequently used expression, corresponding to the mover—the efficient cause; and <4> « the for the sake of which » corresponds to the end—the final cause—to *hou heneka* being a frequently used expression throughout the whole Corpus, and one which had already been analyzed into two senses in *De philosophia*³¹. But instead of anything resembling the material cause, Aristotle lists <2> « the what things being <true> (*ontón*) it is necessary for this to be <true> (*einai*) ».

I place the word <true> in pointed brackets here, because Aristotle uses the verb *einai* and its inflections in both existential and veridical senses, and it is not clear which sense is meant here (or if, somehow, both are meant). I will not attempt to reduce one to the other. Aristotle's brief explanation of the cause offers but little help :

For, *the what things being <true> it is necessary for this to be <true>* does not obtain by assuming a single proposition but does obtain when there is a minimum of two, and when they share a single middle term. Thus, when this single thing <sc. a middle term> is assumed, it is necessary for the conclusion to be <true>.

τό τε γὰρ οὗ ὄντος τοδὶ ἀνάγκη εἶναι μιᾶς μὲν προτάσεως ληφθείσης οὐκ ἔστι, δυοῖν δὲ

²⁹ *Categories* 5, 4a10-11, 4b17-18; see Dancy 1978, 377.

³⁰ *Posterior Analytics* II 11, 94a20-24.

³¹ See note 26 above.

τούλάχιστον· τοῦτο δ' ἐστίν, ὅταν ἐν μέσον ἔχωσιν. τούτου οὖν ἐνὸς ληφθέντος τὸ συμπέρασμα ἀνάγκη εἶναι³².

Aristotle makes the logical point that the second kind of cause—I will call it the « necessitating cause » for convenience—is demonstrated by means of a middle term shared between two propositions. This supports the interpretation of the expression in a veridical sense (« it is necessary for this to be *true* »), because the explanation involves how a conclusion is necessitated by its premises, and what is necessitated by the premises is presumably that the conclusion be *true*. But while this helps us construe the awkwardly abstract phrase, it does nothing to explain how it is supposed to function *as a cause*.

The most striking point is that no specific example of this cause seems to be provided ; Aristotle immediately goes on to give examples of each of the other kinds of cause. It is almost as if Aristotle means to say that there are actually just three kinds of cause, but each can be exhibited in a demonstrative syllogism, thus illustrating logical necessity. In other texts of the Corpus, Aristotle seems to recognize or emphasize just these three other kinds of cause : for example, in *De anima* II 4 :

But the soul is a cause and principle of the living body. But causes and principles are said in many ways, and *the soul is a cause according to the three ways that we have defined* : for the soul is cause of the ensouled bodies <1> *whence the motion* and <2> *for the sake of which* and <3> *as the substance*.

ἔστι δὲ ἡ ψυχὴ τοῦ ζῶντος σώματος αἰτία καὶ ἀρχή. ταῦτα δὲ πολλαχῶς λέγεται, ὁμοίως δ' ἡ ψυχὴ κατὰ τοὺς διωρισμένους τρόπους τρεῖς αἰτία· καὶ γὰρ ὅθεν ἡ κίνησις καὶ οὐδ' ἕνεκα καὶ ὡς ἡ οὐσία τῶν ἐμψύχων σωμάτων ἡ ψυχὴ αἰτία³³.

Notice that in this famous passage Aristotle says that the soul is a cause in *the three* ways that we have defined. But Aristotle can be interpreted as saying that the soul is a cause in three of the <four> ways that have been defined, without intending to imply anything about the total number of causes. Since *De anima* II 4 is not devoted to enumerating the four causes, it need not contain an exhaustive discussion of causes. But in *Post. An.* II 11, only *those* other three kinds of causes are given their own dedicated explanations and examples.

These examples are expressed in a series of syllogisms (all in Barbara) in which the middle term indicates the cause : in the first example, the « what it was to be » cause ; in the second the « what first moved it » cause ; and in the third « the for the sake of which » cause. These examples, in addition to exhibiting each of those three main kinds of cause as a middle term, show that the necessitating cause also operates

³² *Posterior Analytics* II 11, 94a24-27.

³³ *De anima* II 4, 415b8-12.

in them since, if the premises are assumed to be true, then the conclusions will also be true (which is precisely the explanation given for the necessitating cause). Thus each of these syllogisms exhibits the phenomenon of multiple causation : necessity plus at least one other cause. This is especially so in the third example, since Aristotle claims that that syllogism also incorporates both the « what first moved it » and the « for the sake of which » cause. Since it also exhibits the necessitating cause, that one syllogism exhibits three kinds of cause at once. This seems to be the reason why immediately after this example Aristotle next discusses the phenomenon of multiple causation in general :

But it is possible for the same thing to be *both for the sake of something and out of necessity* (καὶ ἕνεκά τινος εἶναι καὶ ἐξ ἀνάγκης), for example : for what reason is the light of a lantern (οἷον διὰ τοῦ λαμπτήρος τὸ φῶς) ? For it is both out of necessity that the small particles pass through the larger pores (if light comes about by the passing through), and it is for the sake of something, in order that we not stumble³⁴.

This example explains both why and how light is generated through a lantern. Two different causes may be given : « for the sake of not stumbling in the dark » and « because small excited particles pass through the larger pores in the artifact ». Neither of those expressions in isolation or together can necessitate any conclusion. For that, the terms would have to be integrated into a syllogism with a middle term. So, let A = Light ; B = Passage of small excited fire particles through larger pores ; C = Not stumbling in the dark.

If (1) Light <of> Passage of excited particles through larger pores in the lantern;
And if (2) Passage of excited particles through larger pores <of> Not stumbling in dark;

Then (3) Light <of> Not stumbling in dark.

The cause of not stumbling in the dark is explained by means of the light, but this is in turn explained by the passage of small fiery particles through larger pores in the lamp. It is probably significant that the primary cause is here described not specifically as the « moving » cause or something like that, but rather as a cause « out of necessity ». This phrase calls to mind the necessitating cause. No doubt that cause is, as ever, operative in the sense that if premises (1,2) are true then it is necessary for the conclusion (3) to be true. But Aristotle now seems to refer not only to logical necessity, but to « passage of excited fire particles through larger pores » as some kind of cause « out of necessity ».

³⁴ *Posterior Analytics* 94b27-31.

It is crucial that in *Post. An.* II Aristotle does not restrict his discussion to merely logical or epistemological matters, but explicitly applies his theory to natural science in II 11 and following³⁵. He does this by explaining that, like the lantern, natural things tend to have multiple causes, being both « for the sake of something » and « out of necessity ». Having already discussed the cause « for the sake of something », he next discusses the multiple senses of necessity :

But there are many things like that, especially those things that are constituted and composed according to nature (μάλιστα ἐν τοῖς κατὰ φύσιν συνισταμένοις καὶ συνεστῶσιν). For on the one hand nature produces them for the sake of something, but on the other hand out of necessity (ἢ μὲν γὰρ ἕνεκά του ποιεῖ φύσις, ἢ δ' ἐξ ἀνάγκης). But necessity is twofold. For there is <necessity> on the one hand in accordance with nature and its impulse (ἢ μὲν γὰρ κατὰ φύσιν καὶ τὴν ὁρμήν), but on the other hand by constraint and contrary to its impulse (ἢ δὲ βίαι ἢ παρὰ τὴν ὁρμήν), just as a stone out of necessity is carried both up and down, but not because of the same necessity (οὐ διὰ τὴν αὐτὴν ἀνάγκην)³⁶.

In this discussion, Aristotle provides only an overly brief example : a stone « out of necessity » falls downwards in accordance with its natural impulse, but by constraint and contrary to natural impulse is thrown upwards.

But explanations specifying causes both « for the sake of something » and « out of necessity » pervade the biological works, especially *De partibus animalium* and *De generatione animalium*³⁷. In the latter, for example, Aristotle offers the following explanation of the early shedding of the front teeth :

But teeth, having come to be for the sake of the better (γενόμενοι τοῦ μὲν βελτίονος χάριν), are shed because sharp things are quickly blunted; so they <the sharp front teeth that are shed earliest> need to be replaced by others in light of their function. But of the broad ones there is no blunting, and they are only smoothed by being worn down over time. But they <the front teeth> are also shed <first> out of necessity (ἐξ ἀνάγκης δ' ἐπίπτουσιν), because the roots of the teeth in the broad part of the jaw are also in strong bone, but those in the front are in a thin part, for which reason they are weak and easy to move³⁸.

³⁵ The examples in *Post. An.* II 12 and 15 are meteorological, in II 13-14 zoological, and in II 16-17 botanical.

³⁶ *Post. An.* II 11, 94b34-95a3.

³⁷ In *De partibus animalium* I 1, Aristotle states a general principle that the end should be stated before the necessary causes (642a2); he integrates both necessary causes and the for the sake of which cause in the paradigmatic explanation of respiration (642a31-b4); and also in his explanations of: eyelashes (658b14-26); deer shedding horns (663b12-20); the epiglottis (665a6-10); cartilaginous vertebrae in serpents (692a3-5); hair on human heads (658b2-7); tails (690a1-4); feet (694b5-9); and beaks (693a10-11). Many more examples could be added : see Johnson 2008, 189-195.

³⁸ *GA V* 8, 789a8-14.

The shedding of teeth is explained as both for the sake of something and out of necessity, exactly as Aristotle says is typical in natural science in *Post. An.* II 11. And in *De generatione animalium* Aristotle uses the example to criticize Democritus' aetiology in general :

But Democritus, neglecting to mention that for the sake of which, reduces all the things which nature uses to necessity (Δημόκριτος δὲ τὸ ὄν ἐνεκεν ἀφείς λέγειν πάντα ἀνάγει εἰς ἀνάγκην ὅς χροῖται ἢ φύσις). There are things like this, but which are also for the sake of something and thanks to what is better with respect to each thing. So, while nothing prevents the teeth coming to be and being shed in this way, it is not because of these things, but because of their end. But these things are causes as movers and as instruments and *as material* (ταῦτα δ' ὡς κινούντα καὶ ὡς ὄργανα καὶ ὡς ἕλη αἴτια). [...] But to say that the causes are out of necessity would be like someone thinking only that the lancet draws the fluids out of the dropsical patients, without thinking that the reason why the lancet cuts them is for the sake of its being good for health³⁹.

The term « instrument » here functions the same way as in the *Protrepticus* passages according to which the soul uses the body as an instrument. But in the *GA* Aristotle also refers to his « moving » cause and the « material » cause (which was not mentioned in *Post. An.*). What was conceived in the *Protrepticus* as an « instrumental » relationship is in *GA* analyzed into the moving and material causes. Aristotle claims that Democritus mentions only necessary causes, but it is Aristotle that interprets them as « movers », « instruments », and « material ». These are Aristotle's concepts, not Democritus' and Aristotle does not suggest that Democritus himself employed the terminology of « material » (or « instruments » or « movers »).

According to Aristotle, Democritus' explanation of the shedding of front teeth is: « because their roots are in the narrow part of the jaw, the front teeth are shed earlier ». Now according to Aristotle's analysis, this explanation is not in fact logically necessary, because there are not here two propositions sharing a middle term. Thus such an explanation could never constitute demonstrative knowledge. It is not until Democritus' purportedly « necessary » cause is linked up with another kind of cause, and specifically the « for the sake of which » cause, that any conclusion will be necessitated, and thus it be possible for there to be demonstrative knowledge of the causes of teeth shedding.

This brings us to the explanation of shedding the front teeth that Aristotle himself provides (789a8-14, quoted above) : the front teeth are shed earlier because they are prone to being blunted and so need to be replaced sooner by newer, sharper teeth. It is for the sake of this function that the front teeth are shed earlier.

³⁹ *GA* V 8, 789b2-15.

If (1) Shedding of teeth earlier <of> Replacement of blunted teeth;
 And if (2) Replacement of blunted teeth <of> Teeth rooted in the narrow part of the jaw;
 Then (3) Shedding of teeth earlier <of> Teeth rooted in the narrow part of the jaw.

This explanation of why there is earlier shedding incorporates both Aristotle's « for the sake of which » cause (« replacement of blunted ones ») and a Democritean « out of necessity » cause (« teeth rooted in the narrow part of the jaw »). Furthermore, there is logical necessity here : assuming the premises (1-2) are true, it is necessary for there to be (3) earlier shedding of the front teeth.

By applying the criteria of *Post. An.* II 11, then, Aristotle has an effective line of criticism of Democritean explanations. Thinking Democritus reduces all the causes to necessity, Aristotle takes the opposite strategy of proliferating the kinds of causes into a fourfold scheme and stipulates that necessity cannot be obtained without reference to one of the three other kinds of cause as well. Democritean causes can only be explanatory when arranged in a syllogism in combination with some other kind of cause.

Aristotle ends *Post. An.* II 11 not by elaborating on the distinction between two kinds of necessity that he mentioned, or by relating these to logical necessity. Instead, he goes on to argue that necessity is associated with spontaneity and luck, causes contrasted with the « for the sake of which » cause :

But in those cases resulting from intention (*ἀπὸ διανοίας*), some do not ever exist as a result of spontaneity (*ἀπὸ τοῦ αὐτομάτου*) (for example a house or a statue), nor out of necessity (*οὐδ' ἐξ ἀνάγκης*), but for the sake of something (*ἀλλ' ἕνεκά του*); but others also exist as a result of luck (*ἀπὸ τύχης*) (for example health and protection). But especially in those cases in which it is possible both to be in a certain way and to be otherwise, when, not as a result of luck, their coming to be is such that the end is good, it comes to be for the sake of this, whether by nature or by art. But as a result of luck nothing comes to be for the sake of something⁴⁰.

In a parallel passage from *Protrepticus* (mentioned earlier) Aristotle makes a similar argument but with reference only to art, nature, and luck. The addition of spontaneity and necessity here indicates that *Post. An.* II 11 was written after the *Protrepticus* and that he wrote it with a specific concern in mind about Democritus, who had emphasized both spontaneity and necessity in his natural philosophy⁴¹. All of the causes mentioned here at the end of *Post. An.* II 11 are also discussed in *Physics*

⁴⁰ *Post. An.* II 11, 95a3-9.

⁴¹ See Johnson 2009.

II, and so are all of these examples : health and safety as ends, and artifacts such as a house and a statue. But the parallels between *Post. An.* II 11 and *Physics* II go far beyond the causes discussed and the examples used. In part, *Physics* II is structured as an expansion of the enumeration of causes in *Post. An.* II 11, as table 1 shows.

	<i>Post. An.</i> II 11	<i>Phys.</i> II 3-6	<i>Phys.</i> II 7-9
The causes as means of gaining knowledge	94a20-21	194b16-23	198a21-24
Enumeration of the four kinds of cause	94a21-b26	194b23-195a2 and 195a8-25	198a14-21
Discussion of multiple causation	94b27-34	195a3-8 and 195a25-b30	198a24-b9
Distinction between two kinds of necessity	94b34-95a3	—	199b34-200b8
Discussion of spontaneity and luck	95a4-9	195b31-198a13	—

Table 1. The order of the discussion in passages enumerating the four causes

We may conclude this discussion of *Post. An.* II 11 by recalling the most surprising point : that the term *hylê* never appears here. That must be because the material cause was not conceived yet. Let us now turn to the conception and development of it in the parallel sections of the *Physics*.

PHYSICS II 3

The next chapter in the Aristotle Corpus devoted to the enumeration and explanation of the four causes is *Physics* II 3. Aristotle introduces the discussion by stating that knowledge in general is obtained by grasping the causes, and this applies specifically to « all of natural change ». He exhorts us to learn the causes of natural change⁴². Just as in *Post. An.* II 11, the introductory protreptic remark is followed by a description of the four kinds of cause :

⁴² « Having made these distinctions we must investigate concerning the causes, what they are like and also how many there are in number. For the purpose of the discussion is knowledge, and we think we know not before we can grasp the reason why concerning each thing (but this is the grasping of the primary cause), it is clear that for us one should also produce this also concerning generation and destruction, and all of natural change, so that by knowing the principles of these, we may try to refer each of the things we are researching to them. » (194b16-23).

Now <1> one mode of cause is said to be that out of which comes to be something persisting (τὸ ἐξ ὃς γίγνεται τι ἐνυπάρχοντος), for example the bronze of the statue and the gold of the cup and the kinds of these. But <2> another <mode of cause> is the form and the example, but this is the account, the one of what something is to be and the kinds of these (for example of the whole octave the ratio two to one, and generally the number), and the parts in the account. Again, <3> whence the first origin of the change or rest, for example the man deliberating is a cause, and the father of the child, and generally the producer of the product and the changer of the thing that is changed. Again, <4> as the end. And this is that for the sake of which, for example health of the walking. For what is the reason he walked? We say, « in order to be healthy », and saying this we think the causal explanation to have been demonstrated. And as many other intermediate movements as bring about the end <are causes in this way> (for example, of health, the thinning or the purging or the drugs or the instruments). For all of these things are for the sake of their ends, but they differ from each other, some being functions, others instruments (τὰ μὲν ἔργα τὰ δ' ὄργανα)⁴³.

Three of these causes clearly correspond to the three from *Post. An.* II 11 and *De anima* II 4: « the form and the example » corresponds to the « the what it was to be »; « whence the first origin of motion or rest » to « the what first moved it »; and « the end » to « the what it is for the sake of »⁴⁴. The example of the end is the same in both texts : health is said to be the (final) cause of someone's walking.

But the fourth kind of cause mentioned here, « the thing out of which comes to be something persisting » (τὸ ἐξ ὃς γίγνεται τι ἐνυπάρχοντος), was not mentioned in *Post. An.* Both the name and the examples of this kind of cause are totally new : the bronze of the statue, the gold of the cup, and « the kinds of these », by which Aristotle apparently means something like « metals », a generic kind that would include both bronze and gold. The term *hylê* does not appear in this enumeration of the four kinds of cause and is not introduced until the following comment about multiple causation.

These then perhaps exhaust the number of ways in which the causes are said. But since the causes happen to be said in many ways, and there are many causes of the same thing not incidentally, for example : of the statue both the statue-maker and the bronze are causes not in accordance with anything else but insofar as it is a statue. But these are not the same mode, but one is a cause *as material*, the other as whence the movement (τὸ μὲν ὡς ὕλη τὸ δ' ὡς ὅθεν ἢ κίνησις)⁴⁵.

⁴³ *Phys.* II 3, 194b23-195a3.

⁴⁴ There are subtle differences in these formulations that I do not have the space to discuss here.

⁴⁵ *Phys.* II 3, 195a3-8.

This is where the term *hylé* is introduced in an enumeration of the four kinds of cause. The *hylé* is exemplified by the bronze of a statue and contrasted the kind of cause that the sculptor is (a moving cause). We can be sure that *hylé* is here used in a semi-technical sense, since it must mean something abstract and general like « material », otherwise Aristotle would be saying that bronze is timber or wood. And yet *hylé* is not yet used as a general term for its own kind of cause—it is given merely as an example of a cause, and specifically a cause of a metallic artifact : a bronze statue or gold cup.

After making some further points about multiple causation that do not concern us here, Aristotle gives a fresh enumeration of the four causes which differs in subtle ways from the previous one.

But all of these causes mentioned just now fall into four modes that are especially evident. For, <1> the elemental letters <are a cause> of their syllables, and the material <is a cause> of their artifacts (*ἡ ὕλη τῶν σκευαστῶν*), and the fire and similar things of their bodies, and the parts <are causes> of their whole, and the hypotheses <are causes> of their conclusion (*αἱ ὑποθέσεις τοῦ συμπεράσματος*), as *the out of which cause* (*ὡς τὸ ἐξ οὗ αἰτιά*); but of these <pairs>, the former are the causes as the substrate (*ὡς τὸ ὑποκείμενον*), like the parts (*ὅσον τὰ μέρη*), but <2> the latter are the causes as *the what something is to be*, and the whole and the composite and *the form*. But <3> the seed and the doctor and the man deliberating and generally the producer, are all causes as *whence the origin of the change* or rest. But <4> there are also causes as the end and the good of the other things. For *the for the sake of which* is best, and end of the other things one chooses⁴⁶.

In this enumeration of four kinds of cause Aristotle names « the out of which » (again, not *hylé*) as the first kind of cause, as in the previous enumeration in II 3. And except for that kind of cause, Aristotle uses names for the three other kinds of cause easy to recognize from *Post. An.* II 11. The term *hylé* appears here, but not as the name of a kind of cause in its own right, but rather as but one example among many of « the cause out of which », including :

1. the elemental letters of the syllables (*ta stoicheia tōn syllabōn*)
2. the material of the artifacts (*hē hylé tōn skeuastōn*)
3. the fire and similar things of the bodies (*to pyr kai ta toiauta tōn sōmatōn*)
4. the parts of the whole (*ta merē tou holou*)
5. the hypotheses of the conclusion (*hai hypotheseis tou symperasmatos*).

The term translated « elemental letters » (*stoicheia*) is the same word used in the *Protrepticus* and frequently used in Aristotle's theoretical works and usually translated

⁴⁶ *Phys.* II 3, 195a15-25.

« elements », a general name of earth, water, air, and fire. Thus, the third example of the cause out of which, « the fire and similar things », also refers to the elements « out of which » bodies are composed, just as the letters are the things « out of which » syllables are composed. Aristotle does not further specify what he means by « the parts » (he does not hint if he has in mind the « parts » of animals), but this example can be interpreted along the same line as the previous examples: just as letters are parts of syllables, and elements are parts of bodies, so in general parts are things « out of which » wholes are composed. The second example is « the material of the artifacts ». We have already been given two examples of causes « out of which »: the bronze of a statue, and the gold of a cup. Nowhere in *Physics* II 3 is the word *hylê* used in a more general way than « material of an artifact ».

The final example of the cause « out of which » is telegraphic and puzzling: « the hypotheses of the conclusion ». But *Post. An.* II 11 seems to provide the key to unlocking this cryptic example. The kind of cause there called « *the what things being <true>, it is necessary for this to be <true>* », was shown to operate where there are at least two premises sharing a middle term; then, if the premises are <true>, the conclusion is <true>. Hence it seems reasonable that commentators have interpreted the reference to « hypotheses » here in *Physics* II 3 as a reference to « premises » and assumed that Aristotle has logical necessity in mind⁴⁷. But it should also be pointed out that the logical necessity of *Post. An.* II 11 now appears not as a kind of cause

⁴⁷ This seems reasonable up to a point, but very problematic if we follow the analogy, as it were, to its conclusions. Is it the case that: just as if the premises are true, it is necessary for the conclusion to be true, so if the letters exist, it is necessary for their syllables to exist? Or if the elements exist, then so do their bodies? Or if the parts exist, then so do their whole? Or if the material exists, then so do their artifacts? The last example most clearly shows the problem: for it is clearly not the case that if a certain material exists (e.g. bronze, gold, iron, bricks, wood), then necessarily a certain artifact exists (e.g. a statue, cup, saw, house, or bed). In fact, as we will see, in Aristotle's view the situation is the exact reverse of this: if certain artifacts will exist, then their materials must exist. For example, it is not the case that if bronze exists, then a bronze statue must exist, or if gold exists then a golden cup must exist, for the bronze material may instead be a sphere, or the gold material a spoon. But, on the other hand, if there is to be a bronze statue, then there will have to be a certain kind of material (bronze), and similarly if a golden cup, then gold. This disanalogy may be used to help explain why Aristotle uses the term « hypotheses » here instead of « premises » in *Physics* II 3. For in *Physics* II 9, Aristotle introduces a kind of necessity not mentioned in *Post. An.* II 11, and which describes how the existence of functional artifacts necessitates the existence of certain materials, and his name for this kind of necessity is « hypothetical » or *ex hypothesi* necessity. Thus, returning to *Physics* II 3, I would propose that in giving *αἱ ὑποθέσεις τοῦ συμπεράσματος* as an example of the « out of which » cause, we should perhaps think not of how premises necessitate conclusions, but of how certain conclusions presuppose certain hypotheses, just as the existence of certain syllables presupposes certain letters, and as the existence of certain wholes (e.g. animals) presupposes the existence of certain parts (e.g. lungs or hands), and, again, certain artifacts (e.g. saws) presuppose certain materials (e.g. iron). I will return to this point after discussing *Physics* II 7.

in its own right but rather as one species of a much more general kind of cause. We see here Aristotle radically expanding and transforming his conception of the « necessitating cause » in *Post. An.* II 11.

The rest of *Physics* II 3 discusses the other varieties of cause. The important and surprising point for the present investigation is that the term *hylé* is never used in this chapter as a general term for a kind of cause, but only as one example among many of this extraordinarily generally conceived kind of cause. Furthermore, it is highly significant that the only example given of *hylé* is the material of artifacts.

PHYSICS II 7

Aristotle offers a fresh enumeration of the four kinds of cause, and an explanation of why they are the four in *Physics* II 7⁴⁸ :

But that there are causes, and that there are as many in number as we claim, is clear. For there are as many in number as things comprehended by the reason why. For the ultimate reason why is referred either to <1> the what it is (in those things without motion, for example : in mathematics it is ultimately referred to the definition of the straight or commensurate or another thing); or to <2> the thing that first moved (for example: why did they go to war? because they were raided); or to <3> something for the sake of which (in order that they could rule), or in those things that come to be, to <4> the material.

Ὅτι δὲ ἔστιν αἷτια, καὶ ὅτι τοσαῦτα τὸν ἀριθμὸν ὅσα φαμέν, δῆλον· τοσαῦτα γὰρ τὸν ἀριθμὸν τὸ διὰ τί περιεῖληφεν· ἢ γὰρ εἰς τὸ τί ἐστὶν ἀνάγεται τὸ διὰ τί ἔσχατον (ἐν τοῖς ἀκινήτοις οἷον ἐν τοῖς μαθήμασιν· εἰς ὄρισμὸν γὰρ τοῦ εὐθέως ἢ συμμέτρου ἢ ἄλλου τινὸς ἀνάγεται ἔσχατον), ἢ εἰς τὸ κινήσαν πρῶτον (οἷον διὰ τί ἐπολέμησαν; ὅτι ἐσύλησαν), ἢ τίνος ἕνεκα (ἵνα ἄρξωσιν), ἢ ἐν τοῖς γιγνομένοις ἢ ὕλη⁴⁹.

Here we have the usual three causes named in a familiar way⁵⁰. But the name for the fourth is not familiar from previous enumerations of the four causes : the

⁴⁸ This gives the impression that either *Physics* II 3 (which is in part a doublet of *Metaphysics* Δ 2) or II 7 is a later insertion, whether by Aristotle or another editor, that does not perfectly fit with the original plan of *Physics* II. The redundancy is difficult to account for.

⁴⁹ *Phys.* II 7, 198a14-21.

⁵⁰ <1> « the what it is » is a slightly different formulation from the earlier and more clumsy expression « the what it was to be », a reference to the form or definition ; <2> « the first mover » (τὸ κινήσαν πρῶτον) is a formulation actually closer to the *Post. An.* II 11 version (ἢ τί πρῶτον ἐκίνησε) than to the *Physics* II 3 version (ἢ ἀρχὴ τῆς μεταβολῆς ἢ πρώτη ἢ τῆς ἡρεμῆσεως; ἢ ἀρχὴ τῆς μεταβολῆς ἢ στάσεως); but still a recognizable reference to the mover or efficient cause; and <3> « the what it is for the sake of » remains a remarkably stable formula throughout these texts.

material (*hê hylê*). This seems to be the first passage in which Aristotle names *hê hylê* as one of the four kinds of cause in its own right. « The material » is now a generic kind of cause, and not merely an example of the « out of which » cause. In fact, the language of the « out of which » cause from *Physics* II 3 has disappeared, and so has the necessitating cause of *Post. An.* II 11. In its place we have the bare term *hê hylê*, which literally means forest, woodland, copse, firewood, fuel, timber, or lumber, but has earlier been instanced only with metallic artifacts (a bronze statue and a gold cup). The examples of the other causes are similar to those given in *Post. An.* II 11⁵¹, but here, when he is naming a new and different kind of cause, Aristotle offers no example. Still, he continues to insist that *hê hylê* is one of the causes the physicist must know.

That the causes, then, are these and this many is clear. But since the causes are four, it is appropriate for the physicist to know about all of them, and by referring to all of them he provides the reason why naturalistically (φυσικῶς): the material (τὴν ὕλην), the form (τὸ εἶδος), the mover (τὸ κινῆσαν), the for the sake of which (τὸ ὄν ἐνεκα)⁵².

Here we have the canonical four causes in their most succinct and familiar formulations. Aristotle next discusses multiple causation. In *Post. An.* II 11, he explained that « it is possible for the same thing to be both for the sake of something and out of necessity » for example a lantern ; in *Physics* II 3 the example was how both the bronze (the material) and the sculptor (the mover) could be causes of a sculpture (another artifact). In those arguments, *two* kinds of cause are said to operate at the same time, but now Aristotle argues that *three* of the four kinds of causes converge.

But the three of these often converge into one thing. For <1> the *what it is* and <2> the *for the sake of which* are identical, and <3> the *whence the first motion* is the same as these in its form. For a human begets a human—and generally as many things as are moved move (and however many do not move are no longer natural; for they have neither motion in themselves nor are they an origin of moving by means of moving, rather they are unmoved). That is why there are three domains: <i> the one concerning immovable things; <ii> the one concerning things moveable but indestructible; and <iii> the one concerning the destructible things). It follows that the reason why is provided by referring to <4> the *material*, as well as to the *what it is*, and to *the first mover*.

⁵¹ The « what it was to be » is instanced by the definition of the « straight » <line> (cf. the « right » <angle> of *Post. An.* II 11); the « what first moved it » by Why they went to war (cf. the example of the Athenian raid on Sardis as the cause of the Persian war). For « the end », however, the problematic example of the postprandial perambulator of *Post. An.* II 11 has been revised to something more coherent, now referring to the final cause of the war : the desire to rule.

⁵² *Phys.* II 7, 198a21-24.

ἔρχεται δὲ τὰ τρία εἰς [τὸ] ἓν πολλάκις· τὸ μὲν γὰρ τί ἐστὶ καὶ τὸ οὐ ἕνεκα ἓν ἐστὶ, τὸ δ' ὅθεν ἢ κίνησις πρῶτον τῷ εἶδει ταῦτό τούτοις· ἄνθρωπος γὰρ ἄνθρωπον γεννᾷ – καὶ ὅλως ὅσα κινούμενα κινεῖ (ὅσα δὲ μή, οὐκέτι φυσικῆς· οὐ γὰρ ἐν αὐτοῖς ἔχοντα κίνησιν οὐδ' ἀρχὴν κινήσεως κινεῖ, ἀλλ' ἀκίνητα ὄντα· διὸ τρεῖς αἱ πραγματεῖαι, ἡ μὲν περὶ ἀκινήτων, ἡ δὲ περὶ κινουμένων μὲν ἀφθάρτων δέ, ἡ δὲ περὶ τὰ φθαρά). ὥστε τὸ διὰ τί καὶ εἰς τὴν βλην ἀνάγοντι ἀποδίδονται, καὶ εἰς τὸ τί ἐστίν, καὶ εἰς τὸ πρῶτον κινήσαν⁵³.

As we saw, form, end, and mover were said to converge also in *De anima* II 4. But here Aristotle goes on to assert that the physicist needs to refer not to three but to four kinds of cause, including *hylé*. The argument correlates each kind of cause with a single domain of explanation.

<i>Domain of explanation</i>	<i>Relevant cause</i>
Immovable and indestructible things	The form and end
Movable and indestructible things	The first mover
Movable and destructible things	The material

Table 2. Domains of explanation and their causes

In the domain of destructible things, then, the reason why is provided by referring to the material. Frustratingly, Aristotle does not provide any examples, but consider bronze statues and gold cups, the examples Aristotle used earlier. Why would Aristotle think that the bronze or the gold provides the reason why—in any sense—for a statue or cup ? The way this kind of cause is supposed to operate as a cause has not yet been stated. And what Aristotle goes on to say again mentions the mover, the form, and the end, but nothing about *hē hylé* :

For, concerning generated things the physicists investigate this mode of causal explanation especially : what comes after what, and what first acted or was acted upon, and the series is always like this. But there are two principles of the things that move naturally, of which one is not natural (for it does not have a principle of motion in itself). But this is the kind of thing that moves something without being moved, such as the unmoved mover of everything and the first of all, and the what it is, and the shape. For it is an end and that for the sake of which⁵⁴.

Aristotle does not explain how *hē hylé* relates to the three kinds of causes that converge in natural things, nor does he give any example. Instead, he glosses the causes with four vaguely familiar phrases :

⁵³ *Phys.* II 7, 198a24-33.

⁵⁴ *Phys.* II 7, 198a33-b4.

Since nature is for the sake of something, there is both need to know this, and to provide the reason why in every way, for example: that from this <being true> is it is necessary for this <to be true> (and the « from this » is said either simply or for the most part), and if this is going to be <true> this here will be <true> (like from the premises the conclusions) and that this was what it is was to be and for the reason that it is better thus (not simply, but with respect to each substance).

ὥστε ἐπεὶ ἡ φύσις ἐνεκά του, καὶ ταύτην εἰδέναι δεῖ, καὶ πάντως ἀποδοτέον τὸ διὰ τί, οἶον ὅτι ἐκ τοῦδε ἀνάγκη τόδε (τὸ δὲ ἐκ τοῦδε ἢ ἀπλῶς ἢ ὡς ἐπὶ τὸ πολὺ), καὶ εἰ μέλλει τοδὶ ἔσσεσθαι (ὡσπερ ἐκ τῶν προτάσεων τὸ συμπεράσμα), καὶ ὅτι τοῦτ' ἦν τὸ τί ἦν εἶναι, καὶ διότι βέλτιον οὕτως, οὐχ ἀπλῶς, ἀλλὰ τὸ πρὸς τὴν ἐκάστου οὐσίαν⁵⁵.

It not perfectly clear how the causes correspond to the glossing terminology, but the following table offers a partial correlation.

Terminology in <i>Physics</i> II 7	Relevant Cause	Examples
τὸ τί ἦν εἶναι <i>the what it is was to be</i>	the form	saw; house
διότι βέλτιον οὕτως <i>for the reason that it is better thus</i>	the end	cutting; shelter or protection
εἰ μέλλει τοδὶ ἔσσεσθαι <i>if it is going to be <true> this here will be <true></i>	the material	iron; stone (if there is going to be a saw or a house) <hypothetical necessity>
ἐκ τοῦδε ἀνάγκη τόδε <i>from this <being true> this too is necessary</i>	?	the interior angles of triangle; the angle in semicircle <simple necessity>

Table 3. Causal terminology and examples in *Physics* II 7

The first two kinds of cause need no further discussion. The material cause is evidently to be correlated with the expression « if it is going to be <true>, this here will be <true> » (*ei mellei todi esesthai*). But it is not clear where the moving cause is supposed to appear on this scheme, or what cause the expression « from this <being true> this too is necessary » (*ek toude anankê tode*) is meant to gloss. At first glance it seems similar to or « the what things being <true> it is necessary for this to be <true> » (*to tinôn ontôn anankê tout'eînai*): the necessitating cause of *Post. An.* II 11. This is also suggested by the parenthetical example « just like the premises of the conclusion » (*hōsper ek tōn protaseōn to symperasma*). (Accordingly, it seems reasonable to translate the expression *ek toude anankê tode* as « from this <being true> this too

⁵⁵ *Phys.* II 7, 198b4-9.

is necessary » and to interpret this cause as a reference to something like the necessitating cause.)

The necessitating cause in *Post. An.* II 11 was subsumed into the « out of which » cause in *Physics* II 3, and then « the material » cause in II 7. But *ek toude anankê tode* cannot be a reference to « the material » cause, if what we have just said about the necessitating cause is true, because material does not necessitate an artifact in the way premises necessitate their conclusion. The existence of two premises sharing a middle term logically necessitates a conclusion, but the existence of bronze does not necessitate a statue, or gold a cup; for the bronze could be made into armor instead, and the gold into a spoon. This brings us to the expression *ei mellei todi esesthai*, the phrase from *Physics* II 7 apparently corresponding to the material cause. It is not clear why Aristotle has offered these glosses so reminiscent of *Post. An.* II 11, but in *Physics* II 9 we learn that it is because of a distinction between two different kinds of necessity.

The account of the distinction between two kinds of necessity in *Physics* II 9 has changed radically from the one offered in *Post. An.* II 11. The distinction is no longer between « natural » necessity and a necessity « contrary to nature ». Instead, Aristotle now distinguishes « the thing out of necessity *by hypothesis* » (*ex hypotheseôs*) and « the thing out of necessity *simply* » (*haplôs*). To illustrate this distinction Aristotle offers yet another example of an artifact, and this seems to be the reason he no longer calls this kind of necessity « natural » : because he needs to liken this necessity « by hypothesis » to the way necessity works in the case of artifacts like walls and saws.

Similarly, although a wall has not come to be without these things, still it has not come to be because of these things except *as because of material* (οὐ μέντοι διὰ ταῦτα πλὴν ὡς δι' ὕλην), but rather for the sake of protecting and saving something (ἀλλ' ἕνεκα τοῦ κρούπειν ἄττα καὶ σώζειν). But, it is similar also in all the other things in which there is the for the sake of which : on the one hand they do not exist without having the nature of the necessary things, but they do not exist because of these things except *as material*, but rather for the sake of something (οὐ μέντοι γὰρ διὰ ταῦτα ἀλλ' ἢ ὡς ὕλην, ἀλλ' ἕνεκά του), for example: Because of what is the saw this thing here? In order for this to be and to exist for the sake of this other thing. But it is not possible for this *for the sake of which* to have come to be, unless it were iron. Therefore, it is necessary for there to be iron, if there will be a saw and its function. This is necessary by hypothesis, but not as an end (ἔξ ὑποθέσεως δὴ τὸ ἀναγκαῖον, ἀλλ' οὐχ ὡς τέλος). For the necessity is *in the material*, but the for the sake of which is in the account (ἐν γὰρ τῇ ὕλει τὸ ἀναγκαῖον, τὸ δ' οὐδ' ἕνεκα ἐν τῷ λόγῳ)⁵⁶.

Aristotle thus contrasts necessity *by hypothesis* with the *for the sake of which* cause, and associates that necessity with the *material*, and the *for the sake of which* cause with the form, providing two examples, both artifacts : a wall and a saw.

⁵⁶ *Phys.* II 9, 200a5-15.

The following explanation of the saw is modeled on the lantern in *Post. An.* II 11 :

Let A = Saw ; B = Iron material; and C = Dividing wood.

If (1) Saw <of> Iron material ;

And if (2) Iron material <of> Dividing wood ;

Then (3) Saw <of> Dividing wood.

The saw is able to divide wood *because* it is made out of iron material. Compare the lantern. It enables us not to stumble in the dark *because* in it small excited particles pass through larger pores (so light is cast). In both cases we have an explanation that refers to a kind of cause that is said to operate « out of necessity »: the necessity *by hypothesis* that if a saw *will* divide the wood, then it *will* be made of iron; or, if we *will* not stumble in the dark, then small particles *will* be passed through larger pores in a lantern.

In the relevant syllogisms, there is also a generic logical necessity at work. But, in both cases, Aristotle suggests that another kind of necessity operates as a cause in addition to this. Aristotle describes this other kind of necessity by contrasting it with the mathematical necessity used to illustrate logical necessity in *Post. An.* II 11. There the example of the cause of the angle in the semi-circle being a right angle was offered to illustrate the formal cause and logical necessity. In *Physics* II 7 the example is the cause of the interior angles of a triangle adding up to the sum of two right angles⁵⁷. Aristotle contrasts the way necessity operates in such cases with the case of « things that have come to be for the sake of something » :

But in the case of the things that have been come to be for the sake of something it is the reverse (ἐν δὲ τοῖς γιγνομένοις ἐνεκά του ἀνάπαλιν): if the end will be or is, then its predecessor will be or is (εἰ τὸ τέλος ἔσται ἢ ἔστι, καὶ τὸ ἔμπροσθεν ἔσται ἢ ἔστιν). Otherwise, just as in that case, if the principle will not be, then the conclusion will not be, so in this case the end and the for the sake of which will not be (εἰ δὲ μὴ, ὥσπερ ἐκεῖ μὴ ὄντος τοῦ συμπεράσματος ἢ ἀρχῆ οὐκ ἔσται, καὶ ἐνταῦθα τὸ τέλος καὶ τὸ ὄβ ἐνεκά)⁵⁸.

The relevant examples, as we should now expect, are of artifacts (a house and a saw) :

⁵⁷ « But there is a resemblance between the mode of necessity in the mathematical things and in the things to come to be according to nature. For, since the straight is this specific thing, it is necessary that the angles of a triangle be equal to two right angles ; but it is not the case that since this <sc. the angles of a triangle being equal to two right angles>, therefore that <sc. the straight is this specific thing>. But if this <sc. the angles of a triangle being equal to two right angles> is not the case, then the straight is not what it is. » (*Phys.* II 9, 200a15-19).

⁵⁸ *Phys.* II 9, 200a19-22.

If a house will be, it is necessary for these things to come to be or exist already, or generally for there to be the material for the sake of something, for example bricks and stones, if a house will come to be. But the end does not exist because of these things except *as material* (οὐ μέντοι διὰ ταῦτά ἐστι τὸ τέλος ἀλλ' ἢ ὡς ὕλην), nor will a house come to be because of them. But, in general, if these things do not exist then there will be neither a house nor a saw unless there are the stones, or the iron. For in the mathematical case, the principles will not be, if the angles of the triangle are not two right angles⁵⁹.

Simple necessity is illustrated by the formal cause (the definition of right angle or straight line) and thus by mathematical necessity, and necessity *by hypothesis* is illustrated by the relationship between the form and material of an artifact. Again, the only examples Aristotle has given of necessity in the case of things that come to be for the sake of something (*en de tois gignomenois heneka tou*) are artifacts : houses and saws. The formula for hypothetical necessity, *ei mellei todi esesthai* must, then, refer to the material cause. The necessity discussed at the end of *Post. An.* II 11 has now been transformed into simple necessity, instanced by mathematical necessity, and necessity *by hypothesis* is instanced by an artifact's material in relation to its form and end.

As for how the moving cause fits into this scheme, we may now observe that Aristotle groups the moving and material cause together at the very end of *Physics* II 7 :

Thus it is clear that the necessity in the physical things is the thing we mention *as material* and its movements (τὸ ἀναγκαῖον ἐν τοῖς φυσικοῖς τὸ ὡς ὕλη λεγόμενον καὶ αἱ κινήσεις αἱ ταύτης). Both of these causes need to be mentioned by the physicist, but especially the for the sake of which ; for it is a cause of the material, but the material is not a cause of the end (αἴτιον γὰρ τοῦτο τῆς ὕλης, ἀλλ' οὐκ αἴτη τοῦ τέλους). And the end is the for the sake of which, and the principle from the definition and the account, just as in the things that come to be in accordance with art, since the house is a certain kind of thing, these things need to come to be and exist already out of necessity ; or, since health is this here thing, it is necessary for these things to come to be out of necessity and exist already. Similarly, if a human being is this here thing, these things. If these, then those. But perhaps the necessity is also in the account. For if by definition the function of the saw is dividing in a certain way, this will not be, if it does not have a certain kind of teeth ; but those cannot be, unless it is iron (εἰ μὴ ἔξει ὀδόντας τοιουσδί· οὔτοι δ' οὐ, εἰ μὴ σιδηροῦς). For even in the account there is a part of the account that is *as material* (ἔστι γὰρ καὶ ἐν τῷ λόγῳ ἕνια μόρια ὡς ὕλη τοῦ λόγου)⁶⁰.

⁵⁹ *Phys.* II 9, 200a24-30.

⁶⁰ *Phys.* II 9, 200a30-b8.

The analogy offered here between the explanation of a house and a human being is the very point of attachment between Aristotle's artifact model and his account of explanation in natural science. But what he says here is extremely telegraphic : « similarly, if a human being is this here thing, these things. » Many questions remain, beginning with : where does the integration of the moving and material causes leave the earlier idea that the moving cause actually converges with the formal and final causes in natural things ? Aristotle does not say anything about this here, nor does he elaborate on how human beings, or any natural things, are to be explained by analogy to artifacts. Instead he reverts right back to the artifact model itself, and the example of the saw.

It must be the task of other works, such as *De generatione animalium* to apply this artifactual model to the explanation of the parts of animals, like teeth. This part of the story, then, belongs to another study. But here we may point out how perfect it is that the explanation of the saw in the *Physics* II 9 involves reference to *a certain kind of teeth* (*odontas toiousdi*, 200b6), teeth both shaped in certain way, and made out of a certain material (iron): for it is precisely in the context of a discussion of teeth (*Peri de odontôn*, 788b3), as we saw, that Aristotle leveled his most general criticism of Democritus' method of explanation of natural things: « Democritus, neglecting to mention that for the sake of which, reduces all the things which nature uses to necessity [...] while nothing prevents the teeth coming to be and being shed in this way, it is not because of these things, but because of their end. But these things are causes as movers and as instruments and *as material* (ταῦτα δ' ὡς κινουῦντα καὶ ὡς ὄργανα καὶ ὡς ὕλη αἴτια) »⁶¹. Democritus explains the animals' teeth like someone who, absurdly, would try to explain an artifact like a saw by referring only to the « material » out of which the saw was made, and not giving the reason why the material had been shaped and moved in that way⁶². Thus his explanations are patently inadequate and do not obtain necessity, and so not demonstrative knowledge. Even « mechanistic » explanations, according to Aristotle, require an explanation of the cause for the sake of which the machine or instrument functions⁶³.

⁶¹ *De generatione animalium* V 8, 789b2-8.

⁶² And so we see this exact criticism frequently leveled by Aristotle against his predecessors (especially Democritus), that they mention only causes that function « as material »: *Metaphysics* A 3, 983a33-984a25 and A 4, 985b4-10; *De partibus animalium* I 1, 640b11-23, along with the additional remark that the explanations given by craftsmen are better than those given by natural philosophers (641a7-17); *De generatione animalium* V 8, 789b2-15.

⁶³ I argued for this thesis with reference to explanations in Aristotle's mechanics and biomechanics in Johnson 2017.

CONCLUSION

The development of Aristotle's theory of *hê hylê* shows that, far from being a neutral and innocuous term, *hê hylê* or « the material » is a highly contrived and theory-laden neologism, one which Aristotle himself invented and then foisted upon his predecessors and contemporaries. Aristotle himself struggled to integrate *hê hylê* with his theory of the three other kinds of causes that remain relatively stable throughout the Corpus and even, as far as we can tell, in the exoteric works : form, mover, and end.

The network of passages examined seems to show the reason why Aristotle conceived of « the material » cause as he did, and why he named it *hê hylê*. For if *hê hylê* means « the material out of which something is made » and has been conceived entirely on the model of artifacts in which some form and end is produced out of some specific material, then although Democritean causes may continue to play some role in explanation, it will be a clearly secondary and merely « hypothetically » necessary role, as instruments and movers for the sake of something else, something which is speculated about by a higher and prior science than Democritus' « material » science.

The justice of this criticism is beyond the scope of the present essay. So too is an account of how Aristotle developed his own concept of the material cause in his biological works and *Metaphysics*. For these developments pertain to later stages of Aristotle's philosophical development.

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