New Perspectives on Aristotle's De caelo

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THE POSSIBILITIES OF BEING
AND NOT-BEING IN DE CAELO 1.11–12

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In De caelo 1.10 (279b4–280a35) Aristotle argues on “physical” grounds against those who hold that the world has a beginning but no end. His main target is, of course, the Timaeus cosmology understood literally. Then, at the end of the chapter, Aristotle undertakes to show through “general” considerations applying to any sort of thing (καθόλου ... περὶ ἄλφας ... σχετικάνον ... φθοράν) whether something can be genēton yet not phtharton or the reverse (280a32–35; cf. 283b17–18). After laying the ground in chapter 11, he sets about the promised demonstration in chapter 12. It consists in an elaborate argument meant to show the mutual entailment of genēton and phtharton, and of their contradictories.

However, in the stretch of text we know as De caelo 1.12, the question of the mutual entailment of genēton and phtharton is not broached straightaway. First comes a discussion, which I shall simply call "L1" (L for logos), that starts from a question about the actual being and actual not-being of a thing that has the possibility of being and also the possibility of not-being (281a28–30). Aristotle’s answer to this question is that those paired possibilities are each realized at different times (282a4–13). Aristotle reaches this conclusion, which I take to round off the discussion L1, by means of a famous argument intended to show that that which is not able to do for a not-being is not able and in some way (281a33–282a4). It seems clear that the discussion L1 is intended to support the main thesis, carried forward from earlier chapters, that genēton ⇔ phtharton. However, it is less clear exactly how L1 is supposed to help establish this. Moreover, L1 is followed by, and indeed seems to turn into, a further stretch of argumentation, L2, in support of the main thesis. L2 begins at about 282a14 and continues to 283a3; it elaborates on various

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2 The contrast of "physical" and "general" methods in Aristotle is discussed by Robert Bolton (2009) in the present volume.
squares of opposition. It is a rather unfortunate argument for two reasons. First, it involves a non sequitur, arising, perhaps, from a false analogy (as I shall suggest in the last section). Secondly, it turns out that Aristotle has adopted an L1-related starting point ("one of the given," 283b4–11) which (a) in any case immediately yields the conclusion that genëton \(\leftrightarrow\) phtharton, and consequently (b) renders L2 redundant (if we accept that starting point). All this raises the suspicion that L1 and L2 were not first developed together as parts of a single coherent argument.

I shall first mainly discuss L1 (sections 1–5 below), and shall then examine L2 (sections 6–15).

(1) The backbone of L1 is the demonstration that what always is/is-not cannot ever not-be/be. This argument has attracted charges of fallacy and confusion; but according to the account presented here, it is sound on its own terms given certain assumptions.

Our examination begins in De caelo 1. 11, where Aristotle clarifies the terms to be used in arguing that genëton \(\leftrightarrow\) phtharton. First, he discusses a number of senses of agenëton and genëton, aptharton and phtharton (280b1–281a1). The upshot is that the most central sense (τὸ κυκλώσα τοῦ ἐνυγμέαν for phtharton is: 'cannot perish, or at one time be and at another not-be,' and similarly for agenëton (281a1–6; cf. 280b31–33). So the central senses of phtharton and genëton are "can be and at another (later) time not-be," and "can not-be and at another (later) time be," as is stated at 281b27–29. The next step is a discussion of "can" and "cannot" as used in the above definitions (281a1–26). Whereas the account of agenëton, aptharton, and so forth was quite complicated and attentive to a variety of uses, some philosophical and some more ordinary, Aristotle's account of "can" here is strikingly simplistic and narrow. He writes as if this auxiliary only governs verbs "φά" such that it makes sense to treat φ-ing quantitatively. "If something can move (κυκλάμενον), or can lift a weight, we always state it with reference to the maximum, for example ‘can lift a 100 talents or walk a 100 stades’" (281a7–9). Of course, if one of these maximally specified "can φ" expressions applies to some subject, it follows that the subject can φ to a lesser extent too. If one can-maximally walk a 100 stades, it follows that one can walk 50 (281a12–14). However, the "can" in the latter context is obviously not "can-maximally," but has a different and logically weaker sense. The question then arises which of these senses of "can" (no others are considered here) is central, and Aristotle says: the maximal one. "Let what can in the central sense (τὸ κυκλώσα τοῦ ἐνυγμέαν) be defined in accordance with the utmost (κατὰ τὴν ἐνυγμέαν τοῦ τέλος)" (281a9–15). This sense now becomes the basis for the argument that is ultimately meant to show that phtharton and genëton (and likewise aptharton and agenëton) necessarily imply one another.

However, there is immediately the awkwardness that the verbs "perish" and "begin" do not in any obvious way govern amounts of anything, so that the allegedly central sense of "can" has no direct application to them. Consequently, Aristotle moves to what ceases or starts when something perishes or begins: namely, being and not-being. He explains that this means being/not-being F, where 'F' is a predicate in any one of several categories (281a30–33). We must bear in mind, therefore, that when in the ensuing discussion he speaks of being/not-being, this always implies a subject which is/is-not thus or so. Thus, if it is a case of the non-being of a substance, then the logical situation is that some matter as subject is/not F, where "F" denotes a substantial form. This fits the target in the Timaeus, since, as is well known, Plato’s cosmos did not begin to be ex nihilo but was formed from pre-existing matter. But now in terms of what medium or dimension are predicative being and non-being to be quantified? The answer is: duration. Speaking strictly, instead of just saying that x can be/not-be (i.e., be/not-be F), we should specify the temporal maximum for which x can be or not-be. To say that x can be/not-be for a certain duration, and that y can be/not-be for a quantifiably different duration, is to ascribe to x and y generically different possibilities or capacities for being/not-being.

3 E.g., Williams (1965) 100–102 and Judson (1983) 228–333, who diagnose the fallacy differently. The interpretation given here does not depart much from what I gave in Waterloo [S. Broadie] (1982) chapter 4 (clearly summarised by van Rijen 1989, 82–87). I should be satisfied to have shown that my approach to the backbone argument of L1 enjoys at least as much textual support as any that charges fallacy; it remains for clarity, or some other influence, to tip the scales of judgement.) Waterloo (1982) did not address much of L2. The book was mainly a response to the influential pioneering work of Hintikka on time and modality in Aristotle, and Hintikka did not focus on Aristotle’s specifically cosmological interest in proving that genëton \(\leftrightarrow\) phtharton, nor on much of the manoeuvring in L2. See Hintikka (1973), especially chapter 5, based partly on Hintikka (1957). Judson (1983), by contrast, does justice to the cosmological concern. Van Rijen (1989, 91–94) gives proper weight to the initial question at 281a28–30; thus, he rightly expounds 281a28–b5 as if the main issue is the logical conditions for combining the possibility (in van Rijen, the "natural capacity") of being F with that of not-being F.

4 For the meaning, see Verdenius (1969) 274.

5 These are the prior terms, i.e., they occur in the analyses of "begins" and "perishes": see 282a1–4.
(2) Now (281a28–b2), suppose there are things which can be and can not-be. Then they can be for some maximal time, and they can not-be for some maximal time. Examples like maximally lifting 100 talents readily suggest finite temporal maxima; but Aristotle assumes that “for an unlimited time” gives a kind of maximum too. The rationale for this is that for a time to be unlimited is (he says) for it to be greater than any time specified (281a33–34). So on this account, “for an unlimited time” entails “for the amount of time that is absolutely greatest.” And this last phrase is tantamount to “always,” a point which Aristotle will soon make explicit (e.g., at 281b25). For “always” indicates more time, and therefore a greater time, than any expression implying “not always,” as for instance “only from the birth of Plato onwards.” Now suppose further that among the things which can be and can not-be, some can be for an unlimited time and can also not-be for an unlimited time (281a33–b1). Then there would have to be, so to speak, two unlimited times, one in which the object can maximally be and the other in which it can maximally not-be. But this is impossible. (Presumably it is impossible because the two unlimited times added together would constitute a time larger than either, with the result that neither was unlimited after all in the sense just explained. In other words, it is assumed that if there were these two times, they would both be parts of the same history.)

It follows that whatever can be for unlimited time necessarily lacks the possibility of not-being for unlimited time. However, Aristotle is in a position to draw the stronger conclusion that whatever can be for unlimited time lacks the capacity to not-be for any time at all: i.e., what can be always, cannot not-be, and what can not-be always, cannot be. For the above stretch of argument proceeds on the basis of a notion of can or possible according to which for something to be possible is for it to be possible (e.g.) now, and something that does not obtain

now is nonetheless possible now if and only if no impossibility results from supposing it to obtain at another time. In slightly different words: something that does not obtain is nonetheless a possibility even during the time when it does not obtain, provided that nothing impossible follows from supposing another time in or during which it does obtain (281b18–23). But if something is exercising a possibility of being for unlimited time, there is no other time, limited or unlimited, in which it can exercise a possibility of not-being either with or without temporal limitation. Hence if x is exercising a possibility of being for unlimited time or always, x has no possibility of not-being for any length of time at all. Moreover, since there is no “other time” than the one unlimited time, if the x in question cannot be for any time at all, this must be because it cannot be for (some or all of) the time during which it is exercising its capacity to be. In other words, it can not-be only if it can not-be while at the same time being—which is impossible. Similarly, if something is exercising its possibility of not-being for unlimited time, it cannot be for any time, except on condition that it can be even while in fact not-being—which is impossible. Consequently, whatever has the possibility of being for unlimited time or always, is for unlimited time or always, because it cannot not-be ever; and likewise mutatis mutandis for whatever has the possibility of not-being always (281b18–25; 29–34).

The next three sections will bring out or fill in various assumptions and ideas that are required for this argument to work.

(3) The argument depends on three ideas unfamiliar in modern treatments of possibility. First, there is the construal of the possibility of a condition S as a possibility belonging to x at, or for, a time (281b15–17). Secondly, there is the idea that, given that S does not belong to x at, or for, a given time t, the possibility at or during t of x’s having S is decided by reference to the non-impossibility of its having S at or for a time other than t (281b17–18). Thus during t, while he is sitting, Callias has the possibility

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6 In treating unlimited time as a maximum, he treats it as a sort of whole. Similarly, in many passages about the heavens and their motion, he uses “always” (ταύτα) and “everlasting” (ἄνακος) to indicate not merely chronological on-and-on-ness, or at-every-point-ness, in both directions, but a sort of natural span—as it were, the life-span of a being that lasts for ever; see section 4 below.

7 Aristotle assumes symmetrical maxima for can be and can not-be. For a given subject, being and not-being are either both for all time (which is impossible), or both for some-but-not-all time. The idea of temporal maxima for not-being, which is necessary for the argument, seems artificial in the light of some illustrations, not others. Weight-lifting and walking suggest maxima only for possibilities of positives; as does the notion of a natural span of life (αἰών); but nature has many alternating spans (e.g., night, day), of which one can figure as negative to the other.

8 They are explored in more detail in Waterlow (1982) chs. 2–4. Whether or not any of them hold for Aristotelian modality in general, they are needed to make sense of possibility in De caelo 1.12.

9 Treating the possibility of S as belonging at or for a time of course does not entail holding that the same possibility cannot belong at/or for different times. However, Judson, if I understand correctly, thinks otherwise. This assumption of his is an important pillar of his contention that interpreting De caelo 1.12 in terms of possibility belonging at/or for a time fails to make good sense (given the other conceptual elements) of “What can be/not-be always, cannot not-be/be.” See Judson (1983) 252, point (1).
of standing if and only if nothing impossible follows from his being on his feet at another time. These two elements of Aristotle’s approach in *De caelo* 1.1.2 stand in contrast to the usual modern understanding. According to the latter, the intuition (however it is achieved) that even if S does not obtain in x at t it is not impossible that it obtains at (e.g.) u ≠ t, would immediately be taken to show that it is possible simpliciter (i.e., without the possibility itself being linked to a time) that S obtains simpliciter (i.e., without the obtaining being linked to a time either distinct from or the same as t). However, if it is possible simpliciter that S obtains, then presumably it is possible simpliciter that S obtains at any given time; so we can coherently think that even granted that S does not obtain at t, it is possible that S obtains at t; just as possible as that S obtains at some other time concerning which it is not yet known whether S does obtain at it or not.

Thirdly, there is the idea of defining a possibility of being/not-being by reference to the temporal maximum to which the subject can be/not-be. Possibilities—i.e., in fact, capacities—for different maxima are specifically different possibilities. Now, if we exercise one capacity, we do one thing; and if we exercise a different capacity, we do something else. For example, if we exercise our capacity to swim, we swim; and if we exercise our capacity to read, we read: these are different kinds of activities. Consequently, if there is a capacity or possibility which is the possibility of being F to the temporal maximum M, and there is also a possibility which is the possibility of being F to the different maximum N, then the exercises of these possibilities are different kinds of being F. And similarly for not-being F. In particular, since Aristotle is persuaded that “always” indicates a maximum, he is committed to the doctrine that the being/not-being of that which is/is-not always is different in kind from the being/not-being of that which is/is not for some lesser maximum. These two main ways of being/not-being F differ from each other not as more and less of one and the same condition or activity, but as distinct and in fact mutually exclusive kinds of being/not-being F. Thus, we should not express the difference by means of different quantification over times, i.e., as the difference between e.g. “(∀t)(F a t)” and “(∃t)(F b t) & (∃t) (~F b t).”

It is the difference, rather, between “a is (F always)” and “b is (F, but not always).” From now on these different temporal “qualities” of being and not-being will be expressed by superscripts on the predicate.

(4) What feeds the idea of maximal being, and in particular the idea that “always” indicates a maximum of time, is the notion of a natural life-span (άνων). For etymological reasons Aristotle thinks this term particularly appropriate to the entire duration of the everlasting heavens or the everlasting cosmos as a whole. The discussion occurs in *De caelo* 1.10. Aristotle has been considering the mode of being of the mysterious incorporeal, non-temporal, things “beyond the cosmos” (279a11–17). Of them, he says:

... they carry out their entire life-span (διατελεῖ τὸν ἔκτασιν ἀνών) unalterable and impassible, possessing of a vital activity (κοῦ) that is the best and the most self-sufficient

(De caelo i.9, 279a20–22)

He then goes on:

In fact, it was by divine inspiration that the ancients voiced this word [sc. ἀνών]. For the completeness (tὸ τέλος) that comprehends the time of each thing’s life so that that time is naturally all within it, is what for each thing is called its life span (ἀνών). For the same reason, both the completeness of the whole heaven, and the completeness that comprehends all time and (time)’s limitlessness (τὴν ἄπειρον), is (called) ἀνών, immortal and divine: ἀνών that gets its name from αὖτε ἐλαύν [always being]. On this the being and living of other things depends, more strictly in some cases and obscurely in others. Both translation and interpretation are debatable. The main queries concern the reference of ὑπὸν at 29 and the meaning of the κοῦ governing τὸν πάντα χρόνον ... πειγόν τέλος (26): is it conjunctive or epicenegetic? If conjunctive, which seems more natural, then two completenesses are mentioned at 25–27, of which the second must be the χρόνον of the entities beyond the heavens, which somehow embraces, without being identical with, τὸν πάντα χρόνον. Ὑπὸν then refers to this, or perhaps to a genetically conceived life-minus-temporal-finite predicatable both of the extra-mundane beings and of the everlasting heavens. If the controversial κοῦ is epicenegetic, only one non-temporally-finite completeness is at issue, that of the heaven, and ὑπὸν refers to it. There is also the question whether the κοῦ linking τὸν πάντα χρόνον and τήν ἄπειρον (26)

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10 The generalised treatment of can if in terms of maximal if-ing seems to be unique to this *De caelo* argument.
11 The second of the two main ways subdivides into various kinds. Where F is a substantial form, so that something’s (the matter’s) being F entails the existence of a member of the kind in question, there will be different temporal maxima for different living species. De gen. et corr. 2.10, 33b610–15; gives examples. However, there are also cases, e.g., when F = “sitting” or “standing” where it seems built into the notion of F that being F, where it applies, will cease at some point though not after any particular laid down interval.

13 This translates διάκος, and means “everlasting in both temporal directions.”
14 I have translated as if this accusative is the object of διατελεῖ, but it may equally be the accusative of duration.
15 Both translation and interpretation are debatable. The main queries concern the reference of ὑπὸν at 29 and the meaning of the κοῦ governing τὸν πάντα χρόνον ... πειγόν τέλος (26): is it conjunctive or epicenegetic? If conjunctive, which seems more natural, then two completenesses are mentioned at 25–27, of which the second must be the χρόνον of the entities beyond the heavens, which somehow embraces, without being identical with, τὸν πάντα χρόνον. Ὑπὸν then refers to this, or perhaps to a genetically conceived life-minus-temporal-finite predicatable both of the extra-mundane beings and of the everlasting heavens. If the controversial κοῦ is epicenegetic, only one non-temporally-finite completeness is at issue, that of the heaven, and ὑπὸν refers to it. There is also the question whether the κοῦ linking τὸν πάντα χρόνον and τήν ἄπειρον (26)
This passage seems meant to defend his application of the term *αλών* to the existence of the incorporeal and timeless beings beyond the cosmos, by reasoning which I reconstruct as follows:

(a) Because their existence is a life of complete and all-inclusive perfection, it is correct to call it *αλών*.
(b) One might, however, be surprised by this, since in ordinary use *αλών* means "natural span," and for ordinary things, i.e., mortal things, the natural span is contained within the life of the cosmos, which extends beyond it in both temporal directions.
(c) But to understand the word *αλών* we should not look to the *temporal finitude* of such mortal spans but to their *completeness* (on mortal terms).
(d) For in fact the term gets its meaning not primarily from these cases; its etymology ('always being') shows that semantic priority lies with a totality that comprehends all time.17
(e) Consequently, the ancient humans must have been inspired when they coined the word, given that the prior sort of case is so far beyond ordinary human experience.

Thus, the idea that "for all time" and "for unlimited time" indicate a temporal maximum or whole is one for which Aristotle has prepared the way quite carefully by the time he gets to the backbone argument of L1, to the effect that what *is/is-not* cannot ever not-be/be. It is worth noting that his expressing this in terms of *unlimited* (or *infinite*; *ἀνεξάρτητος*) time (279a26; 281a34; 283a7–10; 283b39) is in striking contradiction with the *Physics* 3 doctrine of the unlimited (infinite): "it turns out that [the unlimited] is the opposite of what people say it is: it is not that of which no part is outside, but that of which some part is always outside" (260b33–270a2, tr. Hussey 1983). However, perhaps what the *Physics* discussion shows is not that Aristotle has there rejected the notion of an *αλών* that comprehends all time,18 but that he has clarified or re-shaped the notion of the *unlimited* so that, instead of suggesting an all-inclusive whole which is the paradigm of completeness, it now suggests something essentially always incomplete, since "that of which no part is outside is complete and whole" (207a8–9).19

(5) The idea that possibilities of being/non-being are defined by reference to temporal maxima has an interesting consequence, but one that seems to blast a hole in the argument as presented in section 2. Take someone whose possibility, capacity, or power for weight-lifting is defined by the limit of 50 kilos: he can certainly lift, e.g., 25 of the units, but if he does he is not then exercising a concurrently possessed distinct possibility. For different maxima in the same range are mutually exclusive. So if the person lifts any weight below his current maximum, he is still thereby exercising his possibility of lifting that maximum. It is also true, I think, that he exercises that same 50 kg possibility on every gram within every amount he lifts. And, clearly, it can happen that he actually exercises his maximally defined possibility, yet never exercises it to the full. Analogously, then, one who is exercising the power of living the standard human lifespan, say three score years and ten, is engaged in the business of living-three-score-years-and-ten during every decade, year, and minute of the duration of her life. That is the kind of life it is throughout, just as, on a higher level of generality, it is—throughout—the kind of life lived by a *mortal* animal. Clearly, the specific temporal maximality of the life as lived each moment as long as it lasts cannot ensure that the maximum is actually reached. A life may be cut short, or one may lose ahead of time the *conatus* to go on. It therefore looks as if it could be true that

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16 The temporal version of this notion does not enter into the treatment of time in *Phys. 4*, but that may be because Aristotle there is interested in time as a dimension for ordering and measuring finite events, so that consideration of a duration which is the *αλών* or life of the whole universe would be beside the point.

17 At *Phys. 4.6, 207a15–16*, Aristotle criticises Melissus for speaking of the unlimited as a whole, by contrast with Parmenides who held that the whole of being is limited. Aristotle might have ranged his earlier self alongside Melissus in this respect; see Waterlow (1982) 76–77. Bogen and McGuire (1986–1987) sections xv–xxv, argue that there is no inconsistency between the *De caelo* and *Phys. 3* on the unlimited.
something is exercising the grand possibility of being always and yet could in the midst of time cease to be, leaving the maximum unaccomplished. And similarly for not-being always.

Aristotle does not trouble about this gap in his argument. Presumably, he takes himself to be entitled to assume that the temporal maxima will be played out to the full. It may be that his method of demonstrating οὐδέξω rather than by appeal to specifically physical principles is designed to deal only with ideal cases, abstracting from possibilities of interference or failure. (One would not interrupt a geometrical demonstration of the path traced by a rolling cone by pointing out that something might get in the way.) We might wonder what can be learned about reality from a method designed to bring out the attributes of ideal objects. Aristotle would surely answer that in the case which most concerns him and those with whom he is disputing—namely, the being of the cosmos—the ideal is necessarily what is physically actual. The cosmos is so good and so physically all-embracing that nothing outside or inside it could cut it short or make it weary of being. Certainly Plato would have agreed.20

(6) In any case, let it be that Aristotle has established that what is always cannot not-be, and that what is not always cannot be. (He has thereby also established that what can be and can not-be, both is not always and is not at different times.) He now proceeds to draw some conclusions about beginning and perishability: what is always is absolutely (ἀιτίας) (a) imperishable and (b) ungenerable (281b10–282a4). Parallel conclusions are drawn at 282a21–22 for what is not always. We also get the obvious corollary that nothing generable or perishable is everlasting (διδούς), i.e., is always (282a21–22). But we have not yet been given a valid reason for accepting that the attributes phthartos and genetos are twins, that if either belongs to a given subject, so necessarily does the other. Yet this was the main point to be proved, if we consider De caelo 1.12 from the perspective of 1.10. Aristotle reverts to this agendum at 282a25–26:21

If something (a) is agenetos and (b) is—must it be everlasting [i.e., must it be always]? And likewise if something (a) is aphthartos and (b) is—(must it be everlasting)?

20 Cf. van Rijs (1980) 95–98. He, like Waterlow, makes sense of the argument and sees the gap as covered by the assumption that only things composed of perishable matter (Meta. 8.1, 164a26b6) are subject to interruption or repression of exercise of possibilities, along with the assumption that nothing that can be always is thus composed.

21 At this point the discussion I labelled "L1" is under way; it probably starts at 282a14, but for a stretch it incorporates some L1 argumentation: see 281a21–26.

But before examining how he addresses these two questions, we must face the fact that, now, at 282a27–30, he announces that he is using "agenetos" and "aphthartos" (and therefore by implication their contradictories) in their central senses (τὰ κακώς λεγόμενα), and immediately assigns different central senses from the ones established back in chapter 11, 281a3–6. In that earlier place, the central senses were emphatically modal (cf. τὸ διδόναν καὶ μὴ διδόμενον, 5), whereas here they are as follows: "agenetos" applies to that which is now and of which it was not previously true to say 'it is not,' while 'aphthartos' applies to that which is now and of which it will not later be true to say 'it is not.'

(7) This different stipulation of central senses for the same pair of terms surely tells us that the ensuing passage, and perhaps some of what precedes it, belong to a different composition from that of the textually earlier stipulation. Thus, we have evidence that the entire stretch of argument constituting chapters 11 and 12 of De caelo 1 incorporates a piece that was originally written separately. There are no obvious boundaries marking off this piece, and we should surely assume it was Aristotle himself who worked it into the resulting whole. That what we have is a synthesis of different compositions would help explain the inconsequential character of some of the argumentation.22

Should we worry that the discrepancy between the two sets of central senses of "agenetos" and "aphthartos" leaves the entire argument broken-backed? I think not desperately, for a combination of two reasons. First, I suggest, the apparently assertoric set proposed at the textually later point is actually no less modal than the overtly modal set proposed earlier, though modal in a different way. The suggestion is that when Aristotle says that the aphthartos is that which now is and of which it will not later be true to say that it is not, he means that whatever is correctly said to be aphthartos is of a nature such that it both is now and will falsify any future statement that it is not, and correspondingly for the agenetos. The upshot is that (granted the impossibility of interference) the aphthartos cannot perish and the agenetos cannot have begun. Thus, these terms

22 On the inconsequentiality, see Williams (1966) 209–210, also Moraux (1966) lxxxii, n. 1 ad fin. (lxxxiv), Williams and Moraux (writing independently) both conjecture different compositions. See Moraux (1966) lxxxiii, n. 1, for evidence drawn from the Organon and from Aristotle's use of letters as variables at 282a14–21. There may be further evidence in the discrepancy, noted by Williams (1966) 207, between 281b28 and 283b13 (on whether there is a ἄνω τοῦ γενόντος).
are as strong in the second stipulation of senses as in the first. However, if we apply, as I think we should, the “of a nature such that” interpretation across the board, then “phtharton” will mean “such that it now is and later is not;” and correspondingly for “genētōn”; which is to imply that the phtharton must cease and the genētōn must have begun. And at this point we might worry that the modality of this pair of terms is stronger now than when they were introduced earlier, since then they were contradictories of “cannot be, then not be” and “cannot not be, then be.” This worry can be assuaged to some extent if not completely. As we are about to see more fully (this is the second reason mentioned above), the terms of Aristotle’s earlier argument, given certain assumptions, enable him to move not merely from “is/is-not” to “can be/not-be,” but also in the reverse direction. If this liberty could be extended to allow a parallel inference from “can begin/perish” to “begins/perishes” then the modality of genētōn and phtharton in the first stipulation is no weaker than in the second. Now admittedly there is no logically watertight justification, as far as I can see, for extending the liberty in this way. The best one can say, which no doubt is rather lame, is that the earlier argument created a logical atmosphere favorable to sliding from “can q” to “q.”

We can now return to the point where Aristotle at last begins squarely to address the main question, i.e., whether genētōn and phtharton, and likewise their contradictories, are mutually entailing. He leads up by asking: “If something (a) is genētōn and (b) is—must it be everlasting (i.e., must it bealways)? And likewise if something (a) is phtharton and (b) is—(must it be everlasting)?” (282a25–26). The relevance of this to the preceding context is as follows. He has been arguing that what isalways and what is-notalways (these both count as everlasting) are neither genētōn nor phtharton (282a21–22; 281b25–30; 281b34–282a4). That reasoning will also have made it obvious that whatever is both genētōn and phtharton is in the category of the everlasting. Thus, it is quite natural to ask next whether just one or other of the two attributes, being agenētōn and being aphtharton, is sufficient for everlastingness. Aristotle states that the answer is “Yes,” given and only given the assumption that “agenētōn” and “aphtharton” entail one another. And in the course of this he argues that on the same proviso “phtharton” and “genētōn” entail one another too (282a30–282b7).

However, Aristotle next states categorically that “agenētōn” and “aphtharton” do entail one other, on the ground (now categorical) that “phtharton” and “genētōn” entail one another (282b7–9). The latter, he says (282b9–10), is “obvious from what was said earlier”; even so, he now proceeds to spell the matter out more fully (282b10–22). Finally, having established (as he thinks) the inter-entailment of genētōn and phtharton, he proves the inter-entailment of their contradictories (282b23–283a3).

(9) But how has Aristotle obtained the premise that genētōn and phtharton entail each other? The backward reference at 282b9–10 is to 282a4–21. The argument there, like its explication at 282b10–22, relies on a set of relationships which can be represented as a sort of square of opposition. But before looking at what the relationships are supposed to prove, we must face what to some commentators has seemed a difficulty about the terms. The problem is that at 282a4–21 (cf. 282b10–13) Aristotle passes to and fro between two apparently quite different sets of terms without properly distinguishing them. One is overtly modal, the other is not:

<table>
<thead>
<tr>
<th></th>
<th>A—can be always</th>
<th>B—can not-be always</th>
</tr>
</thead>
<tbody>
<tr>
<td>D—can not-be always</td>
<td>C—can be always</td>
<td></td>
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</table>

23 On this interpretation, one must take the contrast between ἑκενεύρεται and δεινόμεν. at 282b19–20 as distinguishing the present being of something that is genētōn from the merely future being of a genētōn that has not been generated yet.

24 The convergence in meaning of the two lots of central senses does not make it less anomalous that Aristotle separately prescribes them both: why do this if the textually second prescription neither verbally repeats the first, nor substantially improves on it? Thus, the inference to different compositions remains in force.

25 282b2 should have a period after οὖν, I believe. The point is that it is clear from the definition just laid down (282a37–30) that, given the assumption, aphtharton and agenētōn severally entail “everlasting.”

26 This is because “agenētōn” and “genētōn,” and “aphtharton” and “phtharton,” are contradictory pairs: they “do not belong to the same thing, but one or other belongs to every given thing” (282b26–28). The first γοῦ of 282b (καὶ γοῦ) is puzzling if, with the editors, we retain it (it is missing from E), and, as D.J. Allan is inclined to think, from Simplicius’ text, since the gist (“phtharton entails genētōn”) does not support the point about what the definition makes clear (see previous note). Nor should it be supporting the truth of the assumption itself, since Aristotle is about to use the latter in showing that, it granted, phtharton entails genētōn and vice versa. Might the γοῦ be an element of καὶ γοῦ = “Yes, and …”? (Denniston 1996, 109–110) even though this is continuous prose?
Let us look first at square II.27 It is assumed to offer an exhaustive division of everything in the relevant universe of discourse. A* and B* are contraries (cf. 282a 6, ἐν οὐσία), while C* and D* are called the “negations” (ἀποφασισμοὶ; a10) of A* and B* respectively. From many other contexts in Aristotle’s works, we might have expected a “negation” to be the contradictory of that of which it is negation, but this is not so here. True, A* and C*, and likewise B* and D*, are mutually exclusive, because even if “not-always” is in some sense weaker than “always”, it is not weaker as “some” than “all” (in Aristotelian logic), or “proper part” than “whole,” where the stronger includes the weaker. But the pairs A* and C*, B* and D*, are also not contraries because neither pair is exhaustive of all options. One exhausts only the options for being, the other for not-being. In so far as C* and D* each entail “is some of the time and is not some of the time,” they entail each other. Aristotle sees C* and D* as “intermediate” between the contraries A* and B* (282a18–19).

Aristotle moves to and fro legitimately between squares I and II because the counterpart terms are mutually entailing (so the relationships within both squares are the same). The problematic entailments are, of course, those running from square I to corresponding points on square II, so let us focus on them. (a) We have already seen28 that something to which A applies, cannot not-be for any time; hence, given that it must fall under some category or other in square II, it must fall under A*. Likewise with B and B*. Now (b) consider something, x, to which C applies; and suppose first that x is, then that it is not. If x is, then it falls under either A* or C*; but it cannot fall under A*, given (as would normally be assumed) that A* entails A, for then by the earlier argument x would be something that cannot not-be for any time. If x is not, then it falls under B* or D*, but it cannot fall under B*, given that B* entails B, for the parallel reason. Hence x falls under C* or D*, since it either is or is not. But either way, since C* and D* entail one another, x falls under C* and D*. By similar reasoning, whatever is D must fall under C* and D*.

(10) We may now return to “genēton ↔ phtharton,” and the question of how this is meant to be established. At 282b8–12, Aristotle writes:

... genēton and phtharton are implied by one another. This too is clear from what was said earlier. For between what is always and what is not-always there is that which is accompanied by neither (ὅ μηδέτερον ἀναλύεται),29 and this is what is genēton and phtharton ... But what was said earlier showed only that C* and D* (= C and D) are between the extremes. No doubt Aristotle has been assuming all along that A* and B* (= A and B) and C* and D* are all instantiated in the universe, and that this is necessarily so. Hence, C* and D* are necessarily both instantiated. However, on a straightforward understanding, C* and D* each imply no more than variation either way between being and non-being. Thus, C* and D* can each be instantiated both by something that is and then is-not (perishes) and by something that is-not, then is (begins); but nothing guarantees that those two modes of instantiation necessarily coincide in one subject. To obtain that result, Aristotle needs a further assumption: that whatever falls under C* or D* is and then is-not, or vice versa, for a determinate, i.e., finite, time in each case (282b12–14). Given this, it is, of course, easy to show that anything under C* or D* must, when it is, have begun and be going to cease, and must, when it is not, have ceased and be going to begin again (282b20–23).

But is it really, as I have just claimed, a further assumption that C* and D* import finite durations of being and not-being? One might think this constraint is already lurking in the principle whereby Aristotle obtained the result that what can be/not-be always cannot not-be/be. That was the principle that being and not-being are exercises of capacities defined by temporal maxima. We might think, given the analogy of maximal powers for weight-lifting and so on, that what has a capacity for less than temporally total being/not-being must have a capacity specifiable by a finite number of units. But we are not forced to think this. The basic idea is that something goes on being/not-being for as long as it can. Now suppose that something begins to be. There is nothing contrary to logic about supposing that it has and exercises the capacity to go on and on without stopping. We can perfectly well think of that as the maximal being-capacity for this type of thing.30

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27 The sets of terms are not set out in squares in our mss, but it is convenient to refer to them in this way.
28 Section 2, above.
30 I.e., neither 'what is always' nor 'what is not always'. Thus also J.L. Stocks in Barnes (1985), and Guthrie (1939). Leggatt (1995) takes μηδέτερον at b11 to refer to to aphtharton and to agenēton, which last appeared at b7.
38 No doubt such a capacity is not for what could be called an áνω of being, since a span, even of the whole of time, is understood as in some way fully bounded.
We have seen Aristotle allowing uncountable or immeasurable maxima in certain cases, since unlimited time in a sense implying ‘all time’ was treated as a maximum. (Not that this got any support from the analogy with weight-lifting powers; could anything lift all the heavy material there is, including its own?) So why should Aristotle not permit unlimited time in the sense of unlimited—in-just-one-direction to function as maximal in certain cases? But then the principle of temporal maxima would not allow him to draw the desired conclusion that genēton ↔ phtharton. It would legitimize beginners that never will cease and ceasers that never began. So just on the verge of drawing the desired conclusion, he shifts to emphasize determinacy of time, whereas at the beginning he had emphasized maximality. He now says:

... genēton and phtharton are implied by one another. This too is clear from what was said earlier. For between what is always and what is not always there is that which is accompanied by neither, and this is what is genēton and phtharton. For it can both be and not-be, each for a determinate time (dōroμένον χρόνον); I mean that the being and the not-being are each for a given amount of time (ποσόν τυχα χρόνον). (282b9–14)

No mention here of maximality. It is as if mere maximality has been quietly forgotten; or, alternatively, it is as if we are now to realize that at the beginning and all along maximality was understood as entailing determinacy.¹¹ We have seen (section 4, above) how Aristotle (starting from his doctrine that the heavenly bodies are animate [cf. De caelo 2.12, 292a18–21] and everlasting) configures the concept of αἰών (determinate span of life) so that all of time counts as an αἰών. On a more epistemic note, one might also point out that “always” provides as logical and informative an answer to “How long can it last?” as any phrase expressing a finite time, such as “one day” or “70 years.” However, the same might be said of the answer “For ever—once it has started.” One might try to exclude such an answer on the ground that it fails to pick out a single length of time: it can apply to an item that x started in the 14th Olympiad, and to another that started in the 30th; but even if we grant that one of those one-way-infinite durations is shorter than the other—the one that started later—why should that rule these cases out of consideration? Ordinary finite natural spans are different lengths for different kinds of beings.

¹¹ Cf. χρόνον τυχα χρόνον at 281a29.

(11) For Aristotle, the question of one-way infinite being/not-being comes up rather as an afterthought, after he has concluded that genēton ↔ phtharton and, therefore, that agenēton ↔ aphtharton. He writes:

But to say that there is no reason why something that comes to be should not be aphtharton, nor why something agenēton should not be and (then) be destroyed (with one-off [dōroμένον] processes of coming to be in the one case and of perishing in the other),¹² is to withdraw one of the given, namely: anything can act or be acted on, or be not-be, either for unlimited time or for a determinate amount of time (ποσόν τυχα χρόνον)—and the reason why something can for an unlimited time is this: unlimited time is in a way determinate (dōroμένον χρόνον), as being the time that which none is greater. But¹³ that which is unlimited (merely) in some direction (το ἕνα χρόνον) is neither unlimited nor determinate.¹⁴

(283a4–10)

To this we can reply that whereas a stretch of being or not-being that is unlimited in some direction is not unlimited absolutely (ἀνάλογος, the opposite adverb to περί), still it does not absolutely lack unlimitedness, and arguably it does not absolutely lack determinacy, since, as we have seen, perhaps specifying such a duration does give information on how long something can and does last. To insist that any such duration is neither unlimited nor determinate in the way or ways relevant to the preceding argument is just to stipulate. Perhaps Aristotle senses the weakness of this, because he now launches a series of arguments for “agenēton ↔ aphtharton” (Moraux (1965) ad loc. calls them “supplementary”) which seem to be designed to manage without the sheer assumption that what is/is not always is/is not for a finite span.

(12) But if we return to the point reached just before the postscript (i.e., to 283a3), it does look as if the whole argument up to now has depended on that assumption. The problem we have just touched on is that the assumption is far from obvious to anyone not already prepared to interpret all duration in terms of natural spans, and yet is necessary for establishing that genēton ↔ phtharton. However, a fact still more

¹² By contrast with the perpetual repetition implied by his preferred model.
¹³ Cf. 281a28–b1.
¹⁴ Keeping the ἕν of the ms, pace Moraux (1965).
¹⁵ 283a8 has been correctly understood by Bogen and McGuire (1986–1987) section xxii, and by Verdenius (1966) 275, except that Verdenius distinguishes, as we would not, between χρόνον (7) and χρόνον (9), thinking the first means “determinate,” the second “defined.” Williams (1966) 205 also sees equivocation here.
exasperating for anyone hoping to find in this passage a decent argument over all is that the assumption by itself is sufficient basis for asserting that genêton ↔ phtharton: and evidently so. Grant that what is/is-not is/is-not for a finite span, and you have already granted that what begins must end and what ends must re-begin. So expecting the opponent to “give” that assumption (283a6) is asking him to surrender on the spot. This is one embarrassment. Another is that the whole I2 apparatus of the squares of opposition marshalling contraries and negations now turns out to be unnecessary for the main task of De cælo 1.11–12. If the above assumption is granted, that task is thereby accomplished, and accomplished very visibly once we are no longer distracted by Aristotle’s efforts with the squares.

(13) But before concluding that this material does not represent a perfectly coherent project (as we have already seen reason to suspect), we should examine another possibility of interpretation. In section 10, I said that C* and D*, straightforwardly understood as implying variation between being and not-being, are satisfiable by what is genêton and aphtharton, and by what is phtharton and agenêton. But a slightly more complex interpretation yields Aristotle’s desired result via square of opposition II and without question-begging assumptions. Read C* and D* as, respectively, “is, then is-not” and “is-not, then is.” Then invoke the principle, which has been at work all along, that being and not-being each divide exhaustively into the two modes of “always” and “not-always,” and ask which mode is exemplified in the different limbs of C* and D* read as above. The answer for “is” in C* is already explicit: it is already presented as the “is” of “is, then is-not.” Bringing out the corresponding point for the “is-not” of C*, we write this as “is-not, then is,” thus obtaining for the whole C* “is, then [is-not, then is].” This secures that the phtharton is genêton. Applying the procedure the other way round to D* secures that the genêton is phtharton.36 On this reading, when Aristotle insists at 283a11–11 that the being and the not-being are either for ever or for a finite time, he is not clutching at an assumption extraneous to the second square of opposition, but is drawing on the meaning of its subcontraries.

Unfortunately, there is really no evidence in the text for attributing to Aristotle the above analyses of C* and D*.37 So it seems safest to adopt what I called the “straightforward” interpretation of C* and D*, a course which makes the inference to “genêton ↔ phtharton” a non sequitur.

(14) However, if this is our picture, we should not rest with viewing the failure of the whole complicated argument. We should also note something of abiding interest here. The argument reveals a fascinating moment in the development of modal concepts. The notion here forged of a “can be/not-be always” that excludes the possibility of not-being/being for any time at all, constitutes a powerful, albeit narrow, interpretation of impossibility and necessity. Particularly interesting is the fact that in this system contingency cannot be defined as a conjunction of possibilities, ⊕ p and ⊕ ¬p, such that the conjuncts are severally entailed by, respectively, p and ¬p.38 This is because in this system’s square(s) of opposition the subcontraries entail each other, whereas in a regular modal square they are only mutually compatible.

Thus, here we have a non-synthetic concept of the neither-necessary-nor-impossible: i.e., a modality not composed out of two mutually independent elemental possibilities each consistent with, and following from, one of a pair of opposed necessities, the necessity of being and the necessity of not-being. Metaphysically, the possibility of being which belongs to something that has also the possibility of not-being is a different sort of possibility from (and alien to, exclusive of) that implied by necessary being. This is clear if we think of that which necessarily is as having its necessary being grounded in a possibility (or power) for being such that it is of the very nature of this possibility to exclude any possibility of not-being (and vice versa for what necessarily is not). On these terms, that which contingently is cannot be defined or even coherently described as combining the possibility implied by necessary being (taken on its own) with that implied by necessary not-being (taken on its own).

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36 Since the procedure is indefinitely repeatable, the same subject begins and ceases to be (i.e., be F) infinitely many times. Thus, it seems C* and D* apply only where the subjects of the predications are everlasting, which would exclude such classic subuniversal contingencies as accidents and human voluntary action (De interp. 9, see esp. 19812–21; Eth. Eud. 2.6.) See Sorabji (19)80) 128–130, and Waterlow (1982) 61–62.

37 His understanding of the possibility of what is not by reference to "another time" surely means that he interprets "can be/can-not-be always" as "can be, then not-be/can not-be, then be" (cf. n.22 at 283b21). But nothing in the text encourages us to think that he took the further step of analysing what follows the "then" into another expression of the form "—, then—." In any case, such an analysis could not provide independent grounds for rejecting one-way infinities of being/not-being, since it allows instances of C* and D* that are/are not, never having begun to be/not-be — and then are/not are.

38 Kneale and Kneale (1962) 85; "a statement of contingency is a disguised conjunctive statement."
When the two-way possibility that constitutes contingency is conceived of non-synthetically, the possibilities of being and of not-being involved are mutually entailing.

(15) It is logically possible, of course, that something that possesses some kind of non-synthetic possibility of being and of not-being, either is, or is-not, at all times. But our passage surely rests on the assumption that the only basis on which something could be/not-be at all times is its possession of what we may call a monolithic possibility of being, or one of not-being, i.e., one that excludes any possibility of the opposite. Or perhaps, rather, it is assumed that we could not rationally assert that something is/is-not at all times unless we presupposed for it the relevant monolithic possibility. (The monolithic possibility is itself explained in terms of temporally omni-comprehensive natural spans of being: we shall return to that notion at the end.) The main point now is this: in a scheme where omni-temporal being and not-being are grounded on the corresponding monolithic possibilities, that which contingently is, is at one time and not at another, and likewise mutatis mutandis that which contingently is-not. Hence, not only is it the case (a) that the modality of contingency with which we are concerned is not merely a conjunction, but a mutual entailment, of possibility of being and possibility of not-being. It is also the case (b) that, on the contingent level, actual being and actual not-being are mutually entailing (as holding at different times). As we have seen in section 10, each of these mutual entailers applies to what is genēton and to what is phthisarton, but without its logically following that genēton ↔ phthisarton.

At 282b14–22, Aristotle assembles the four terms "is-always," "is-not-always," "genēton," "phthisarton" as if in a further square of opposition (the third in our account). Analogy may have misled him to the conclusion that its subcontraries ("intermediates", b15–17) entail each other—analogy with various other squares already invoked in his argument and in our commentary, where mutual entailment of subcontraries indeed obtains. We can certainly understand why he hoped to validate a category that necessarily unites the genēton and the phthisarton. If each of these is a modular element that could sometimes occur without the other, one teaming up with cannot-end, the other with cannot-have-begun, then, at that rate, the everlasting (διόταν) could turn out to be so by an external, or brute, conjunction of the modular element cannot-have-begun with the modular element cannot-end.

A treacherous analogy, then, should perhaps carry blame for Aristotle's confidence that genēton ↔ phthisarton, and that this is demonstrably so. Certainly, a sense that demonstration is required must be what explains the windings of his argument in De caelo 1.12. On the other hand, his sense there that demonstration has been achieved is due not only to the work he has sunk into elaborating the squares of opposition, but also to his assumption, based on considerations in chapter 11 (281a27–27), that being and not-being are for temporal maxima. This carries with it the claims (a) that one sort of temporal maximum is the complete plenitude of time; and (b) that the only alternative sort of temporal maximum is a finite length of time. The exhaustiveness of this division is supported by the notion that something's duration is its natural and fully bounded span. Given (a) and (b), little work is needed to derive the conclusion that what comes to be must perish, and what perishes must have begun. In fact, it follows trivially.

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TWO STANDARDS FOR INQUIRY
IN ARISTOTLE'S DE CAELO

ROBERT BOLTON

One must not look for the same accuracy in λόγοι as in what comes through perception.

(Pol. 7.7, 1328a19–21.)

1. Aristotle's scientific method in the De caelo

It has been clear since ancient times that the De caelo raises puzzling questions concerning Aristotle's scientific method. Already in Simplicius, for instance, we find clear attempts to identify peculiar features of Aristotle's method in the study of the heavens (Diels 1882, 292.3–20; Heiberg 1894, 510.19–31). Most, if not all, of the questions arise most prominently in connection with passages found in books 1–2, a fact that perhaps itself calls for an explanation. But for the investigation of these questions it is most useful to begin with what is arguably the most important remark on method in the De caelo, which comes in a passage in book 3, chapter 7. There Aristotle is discussing how the basic sublunar elements—earth, air, fire, and water—are generated from each other. He criticizes at some length on methodological grounds the view expressed in Plato's Timaeus that there is one exception to the general rule of the transformation of these elements into each other, namely, in the case of earth. Earth alone, Plato says, cannot be transformed into the other elements (54c–56d). This results from the need, in order to achieve the greatest perfection in the cosmos, as Plato puts it, to use two different types of basic triangles, or triangular surfaces, not constructible from each other, in order to build up the regular geometrical solids which, on Plato's account, compose the different elements (53c–55d).1 In response, Aristotle says this:

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1 Rutgers University.

1 Earth alone, on Plato's story, is built up out of isosceles right triangles while the