

ARISTOTLE ON PRIMARY TIME IN *PHYSICS* 6

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1. Introduction

FOR Aristotle, the science of Physics is the study of nature (*phusis*). Or more precisely, it is the study of bodies in so far as they are natural, or have a nature.¹ In this respect, Physics differs from e.g. Geometry, which is the study of bodies in so far as they have magnitude.² A body's nature is defined as its 'principle of change and rest',³ i.e. those features of a body which determine when it is changing and when it is at rest, and which changes it undergoes. As Aristotle says, 'x is at rest' should be taken to mean something like 'x can change but is not changing',⁴ so another way of saying what Aristotle means is that Physics is the study of bodies in so far as they embark on, undergo, and stop changing.

Two Aristotelian examples. First, a stone falls naturally when it is dropped from a height. Why? Well, it has within it a principle of change, namely of local motion—when it is out of the rightful place of the element earth it falls to that place. So its nature determines that it will fall when in those conditions, as long as there is nothing in its way (a case discussed by Aristotle in *Physics* 8. 4). But equally, when it gets to the rightful place of earth (and certain other conditions are fulfilled), it no longer falls—it comes to a stop. Its nature

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This paper is a greatly expanded version of my article 'Le temps primaire du commencement d'un changement' ['Temps primaire'], in J.-F. Balaudé and F. Wolff (eds.), *Aristote et la pensée du temps* (Le Temps Philosophique, 11; Université Paris X-Nanterre, 2005), 99–111. My original interest in the topic was sparked by Jonathan Barnes and by hugely enjoyable conversations in Geneva in the summer of 1997 with Franco Paracchini. For specific comments on the present text or its ancestors, I am grateful to Andreas Anagnostopoulos, Jonathan Barnes, Jonathan Beere, Arnold Brooks, Antony Eagle, Edward Hussey, John Hyman, Boris Kment, Hendrik Lorenz, Ofra Magidor, Mohan Matthen, Pierre Pellegrin, Jacob Rosen, Ralph Wedgwood, Christian Wildberg, and audiences/seminar participants in Oxford, Cambridge, Norwich, Paris, Berlin, and Princeton.

¹ Cf. *Phys.* 2. 2, 193^b22–194^a12.

² Ibid.

³ *Phys.* 2. 1, 192^b20–3.

⁴ *Phys.* 6. 3, 234^a32–3; cf. 5. 2, 226^b15–16; 6. 8, 239^a13–14.

determines what conditions need to be in place for it to embark on its journey, and the conditions under which it stops.

Second example. A human being takes in food, and its nature (its soul) determines how it changes in response to this food—it grows, and distributes the food accordingly. The soul also determines what limits there are to the growth of a human. We do not just grow and grow as we eat, unlike a fire, which just grows and grows as more and more is fed to it: ‘while the growth of fire goes on without limit so long as there is a supply of fuel, in the case of all complex wholes formed in the course of nature there is a limit or ratio which determines their size and increase’ (*DA* 2. 4, 416^a15–17). Hence the soul is also a principle of rest, in the sense that it determines when certain processes stop, and is responsible for maintaining those end-states when they are achieved.

Now, if something’s nature is its principle of change and rest, then obviously a study of Nature (or some preliminary to it) has to get to grips with what principles are, and what change and rest are. So it is no surprise that in his *Physics* Aristotle investigates not just questions concerning how many principles there are (*Physics* 1)⁵ and what sorts of principles there are (2. 3), but also the definition of (3. 1–3) and preconditions for (4) motion and the other kinds of change, namely qualitative change (i.e. alteration), quantitative change (i.e. growth and diminution), and substantial change (i.e. when something comes into being or passes out of being). In books 5–8 Aristotle explores further features of change, including whether it is continuous, whether it has contraries, how to individuate changes, whether it can go on for ever, etc.⁶ But Aristotle also investigates what happens when an object transitions from resting to changing, and from changing to resting, and this is no surprise given that nature is a principle of both change and rest.

2. Does change harbour paradox?

Given the central importance of the concept of change in *Physics*, the student of nature would do well to ensure that the notion does

⁵ Book 1 might even originally have been a separate treatise called ‘On Principles’ (*Περὶ ἀρχῶν*). See W. D. Ross, *Aristotle’s Physics: A Revised Text with Introduction and Commentary* [*Physics*] (Oxford, 1936), 1–19, esp. 5.

⁶ Books 5, 6, and 8 might even originally have formed a separate treatise with a title reflecting this, namely ‘On Change’ (*Περὶ κινήσεως*). See Ross, *Physics*, loc. cit.

not harbour paradox, and can be invoked without danger in the sciences. In particular, the student of nature should not simply assume that just because we happily use the concept of change in our everyday speech, it is conceptually unproblematic. For instance, Aristotle is very concerned in the *Physics* to ‘clean up’ the concept of being *somewhere*, or being in a *place*, and provide a thorough account of what a place is, even though we unthinkingly invoke the concept in our ordinary speech.⁷ But if a particular concept cannot be made precise, or can be shown to be of no conceptual use, e.g. the concept of being empty (discussed in *Physics* 4. 6–9), Aristotle is prepared simply to reject its use. (Aristotle notoriously thinks there is no such thing as being absolutely empty.) If it turns out that we can make no sense at all of what it is for something to change, or start to change, or stop changing, or be at rest, then we should not use these notions in our physics or biology, on pain of framing theorems invoking those concepts which will turn out to be false or even nonsense.

This last point is particularly important. One of Aristotle’s main goals in his study of nature is to get clear about what the soul is, i.e. what feature it is that marks out animate bodies from inanimate ones. What is distinctive of the soul is that only those bodies which possess a soul can engage in certain changes, e.g. growing, swimming, eating, sneezing, and indeed it is precisely because those bodies have a soul that they engage in these changes. But if the whole notion of a ‘change’ turns out to be problematic—if it turns out that the things we want to say about motion and change are ill-founded—then characterizing the soul as that which is responsible for certain changes will, in turn, be unacceptable. We will be left without an adequate characterization of the soul, and without the right to continue to conceive of certain bodies as ensouled. There could be no biology. Similar considerations apply to astronomy, as Aristotle conceives of it.

In *Physics* 3 Aristotle offers a definition of what change is, but it is in *Physics* 5 and 6 that he engages in a sustained discussion of the properties of changes, what the different types of change are (5. 1, 2), how to individuate them (5. 4), which changes are contrary to which (5. 5), what the relation between change and rest is (5. 6), which aspects of change are continuous (6. 1, 2), how the continu-

⁷ For a treatment of Aristotle’s account of place along these lines see B. Morison, *On Location: Aristotle’s Concept of Place [Location]* (Oxford, 2002).

ity of time (the number of change) and magnitude (the thing which changes) are related (6. 4), what happens in the transitions from rest to change, and change to rest (6. 5), what the internal structure of change is (6. 6), what role the finite and infinite play (6. 7), what the properties of rest are (6. 8), and finally how to solve Zeno's paradoxes of motion (6. 9).

The discussion of Zeno's paradoxes helps illustrate the claim that in books 5 and 6 Aristotle is, among other things, considering the suitability of the concept of change for physics. For if that claim is true, it is easy to see why Aristotle needs to confront the paradoxes: they are challenges which must be met if we are to understand what change or motion is. For instance, they appear to threaten Aristotle's oft-repeated tenet that all changes are changes *from* something *to* something,⁸ since on Zeno's picture, changes can never come to completion. Zeno appears to open up the possibility that changes could go on for ever without ever reaching their endpoint. It is surely no coincidence either that the important point Aristotle makes in other contexts about certain activities (*energeiai*), namely that, unlike changes (*kinēseis*), they can go on for ever, also appears to be threatened by Zeno's never-completing changes.⁹

Many of the questions in *Physics 6* concern the relation between time and change. Motion takes time. If I drop a stone and it falls to the ground, the falling takes a certain amount of time. The fact that changes, processes, or whatever take time marks them out from the natural bodies which themselves undergo these changes. For a stone does not *take* a certain amount of time. What takes time is the stone's doing something, e.g. falling to earth, but the stone itself does not take time. This connection between change and time is not coincidental; Aristotle actually defines time in terms of change (specifically, as the number of change in respect of the before and after).¹⁰

But because changes or processes take time, we wonder *how much* time they took, i.e. how long they lasted. And in addition, we enquire into *when* they occurred, which will be a matter of determin-

⁸ *Phys.* 5. 1, 224^b1; for other references see n. 36 below.

⁹ No doubt *Physics 5* and 6 also fulfil a further function, that of clarifying the properties of change in preparation for the complex argument of *Physics 8*, which at crucial points draws on theorems proven in those books, e.g. 8. 7, 260^b19–21. (I am grateful to Sebastian Odzuck for help with this.)

¹⁰ *Phys.* 4. 11, 219^b2. For a complete treatment see U. Coope, *Time for Aristotle: Physics IV. 10–14* (Oxford, 2005).

ing when they started and when they finished. This will often be precisely in order to determine how long they lasted. But there might be other reasons why the student of nature wishes to know when a particular change occurred, i.e. when a particular body underwent a change, for instance in order to determine what the conditions obtaining in the environment of that body were when the change was initiated.

In the chapter of *Physics* 6 which is the main focus of this paper, namely 6. 5, Aristotle is particularly interested in two central questions which one might raise concerning change: when something started changing, and when it finished changing. Quite apart from the purely chronological question of when these things occurred, we want to know whether there are some mysterious states apart from motion and rest (as it were, the states of ‘getting going’ or ‘coming to rest’). And if so, do natural bodies have a principle to be in those states too? Do objects move seamlessly from change to rest and back to change again? Just as we students of natural philosophy need to be clear about what happens when one body is in contact with another—about how a body relates to the rest of the world, and how the parts of a body relate to one another—so we need to be familiar with the structure of change, and how changes and periods of rest relate to each other.

We tend to think that we have a firm grasp of what change, or *kinēsis*, is, according to Aristotle, even if his definition of it in *Physics* 3. 1 is famously obscure. In part, this is because we are confident of our understanding of the ordinary English word ‘change’, so that even if we might find it hard to define that word, we are able to use it without too much reflection. However, one of the lessons of Aristotle’s discussions of *kinēsis* in book 6 is that we need to be more cautious in our use of the word. We use the word ‘change’ to cover a wider range of phenomena, e.g. in locutions such as ‘at that point, the water changed into ice’. But this transition, from water to ice, is not a change according to Aristotle. It is the *culmination* of a change, and happens instantaneously, whereas according to Aristotle, all changes take time (i.e. take place over a stretch of time). The *change* which culminated in the water becoming ice was the cooling or freezing of the water, and *that* did take a certain amount of time. Thus, for Aristotle, there are *transitions* which are not *changes*. (This is one reason some have preferred to translate *kinēsis* as ‘process’ and not ‘change’.)

These transitions provide yet another reason for being wary of the so-called Cambridge definition of what it is to change, namely that x has changed just when something is true of x at one time and false of x at another. This (failed) definition is already infamous for allowing for ‘mere Cambridge’ changes, such as when Socrates is taller than Theaetetus at one time and shorter than him at a later time, without his having himself changed height. But the definition will also certify as changes more subtle examples of transitions which will turn out not to be Aristotelian processes. If it is true at t_1 that x is changing, and true at t_2 that x has come to rest, it most certainly does not follow, according to Aristotle, that x has undergone a change *from* changing *to* resting. (*Mutatis mutandis*, if it has gone from resting to changing.) Among other aspects of change, *Physics* 6 examines in detail the nature of these transitions from rest to change, and from change to rest, neither of which are themselves changes.

The importance of the observation that for Aristotle *kinēsis* is much narrower than might at first appear cannot be overstated. For it is a corollary of this view that to say that something is not subject to change *leaves open* that the thing in question engages in transitional switches which are not changes. And so when Aristotle claims that the soul is not subject to *kinēsis* (*DA* 1. 3, 406^a2),¹¹ this does not rule out switches such as, for instance, those from perceptual inactivity to perceptual activity.¹² Biology will be riddled with examples of such switches or transitions. Small wonder, then, that *Physics* 6 takes upon itself a close study of the conceptual range of the notion of *kinēsis*.

3. Changes have no beginning, but they do have an end: traditional reconstruction

Here is the central stretch of text that will concern me in this paper: *Physics* 6. 5, 235^b30–236^a27 (the translation is mine):

ὅτι 235^b30

μὲν τοίνυν τὸ μεταβεβληκός, ὅτε μεταβέβληκε πρῶτον, ἐν
ἐκείνῳ ἔστί, δῆλον· ἐν ᾧ δὲ πρῶτῳ μεταβέβληκεν τὸ μετα-

¹¹ ἔν τι τῶν ἀδυνάτων τὸ ὑπάρχειν αὐτῇ κίνησιν.

¹² For a similar point see J. Rosen, ‘Motion and Change in Aristotle’s *Physics* 5. 1’, *Phronesis*, 57 (2012), 63–99 at 64.

βεβληκός, ἀνάγκη ἄτομον εἶναι. λέγω δὲ πρῶτον ὃ μὴ
 τῷ ἕτερον τι αὐτοῦ εἶναι τοιοῦτόν ἐστιν. ἔστω γὰρ διαιρετὸν τὸ
ΑΓ, καὶ διηρήσθω κατὰ τὸ *Β*. εἰ μὲν οὖν ἐν τῷ *ΑΒ* μετα- 235^b35
 βέβληκεν ἢ πάλιν ἐν τῷ *ΒΓ*, οὐκ ἂν ἐν πρώτῳ τῷ *ΑΓ* με-
 ταβεβληκός εἴη. εἰ δ' ἐν ἐκατέρῳ μετέβαλλεν (ἀνάγκη γὰρ
 ἢ μεταβεβληκέναι ἢ μεταβάλλειν ἐν ἐκατέρῳ), κἂν ἐν τῷ 236^a1
 ὅλῳ μεταβάλλοι· ἀλλ' ἦν μεταβεβληκός. ὁ αὐτὸς δὲ λό-
 γος καὶ εἰ ἐν τῷ μὲν μεταβάλλει, ἐν δὲ τῷ μεταβέβλη-
 κεν· ἔσται γὰρ τι τοῦ πρώτου πρότερον· ὥστ' οὐκ ἂν εἴη διαι-
 ρετὸν ἐν τῷ μεταβέβληκεν. φανερόν οὖν ὅτι καὶ τὸ ἐφθαρμέ- 236^a5
 νον καὶ τὸ γεγονὸς ἐν ἀτόμῳ τὸ μὲν ἐφθαρταὶ τὸ δὲ γέ-
 γονεν.
 λέγεται δὲ τὸ ἐν τῷ πρώτῳ μεταβέβληκε διχῶς, τὸ
 μὲν ἐν τῷ πρώτῳ ἐπετελέσθη ἢ μεταβολή (τότε γὰρ ἀλη-
 θεὸς εἶπεῖν ὅτι μεταβέβληκεν), τὸ δ' ἐν τῷ πρώτῳ ἤρξατο με-
 ταβάλλειν. τὸ μὲν οὖν κατὰ τὸ τέλος τῆς μεταβολῆς πρῶ- 236^a10
 τον λεγόμενον ὑπάρχει τε καὶ ἔστιν (ἐνδέχεται γὰρ ἐπιτε-
 λεσθῆναι μεταβολὴν καὶ ἔστι μεταβολῆς τέλος, ὃ δὴ καὶ
 δέδεικται ἀδιαίρετον ὄν διὰ τὸ πέρασ εἶναι): τὸ δὲ κατὰ τὴν
 ἀρχὴν ὅλως οὐκ ἔστιν· οὐ γὰρ ἔστιν ἀρχὴ μεταβολῆς, οὐδ' ἐν
 τῷ πρώτῳ τοῦ χρόνου μετέβαλεν.¹³ ἔστω γὰρ πρῶτον ἐφ' ᾧ 236^a15
 τὸ *ΑΔ*. τοῦτο δὴ ἀδιαίρετον μὲν οὐκ ἔστιν· συμβήσεται γὰρ
 ἐχόμενα εἶναι τὰ νῦν. ἔτι δ' εἰ ἐν τῷ *ΓΑ* χρόνῳ παντὶ ἡρε-
 μεῖ (κείσθω γὰρ ἡρεμοῦν), καὶ ἐν τῷ *Α* ἡρεμεῖ, ὥστ' εἰ ἀμε-
 ρές ἐστι τὸ *ΑΔ*, ἅμα ἡρεμήσει καὶ μεταβεβληκός ἔσται· ἐν
 μὲν γὰρ τῷ *Α* ἡρεμεῖ, ἐν δὲ τῷ *Δ* μεταβέβληκεν. ἐπεὶ δ' 236^a20
 οὐκ ἔστιν ἀμερές, ἀνάγκη διαιρετὸν εἶναι καὶ ἐν ὄψεσιν τῶν τούτου
 μεταβεβληκέναι· διαιρεθέντος γὰρ τοῦ *ΑΔ*, εἰ μὲν ἐν μηδε-
 τέρῳ μεταβέβληκεν, οὐδ' ἐν τῷ ὅλῳ· εἰ δ' ἐν ἀμφοῖν μετα-
 βάλλει καὶ ἐν τῷ παντί, εἰ δ'¹⁴ ἐν θατέρῳ μεταβέβληκεν,
 οὐκ ἐν τῷ ὅλῳ πρώτῳ. ὥστε ἀνάγκη ἐν ὄψεσιν μεταβεβλη- 236^a25
 κέναι. φανερόν τοίνυν ὅτι οὐκ ἔστιν ἐν τῷ πρώτῳ μεταβέ-
 βληκεν· ἄπειροι γὰρ αἱ διαιρέσεις.

[235^b30] Therefore it is clear that that which has changed, when primar-
 ily it has changed, is in that to which it has changed: but the primary time
 in which that which has changed has changed must be indivisible. I call
 'primary' that which is such-and-such not in virtue of something other
 than it being such-and-such. For let [235^b35] *AC* be divisible, and let it
 have been divided at *B*. If then it has changed in *AB* or again in *BC*, *AC*
 cannot be the primary time in which it has changed. If, on the other hand,

¹³ I read *μετέβαλεν* here with E²FK, rather than *μετέβαλλεν*, which Ross prints. More on this below.

¹⁴ Reading *εἰ δ'* (with the manuscripts) instead of Ross's *εἴτ'*.

it was changing in both (for necessarily [236^a1] it must either have changed or be changing in both of them), then it would be changing in the whole too; but our assumption was that it had changed. The same argument applies too if it is changing in one part but has changed in the other: for there will be something prior to what is primary. Therefore [236^a5] the time in which it has changed cannot be divisible. Thus it is clear that both that which has been destroyed and that which has come into being have been destroyed and have come into being in an indivisible time.

‘The primary time in which something has changed’ is said in two ways. In one, it is the primary time in which the change finished (for at that point it is true to say that it has changed), and in the other it is the primary time in which the thing started [236^a10] to change. The one that is said to be primary in relation to the end of the change is both real and exists (for it is possible for a change to finish, and there is an end of a change, which has in fact also been shown to be indivisible since it is a limit), whereas the one in relation to the start of the change does not exist at all, for there is no beginning of a change, at least there is no [236^a15] primary part of the time in which it embarked on change. For let the primary time be AD. Then this is not indivisible. For then the nows would be next to each other. Again, if it were at rest in the whole of the stretch of time CA (for let us grant that it is at rest), then it would be at rest in A too, with the result that if AD¹⁵ is partless, it will simultaneously be at rest and have changed; [236^a20] for it is at rest at A and has changed at D. But if AD is not partless, it must be divisible and it must have changed in any part of it whatsoever, for suppose AD is divided, then if it has changed in neither part, it will not have changed in the whole either, and if it is changing in both, it is changing in the whole too, and if it has changed in one or the other, [236^a25] the whole will not be the primary time in which it has changed. So it must have changed in any part whatsoever. It is clear then that the primary time in which the thing has changed does not exist. For the divisions are endless.

The basic structure of this text is as follows. In the first section, 235^b30–236^a7, Aristotle proves—or attempts to prove—that something he terms ‘the primary time in which that which has changed has changed’¹⁶ must exist and be indivisible.¹⁷ In the second section, 236^a7–27, Aristotle specifies that the phrase *to en hōi prōtōi metablēken* (‘the primary time in which something has changed’)

¹⁵ There is a misprint (‘AC’) at this point in the revision of Hardie and Gaye’s translation of the *Physics* in J. Barnes (ed.), *The Complete Works of Aristotle: The Revised Oxford Translation* (Princeton, 1984). The misprint is not present in Hardie and Gaye’s original translation in W. D. Ross (ed.), *The Works of Aristotle*, vol. ii (Oxford, 1930). Thanks to John Cooper for spotting this.

¹⁶ 235^b32: ἐν ᾧ πρῶτῳ μεταβέβληκεν τὸ μεταβεβληκός.

¹⁷ 235^b33: ἄτομον.

actually has *two* meanings.¹⁸ According to the first meaning, it refers to the primary time in which something finished changing¹⁹—in this sense of the phrase, the primary time in which something has changed exists, and indeed is the primary time whose existence Aristotle had proven in the first section. According to the second meaning, it refers to the primary time in which something started to change²⁰—in this sense of the phrase, the primary time in which something has changed does *not* exist, and Aristotle offers a long and intricate argument in 236^a15–27 to prove this.

I shall be saying a lot more about the meaning of the key phrase *to en hōi prōtōi metablēken* in this paper. But rising above its intricacies for a moment, we can see that in the course of this stretch of text Aristotle makes a claim which at first sight—and indeed at many subsequent sights too—seems absurd: namely, that a change has no beginning,²¹ although it does have an end (236^a10–11). ‘Absurd’ is my choice of word, but even Aristotle’s closest pupil and successor Theophrastus called the contention ‘amazing’.²² (As always with Theophrastus, we should not assume that this means that he is criticizing his Master. More likely is that he was simply softening up the reader: ‘this may seem amazing, but actually you’ll see that it is quite true’.²³)

But why is it absurd or amazing to say that changes have no beginning, but do have an end? Presumably for the following three reasons at least:

- (a) How can something get going if its moving has no beginning?
- (b) The claim seems arbitrarily asymmetric—why should there be a difference between the beginning and end of a change?
- (c) If a change has no beginning, what about the period of rest which occurred before it? Did it have an end? In any case, do periods of rest have the same properties as changes, and if not, why not?

¹⁸ 236^a7: λέγεται δὲ τὸ ἐν ᾧ πρώτῳ μεταβέβληκε διχῶς.

¹⁹ 236^a7–8: τὸ μὲν ἐν ᾧ πρώτῳ ἐπετελέσθη ἢ μεταβολή.

²⁰ 236^a9–10: τὸ δ’ ἐν ᾧ πρώτῳ ἤρξατο μεταβάλλειν.

²¹ 236^a14: οὐ γὰρ ἔστιν ἀρχὴ μεταβολῆς.

²² θαυμαστόν (Themist. *In Phys.* 195, 8 Schenkl=156A FHS&G); θαυμαστά (Simpl. *In Phys.* 986, 6 Diels=156B FHS&G).

²³ For another example of a merely apparent criticism on the part of Theophrastus see B. Morison, ‘Did Theophrastus Reject Aristotle’s Account of Place?’, *Phronesis*, 55 (2010), 68–103.

Excited by Aristotle's claim that a change has no beginning, commentators have attempted to reconstruct his argument, and have almost uniformly understood him to mean the following: there is no *first instant* or moment of a change. I shall be arguing that Aristotle does not mean that and does not assert that, and I shall be examining the relevant text more closely in a moment. But an orthodox version of the argument is worth laying out.

The argument is supposed to go like this. Suppose that x is at rest, and then moves. Suppose further that there is a last moment, t_1 , at which x is at rest. Then let the first moment at which x is moving be t_2 . Either t_2 is previous to t_1 , or $t_2=t_1$, or t_2 is after t_1 .

- (Step 1) If t_2 were previous to t_1 , then there would be a period of time, namely from t_2 to t_1 , during which x would be both at rest and in motion, which is impossible.
- (Step 2) If t_2 were identical to t_1 , then at that instant, x would be at rest (because t_1 is the last moment of rest), and x would be in motion (because t_2 is the first moment of motion). But this is impossible.
- (Step 3) But if t_2 were after t_1 , then, since two instants cannot be consecutive—rather, they must bound a period of time—there would be a period of time between t_1 and t_2 during which x would be neither in motion, nor at rest, which is impossible.

So t_2 is not previous to t_1 , nor identical with t_1 , nor after t_1 . Therefore it does not exist.

This does indeed have the makings of a really good paradox. There are two important assumptions lying behind it.

- (a) It is supposed that ' x is in motion' and ' x is at rest' are contradictories—they cannot be true together and yet one must be true.
- (b) It is supposed that time is a continuum, and that instants are like points on a line, in that between any two points there is another point.

I do not intend to take issue with either of these assumptions; Aristotle endorses them both and that is good enough for my purposes here. One of the things I want to do in this paper is cast doubt on whether Aristotle ran the argument in the form just given.

My first doubt is that the argument given *is* arbitrary, in this re-

spect: it established only that *if* there is a last moment of rest, *then* there is no first moment of motion. In other words, it only establishes a conditional, and not the desired claim (the consequent of the conditional). One way of seeing why this matters is that if we hypothesize the contrary of the antecedent (that there is no last moment of rest), we could perfectly well hypothesize a first moment of motion, without contradiction. But there is no hint of an appreciation of this in Aristotle's text.

My second doubt is that when we turn our attention to the other end of the change, we can use exactly the same form of argument to argue from the assumption that there is a last moment of motion, to the conclusion that there is no first moment of rest. However, Aristotle definitely does not do this. He argues that the end of a change and the beginning of the subsequent period of rest *coincide*, and occur instantaneously. (I shall say more about this later.)

My third doubt is that nowhere does Aristotle ever talk of the first or last moment of change or rest using an expression involving the word for an instant (*nun*).²⁴ He uses a locution which sounds similar to this—but is not identical, and is in fact crucially different. That locution is *to en hōi prōtōi metablēken* (235^b32–3; 236^a7), which I have translated as ‘the primary time in which it has changed’. This phrase does not refer to an instant as a matter of its meaning, and nor does it refer to something which is first—at least, not if by that we are to understand *temporally* first. Or so I shall argue.

One reason for thinking that Aristotle is not referring to the first *instant* of a change when he uses this locution is quite simply that he does not use the Greek word for ‘instant’ (*nun*) in it. But even if this does not convince you, there is irrefutable proof that the phrase *to en hōi prōtōi metablēken* is not supposed to be *understood* in its very meaning as referring to an instant, and that is that Aristotle undertakes to *prove* that the time *en hōi prōtōi metablēken* (when that phrase is understood to refer to the end of a change) is not a stretch of time but is an instant (235^b34–236^a5). If that phrase simply *meant* ‘the first instant in which the thing has changed’ *vel sim.*, then it would be entirely otiose—and scarcely intelligible—to prove that this was not a stretch of time (and the argument would look very different from the complex one that Aristotle actually gives at 235^b34–236^a5). Moreover, Aristotle also proves that the time *en hōi prōtōi*

²⁴ ‘The first instant of change’ would presumably correspond to an expression such as τὸ τῆς μεταβολῆς πρῶτον νῦν.

metabēlēken (when that phrase is understood to refer to the beginning of a change) is *neither* an instant (236^a16–20) *nor* a stretch of time (236^a20–6). Again, if the phrase simply *meant* ‘the first instant in which the thing has changed’ *vel sim.*, then it would be entirely otiose to prove that it was not a stretch of time, and mystifying to prove that it was not an instant.

But in fact it should be obvious that Aristotle is not using the word *prōton* to refer to temporal priority, because his explanation for what the word *prōton* does mean in this context makes this explicit (235^a33–4): ‘I call “*prōton*” that which is such-and-such but not in virtue of something other than it being such-and-such.’²⁵ Whatever this means, it does not even *sound* like a definition of ‘first’ in the sense of ‘temporally first’. A better translation would be something like ‘primary’, in the sense of ‘logically primary’, or perhaps ‘primary in being’ or something like that. This sense of the word needs some explanation, which I shall now attempt to provide. Indeed, once we have understood how Aristotle intends the word *prōton* to be understood, we will see immediately why it is that we should not introduce talk of instants either.

4. The meaning of *prōton*, and an analogy with places

A helpful place to start in elucidating Aristotle’s meaning is a passage right at the beginning of *Physics* 6. 6 (236^b19–23):

Every changing thing changes in a stretch of time, but changing in a stretch of time can be understood as meaning either in a primary stretch of time, or in respect of some other stretch of time (e.g. something changes in some year in virtue of the fact that it changes on some day). So the primary stretch of time in which a changing thing changes is such that necessarily the thing is changing in any part of it whatsoever.

The point behind this is the following. Suppose someone asks me: ‘When did you go to the City?’. I might reply: ‘In 2011’. ‘When in 2011?’, he persists. ‘On December 5th’, I reply. It is in virtue of the fact that my journey to the City occurred on 5 December 2011 that it occurred in 2011. The ‘in virtue of’ here (*hoti*) captures the fact that from ‘I went to the City on 5 December 2011’ we can infer ‘I went to the City in 2011’, but not vice versa. (There are plenty of things

²⁵ λέγω δὲ πρῶτον ὃ μὴ τῷ ἑτερόν τι αὐτοῦ εἶναι τοιοῦτον ἔστιν.

which happened in 2011 but which did not happen on 5 December 2011.) So, as Aristotle puts it in the text just quoted, the change (my journey to the City) took place in some year (2011) in virtue of the fact that it took place on some day of that year (5 December).

Now, in Aristotle's terminology, 2011 is not the primary time of my journey to the City, since there is a part of 2011 in which my journey occurred, namely 5 December 2011. Now in fact, 5 December 2011 is not the primary time either, since my journey did not occur during the *whole* of that time, but only in the evening of 5 December. Even then, we could be more precise about when my journey took place within that stretch (between 5.42 p.m. and 7.16 p.m., or whatever).

What I mean by being 'more precise' is the following. I specified the time of my journey as (first) 2011 (call this time A), (then) 5 December 2011 (call this time B), (then) the evening of the fifth (time C), and (finally) the stretch between 5.42 p.m. and 7.16 p.m. on that day (time D). In so doing I specify the time of my journey more and more precisely, in this sense: anything which happens in time B happens in time A but not vice versa, so B is a more precise time-stretch than A. Similarly, anything which happens in time C happens in time B but not vice versa, so C is a more precise time-stretch than B. Likewise, anything which happens in time D happens in time C but not vice versa. So D is the most precise out of all the given time-stretches.

Let us assume that D is the most precise stretch of time for the journey. In that case, it qualifies as the primary time in which the journey took place, since I was engaging in my change (journeying to the City) at every substretch of it (as Aristotle puts it in the text above: 'necessarily the thing is changing in any part of it whatsoever'). Moreover, there is no part of my journey which lies outside that stretch of time either. Hence, that stretch of time exactly fits my journey: it is the most precise specification possible of when my journey took place. That stretch of time D has an important property: *any* stretch of time which *includes* D will be a true answer to the question 'when did the journey take place?'. Possible answers include: winter 2011; the second decade of the twenty-first century; the twenty-first century itself; etc. Thus, the primary stretch of time (D) in which the change took place has explanatory value; we can explain why any true answer to the question 'when did the

journey take place?’ is true by adverting to the fact that the time-stretch specified in that answer includes D.

There is a parallel for this in *Physics* 4. 1–5, Aristotle’s account of place.²⁶ Imagine somebody asking me where I am. I reply: ‘I am in Princeton’. They then ask further: ‘Where in Princeton?’—‘In Marx Hall’—‘Where in Marx Hall?’—‘On the second floor’—‘Where on the second floor?’—‘In room 208’. Each time, I specify a more precise place where I am. The sense in which each of my replies is more precise is the following. Everything in Marx Hall is in Princeton, but not vice versa. (For instance, Firestone Library is in Princeton, but not in Marx Hall.) Likewise, everything on the second floor of Marx Hall is in Marx Hall, but not vice versa. Everything in room 208 is on the second floor of Marx Hall, but not vice versa.

Aristotle holds that everything which has a place has a *primary* place—i.e. a *most precise* place. Special features of this place include the following: it must contain nothing besides that of which it is the primary place (*Physics* 4. 2, 209^b1). Aristotle thinks that a corollary of this is that it must be a surface, and in fact he famously says that *x*’s primary place is ‘the inner surface of *x*’s surroundings’. The importance of *x*’s primary place, *p*, is that since *p* is *x*’s most precise place, it is in virtue of the fact that *x* is in *p* that *x* is in anything at all. So, for instance, I am in the air at the moment in virtue of the fact that I am in this surface of air. Anything in this surface of air is in the air, whereas it is not the case that anything in the air is in this surface of air.

I do not want to discuss here the merits of Aristotle’s remarks about place.²⁷ What is important for our purposes is that Aristotle refers sometimes to *x*’s primary place as that in which *x* is non-derivatively (*kath’ hautō*), the contrast being with those things which *x* is in derivatively (*kath’ heteron* or *kat’ allo*).²⁸ This is

²⁶ A parallel remarked by Ross in *Physics*, in his note to 6. 6, 236^b20–1 (in his commentary he often renders *πρῶτον* by ‘commensurate’). He does not mention the parallel in connection with Aristotle’s first elucidation of what ‘primary’ means, at 6. 5, 235^b33–4. My temporal example is similar to that given by Wagner, in *Aristoteles: Physikvorlesung* (Berlin, 1967), 626–7, translated and endorsed as correct by Strobach, in *The Moment of Change: A Systematic History in the Philosophy of Space and Time [Moment]* (Dordrecht, 1998), 74–5. Wagner does not mention the parallel with place, nor does Strobach. Hardie and Gaye often translate *πρῶτον* as ‘primary’, which suggests that they also saw that temporal priority is not at issue.

²⁷ See Morison, *Location*, for a full discussion of these issues.

²⁸ See *Phys.* 4. 2, 209^a31.

mirrored by his contrast in *Physics* 6. 6 between the *primary* time in which a changing thing changes, and the time in which it changes *in respect of something else* (*kath' heteron*, 236^b21).

Now, at *Physics* 6. 6, 236^b19–23, Aristotle was addressing the question of when something is *changing*, i.e. when a change occurs. Since changes *take time*, the question ‘when did the change occur?’ can be answered truly only by a specification of a *stretch* of time (Aristotle’s word for a stretch of time is *chronos*), hence why Aristotle points out that ‘every changing thing changes in a stretch of time’ (236^b19). But of course, some things happen instantaneously, and do not take time. For instance, my *arrival* in the City is a good candidate for being just such an instantaneous occurrence. (As we shall see, Aristotle is very interested in such occurrences.) But notice that there is exactly the same structure to possible answers to the question ‘When did he arrive in the City?’. There are more or less precise answers to the question (‘in 2011’, ‘on December 5th’), and there will be a most precise answer (one which specifies the exact instant at which I arrived). This most precise answer will be the primary time at which I arrived. In this case, the primary time of the relevant occurrence is not a stretch of time (a *chronos*) but rather an instant (a *nun*). So although some true answers to the question ‘when did he arrive?’ will specify stretches of time (answers such as ‘2011’), those answers will be true *because* they contain the primary time of my arrival (namely a certain instant which is contained in 2011).

Taking into account that things which happen can be either changes or instantaneous occurrences such as arriving, we can point to the following parallels between what Aristotle says about place, and what he says about time:

- (a1) A body *x* is in a place P in respect of something else iff *x* is in P but there is something *y* in which *x* is such that *y* is part of P and *x* is in *y*.
- (a2) A change/occurrence *x* is in a time T in respect of something else iff there is something *y* in which *x* is such that *y* is part of T and *x* is in *y*.
- (b1) A body *x* is in a place P primarily iff *x* is in P but there is nothing else *y* in which *x* is such that *y* is part of P and *x* is in *y*.
- (b2) A change/occurrence *x* is in a time T primarily iff *x* is in T

but there is nothing else y in which x is such that y is part of T and x is in y .

The notion, then, of a primary time in which some change/occurrence x happens is thus far from being simply a matter of the *first moment* at which x happens, or something like that. There is no explicit mention of *moments* at all, nor is there any hint of *first moments*. The primary time of an event E (an occurrence or a change or whatever) is the time AB —either a stretch of time ($A \neq B$), or an instant ($A = B$)—such that E occurs in AB , and no part of E occurs at any time outside AB , and such that there is no stretch of time CD which is a part of AB in which E is not taking place.

5. The primary time in which something has changed

In *Physics* 6. 5, 235^b30–236^a27, Aristotle will attempt to prove two things: that there is no primary time at or in which something *began* to change (236^a15–27), but there is a primary time at or in which something *finished* changing (235^b34–236^a5). Or, to put this another way, there is no way to specify precisely *when* something does enough changing to count as having changed, i.e. when it transitions from rest to change, but there is a way to specify precisely *when* it transitions from change to rest. That this is what Aristotle is doing should be uncontroversial; he tells us in 236^a7–15 that this is exactly what he is going to do. But what demands explanation is how Aristotle can claim that the single locution, *to en hōi prōtōi metablēken*, can refer to either the primary time in which something began to change, or the primary time in which something finished changing. This is what I want to linger on in this section, before investigating in the next section the two arguments that Aristotle gives for his twin claims (that there is no primary time at which it started to change, but there is a primary time at which it finished changing).

Aristotle is clear that *to en hōi prōtōi metablēken*, which literally means ‘the primary [time] in which something has changed’, can be taken in two quite different ways (236^a7–10):

λέγεται δὲ τὸ ἐν ᾧ πρώτῳ μεταβέβληκε διχῶς, τὸ μὲν ἐν ᾧ πρώτῳ ἐπετελέσθη ἡ μεταβολή (τότε γὰρ ἀληθὲς εἶπεν ὅτι μεταβέβληκεν), τὸ δ' ἐν ᾧ πρώτῳ ἤρξατο μεταβάλλειν.

236^a10

‘The primary time in which something has changed’ is said in two ways. In one, it is the primary time in which the change finished (for at that point it is true to say that it has changed), and in the other it is the primary time in which the thing started to change.

There are two puzzling features in Aristotle’s elucidation of the double meaning of the phrase *to en hōi prōtōi metablēken*. (i) How on earth can one and the same phrase manage to refer both to the *start* of a change and to the *finish*? (ii) How can it be that a phrase which contains the *perfect* form ‘has changed’ (*metablēken*) can have its meanings unfolded by phrases containing *aorist* forms, namely ‘finished’ (*epetelesthē*) and ‘started’ (*ērxato*)?²⁹ After all, the Greek perfect typically captures the idea that something is in a certain state, a state which has been reached as a result of the past performance of the action specified by the relevant verb. The aorist, on the other hand, simply states that an action occurred in the past, viewing that action as a whole, and saying nothing about the agent’s current condition.

We should note that the ambiguity Aristotle points to is all due to the meaning of the word *metablēken*. For the phrase which is said to have two meanings is *to en hōi prōtōi metablēken*, and yet the string of words *en hōi prōtōi* appears in the elucidations of *both* of the two meanings: *to en hōi prōtōi epetelesthē hē metabolē*, and *to en hōi prōtōi ērxato metaballein*. So it is not the word *prōtos* which is responsible for generating the two meanings. Therefore it must be all down to the word *metablēken*. But before we get into clarifying what *metablēken* means, we first have to decipher the grammar of the whole phrase *to en hōi prōtōi metablēken*. It is a noun phrase formed by the article followed by a relative clause, but there is no explicit antecedent for the relative pronoun. It is clear that in English one has to supply a noun such as ‘time’ as antecedent for *en hōi prōtōi*. Now, one must remember that the word ‘time’ is not here translating the word *chronos*. Aristotelian Greek lacks a word which is neutral as between ‘stretch of time’ (*chronos*) and ‘instant of time’ (*mun*), a word which would be genus, as it were, to those two species. But it is easy to see that the phrase *to en hōi prōtōi metablēken* must

²⁹ Strobach (*Moment*, 73) states correctly that ‘*μεταβέβληκεν* is in one sense synonymous with *ἤρξατο μεταβάλλειν*; in another sense it is synonymous with *ἐπετελέσθη ἢ μεταβολή*’, and offers the following terse explanation for what is going on: the distinction between two types of aorist (ingressive and perfective) is ‘transferred into the two different meanings of *μεταβέβληκεν*’ (257 n. 77). In my text I offer a fuller and somewhat different explanation.

be neutral in its meaning as between ‘stretch of time’ and ‘instant’, because when denying the existence of the primary time in which something started to change, Aristotle proves that it can be *neither* an instant *nor* a stretch of time.³⁰

Since the word *prōtōi* in our phrase is in apposition to the relative pronoun, it is easiest to render the phrase in English by taking it outside the relative clause, supplying the missing noun, to give us the following rendering of *to en hōi prōtōi metablēken*: ‘the primary time in which the thing has changed’. So now, we must look at the Greek perfect form *metablēken*. It means something like this: ‘*x* is in a state of having changed’. As Goodwin³¹ puts it in his description of the Greek perfect: ‘The Perfect represents an action as already finished at the *present* time’ (§ 17.1); ‘[I]t implies the performance of the action in the past time, yet *states* only that it *stands completed* at the *present* time’ (§ 17.2 Note 1). The perfect tense has perfective aspect.³² So, for instance, to ask ‘when primarily something has changed’—*hote metablēken prōton* (cf. 6. 5, 235^{b7}; 31)—is to ask when primarily something is in the state of having changed. Since this state can endure for a while, this would be to ask when exactly the thing is in the state of having changed.

But what about *to en hōi prōtōi metablēken*? Is this a phrase referring to the time when the thing is in the state of having changed? The answer is no. To see this, we have to notice something about the English perfect. As Comrie puts it: ‘in English, the Perfect may not be used together with specification of the time of the past situation, i.e. one cannot say *I have got up at five o’clock this morning*, because the specific reference to the point of time *at five o’clock this morning* is incompatible with the English Perfect’.³³ However, Comrie points out that other languages *do* allow for perfect forms

³⁰ Hence one should absolutely resist the temptation to translate the phrase τὸ ἐν ᾧ πρῶτον μεταβλήκεν as ‘the first instant in which something has changed’, or ‘le premier (moment) dans lequel ce qui a changé a changé’, as Pierre Pellegrin translates it (‘Début et fin du mouvement et du repos: remarques sur la communication de Benjamin Morison’ [‘Remarques’], in J.-F. Balaudé and F. Wolff (eds.), *Aristote et la pensée du temps* (Le Temps Philosophique, 11; Université Paris X–Nanterre, 2005), 113–26 at 121). I rather like Hardie and Gaye’s original (1930) translation: ‘the primary when in which something has changed’. But the nominalization of ‘when’ is a little awkward.

³¹ W. W. Goodwin, *The Syntax of the Moods and Tenses of the Greek Verb* [*Syntax*], 3rd edn. (1867; repr. Cambridge Library Collection; Cambridge, 2009).

³² Emphasized by Strobach, *Moment*, 73.

³³ B. Comrie, *Aspect* (Cambridge Textbooks in Linguistics; Cambridge, 1976), 54. He does acknowledge that there are a few instances where it is not excluded that

to be modified by adverbial phrases specifying when the relevant action or event took place, and produces examples from Spanish and Russian; he also points out that in English you can achieve the same result if you add the specification ‘as an afterthought’: ‘I have been to Birmingham, last week in fact’.³⁴ I submit that when Aristotle wonders *in what time* something has changed, he is wondering *when it got the changing done that qualifies the thing as having changed*, much as we might wonder, if someone says ‘I have been to Birmingham’, when it was that they went to Birmingham. When we ask when they went there, we are asking when the event took place which qualifies them as now being in the state of having been to Birmingham—when the event took place which qualifies them *now* as being past-Birmingham-visitors. (This is distinct from asking, for instance, how long they have been in the state of being past-Birmingham-visitors.)

In Greek, can temporal adverbial phrases, modifying perfect verbs, play this role of specifying when the relevant action took place which put the object in the current state expressed by the perfect? I think they can, and I think we get a prime example elsewhere in *Physics* 6. Consider the following claim in *Physics* 6. 6: ‘Everything which is moving must be in a state of having moved previously’ (236^b33–4).³⁵ The adverb ‘previously’ (*proteron*) modifies the perfect infinitive ‘be in a state of having moved’ (*kekinnēsthai*). But what is being said to have occurred previously is not the state of having moved—that state is current—but rather the *moving* which put the thing in its current state of having moved. So the adverb ‘previously’ is modifying a perfect form, but it refers to the time when the relevant *action* itself took place, rather than to when the thing is in the *condition* of having performed the action. Similarly, I claim, our key phrase ‘the time in which primarily the thing has moved’ is referring to the time in the past when the object which is currently in the state of having moved got the moving done which makes it count as now being in the state of having moved.

Thus, the basic meaning of *metabēlēken* is ‘*x* is in a state of having changed’, and the phrase *en hōi prōtōi* is inviting us to specify exactly (*prōtōi*) when *x* engaged in the change which put it in the

we specify some time in which the relevant event or action occurred—we *can* say ‘I have seen Fred today’—‘provided that the time includes the present’ (ibid.).

³⁴ Ibid. 54–5.

³⁵ πᾶν τὸ κινούμενον ἀνάγκη κεκινήσθαι πρότερον.

state of (now) having changed. Now we have an answer to one of the puzzles about the phrase *to en hōi prōtōi metablēken*, namely why it is that Aristotle feels he can gloss its meanings using verbs in the aorist, given that the verb in the phrase is perfect. The answer is that the phrase refers to the time when the object in question *performed the change* (aorist) which makes it true that it now counts as *having changed* (perfect). The change in aspect is to be explained in a similar way to the explication of why there is a change in aspect in English when I ask when it was that you *went* to Birmingham (aorist), after learning that you *have been* (perfect) to Birmingham; I am asking when you performed the change, i.e. going to Birmingham, which makes it true that you now count as having changed, i.e. as having been to Birmingham.

So far so good. But we still have not generated the double meaning that Aristotle insists the phrase *to en hōi prōtōi metablēken* has, whereby it can refer both to the start and to the end of a change. For that, we need to introduce one further complexity. We have to note that Aristotle starts *Physics* 6. 5 with the following observation: ‘every changing thing changes from something to something’ (235^b6–7).³⁶ Every change, in other words, has a starting-point and an endpoint. When *x* changes, *x* changes from having F predicated of it to having G predicated of it, where ‘F’ and ‘G’ may name places (in which case the change in question is locomotion), or qualities (in which case the change in question is alteration), etc. To put things slightly less clumsily: when *x* changes, *x* changes *from* being F and *x* changes *to* being G. I draw attention to Aristotle’s observation because we have to note that there are three different things we might say about *x*, each of them using the verb ‘to change’: ‘*x* changes’, ‘*x* changes from being F’, and ‘*x* changes to being G’. Thus, when Aristotle uses the verb form *metablēken*, he might have in mind any one of three different things: (1) ‘*x* has changed’ (as in ‘*x* has undergone its entire change’, or ‘*x* has changed from being F to being G’), (2) ‘*x* has changed from being F’, and (3) ‘*x* has changed to being G’. These statements have different truth conditions. In the middle of the change in question, for instance, (1) is false, as is (3), but (2) is true.

Thus, there are in fact *three* different things that Aristotle could mean by the phrase *to en hōi prōtōi metablēken*. It could mean

³⁶ The observation is a familiar one in the three books constituting the *Περὶ κινήσεως* (5. 1, 224^b1; 225^a1; 6. 4, 234^b11; 8. 2, 252^b10).

(1) the primary time in which x did the changing necessary to put it into a state of having changed from F to G (of having completed the whole change, in other words), or (2) the primary time in which x did whatever is necessary to put it into the state of having changed from F, or (3) the primary time in which x did whatever is necessary to put it into a state of having changed to G. In our passage, we have Aristotle using the phrase in senses (2) and (3). Thus, Aristotle glosses one meaning of *to en hōi prōtōi metablēken* as *to en hōi prōtōi epetelesthē hē metabolē*: the primary time in which the change finished. This is the primary time in which x did whatever is necessary to put it into a state of *having changed to being G* (meaning 3). And he glosses the other meaning of *to en hōi prōtōi metablēken* (the other meaning relevant for our passage) as *to en hōi prōtōi ērxato metaballein*: the primary time in which the change started. This is the primary time in which x did whatever is necessary to put it into a state of *having changed from being F* (meaning 2).

If I am right about this, then we would expect Aristotle somewhere to use the locution ‘the primary time in which x has moved’ in sense (1)—i.e. to refer to the exact time in which the *whole* change took place (a stretch of time, necessarily). Here, the perfect ‘ x has moved’ would mean ‘ x is in the state of having completed the whole change’. And we do get just this, in *Physics* 6. 6, where Aristotle, in the course of another long and involved argument, says: ‘If something has changed [*kekinētai*] in the primary time XR over the magnitude KL, then . . .’ (236^b34–5). Here, the primary time in which the thing in question has changed (*kekinētai*) is the primary time in which the *whole* change took place—the primary time in which the thing changed from being F to being G (that Aristotle has the whole change in mind is clear from the fact that there is a *magnitude* specified over which the thing has changed, and the change in question occupies the *stretch* of time XR). Thus, I contend, we find in *Physics* 6 all three uses of the perfect in conjunction with a temporal adverbial modifying phrase of the form ‘in such-and-such a time’. Each time, the temporal modifier specifies when the item in question performed whatever is necessary to put it into the state of having changed, where this state might be any of these three: having changed from F, having changed to G, or having changed from F to G.

As I said above, English cannot easily use these temporal modifying phrases with the perfect, so it is difficult to render some of

these formulations in idiomatic English. However, it is possible to find examples in English of the use of the phrase ‘*x* has moved’ to mean both ‘*x* has moved from being F’ and ‘*x* has moved to being G’. Suppose I am on a train, which is sitting at the station, and I am waiting for the train to leave; I might exclaim, when the train has finally left, ‘we have moved!’. But suppose that the ticket inspector now comes up to me and tells me to move seats (perhaps I am sitting in the wrong one); I get up and move from that seat to another, and I tell him ‘OK, now I have moved’. In the first case, my utterance is supposed to capture the fact that we have started to move; in the second case, my utterance is supposed to capture the fact that I have completed the move (to another seat).³⁷

So I hope to have offered explanations for (i) why the phrase ‘the primary time in which something has changed’ has two meanings, referring to both the end and the start of the change, and (ii) why Aristotle employs the aorist forms ‘finished’ and ‘started’ in unpacking those two meanings, despite the presence of the perfect form ‘has changed’ in the phrase itself.

With this groundwork, we can turn to the substantive philosophical claims that Aristotle is going to make concerning the primary time in which something started changing and the primary time in which something finished changing. What Aristotle will claim is that we cannot pinpoint *when* something started changing, i.e. did the changing necessary to count as having changed, whereas we can pinpoint exactly *when* the thing completed the change. Or, to use the examples from the train, we cannot pinpoint when the train did what is necessary to count as having moved from its starting-point, but we can pinpoint when it was that I did what is necessary to count as having moved to my new seat.

³⁷ I am grateful to Myles Burnyeat, Christian Wildberg, Jonathan Beere, Jacob Rosen, and especially Hendrik Lorenz, for discussion of the Greek perfect. In Burnyeat’s already classic 2008 paper ‘*Kinēsis* vs. *Energeia*: A Much-Read Passage in (but not of) Aristotle’s *Metaphysics*’, *Oxford Studies in Ancient Philosophy*, 34 (2008), 219–92, he details two uses of the Greek perfect which are exploited in *Metaphysics* Theta. Jonathan Beere showed me that the ambiguity in the phrase τὸ ἐν ᾧ πρῶτον μεταβέβηκεν that Aristotle points to in the *Physics* cannot be explained by the same ambiguity in the Greek perfect that is exploited in the *Metaphysics* (see also J. Beere, *Doing and Being: An Interpretation of Aristotle’s Metaphysics Theta* (Oxford Aristotle Studies; Oxford, 2009), 221–6).

6. The end of the change

The actual way that Aristotle's discussion progresses is like this. In 235^b30–236^a7 he observes and attempts to prove that there is indeed a primary time in which something has changed, and this time is in fact indivisible. At this stage in the argument Aristotle does not reveal that the phrase *to en hōi prōtōi metablēken* is ambiguous, and could refer to the beginning of a change as much as to the end of a change. At this point (no doubt under the influence of the preceding discussion in 235^b6–30) we are concerned only with what happens at the end of a change, and we do not suspect that we are going to turn our attention to the beginning of a change. But that is what happens at 236^a7–15, when Aristotle observes the ambiguity in the phrase *to en hōi prōtōi metablēken*, and observes that when this phrase refers to the end of a change, there is such a thing as the primary time in which the thing has changed, but when it refers to the beginning of a change, there is no such primary time. Then, in 236^a15–27, he gives the proof for this latter claim.

Thus we need to start with Aristotle's proof in 235^b30–236^a7 that there is a primary time in which something has changed, where this can be paraphrased as something like the following claim: when something changes from being F to being G, there is a primary (i.e. most precise) time in which something makes the transition to having changed to being G. His argument that there is such a primary time, and that it is indivisible, is actually rather difficult.

Here is the complete argument (235^b32–236^a5):

the primary time in which that which has changed has changed must be indivisible. I call 'primary' that which is such-and-such not in virtue of something other than it being such-and-such. (1) For let AC be divisible, and let it have been divided at B. (2) If then it has changed in AB or again in BC, AC cannot be the primary time in which it has changed. (3) If, on the other hand, it was changing in both (for necessarily it must either have changed or be changing in both of them), then it would be changing in the whole too; but our assumption was that it had changed. (4) The same argument applies too if it is changing in one part but has changed in the other: for there will be something prior to what is primary. (5) Therefore the time in which it has changed cannot be divisible.

The form of this argument is a *reductio*: the supposition that the primary time in which the thing completes the change is divisible is

shown to be impossible, by examining the various different possibilities for that scenario and ruling each out; Aristotle then infers that the primary time in which the thing completed the change must be indivisible. We can see immediately that there is a problem with this reasoning: it presupposes that the primary time in which the thing completes its change actually exists. When Aristotle discusses the primary time in which something *started* its change, he shows that it can be neither divisible nor indivisible; here, where he discusses the *end* of the change, there is only a proof that the primary time in which the thing finished changing cannot be divisible.

None the less, we can follow through the details of the proof. First, we assume that (1) the primary time AC is divisible, and we divide it at B; in other words, we assume first (for *reductio*) that AC is a stretch of time, not an instant. (2) But if the thing in question transitions to its endpoint in either AB or BC, then AC could not be the primary time of this transition, since there would be a part of it (AB or BC) in which the transition was made. (Suppose I journeyed from Princeton to New York City on Monday; I left at 5.42 in the afternoon and arrived at 7.16 in the evening. Is the stretch of time from 7.00 to 7.30 the primary time of my arrival? No, because we can divide it into two parts at 7.15, and see that I arrived in one of the parts; hence 7.00 to 7.30 is not the primary time of my arrival.) (3) But any putative primary time of the completion of the change cannot be one in which the object is in motion throughout the stretch of time (i.e. is at every instant still in motion): for then it does not complete the change in that stretch. (Aristotle assumes that when it completes the change it is no longer in motion.) So if it is changing across both parts of AC, then AC is not after all a stretch of time in which it makes the transition to having changed. (4) Aristotle continues rather perplexingly by talking again about the first case, when the thing has changed in either AB or BC.³⁸ He says: 'The same argument applies too if it is changing in one part but has changed in the other; for there will be something prior to what is primary.' If, for instance, the thing is changing in AB but then transitions to having changed in BC, then AC is not the primary time of the transition, since BC is prior to it. The thing will be changing in AC derivatively; to be more precise, it is changing in BC, and *therefore* changing in AC derivatively. (It is a rather strange feature of this argument that Aristotle is apparently prepared to al-

³⁸ Ross: 'Aristotle by oversight adds this as if it were a separate case' (ad loc).

low that the thing may have changed in AB but then be changing in BC.)

From all of this Aristotle draws the conclusion that AC must be indivisible—i.e. an instant, on the grounds that he has exhausted all the possible options if AC is divisible.

Now, as I said earlier, this argument seems only to show the following: *if* there is a primary time in which the thing has changed, then it must be indivisible.³⁹ Take any stretch of time during which something completes its change. For example, imagine again I go from Princeton to New York City, and that I arrive in New York early in the evening (at 7.16 p.m.). Let us stipulate that an evening begins at 6.00 p.m. (instant A) and ends at 12.00 a.m. (instant B), and let us divide it into two halves, at 9.00 p.m. (C). Then BC is not the primary time at which I completed the journey to New York, since I arrived in AC. Now concentrate on AC, and divide that at an instant D, and so on. What guarantee do we have that this division will come to an end at an instant or a point? We know that any *stretch* of time we take will fail to be the primary time in which I completed the journey (that is what the argument we have just looked at establishes—or purports to establish), but we have no argument as yet that there will actually be an instant at which I arrive. I do in fact think that such an argument can be constructed along Aristotelian lines—and I shall give it later in this paper (see below, Section 9)—but Aristotle’s actual argument at this point in the text seems to be incomplete. I wish I knew of an interpretation according to which he would have offered a plausible argument for this here, but there does not seem to be one.

7. The beginning of the change

Meanwhile, there is the question of the beginning of a journey, which Aristotle turns his attention to at 236^a7. As I said earlier, Aristotle starts by pointing out that the phrase *to en hōi prōtōi metabēlēken* is ambiguous, and by pointing out that it can refer to the primary time in which something started to change. He states outright that such a primary time does not exist at all (*holōs*). For

³⁹ Cf. D. Bostock, ‘Aristotle on Continuity in *Physics* VI’ [‘Continuity’], in L. Judson (ed.), *Aristotle’s Physics: A Collection of Essays* (Oxford, 1991), 179–212 at 195–6.

‘there is no beginning of a change, at least there is no primary part of the time in which it embarked on change’ (236^a14–15).⁴⁰ His argument here is a better one, although it is somewhat complex and its interpretation is controversial.

In broad outline, Aristotle argues as follows. He labels ‘AD’ the primary time in which *x* started its journey. His strategy will be to show that AD cannot be partless (236^a16–20), and cannot be extended (236^a20–7). Hence the primary time does not exist (236^a26–7).

Each section of the argument needs extensive comment.

(i) 236^a16–20

Then [AD] is not indivisible; for then the nows would be next to each other. Again, if it were at rest in the whole of the stretch of time CA (for let us grant that it is at rest), then it would be at rest in A too, with the result that if AD is partless, it will simultaneously be at rest and have changed; for it is at rest at A and has changed at D.

We are assuming that the primary time in which *x* started its journey is AD, and we are supposing AD to be partless. Now, within this supposition that AD is partless, Aristotle considers two possibilities: first, that AD is an indivisible *stretch* of time, and second, that AD is in fact an instant. The arguments against each are separated by the *eti* at line 17. So first, Aristotle considers that AD is an indivisible stretch of time, i.e. a stretch of time bounded by two instants but not divisible. (This would be the temporal equivalent of what would be in geometrical terms an indivisible *line*, a curious phenomenon on which there survives a spurious Aristotelian treatise, *On Indivisible Lines*.⁴¹) This possibility, however, Aristotle dismisses with the

⁴⁰ The manuscripts differ in their readings at 236^a15. Some have *μετέβαλλον*; some have *μετέβαλεν*. Ross goes with the imperfect, but I think the aorist is preferable (and I have translated it here). The aorist is often used to express ingressive aspect: ‘The Aorist of verbs which denote a *state* or *condition* generally expresses the *entrance into that state or condition*’ (Goodwin, *Syntax*, § 19 Note 1). This fits well with what Aristotle is saying here: there is no primary time in which the thing gets moving, or embarks on its change. (For another ingressive aorist in a similar context see 6. 8, 239^a11: *ἡρέμησεν*; there, Aristotle shows that there is no primary time in which something embarks on rest, i.e. gets some resting done. For more on this, see sect. 11 below.) The imperfect might also seem appropriate because at the beginning of the change from being F to being G, when the thing has changed from being F, it is *still* changing, and the imperfect *μετέβαλεν* might seem to capture this. But we have the easy—and paralleled—use of the ingressive aorist available.

⁴¹ See M. Timpanaro Cardini, *Pseudo-Aristotele: De lineis insecabilibus* (Testi e documenti per lo studio dell’antichità, 32; Varese-Milan, 1970).

shortest of arguments: ‘for then the nows would be next to each other’. The reference has to be to A and D being contiguous, because there is no other pair of instants under discussion. So what we have is a metaphysical argument against the possibility of such indivisible stretches, as Ross says in his note ad loc.: ‘To treat AD as indivisible would be to adopt the view which regards time as made up of very short indivisible units of time contiguous to one another.’⁴² This has already been shown by Aristotle to be impossible in the first chapter of book 6 of the *Physics*, so what we have here is a compressed argument drawing on a previously established result.

After *eti* at 236^a17, Aristotle considers the second, and more familiar, possibility, namely that AD might be indivisible because it is an instant. This is equivalent to the supposition that A and D are identical. This option cannot be ruled out on metaphysical grounds alone, and so receives a more extended argument. Aristotle will show that under this supposition, the thing in question will still be at rest at A, and yet will have already moved at D—which, seeing that A and D are identical, is impossible.

He shows this by taking a stretch of time CA, where C is an instant somewhere in *x*’s immediately preceding period of rest. If it is at rest during the whole of CA, then it will be at rest at A (236^a17–18). Now, this is not an argument from, so to speak, the whole to the part. Rather, Aristotle is pointing out that if AD is the primary time in which *x* started its journey, and before *x* started its journey it was at rest (as opposed to just coming into existence at A), then *x* must also be at rest at A. For either *x* has got moving by A or it has not. If it has, then AD cannot be the primary time in which *x*

⁴² Ross, *Physics*, 650. I am grateful to Antony Eagle for showing me the naturalness of this interpretation. It might be tempting to think that two different instants are being denied to be contiguous, namely the indivisible primary time, identified as the first instant of motion, and the last instant of rest. This would then be step 3 of the argument given above on page 158: there is no first instant of motion because it would have to be contiguous with the last instant of rest. This is Bostock’s position in his note ad loc. in R. Waterfield (trans.), *Aristotle: Physics* (Oxford, 1996), 277: ‘Aristotle assumes that there is a last instant before the change begins, so if AD were a first instant at which the change has begun, these two instants would be next to one another. But that is impossible.’ I have given reasons for thinking that Aristotle is not talking about first instants here, but even if he were, he certainly has not mentioned yet a last instant of rest. (My discussion of Aristotle’s argument dismissing the possibility of AD being an indivisible stretch of time fills a gap in Morison, ‘Temps primaire’, a gap noticed by Paracchini, ‘Raisons et déraison d’un étonnement millénaire: à propos de l’analyse aristotélicienne du changement dans *Phys. Z 5*’, in M. Bonelli and A. Longo (eds.), «*Quid est veritas?*»: *hommage à Jonathan Barnes* (Naples, 2010), 87–114 at 103 n. 36.)

started to move, because it has already started to move by A. So it has not moved yet by A, and is therefore at rest. But, Aristotle argues, AD was supposed to be the primary time in which it started to move, so it must have started to move in AD. As Aristotle puts it, it is at rest at A, and yet must have moved at D (236^a19). But A and D are identical, so there is a contradiction.

(ii) 236^a20–7

(1) But if AD is not partless, it must be divisible and it must have changed in every part of it whatsoever, for (2) suppose AD is divided, then if it has changed in neither part, it will not have changed in the whole either, and (3) if it is changing in both, it is changing in the whole too, and (4) if it has changed in one or the other, the whole will not be the primary time in which it has changed. So it must therefore have changed in any part whatsoever. (5) It is clear then that the primary time in which the thing has changed does not exist. For (6) the divisions are endless.

In this text Aristotle shows that the primary time AD in which x started to change cannot be a stretch of time either, and then concludes in the final sentence (5) that, since it is not an instant and it is not a stretch, it does not exist. Proposition (6), ‘for the divisions are endless’ (236^a27), belongs with the proof that the primary time AD is not a stretch of time.

Recall that in 236^a16–20 Aristotle showed that AD is not an instant, i.e. is not indivisible. Here, then, he considers the possibility that it is divisible, i.e. a divisible stretch of time. Aristotle wants to show that in this case too, no stretch AD can be the *primary* time in which x started moving. To show this, we first of all observe that if AD is the primary time of x ’s transition from rest to movement, then this transition is ongoing in any and every extended part of AD, as Aristotle says in (1). For suppose we divide AD at some point, namely F. Then (2) if x started to move in neither AF nor FD, AD would not be the primary time in which x started to move. And (3) if x is moving in both, then it started moving in neither AF nor FD. And (4) if it started in one, and not the other, then AD could not be the primary time in which x had started to change. And so x must have started to change in both AF and FD—i.e. AD must indeed be the primary stretch of time in which x does the changing necessary to count as having got moving, and so x started changing across the whole of AD: every part of AD contains part of x ’s transition from rest to movement.

But now, if every part of AD contains part of x 's transition from rest to movement, as it would have to if it were the primary time of x 's transition, then AD cannot after all be the primary time in which x started to move, for the following reason. Let us focus on locomotion for a moment. Since AD is a stretch of time, x covered a certain amount of ground during it (if it did not, then it did not get going in it). But now, we can divide AD into two; x covered some ground in the first half, and some more ground in the second half. But then that first half of AD already contains x 's starting to move. The second half of AD does not even look any more like a time during which part of x 's transition occurred. Given that x covered some ground in that time, that period of time encompasses an occurrence which counts as x 's starting to move. But of course, we can make the same observation about the first half of AD: we can divide it, and find always that in the first half of that division x has covered some ground, and so that stretch of time will encompass the transition. Hence, because we can always divide time at any point we want—as Aristotle puts it: ‘the divisions are endless’ (6)—we can always find a substretch of AD which will count as the primary time in which x has started moving.

Now, I have followed closely Aristotle's own argument of 236^a15–27. Notice that I have not talked of a ‘first moment of change’. Nor did I have to *suppose* that there *is* a last moment of rest. The whole structure of the argument was simply that *if* there is such a primary time *then* there is no such primary time, and if the supposition that P implies that it is not the case that P, then it is not the case that P.

Does it follow from Aristotle's argument that there is no first moment at which x has started to change? Yes. For if there were a first moment of x 's change (in the sense: a first moment at which x started to change), then it would be the primary time in which x started to move. But there is no such primary time. So there is no first moment of change (in that sense). But this is not what Aristotle tries to prove, although it is a corollary of what he says.

8. An assumption

One assumption that I am making is that if something has changed and is still changing at a particular instant, then it has already ‘covered some ground’ i.e. it has already changed over a certain magnitude, where this could mean that it has covered some ground,

grown a certain amount, or increased by a certain weight, etc. It seems to me to be the assumption responsible for the result that Aristotle obtains, and it seems completely justified by the meaning of 'x has changed'. Indeed, Aristotle will go on in *Physics* 6. 6, 236^b32–237^a17, to prove this result, with an argument that does not depend on what he proves in *Physics* 6. 5. (He starts from the simple thought that anything which has changed has changed from something to something. But distance, size, weight, or whatever are all divisible, and so the change must be divisible. Change does not happen by 'leaps'.)

9. Primary time of the end of a change, and the asymmetry between the beginning and the end

I now want to return to Aristotle's argument that there is a primary time in which something finished changing. You will recall that this argument seemed only to establish that *if* there were such a primary time, it would be an instant. What we want is an argument which actually shows that there is such an instant. Now, the reason why we do in fact seem licensed to suppose that there *is* such an instant is that when something has finished changing, it is at rest. But if something has finished changing, it is not the case that it must have 'got some rest done'. As one might put it, in the case of motion: to *arrive* somewhere is not *yet* to have stayed still at that place (although it may be impossible to arrive somewhere without that arrival initiating a period of rest). So we have an asymmetry between the two cases Aristotle is discussing: (*a*) for something to count as having started changing, it must have got some changing done, and therefore it must have covered some ground in its change, but (*b*) for something to count as having finished changing, it is not the case that it must have been at rest already for a period of time. Case (*a*) allows one to run an argument like Aristotle's in 236^a20–7: when you try to single out when the thing started to change, you have to give a temporal indication which covers some amount of the change (otherwise you have not singled out when it got enough changing done to qualify as having changed), but any amount of the change your temporal indication covers will contain a part (the later of the two parts) which is not the transition from rest to motion. Case (*b*) does not allow such an argument, because there is no period of rest to appeal to.

In short, we can have a primary time of the end of a change, which is an instant, because there is no conceptual reason why there should not be an instant which is simultaneously one at which x finishes changing and at which x is at rest (presumably by being the limiting instant of a longer period at which x is at rest). However, we cannot have a primary time of the beginning of a change, where this is conceived of as being when x transitions to being in motion, because ‘ x has moved from being F ’ implies that x has got some moving done, and no amount of moving is small enough to be the beginning of the motion. In slogans: ‘ x has finished changing’ does not imply ‘ x has got some resting done’, but ‘ x has started changing’ does imply ‘ x has got some changing done’.

10. First objection: there is no motion or rest at an instant

Many would produce an objection to Aristotle’s arguments—and for that matter my interpretation of them—by pointing to Aristotle’s notorious doctrine that nothing is moving or at rest in an instant, and then pointing out that my reconstruction of Aristotle’s arguments makes liberal use of statements predicating motion or rest of something at an instant. It is true that Aristotle does say that nothing is moving in an instant,⁴³ and he extends this claim to being at rest: ‘since nothing is of such a nature as to move in an instant, it is clear that nothing rests in an instant either’.⁴⁴ But this statement is ambiguous between ‘nothing can truly be said to be moving *at* an instant’ and ‘nothing can truly be said to move *during* an instant’. The second of these is, I judge, what Aristotle meant to say, not the first. That is, he meant to claim that nothing can *get any movement done* in an instant. Equally, in the same sense, nothing can get any rest done in an instant.⁴⁵

That this must be what Aristotle means is strongly suggested by the fact that he uses the notions of being at rest at an instant and being in motion at an instant throughout his complex discussion of the continuity of change. For instance, when giving his argument

⁴³ *Phys.* 6, 3, 234^a24: οὐθὲν ἐν τῷ νῦν κινεῖται.

⁴⁴ *Phys.* 6, 3, 234^a33–4: ἐπεὶ ἐν τῷ νῦν οὐθὲν πέφυκε κινεῖσθαι, δῆλον ὡς οὐδ’ ἡρεμεῖν.

⁴⁵ So—although this will be a case that Aristotle himself denies is possible—a swinging pendulum that is at rest momentarily at the end of each swing gets no rest done over a day’s worth of swinging. You cannot add up all the instants and get, say, five minutes’ worth of rest.

that there is no primary time in which something has changed, he claims (in the course of his argument) 'it is at rest in A' (*en tōi A ēremei*, 236^a18). In an attempt to preserve the orthodoxy that Aristotle does not allow motion or rest at an instant, Richard Sorabji has argued that this statement is not something that Aristotle endorses *in propria persona*, but rather something that he concedes to his opponent, only to derive a contradiction from it.⁴⁶ But whatever one makes of Aristotle's statement at 236^a18, you only have to consider the primary time at which *x* has finished changing. This, as Aristotle remarks, is indivisible, i.e. an instant. (His argument for this may have been doubtful, but it is none the less what he claims.) However, at that instant *x* has finished changing (according to Aristotle)—and is therefore at rest. No doubt it does not get any resting done in that instant, but nothing precludes Aristotle from making statements about what is true of the object at that instant (namely, it finished changing and is at rest).

Of Aristotle's four arguments for why nothing is in motion in an instant (*Physics* 6. 3, 234^a24–^b9), not all are easily taken as arguments for why something cannot get any motion or rest done in an instant. Perhaps in the end Aristotle did not clearly see the difference between moving at an instant and getting some motion done during an instant (as far as I can tell, the Greek is the same for both). But on balance, I think that Aristotle should not be taken to be committed to the view that there is no motion or rest *at* an instant. His position seems to be this: motion and rest take place over *periods* of time, and at any instants within those periods of time the object in question is actually in motion (or at rest). Being in motion or at rest *at* an instant is derivative from being in motion or at rest *over* a period which includes that instant.

⁴⁶ '[T]he reference to rest at an instant is more easily taken as *ad hominem*, not as representing Aristotle's *own* opinion' (R. Sorabji, *Time, Creation and the Continuum* (London, 1983), 415 n. 17; his emphases). Bostock agrees ('Continuity', 193; 210). In arguing this, Sorabji is recanting his earlier view (in 'Aristotle on the Instant of Change' ['Instant'], *Proceedings of the Aristotelian Society*, suppl. 50 (1976), 69–87), where he rightly claims that 'although [Aristotle] denies that things can *change* or *remain* in the same state at an instant, he concedes there are many other things that can be true of them at an instant' (81), and identifies our passage as an instance of Aristotle making just such a predication, *in propria persona* (84).

11. Second objection: there is no primary time at which something at rest is at rest

In *Physics* 6. 8 Aristotle turns his mind to periods of rest. At 239^a10–11 he states that there is no primary time when something rested.⁴⁷ At first glance it looks as if Aristotle is flatly denying that there could be a primary time at which something has stopped changing and is at rest, which would therefore be the primary time at which it came to a halt. If so, it appears that he is denying that there is a primary time of the end of a change! As Pierre Pellegrin translates it: ‘il n’y a donc pas non plus de ⟨moment⟩ premier dans lequel [il vaudrait mieux dire: auquel] ce qui est en repos est arrivé en repos’ (‘Remarques’, 124).⁴⁸ This would deny what I have taken Aristotle to prove in 6. 5, 235^b34–236^a5, where I interpreted him as arguing that there is a primary time in which something stops changing (and that this time is an instant).⁴⁹

In fact, Pellegrin’s translation must be the wrong way of taking 239^a10–11. Aristotle is not contradicting in *Physics* 6. 8 what he says in *Physics* 6. 5. He is not saying that there is no primary time in which something *arrived at a state of rest* (‘est arrivé en repos’), but rather denying that there is a primary time in which something *gets any rest done*.⁵⁰ After all, time is infinitely divisible (239^a17–22) and no rest can be done in an instant (239^a11–17). Hence there is no primary time in which *x* has actually got some rest done.

More carefully, Aristotle’s argument for this is as follows. Suppose *x* has stopped changing at instant A. It is therefore at rest from instant A onwards. However, by the time of A, it has got no rest done yet. So what is the primary time in which it got some rest done? For any instant B later than A, AB cannot be the primary time in which *x* got some rest done, because such a period of time can always be divided (239^a22) at a point C such that *x* will have got

⁴⁷ οὐδὲ δὴ τὸ ἡρεμοῦν ὅτε πρῶτον ἡρέμησεν ἔστιν.

⁴⁸ Notice that Pellegrin supplies ‘moment’ with πρῶτον.

⁴⁹ Pellegrin complains: ‘Bien qu’il ne fasse pas une théorie du repos aussi développée que sa théorie du changement, Aristote esquisse donc cette théorie du repos, et je ne comprends pas que B. Morison le nie’ (ibid.). This section addresses that lack of comprehension. Sorabji also worries that what Aristotle says in 6. 8 is in tension with 6. 5 (‘Instant’, 84).

⁵⁰ One needs to translate correctly the ingressive aorist ἡρέμησεν (see n. 40 above).

some rest done in AC. So there is no *primary* time in which x has got some rest done (239^a20).

Note that this result concerning rest is mirrored exactly by change. Just as there is no primary time at which x got some amount of rest done, there is no primary time in which x got some amount of change done (this is what was shown in 6. 5, 236^a20–7: there is no primary time in which something started to change). This nice mirroring confirms my reconstruction of the previous argument in 6. 5. The two arguments are virtually identical in structure: both possibilities, that the primary time be indivisible and that it be a stretch, are rejected, and this is followed by the *reductio* move. Moreover, in both cases the *reductio* move is followed by an explanation of why the primary time cannot be a stretch of time—an explanation which technically belongs to the second limb of the dilemma. So at 6. 5, 236^a27, Aristotle ends the discussion by saying ‘for the divisions are endless’, whereas at 6. 8, 239^a20–2, he ends by saying ‘the reason for this is that . . .’. Thus, far from casting any doubt on my reconstruction of Aristotle’s view in 6. 5, the passage from 6. 8 is very much in line with it. (Although the two arguments are similar in structure, the one in 6. 8, 239^a14–22, is somewhat easier to follow, I find.)

Pellegrin and Sorabji are right to call attention to 6. 8. It gives us a wealth of information concerning Aristotle’s views on rest and change. In 239^a10–22, as we have just seen, Aristotle proves that there is no primary time in which something embarks on rest (i.e. gets some resting done). In 238^b26–239^a10 he also proves that there is no primary time in which something *comes to a stop*,⁵¹ i.e. there is no privileged part of the change which we can single out as being the last part, solely on the basis of the logic of change.

The argument goes like this. The primary time in which something comes to a stop (call it AB) is either an instant or a stretch of time. (i) It is not an instant (239^a3–6), and (ii) it is not a stretch (239^a6–10), therefore ‘there will not be a primary time in which it comes to rest’ (239^a10). (i) Why is the primary time not an instant? Well, there is no getting any motion done in an instant, so there is no coming to a rest in an instant. Why is there no getting any motion done in an instant? Because if there were, then the thing would have to have moved (*kekinēsthai*, 239^a5) in part of the instant. The theorem Aristotle is drawing on is that if x moves in

⁵¹ 239^a10: οὐκ ἔσται ἐν ᾧ πρῶτω ἴσταται.

AB, then something that moves at the same speed as x , starting at A, but stopping halfway (distance), will stop before x . At that point, before B, it will be in a condition of having moved a certain distance (half). So equally, x , when it is at that point, will have moved a certain distance. But if x has to be in the condition of having moved that distance halfway through AB, AB cannot be indivisible. (ii) Why is the primary time not a stretch of time? Well, if it is, then the thing is moving in all parts of the time (by the definition of primary time). This is impossible, so in fact 'there will not be a primary time' (239^a9–10). This argument is obviously highly compressed. Aristotle observes that if the primary time is a stretch, then the thing is moving in all parts of the time (so much follows from the definition of primary time). But in that case, if we divide the primary time into two, then the thing is still moving in the second half of the time, and so it is coming to rest in the second half. But in that case, the second half of the original stretch is a better candidate for being the primary time. But there is an infinite supply of subparts of the stretch of time which will be better candidates for the primary time. If the last second is the primary time, what about the last half-second? And the last quarter-second? Etc. In each of these stretches, the thing is coming to rest. But there is no limit to how short a period in which it is coming to rest can be.

Since the only remaining option for the primary time of the thing's coming to rest, were it to exist, was that it was a stretch of time, and this has been shown to be impossible because of the infinite divisibility of time, then it follows that there is no primary time in which it is coming to rest.⁵²

One intriguing thing about this argument is the parallel Aristotle insists on between this result and some result concerning move-

⁵² This represents my unpacking of the Aristotle's claim at 239^a8–10: *ἐπεὶ οὐδὲν χρόνος ἐστὶν ἐν ᾧ πρῶτῳ ἴσταται, καὶ οὐκ ἄτομον, ἅπας δὲ χρόνος εἰς ἄπειρα μεριστός, οὐκ ἔσται ἐν ᾧ πρῶτῳ ἴσταται*. Aristotle's sentence has a slightly odd structure. The first half of the protasis of the *ἐπεὶ* clause ('the primary time in which the thing comes to rest is a stretch of time and not indivisible') is obviously not *endorsed* by Aristotle, since the apodosis denies the very existence of the primary time in which something comes to rest. The puzzle is that *ἐπεὶ* normally means 'since', and in sentences of the form 'since P, Q', 'P' is usually endorsed by the speaker. The only way to understand what is going on is to take the protasis not as expressing something Aristotle actually endorses, but as expressing the other *live option* at this point in the argument, namely that the primary time is a stretch of time (since, as has already been proven, it is not indivisible). So although Aristotle does not in fact endorse the protasis, it expresses *the best remaining option according to the argument, if the primary time is to exist at all*. Hence my paraphrase in the text.

ment (238^b36–239^a1): ‘Just as there is no primary time in which the moving thing *kineitai*, so there is no primary time in which the thing comes to rest.’⁵³ What is Aristotle referring to here? It must be a reference back to the claim in 6. 5 that there is no beginning of change, that is, that there is no primary time in which something embarks on motion. The reason why it must be a reference to this is that this is the only previous result he has shown concerning the non-existence of a primary time. (The other result he showed was the *positive* result that there is a primary time of the end of a change.) Thus, we must translate *kineitai* accordingly: ‘just as there is no primary time in which the moving thing *gets going*, so there is no primary time in which the thing comes to rest’.⁵⁴

Thus in 6. 8, far from discovering anything which threatens our reconstruction of 6. 5, we find Aristotle proving more results concerning the transition from change to rest, all of which are consonant with what we found in 6. 5

12. Two philosophical difficulties

It is time to take stock. The following picture is emerging of Aristotle’s view of change and rest.

- (1) There is no primary time in which something gets underway (6. 5, 236^a15–27). There is, in other words, no most precise way of specifying when something transitions from being at rest to changing.
- (2) There is a primary time in which something finished changing (6. 5, 235^b30–236^a7). There is, in other words, a most precise way of specifying when something transitions from changing to being at rest. This transition happens at an instant.
- (3) There is no primary time—no most precise specification—of when something embarks on its period of rest by getting some resting done (6. 8, 239^a10–22).
- (4) There is no primary time—no most precise specification—of when something comes to a stop while changing (6. 8, 238^b36–239^a10).

⁵³ ὥσπερ δὲ τὸ κινούμενον οὐκ ἔστιν ἐν ᾧ πρώτῳ κινεῖται, οὕτως οὐδ’ ἐν ᾧ ἴσταται τὸ ἰστάμενον.

⁵⁴ One way of seeing how *κινεῖται* can mean this is to think of the meaning of the active form, *κινεῖν*: it can mean *to get something moving*.

Aristotle chooses to express the first of these claims as the claim that a change has no beginning (236^a14).⁵⁵ And he chooses to express the second of these claims as the claim that a change has an end (236^a12).⁵⁶ Notice that he does not attempt to express any result about rest using the language of stopping and starting: ‘*x* starts to be at rest’, or ‘*x* finishes being at rest’ do not appear to be well formed for Aristotle. Thus, he formulates questions concerning when something starts to change and finishes changing, but does not raise questions in this form about rest. To express the idea behind ‘embarking on a period of rest’, he uses the ingressive aorist (239^a11: *ēremēsen*), a form which he also used of motion in 6. 5 (236^a15: *metebalen*—see n. 40 above). But when talking about rest, he does not employ the circumlocution with an auxiliary verb that he used of motion in 6. 5 to express embarking on motion (236^a9–10: *ērξato metaballein*).

Now, there is a primary time in which *x* finished changing. And this primary time is an instant. And even if *x* does not get any resting done in that instant, that instant does bound a period of rest for *x*. We also know that at the end of that period of rest, when *x* starts changing again, there is no start to that change. Does that mean that change is somehow open-ended at the start, but closed at the end, whereas rest is closed at the start, and open-ended at its end? I do not think so. We need to follow Aristotle’s form of words very carefully. He says ‘there is no beginning of a change; at least, there is no primary part of the time in which it embarked on change’ (6. 5, 236^a14–15),⁵⁷ meaning that there is no primary time in which something *started* to change. This obviously does not mean that changes never start. It means rather that there is no way of pinning down exactly when something got enough changing done to count as having started. *This* aspect of his view (that there is no primary time in which something started to change) seems to be unobjectionable. To take the case of motion, Aristotle is claiming that we can say exactly when something *arrived* (this is when it finished moving), but we cannot say exactly when something *left*. An arrival is a punctual event whose precise timing can be pinned down. A departure is not—at least, if one understands by ‘departure’ a single event that takes place which qualifies something to count as having departed;

⁵⁵ οὐ γὰρ ἔστιν ἀρχὴ μεταβολῆς.

⁵⁶ ἔστι μεταβολῆς τέλος.

⁵⁷ οὐ γὰρ ἔστιν ἀρχὴ μεταβολῆς, οὐδ’ ἐν ᾧ πρώτῳ τοῦ χρόνου μετέβαλεν.

there just is no such event. But there are two things which do seem to be questionable about Aristotle's view. (i) Why identify the beginning of a change as when the changing thing *started* to change? (ii) Why conclude from the fact that there is no *primary time* when the thing started to change that there is no such thing as the beginning of the change, i.e. that *if* you cannot pin down when something has started to change, *then* there is no beginning of the change?

Let me take the two questions in turn. (i) Why does Aristotle identify the beginning of the change as when the thing *started* to change? To answer this, we have to identify what other options there might be. Presumably something can be *starting* to change without *having started* to change. Ordinary language certainly seems to allow this: 'Quick, the game is starting' we cry, when the players are forming up on the pitch. Aristotle identifies the start of a change with some part of the change, and then finds himself unable to pin down what that part is. But what if we took instead an instant when the thing is still at rest? One advantage of this way of looking at the matter is that one could then point to a parallel between the *beginning* and the *end* of a change: where the start of a change would be when something is starting to change (*and is still at rest*), so the end of a change is when something has finished changing (*and is newly at rest*). The start of a change, in this sense, would then have a primary time, namely the last instant of rest. I can see no reason why Aristotle could not agree with this—it is not inconsistent with what he says. After all, he says that 'there is no beginning of a change; at least, there is no primary part of the time in which it embarked on change' (236^a14–15), and the exegetic *oude* (which I have translated as 'at least') is consistent with the thought that there might be another way of explaining what the beginning of a change is. He is prompted to talk of the beginning of a change in these terms only because he is interested, at that point in the text, in the question of when something does the changing necessary to count as *having changed* (*metabēlēken*); he never asserted that this was the only way of understanding what might be meant by the beginning of a change.

Moreover, this is not his actual practice. When talking in *De incessu animalium* 4 about how humans get moving, Aristotle says: 'The manner in which we step out also shows that the origin of movement is in the right side; for all humans put the left foot foremost, and, when standing, preferably place the left foot in front, un-

less they do otherwise accidentally' (706^a4–9, trans. Forster, lightly adapted). Here, Aristotle seems perfectly happy to talk about what is going on when we start moving—presumably because he is talking about what happens when we take our *first step*. I conclude that in *Physics* 6. 5 Aristotle is denying that there is a beginning of a change only in one, specific, sense of 'beginning'.

The fact that there is a clear bounding instant at the beginning of a change—even if Aristotle chooses not to call it the beginning of a change in *Physics* 6—is reassuring. Changes are clearly delimited by bounding instants—the last instant of rest beforehand (at which x has not yet changed from its initial state), and the first instant of rest afterwards (at which x has changed to its final state). So effectively, Aristotle is committed to the theory that changes occupy open intervals of time.⁵⁸ That we should interpret Aristotle this way is suggested by the fact that in both *Phys.* 6. 6, 236^b34–5, and 6. 8, 239^a23–6, he is comfortable referring to the primary time of the whole change from initial state to end state, and that primary time is a stretch of time—the stretch of time, I contend, between the two bounding instants.⁵⁹

So we do not have to conclude that changes are ineliminably vague, or anything like that. We could treat the bounding instant of a change as its start, or we could treat the first step of an animal's journey as the beginning of that journey. What Aristotle observes in 6. 5 is that as a matter of the logic of the concept of change, there is no privileged part of a change such that it is in virtue of having done that much changing that something should count as having changed. This does not threaten the fact that one can identify a bounding instant at the start of a change, and it does not threaten the possibility that for any given change, facts about what kind of

⁵⁸ Cf. Sorabji: 'I am not saying that the period of motion has no boundary. It will have an instant bounding it on either side' ('Instant', 73).

⁵⁹ Arnold Brooks draws my attention to *Phys.* 6. 3, 234^a34–^b5, where Aristotle argues that something cannot be in motion at an instant, because then it will also be able to be at rest in an instant, and then what are we to say of the instant bounding on one side a period of rest and on the other a period of change? The thing would be both at rest and in motion in that instant, and this is impossible. Brooks wonders whether this argument directly refutes my interpretation of Aristotle whereby the end of the change is also the bounding instant of rest, and my suggestion here that the beginning of change be identified with the bounding instant of rest. The solution is this: even though these bounding instants bound the periods of change, they are not instants at which the object is changing (or getting any change done), and so we are not led to claim that the object is both in motion and at rest at the same time.

change it is might contextually determine a candidate for the first part of it.

(ii) Why is it that Aristotle argues from the fact that there is no primary or exact time at which something has started to change that there is no beginning of change? He seems to have a thought such as the following: if there is no exact time in which an event or a process, or whatever, happens, then it does not really exist. But is that really a sufficient reason for denying its existence?

A useful way of seeing the puzzle here is to return to the comparison between places and times. I said before that something has a place iff it has a primary place. This works in the following way. All and only bodies with surroundings are in a place. The primary place of a body x —that in virtue of which x is in any part (proper or improper) of its surroundings—is the inner surface of these surroundings. There is nothing, therefore, which has surroundings which does not have a primary place. When I ask where some body x is, the answer which is given may be more or less precise (I have explained earlier what I mean by this). In other words, answers may specify more or less precisely where x is. Imprecise places—non-primary places—feature in less precise answers, but the respondent is still attempting to *say where* x is. In general, exchanges such as the one I constructed before with the sequence of questions ‘where is x ’, each time eliciting a more and more precise answer—‘Marx Hall’, ‘On the second floor’, ‘In room 208’—must have an end-point, according to Aristotle, namely at the specification of x ’s primary place. If there is no end to this sequence, then x has no place to be specified. Primary places are what guarantee occupancy of a place, i.e. to be in a place (*en topōi*) is to have a primary place.

Given the identical characterizations of a primary place and a primary time, it appears to follow that for something to be in time or in a time (*en chronōi*) is for something to have a primary time. There has to be a *most precise* specification of *when* something occurred for it to be possible to specify the time when it happened *even imprecisely*. Thus, Aristotle’s thought seems to be that we cannot specify the precise time when the start of any change (in the sense of when the thing *started* to change) actually occurred. What Aristotle is denying is that there is a start of a change *in the sense of there being some part of the change which counts as its beginning*, since it can never be specified which instant or substretch of the change this would be.

But is the fact that we cannot say when something takes place (because it lacks a most precise specification of when it happens) enough to justify us in denying its existence? One of Aristotle's own doctrines seems to be available here to use against him. To motivate this, I need to talk about places again.

Although not everything has a *place*, everything which exists is *somewhere*, according to Aristotle. Basically, for x to have a place, x has to be related in an appropriate way to its surroundings, namely by being in contact with them. All things which exist and which *either* are not related in this way to their surroundings, *or* have no surroundings, have to be appropriately related to something which *does* have a place in order to count as being somewhere.

Consider some examples. Take the infamous goat-stag (cf. *Phys.* 4. 1, 208^a30). It does not exist, so it is nowhere. Take knowledge (4. 3, 210^b1). It is somewhere in virtue of being in souls, and souls are in turn somewhere in virtue of being in bodies, which do have a place. Take heat (4. 3, 210^b26–7). This is an especially good example since we obviously *locate* heat. Most of us prefer to go somewhere where it is hot for our holidays, for instance; or to take an example more suited to Aristotle's biological explorations, animals seek warmth, or seek to be near warmth. Yet warmth is not the sort of thing to be in contact with its surroundings. Hot things, however, are, and that is Aristotle's answer: heat is somewhere in virtue of being a property (*pathos*) of bodies, which *do* have places. Lastly, take the top half of the water in a glass of water. It is not in contact with its surroundings—not entirely, anyway—since it is continuous with (rather than in contact with) the other half of the water. And yet we can *locate* it, since we locate it as *part* of something which does have a place, namely all the water in the glass.

With all these last-mentioned items, we *can* say where they are (knowledge, heat, parts), but we must understand that they are not somewhere because they have a *place* strictly speaking, but because they are related in various significant ways to things which *do* have places. In other words, such items as the ones I have just listed lack primary places (because they lack places), but we can still say where they are.

But I have been insisting throughout on the analogy between places and times for Aristotle. And so we need to ask ourselves why it could not be the case that the beginning of a change is the kind of item which does not have a primary time, and yet which can be

'located' in time, just as things like knowledge and heat can be located, even though they do not have primary places. The analogy looks to be promising. After all, Aristotle does actually believe that *changes* themselves have primary times (6. 6, 236^b34–5; 6. 8, 239^a23–6) and they are paradigmatically things *in time*, neatly delineated by bounding instants (as I suggested in (i) above). Perhaps starts of changes (in the sense Aristotle is concerned with) are just related somehow to changes, such that we can actually say when they take place, even though they do not have primary times.

Ingenious though this might be, I think that to attempt such a move would miss the force of what exactly Aristotle is denying in 6. 5. For Aristotle's point is that there is no minimum length of time a change must take such that it counts as having started in virtue of having lasted at least *that* long. (In much the same way, if matter is infinitely divisible, one cannot say how much space something must take up in order to count as being extended, i.e. a minimum extension such that it is in virtue of something being extended by at least *that* much that it counts as being extended. A point is too small; anything else is too large.) If that is what someone means by the expression 'the beginning of a change', then it is indeed true that we cannot say when the beginning of a change is. If you want to think of the start of a change in the way I suggested above, as the bounding instant between the change and the prior period of rest, that is fine, and you can say when that happens. And if you want to consider the first step of an animal's journey as the beginning of its journey, that is fine too. But if you want to think of the start of any change as that privileged part of the change such that it is in virtue of the object having gone through *that* part of the change that it counts as having changed, then there are problems.

One cannot say that the start of a change (in the sense Aristotle is interested in here) is related to the change as heat or knowledge is related to a body with a place, because the start of a change (in this sense) is just the kind of thing which would, were it to exist, happen at a certain time. It is not that the start of the change, so understood, is metaphysically a different kind of thing from a change; the sort of start of a change that Aristotle has in mind is precisely supposed to be locatable in time, as a change is locatable in time. And the problem with such alleged beginnings of change is that they cannot take place in an instant (because the thing cannot get any changing done in an instant), and they cannot take place in a stretch, because al-

though such a stretch would have a clearly defined first limit (the last instant of rest; instant A in Aristotle's argument in 6. 5), it would have no determinate end limit. At any instant D you choose after A, the object will have changed a certain amount during AD, and hence you can choose a substretch of AD (starting at A, and ending, say, at B) such that the answer to the question 'did it start to move in BD?' will be no (and so AD is not the primary time of the start of the change). Starts of changes just are not clear-cut in the way that they should be if they are to have a primary time; if, in other words, they are to be properly speaking in time. There really is no such thing as *the* start of a change, where this is understood as a part of the change in which some changing gets done.

13. How does this concern the student of nature?

What is the lesson that the student of nature should draw from this? I take it that it is something like the following. Physics and Biology can still make use of the notion of starting to do something. Indeed, Aristotle himself continues to do so. For instance, he investigates how animals get moving, in *De incessu animalium*. But in the light of Aristotle's investigations in the *Physics*, we need to remember that if we are going to talk of the start of a change (e.g. the start of an animal's journey to find food), then something other than the conceptual nature of change itself must be determining which stretch we are referring to. So, for instance, when we are talking about the beginning of the animal's journey, the context might determine that we are talking of its first step. Once we have absorbed the lessons of *Physics* 6, we can continue to talk about the starts of change, and the ends of change, and changes themselves, when they occur, etc., safe in the knowledge that we understand what we mean when we do so, and that we understand the pitfalls accompanying the notion. In much the same way, Aristotle can talk, in his biological works, of *where* the parts of the body are, safe in the knowledge that it has been established how parts of the body are *somewhere* in a different way from bodies themselves. The student of nature can carry on deploying the concept of change in her explanations of the world, despite the recalcitrant difficulties which that concept offers.

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OXFORD STUDIES
IN ANCIENT
PHILOSOPHY

EDITOR: BRAD INWOOD

VOLUME XLV

WINTER 2013

OXFORD
UNIVERSITY PRESS