Chapter II

Animal and Celestial Motion: the Role of an External Springboard

De Motu Animalium 2–3

URSULA COOPE

1. Introduction

In *De Motu Animalium* chapter 2, Aristotle argues that when an animal moves itself, there must not only be something at rest within the animal (as he argued in chapter 1), but also something at rest that is external to the animal.[1] The animal moves itself by pushing back against this external thing (698^{b}13–15). He immediately goes on to say that this claim, as well as contributing to the analysis of self-motion, also has a certain wider import: it 'contains some theoretical interest (ἔχει . . . τὴν θεωρίαν),[2] not only extending to animals, but also to the movement and locomotion of the all (τοῦ παντός)' (698^{b}10–12). He then begins chapter 3 with a puzzle about the movement of the heavens (699^{a}12–14). We shall need to consider why, in a treatise on animal self-motion, Aristotle devotes so much attention to questions about heavenly movement.[3] In relation to his

[1] I was helped to improve this paper by discussion with many participants at the Symposium Aristotelicum, but I have learnt especially from comments made by David Charles, Alan Code, John Cooper, Pavel Gregoric, Pieter Hasper, André Laks, Stephen Menn, Oliver Primavesi, and Christof Rapp. Most of all, I have benefited from discussing both my paper and his with Ben Morison. There is a continuous argument that stretches from ch. 3 to ch. 4, so it will be helpful for readers to consider our two papers together.

[2] Compare the phrase 'ἔχει . . . φιλοσοφίαν' (*Ph.* I 2,185^{a}20).

[3] I discuss this on pp. 248–51 below.

Aristotle's De Motu Animalium: Symposium Aristotelicum. Christof Rapp and Oliver Primavesi, Oxford University Press (2020).
 DOI: 10.1093/oso/9780198835561.001.0001

remarks at the beginning of chapter 2, we need to ask: why does Aristotle think that his claim about the conditions needed for animal self-motion sheds light upon the movement of the universe?

The answer, I shall suggest, is that Aristotle expects this account of the necessary conditions for animal self-motion to enable us to rule out certain hypotheses about the causation of the motion of the universe. In chapters 1 and 2, we learn that for an animal to move itself, it must have an internal part that is at rest (in the way that a joint is at rest, relative to the movement of the limb below it), and it must support itself against something that is at rest. From this, it follows that the heavenly sphere cannot be a self-mover in the way that an animal is. (It does not have anything to play the role of joints.) Moreover, as we learn in chapters 3 and 4, the heavenly sphere could not be moved by some distinct agent that was itself a self-mover, since there would be nothing that was strong enough to serve as the support for such a self-mover. This raises two questions. First, how does the heavenly sphere get moved, if its movement does not have its origin in self-movement (as Aristotle's remark at 698^{a}7 sq. might have led one to expect it would)? And second, does its movement (like that of an animal) depend upon the existence of some external unmoved thing (as we might expect from Aristotle's remark at 698^{a}14 sq., that it is impossible for there to be movement unless there is something at rest)? As we shall see, Aristotle goes on to raise considerations that eventually suggest that what moves the heavenly spheres must be an unmoved mover that is neither in the universe nor a part of it. Thus, though it is true that the movement of the spheres, like animal self-movement, depends upon the existence of an unmoved external thing, in the case of the spheres this external thing is an unmoved *mover*, and hence has a role very different from that of the external springboard, the necessary condition for animal self-movement that we learn about in *MA* 2.

2. The Precondition for Animal Self-Movement: There Must be Something at Rest that is External to the Animal

Aristotle starts out chapter 2 with the claim that any rest within animals will be ineffective (ἄκυρος), unless there is also something outside them that is 'ἁπλῶς ῥᾳδίως καὶ ἀκίνητον' (698^{b}9). As he goes on, it becomes clear that his point is that the animal, in moving itself, needs something to push against: if the ground gave way beneath our feet, we would not be able to walk; if the

water offered no resistance to the movements of our limbs, we would not be able to swim:

> For just as also in it [the animal][4] there must be something unmoved, if it is going to move, so even more there must be something unmoved that is external to the animal, pushing off against which the moved thing is moved. For if it always gives way, as for mice in pitch or for men walking on sand,[5] the animal will not move forward, nor will there be any stepping if the earth does not stay still, nor flying nor swimming unless the air or the sea provides some resistance (*MA* 2, 698^{b}12–18).

This immediately raises a question: why does Aristotle say, at 698^{b}9, that the external thing must be at rest, and indeed ἁπλῶς at rest?[6] After all, his own examples seem to give the lie to this: birds can fly in the wind, the water moves as we swim through it, and we can walk over a moving surface.[7] What is needed is something that offers resistance (something 'pushing off against which, the moved thing is moved') not necessarily something that is itself at rest. Perhaps his point is simply that if something is to offer resistance in the appropriate way, then there must at *some* point be a thing that is at rest for the resisting medium to press against: for example, the water can offer resistance because it is contained by the river banks. The situation Aristotle imagines, in which the thing

[4] An alternative would be to take 'it' ('αὐτῶι') here as referring to the universe. In that case, Aristotle's point would be that just as, in the case of the universe, there must be something unmoved if there is going to be movement, so also there must be something unmoved external to the animal. However, I think this is unlikely to be the right interpretation. The contrast between 'ἐν' (698^{b}12) and 'ἔξω' (698^{b}14) suggests that 'ἐν' means *in* (as opposed to outside) rather than *in the case of* (for which he uses the word 'ἐπί' at 698^{a}12). And Aristotle is going to argue that the unmoved thing that is a necessary condition of the movement of the universe cannot be something that is in the universe.

[5] Aristotle's thought must be that a mouse that falls into a tub of pitch will sink down into the pitch and hence not be able to move forward, just as a man would sink into deep loose sand and hence not be able to walk across it. For the image of a mouse in pitch see Herodas, *Mimes* II.62 'I have suffered from this Thales like the mouse in pitch' and Theocritus, *Idylls* XIV.51 'I am like the mouse that has tasted pitch'. Verity and Hunter comment: '"a mouse tastes pitch" was used proverbially of someone whose troubles are only just beginning; presumably the mouse falls into the pitch-barrel and perishes' (Verity/Hunter 2002, 104).

[6] An alternative possibility is that he is referring here to the cosmic unmoved mover (so he isn't claiming that the thing the animal pushes against must be ἁπλῶς at rest). His point, then, would be that animals can't move themselves unless there is, in addition, an unmoved mover of the universe. This unmoved mover would be 'unqualifiedly' unmoved—that is, unmoved in every sense. (He has already mentioned, in 698^{a}9, that this primary mover must be unmoved.) However, there are two things that make this interpretation unlikely. First, in the *Physics* Aristotle confines 'rest' to things that are by nature such as to move but are deprived of movement (221^{b}12–14). If his usage is the same in the *MA*, then the fact that he says the thing in question is 'at rest' (as opposed to, say, 'unmoved') suggests that at 698^{b}9 he does not have in mind the primary unmoved mover. Second, the contrast in this first sentence between the thing that is at rest 'in the animal' and the thing that is outside suggests, I think, that he means the thing that is unmoved here to be the support that the animal rests upon in moving itself.

[7] Elsewhere (*IA* 705^{a}8–12).) he is quite explicit that the pushed-against thing need not be immobile.

pressed against 'always gives way' is a situation in which the mover tries to press against something, which in turn presses against something else, which in turn presses against something else, where at each stage the thing pressed against gives way, so that there is nothing to offer any resistance.[8]

The important point about the external thing against which the mover presses is that it cannot be moving *with the movement of the moved thing*. In this, it differs from the unmoved element within the moved thing. When the animal walks, there must be some part (say the hip, 698^{b}4) that remains at rest. The hip is at rest relative to the leg (it does not swing back and forth as the leg does, when one takes a step), but of course since the hip is a part of the animal, when the animal walks from A to B, its hips will also move from A to B.

If Aristotle's main point is that the animal must push against something that is not itself undergoing the same movement the animal is undergoing, this explains why he goes on to emphasize that the thing that offers resistance must be 'different from the thing moved, i.e. as a whole different from the whole of it', and that 'what is in this way unmoved is no part of the thing that is moved' (698^{b}19–20). If the thing that offered resistance were any part of the thing moved, then it would itself be carried along with the movement of the moved thing, and hence would not be able to offer resistance. The thing that is 'in this way unmoved' here (*τὸ οὕτως ἀκίνητον*, 698^{b}20) contrasts with the joint within the animal: the joint is also (in a sense) unmoved, but is carried along with the movement of the animal, so it is not unmoved in the sense in which the ground or resisting medium is unmoved.[9]

3. The Example of the Boat

As evidence for this claim that there must be something external to the moving thing that offers resistance, Aristotle cites various facts about the ways in which boats can and cannot be moved:

> Evidence for this is the following puzzle: why is it that one moves a boat easily from outside, when one pushes it with a pole, striking against the mast or some other part, but if someone who was in the boat itself were to try to do this, he would not move it—nor would Tityus, and not even Boreas blowing from within the boat, if he happened to be trying to sail in the way that the painters make him, for they paint him sending out the breath from it [i.e. from within the boat]. For whether one throws the breath out gently, or forcefully so as to make a very great wind, and whether it is

[8] For this suggestion I'm indebted to Pavel Gregoric.

[9] For a fuller discussion of the sense in which the joint is unmoved, see Rapp, this volume, chapter I, pp. 220–35.

> something else [than air/breath] that one throws out or pushes, it is necessary, firstly, to push leaning against some resting part of oneself, and then moreover that this part—or the agent of whom it is a part—remains at rest fixing itself against something external. He who pushes the boat, being himself inside the boat and fixing himself against the boat, clearly does not move it, because it is necessary that that against which he fixes himself remain at rest. But it happens that in this case what he is moving [i.e. trying to move] is the same as what he is fixing himself against. But if he pushes or pulls from outside he does move it. For the ground is no part of the boat (*MA* 698^{b}21–699^{a}11).

He introduces the discussion of moving the boat by saying that there is a puzzle that provides evidence for his claim that the internal mover must fix itself against a stable external thing. The sense in which the puzzle is evidence for this claim is that the best solution to the puzzle depends on accepting the claim. What, then, is the puzzle? Presumably, the puzzle arises because it would be natural to assume that if one pushed the boat (provided that one pushed hard enough), it would move. What is puzzling is that this is not in fact the case. One can only move the boat if one is in contact with something at rest external to the boat (or in contact with something that is in contact with something . . . that is at rest). Aristotle emphasizes that there is no way to move the boat without exerting pressure on some stable external thing. One cannot push the boat by pushing on some part of it, if one is standing inside it. And one couldn't move it by exerting any other pressure on it (e.g. blowing into its sails) if the source of that pressure was not in contact with (and pressing against) something external.

Of course, the boat itself is not a self-mover. The example of the boat illustrates a more general point, which applies also to self-movers: if X is to move Y, then X must either itself be external to Y or (if it is not itself external to Y) it must at least be able to fix itself against something that is at rest (relative to Y), and is (thus) external to Y.[10]

Interestingly, the general claim Aristotle defends here is not, in fact, true. Though a god sitting within a boat could not move it forward by blowing *into its sails*, he could move it by blowing (or hurling things) out of the back. Aristotle might admit this, and point out that in blowing out the back, one is pushing against the surrounding air. But in fact, he would be wrong to suppose that the success of this method depends on resistance from the surrounding air. When the god exerted a force on whatever he threw out the back (e.g. the rock), it would exert an equal and opposite force on him, and hence on the boat.

[10] The application to self-movers is: if X is to move itself (X), then (since clearly X cannot be external to itself) X must be able to fix itself against something that is at rest relative to X, and is thus external to X.

(That is how rockets move themselves.)[11] So the conclusion Aristotle draws from his examples is not in fact the right one. In order to move itself, a thing does not need to exert pressure on something that is already, when the movement is initiated, external to it. But Aristotle *would* be right to make a closely related point. In order to move the boat in this way, it is necessary to be able to exert a force on something that is *separable* from the boat (such that the force one exerts on that thing is not thereby exerted on the boat). This is what one would be doing, in blowing, or hurling things, out of the back.

Note that this last point highlights a question that is not fully answered in chapter 2: in what sense, exactly, must the thing the mover supports itself against be 'external' to the thing moved? At some points, Aristotle says that the support has to be 'outside' (ἔξω/ἐξωθεν) the thing moved (698^{b}9, ^{b}14, 699^{a}5, ^{a}9 sq.); at others, that it has to be different from and no part of the thing moved (698^{b}18–20, 699^{a}9 sq.). What exactly is the relation between these two conditions, and are they equally important? As we shall see, this question starts to matter in the next chapter, when we encounter various ways in which the two conditions might come apart.[12]

4. The Movement of the Universe: Aristotle's Initial Question in *MA* 3

Aristotle begins chapter 3 by saying that someone might raise a puzzle, 'Ἀπορήσειε δ' ἄν τις'. He then poses a question, which he goes on to answer in the rest of chapter 3 and the first part of chapter 4 (up to 700^{a}6). Before looking at his answer, we need to ask (i) what exactly the question is, (ii) why it is puzzling, and (iii) why Aristotle thinks it an important question to discuss, in the course of an account of animal self-movement.

(i) The question

There is a textual difficulty: at line 699^{a}13, manuscript E has 'εἶναί τε δεῖ ἀκίνητον', while the manuscripts in group (β) have 'εἶναι (τε) τι δεῖ ἀκίνητον'.[13]

[11] The idea that a rocket might move itself in this way in a vacuum was mocked in a *New York Times* editorial of 1920 (commenting on the ideas of Robert Goddard, the pioneer of rocket design). Surely, the editors scoffed, a scientist of Professor Goddard's eminence cannot be so ignorant as not to be aware of 'the relation of action to reaction, and of the need to have something better than a vacuum against which to react.' Apparently, in 1920 the editors of the *New York Times* were still Aristotelians!

[12] Arguably, the poles are 'in' (ἐν) but not a part of the heavens. The earth, on a certain view, is inside (ἐντός) the 'all' but not a part of it.

[13] The manuscripts of the β-family have preserved 'τι' as the subject of 'δεῖ' (either with or without an additional 'τε') whereas in the α-family the 'τι' is omitted throughout. The resulting α-reading 'τε δεῖ' has

On the E-reading, the question posed is whether, if something moves the whole heavens, it (the mover) must be unmoved and external. On the new β-reading, the question posed is whether, if something moves the whole heavens, there must be something that is unmoved and external.[14]

From the context, the β-reading seems much more likely. Aristotle has just shown that there must be something at rest and external to an animal, if the animal is to move itself. What he has shown is not that there must be a *mover* that is external and at rest, but rather that there must be a kind of springboard that the animal can push against when it moves itself. A natural further question to ask, then, is whether there also must be something at rest and external to the heavens, in order for the heavens to be moved. If Aristotle means to ask whether what he has just said about animals applies (in some sense) to the movement of the universe, then he cannot be restricting his question to whether there is a *mover* that is external and at rest.

Moreover, the lines that immediately follow this question are naturally taken as sketching out a reason for answering it in the affirmative. In these lines (699^a14–17), Aristotle considers two alternatives, and claims that on either of them, there will be something that is unmoved and not a part of the heavens. Either the thing that moves the heavens is itself moved or it is not. If it is itself moved, then it must move the heavens by supporting itself against something (a kind of springboard) that is at rest and is no part of the heavens.[15] (Aristotle thinks he has shown this with the boat example in the previous chapter.) On the other hand, if the thing that moves the heavens is itself unmoved, then clearly it cannot be part of the heavens (since they are moved), so this unmoved mover will itself be something unmoved that is no part of the heavens:

> For if, being moved itself, it [the thing that moves the heavens] moves it [the heavens], then necessarily it produces movement while touching something unmoved, and this

been preserved in Parisinus E, whereas in the γ-family it has been further changed to '*θέλει*'. The γ-reading does not fit the sense of the passage well, for reasons Nussbaum gives in her commentary (Nussbaum 1985, 292–3): what is at issue is whether there *must* be something unmoved. Nussbaum (who was unaware of the fact that direct descendants of β, i.e. of her 'unknown source', are extant) reads '*τε δεῖ*' (1985, 28 sq.). She prints the text with a comma after '*τοῦτο*' followed by an added '*καί*': '*εἶναι τε δεῖ ἀκίνητον καὶ τοῦτο, < καὶ> μηθὲν . . .*', and translates 'One might raise the puzzle: if something moves the whole heavens, must this too be unmoved, and be neither in any part of the heavens nor in the heavens?' Barnes sees the philosophical case for '*τι*' (which I explain below) and suggests this as an emendation (1980, 224).

[14] 'If something moves the heavens, must there be something unmoved and must this be neither any part of the heavens nor in the heavens?' This, then, would be the same as the question Aristotle asks at 699^b32 sq.

[15] What Aristotle says here is only that the mover would have to be *touching* (*θιγγάνον*) something unmoved. However, his justification for this claim is clearly that a mover of this kind would need to *support itself against* something unmoved, and that to do so it would have to be in contact with the unmoved thing.

> [unmoved thing] must be no part of the mover. If the mover is itself[16] an unmoved thing, it will equally be no part of what is moved (*MA* 3, 699ª14–17).

But this argument only gives us a reason for answering the initial question in the affirmative, if what that question asks is whether there must be *something* (not necessarily a mover) that is external and unmoved. An external unmoved thing that functioned as a springboard would not itself be a mover.[17]

(ii) Why is it puzzling?

As I have said, after Aristotle has claimed that the existence of something external and unmoved is a necessary condition for animal self-movement, it is natural for him to ask whether the existence of some such thing is also a necessary condition for heavenly movement. However, showing that this is a natural question does not yet explain why Aristotle thinks that, in asking it, he is raising an ἀπορία.

This is, in fact, one of a series of ἀπορίαι in these chapters. In chapter 2, Aristotle raised an ἀπορία about how one moves a boat (698ᵇ21–24): however much strength a mover has, if it tries to move the boat from the inside (without having any contact with anything external), it will not succeed. As we saw, this counted as an ἀπορία because it was contrary to what one might expect. Aristotle goes on to consider further ἀπορίαι in chapter 4: at 699ᵇ12–13, an ἀπορία about the movement of the parts of the universe (which he introduces as closely related to the discussion of Atlas that immediately precedes it); at 700ª12–14, an ἀπορία about the movement of lifeless things.

However, it might seem odd to describe our question at 699ᵇ12–14 as something about which one might raise an ἀπορία, given that what follows (in chapter 3 and the first part of chapter 4) is simply a sustained argument for answering it in the affirmative. What is meant to be *puzzling* here? Aristotle's response, I think, would be that the affirmative answer to the question is itself

[16] 'Itself' is meant to capture the meaning of '*εὐθύς*'—the sense is: on this alternative, we need look no further for an unmoved thing, because the mover itself already is an unmoved thing.

[17] As Barnes says, 'the puzzle is not whether the *mover* of the universe must be unmoved, but whether, if the universe has a mover, there must be *something*—either the mover (ª16) or its support (ª14)—which is outside the universe and unmoved' (1980, 224). Note, though, that even on the interpretation I am proposing Aristotle does not fully answer his initial question (699ª12–14) in lines ª14–16. Part of that question has dropped out of consideration. Nothing is said in ª14–16 about whether the unmoved thing could be topologically in the heavens (without being a part of them). According to the Atlas story that Aristotle goes on to elaborate, the springboard on which the mover rests is within the heavens (in the sense that it is within their orbit) but is not a part of them. So in ª14–16 Aristotle does not yet give a conclusive reason to suppose that there must be something that is unmoved and is neither in nor a part of the heavens—for this, we need to turn to the complex argument that follows.

puzzling. This affirmative answer implies that there must be something that is neither a part of the heavens nor in them. *Prima facie*, that is puzzling: how *could* there be anything outside the heavens? Elsewhere Aristotle equates the heavens with the 'all'[18] and says that there is nothing outside them: 'alongside the all and the whole, there is nothing outside the all (*παρὰ δὲ τὸ πᾶν καὶ ὅλον οὐδέν ἐστιν ἔξω τοῦ παντός*), and for this reason all things are in the heavens, for the heavens, presumably, are the all (*ὁ γὰρ οὐρανὸς τὸ πᾶν ἴσως*)' (*Ph.* IV 5, 212^{b}16–18).[19] In *De Motu Animalium*, Aristotle does not resolve this puzzle: he does not tell us how to make sense of the idea that there is an unmoved mover of the heavens that is not 'in' the heavens. For a discussion of this, we need to look to the *Physics*.[20] Why, then, does he think it important to raise this puzzle in the *De Motu Animalium*? Does it shed light, in some way, on the movement of animals?

Before answering this, it is helpful to note a possible further source of puzzlement. Aristotle may think that there is something puzzling, not only about the fact that there is something unmoved that is external to the heavens, but also about the sense in which this turns out to be true. For although it is true that there must be something external and unmoved if the heavens are to move, this external unmoved thing will turn out *not* to be a springboard against which the mover of the heavens pushes (as one might expect it to be, after the discussion of animal self-movement).[21] As we shall see, this second possible source of puzzlement bears on the question of why Aristotle finds it relevant, in a discussion of animal self-movement, to ask about the movement of the heavens.

(iii) Why is this question about the movement of the heavens relevant, in a discussion of animal self-movement?

In the first paragraph of the treatise, Aristotle introduces the *MA* as an account of the cause of animal self-movement. Against this background, the discussion of the movement of the universe in 699^{a}12–700^{a}6 might seem something of a digression. As we have seen, Aristotle mentioned at the beginning of chapter 2

[18] I discuss below (pp. 252–3) exactly what Aristotle means by 'the heavens' in *MA* 3.

[19] This, Aristotle explains, is the reason why there is a difficulty about ascribing place to the heavens: there is nothing external to function as their container.

[20] *Ph.* VIII 10: the unmoved mover is without magnitude and is, in some sense, at the circumference of the universe.

[21] Why expect the account of whatever moves the heavens to be similar to the account of animal self-motion? One reason is that Aristotle says early in chapter 1 that he has shown elsewhere (in the account of eternal motion) that the origin of other movements is what moves itself and the origin of that is unmoved (698^{a}7 sq.). This suggests that the origin of heavenly movements is something that moves itself. And it is natural to think that the account Aristotle has given of animal self-motion will apply to any being that moves itself.

(698^{b}10–12) that his claim about the need for an external support had some importance for the study of the motion of the universe, but why does he go on to discuss heavenly motion at such length here? Are these simply interesting remarks on a different (though of course related) topic, or does Aristotle think these remarks have some important role to play in advancing his discussion of the movement of animals?

Our concerns here bear on more general questions about Aristotle's method. To what extent should we expect an Aristotelian treatise to be tightly focused on one theme, introduced at its beginning? For Aristotle, what counts as a digression? And in what ways can the discussion of an *ἀπορία* contribute to establishing positive conclusions?

One way to explain the relevance of Aristotle's remarks about heavenly movement is the following. Though Aristotle's theme is animal self-motion, he approaches it by first articulating certain general principles: principles that apply not only to animals but also to other moving things. For instance, in chapter 1, he tells us that the origin of other movements is that which moves itself, the origin of that which moves itself is unmoved, and the first mover is unmoved (698^{a}7–11). He goes on to clarify his remark about the origin of self-movement, as it applies to animals: their movement depends both upon an internal unmoved origin (a joint) and also on the existence of something that is external and unmoved (a springboard). But for a full understanding of these initial principles, Aristotle needs to investigate their scope more generally, and to explain in what sense (if at all) they apply to other kinds of movement (and to other kinds of self-movement, if there is anything that counts as a self-mover but is not an animal). On this interpretation, Aristotle's interest here extends, not merely to explaining animal self-movement, but also to clarifying certain more general principles that govern not only animal self-movement but also (though perhaps in a different sense) other kinds of movement.[22]

That this is *part* of Aristotle's strategy here seems quite likely. It helps to explain, for instance, why after discussing heavenly motion, he goes on at the end of chapter 4 to raise questions about the movement of inanimate things. However, this still leaves us asking whether there is also some more specific way in which the extended discussion of heavenly motion advances the inquiry into animal self-movement. In what follows, I shall suggest that there is.

Suppose we start out with the thought that animals move themselves, and we notice that in order to do so they must have an internal unmoved joint and must rest on something external that is unmoved. We might be tempted to leave our

[22] For helping me to see this, I am indebted to David Charles, Pavel Gregoric, and Christof Rapp. Rapp (this volume, chapter I, section 3) discusses the general claims Aristotle makes (in lines 698^{a}7–11) about self-movers and the unmoved.

account of animal self-motion there, and to think that this is a full account of the role of unmoved things in an animal motion. We notice, then, that heavenly motion cannot be explained in an analogous way. The outermost sphere of the heavens is not a self-mover (it does not have anything analogous to joints); nor can it be moved by a self-mover (like Atlas) that supports itself against a springboard. It must, then, be moved by a different kind of mover: an unmoved mover that is neither in it nor a part of it (and that, presumably, produces motion in a way rather different from any so far discussed). As we have seen, this is a puzzling conclusion about the outermost heavenly sphere, if that is supposed to encompass everything there is (for how *can* there be something that is neither a part of this sphere, nor, in any sense, in it?). But once we have seen that there is reason to accept this conclusion about heavenly motion, we might start to wonder whether there is anything that plays an analogous role in the motion of animals.

In *MA* 1, Aristotle emphasizes that animal self-motion and eternal heavenly movement *both* presuppose the existence of something unmoved (698ª7–11, 14–16).[23] But once he has spelt out the *way* in which each depends upon the existence of an unmoved thing, this similarity starts to seem rather superficial. An animal, as we have seen, moves itself by pushing against an unmoving (or at least resisting) surface or medium (a springboard, not a mover). The outermost sphere of the heavens appears to require an external unmoved *mover*.[24] The unmoved thing seems, then, to play a very different role in these two cases. That suggests a question: is it really right to conclude that the similarity between the movement of the heavens and the movement of animals is this superficial, or should we, instead, expect that in the case of animal motion too there is a mover of another sort: an unmoved mover that is neither in the animal nor part of it? Might it turn out that animal motion and the motion of the heavens are, after all, alike in *this* way, even though they differ in that animals (unlike the heavens) move themselves in a way that presupposes that there is something for them to push back against? The reason Aristotle raises this puzzle about the movement of the heavens at the start of his account of animal self-motion is, I suspect, because he wants to motivate questions of just this sort.

My suggestion, then, is that the realization that there must be an unmoved mover in the case of heavenly motion motivates the search for something to play that role in the case of animal self-motion. This, of course, raises the question why Aristotle would suppose that heavenly motion and animal self-motion were alike in this way. There would be an obvious reason to suppose this if the

[23] The '*καί*' at 698ª14 brings out that this is a way in which heavenly movement and the movement of animals are *alike*.

[24] This is what the argument of chapters 3 and 4 suggests. As I have said, whether (and if so in what sense) the unmoved mover really does have to be external, is a question Aristotle discusses in *Ph.* VIII 10.

spheres were themselves self-movers or living things. Nussbaum claims that elsewhere Aristotle is committed to this view,[25] but in fact the evidence is rather uncertain. At *Cael.* 285ª29 sq., Aristotle says that the heaven is ensouled and possesses a principle of movement. But when he spells out a little later the way in which heavenly motion is caused, he claims that the stars (not the heavenly spheres themselves) participate in action and life (πράξεως καὶ ζωῆς, 292ª18–21), and he invokes these facts to explain the way in which they move.[26] Perhaps this suggests at least that the heavenly spheres are moved by self-movers: the stars. But is there evidence that Aristotle is presupposing such a view in *MA*? Aristotle doesn't say explicitly, in *MA*, that the heavens are moved by a self-mover, but he does say, in chapter 1, that those movements that are not themselves self-movements have their origin in self-movement (698ª7 sq.). This is something he claims to have established elsewhere, in his discussion of eternal motion (698ª9 sq.).[27] So Aristotle seems committed to the view that, if the heavenly motions are not themselves instances of self-motion, they at least have their origin in self-motion. He is not here concerned to spell out in more detail how, exactly, heavenly motion is caused, but this connection with self-motion is already enough to suggest a similarity with the motion of animals. If heavenly motion, though it has its origin in a self-motion, is *also* caused in some way by the operation of an unmoved mover, this raises the question whether self-motion more generally has its origin in some unmoved mover.[28]

5. Aristotle's Strategy for Answering this Question

The remainder of chapter 3 and the first half of chapter 4 (up to 700ª6) constitute Aristotle's answer to the question he has posed: if there is something that moves the heavens, must there be something that is unmoved and external to them (i.e. neither in them nor a part of them)? As we have seen, his answer will be to accept the puzzling conclusion: yes, if the heavens are to be moved, there must be something unmoved that is external to them and is not a part of them. His strategy for arriving at this answer is already suggested by his initial remarks

[25] Nussbaum 1985, Essay 2, 120 and 132.

[26] I am grateful to Stephen Menn for pointing this out.

[27] See Rapp (this volume, chapter I, section 3, pp. 211–17) for discussion of which of his works Aristotle has in mind here.

[28] Of course, Aristotle already said in ch. 1 that the first mover must be unmoved (698ª8–9). What chapters 3–4 add is a detailed argument that there must be such an unmoved mover in the case of heavenly motion (and a demonstration that in certain other respects, whatever causes heavenly motion is *not* like an animal self-mover).

in lines 699[a]14–17, where he considers two different possible movers of the heavens (they might be moved by a moved mover or they might be moved by an unmoved mover), and claims that in either case, there would have to be something unmoved that was not a part of them.

In what follows, he goes on to consider in turn each different conceivable option for what the mover of the heavens might be. Is the mover something that is itself moved (for instance, is it a self-mover), or is it unmoved? Is the mover part of the heavens, or not? Is the mover outside the heavens, or inside them? He aims, as a result of considering these options, to show that the only possible mover of the heavens is something that is outside them, not a part of them, and is unmoved. From this conclusion, an answer to his main question follows:[29] if the heavens are moved, there must indeed be something that is outside them, not a part of them, and is unmoved (and, as it turns out, that something must be the mover of the heavens).

Before we can look in detail at the development of this argument in the rest of chapter 3, we need to get a little clearer about what Aristotle means here by 'the whole heaven', '*τὸν ὅλον οὐρανόν*', and about what it is for something to be neither 'in' nor 'of' (that is, a part of)[30] the heaven. In *Cael.* I 9, 278[b]9–21, he helpfully spells out the different meanings of '*οὐρανός*'. This word can be used to mean the outermost sphere (either the body at the 'extreme circumference of the whole', or the 'substance of the extreme circumference'). Aristotle calls this outermost sphere 'the upper region, which we take to be the seat of all that is divine'. 'Heaven' can also, by extension, mean all of the body that is continuous with this upper region, that is, it can mean the nested series of spheres containing the sun, the moon, and the stars.[31] Finally, it can be used of all the body that is within the extreme circumference. In this sense, Aristotle sometimes speaks of 'the whole' or 'the all'.

It is not easy to determine which of these senses Aristotle is using in our passage.[32] On the one hand, at 698[b]10–12, he says that his inquiry will shed light

[29] Or at least, this answer follows, so long as we assume, with Aristotle, that if the heavens are moved there must be something that moves them.

[30] Primavesi reads '*μηθὲν εἶναι τοῦ οὐρανοῦ*' rather than '*μηθὲν εἶναι τοῦ οὐρανοῦ μόριον*' at line 699[a]13, but even if this is right, I take it that by being 'nothing of the heaven' Aristotle here understands *not being a part of the heaven*. Something can be 'in the heaven' without being a part of the heaven: the poles are 'in the heaven' but are not parts of the heaven. Aristotle's remark in the immediately following lines, [a]14–17, concerns whether there must be something unmoved that is not a *part* of the thing that is moved. Later (when he considers the poles), he asks whether the unmoved thing needed for heavenly movement might be something that was not a part of the heavens, but was nevertheless in them.

[31] The moon is on the sphere that is closest to the earth; the fixed stars are on the outermost sphere. Between these there are spheres that contain the different planets (*Metaph. Λ* 8).

[32] The difficulty is perhaps partly explained by the fact that Aristotle goes on to discuss the views of various different people with whom he disagrees (those who think that the poles move the heavens; those who think that Atlas moves the heavens). The proponents of these views may not have been very

on the movement of the 'all'.[33] Moreover, the discussion of Atlas presupposes that what Atlas moves is, in some sense, 'the all', not merely the heavenly sphere(s). This assumption is needed to justify Aristotle's conclusion that on this story the earth, since it can be no part of what is moved, can be no part of 'the all' (699^{a}31 sq.). On the other hand, at 699^{a}17–20, Aristotle's point seems to be about the outermost sphere (or at most about the series of heavenly spheres): no part of it can remain still. Similarly, the reason why the poles cannot move the sphere is that they could not cause a *single* (and, I think he must mean, simple) movement (699^{a}23 sq.). Aristotle clearly thinks that the outermost sphere must have a single (and simple) movement. Each of the nested heavenly spheres moves with a complex movement because it is influenced not only by its own mover but also by the movements of the spheres that are external to it: what a particular sphere's own mover contributes is a simple movement.[34] This suggests that, when Aristotle is discussing the poles, he is discussing a proposal about the mover of any individual sphere, not a proposal about the mover of the universe as a whole. He has given no reason to suppose that the whole universe participates in some single, simple, unified movement. I conclude (though without much confidence) that '*οὐρανός*' here means the outermost sphere, but that Aristotle is sometimes prepared to describe the movement of the outermost sphere as the movement of 'the all', because of the special role this movement plays in relation to all other movements. The outermost sphere surrounds everything there is. Its movement contributes to the movement of the other spheres,[35] and hence to the movement of the sun, which in turn contributes to the movements of all living things.

What, then, is it for something to be 'in' the heavens, and what is the relation between being 'in' the heavens and being (a part) 'of' them? One way in which X can be in Y is by being a part of Y. In *Physics* IV 3, Aristotle outlines various other senses of 'in', and claims that the strictest (*κυριώτατον*) sense of 'in' is the sense in which a thing is 'in' a vessel or a place (210^{a}24).[36] If the outermost sphere is the 'heaven', then everything that is inside this sphere counts, in this sense, as 'in' the heaven (at 699^{b}1–11 Aristotle uses the word '*ἐντός*' for this sense of 'in'). However, the poles (which Aristotle discusses at 699^{a}20–24) are not in this sense 'in' the heaven. They are points on the outermost sphere, and so are neither inside the sphere nor a part of it. Hence, they are 'in' the sphere in a

clear about what exactly they took the 'heavens' to be, and they needn't, of course, have agreed with the Aristotelian story on which the heavenly realm is constituted by a nested series of moving spheres.

[33] At 699^{b}33 sq., Aristotle again asks whether his conclusions apply to the 'all'.

[34] Each of the sun, moon, and planets has a *complex* movement that can only be explained by supposing it to be caused by a nested series of spheres (*Metaph. Λ* 8, *Cael.* II 12, 292^{b}31 sqq.).

[35] *Cael.* II 12, 292^{b}31 sqq.

[36] See Morison 2002, 67 sqq. for discussion of different senses of 'in'.

different sense, also spelt out in *Physics* IV: in the way that a limit is 'in' what it limits (212^{b}28).

We can now see how Aristotle implements his strategy in the remainder of chapter 3. First, he points out that nothing that was unmoved could be a part of the heavens.[37] From this, it follows that the mover of the heavens cannot be something that is unmoved and is a part of them (699^{a}17–20). Second, he considers one way of spelling out the possibility that the heavens are moved by something that is unmoved, is in[38] them, but is not a part of them. This is the view that the poles are the unmoved movers of the heavens.[39] Aristotle argues against this in lines 699^{a}20–24. Finally, he argues at length against the possibility that the heavens are moved by something that is itself moved and is in them (whether or not this mover counts as a part of the heavens is irrelevant to his argument). His argument against the Atlas myth is meant to rule out any possibility of this kind (699^{a}27–^{b}11).[40]

By the end of chapter 3, then, Aristotle has given some arguments (to be concluded in chapter 4) against the view that the heavens are moved by a *moved* mover. His remarks about Atlas are meant to show that the heavens cannot be moved by a moved mover resting on something (like the earth) that is within them. At the beginning of chapter 4, he will give a more general argument to show that what moves the heavens cannot be a moved mover, resting on something that is either within or external to them.[41]

This leaves only the possibility that what moves the heavens is an *unmoved* mover. But Aristotle has also, in chapter 3, ruled out two ways in which there might be an *unmoved* mover of the heavens. If the mover is unmoved, it cannot be in the heavens and a part of them; nor can it be in them but not a part of them (in the sense in which the poles are in them but not a part). If the mover is unmoved, this leaves only two options: either this unmoved mover is not a part of the heavens, but is within (*ἐντός*) them (and hence not 'in' them in the sense that the poles are), or it is external to the heavens, i.e. neither in them nor a part of them.[42] In chapter 4, Aristotle goes on to

[37] I assume here that a part is an extended part. The poles, for instance, do not count as parts of the heavens.

[38] In the sense of '*ἐν*' (in) but not '*ἐντός*' (inside, within).

[39] The poles are indivisible points and hence are not parts of the heavens (at least, if a 'part' is something that would measure out the whole, as Aristotle suggests at *Ph.* 218^{a}6 sq.), but there is a sense in which the poles are 'in the heavens' (as a limit is 'in' what it limits, cf. *Ph.* IV, 212^{b}28).

[40] The beginning of ch. 4 (699^{b}12–31) is also relevant to Aristotle's argument against the Atlas myth.

[41] This possibility is ruled out at the beginning of ch. 4, where Aristotle attempts to show that nothing that moves the heavens can do so by pushing back against an unmoved springboard (whether that springboard is within the heavens or outside them). For discussion, see Morison this volume, chapter III, pp. 281–86.

[42] Again, the unmoved mover couldn't be a part of the heavens without being in them.

rule out the first of these options. He claims that what moves the heavens cannot be an unmoved mover that is within them.[43] Thus, only one possibility remains: the mover of the heavens is *unmoved* and is *neither in the heavens nor a part of them*.

6. Could there be an Unmoved Mover that was a Part of the Heavenly Sphere?

Aristotle quickly dismisses this possibility, on the grounds that the heavenly sphere is in motion. If a part of it were at rest, then the continuity of its motion would be broken. It would, as Aristotle says, be torn apart:

> If the mover is itself an unmoved thing, it will equally be no part of what is moved. And in this at least, they speak rightly who say that when the sphere is carried around in a circle, no part of it at all remains at rest. For (if it were) either it would be necessary for the whole of it to remain at rest, or for its continuity to be torn apart (3, 699^{a}16–20).

Given what Aristotle has said about self-motion, this also rules out the possibility that the heavenly sphere could move itself in the way that an animal does, for Aristotle has argued, in chapter 1, that an animal can only move itself if a part of it is at rest. This is possible, for an animal, because an animal has joints. Its movement is not simple and continuous, in the way that the movement of the outermost sphere is. That is why an animal can be a self-mover, but the heavenly sphere cannot be (or at least, it is why the heavenly sphere cannot be a self-mover *in the sense that an animal is*).[44]

7. Could there be an Unmoved Mover that was in the Sphere but Not a Part of it?

This leaves, however, the possibility that there could be an unmoved mover that was in the heavenly sphere, but not a part of it. As I suggested above, the poles might be thought of as unmoved movers of this sort. (They are 'in' but not a

[43] This is perhaps the possibility Aristotle considers at ch. 4, 699^{b}4 sq., when he says that it would seem absurd if the mover were inside (ἐντός).

[44] Stephen Menn pointed out to me that a further reason for thinking that a heavenly sphere could not, in any sense, be a self-mover is that Aristotle argues (in *Ph.* VIII, 10, 266^{a}24 sqq.) that what moves the spheres cannot itself have magnitude (since it would have to have infinite power, and nothing with magnitude can have such power).

part of the sphere, in the sense that a point is in but not a part of a line.[45] They are unmoved—at least in the case of the outermost sphere—because the sphere turns around them, as the spinning top in *Republic* IV turns round its axis.)[46] This, I suggest, is why Aristotle goes on to consider, and rule out, the possibility that the poles are the movers of the heavens.[47]

His response is that the poles are not the kinds of things that could be movers. The first reason he gives for this is that the poles are points without magnitude:

> But they don't judge well in ascribing some power to the poles, these being things that have no magnitude and are termini and points (3, 699^{a}20–21).

It is not entirely clear why he thinks this shows they cannot be movers, given that he argues, in *Physics* VIII 10, that the unmoved mover of the heavens cannot have a magnitude and that this is because it would be impossible for an infinite power to be present in a finite magnitude (266^{a}24 sqq.). Here in the *MA,* he seems to suggest that because the poles don't have magnitude, they can't have any power at all. However, these two views can be reconciled. Although the poles don't have magnitude, they are the indivisible limits of something that has a magnitude. Suppose Aristotle thinks that the amount of power a magnitude of a certain type possesses must be in some proportion to its size.[48] Since there is no infinite magnitude, no magnitude can have infinite power. As magnitudes get smaller and smaller, they have less and less power. The limiting case of this would be an indivisible point (the limit of a magnitude). It is natural to think, then, that such a point can have no power. From this, one might reasonably conclude that a thing with infinite power would have to be neither a magnitude nor the limit of any magnitude.

The second reason he gives for denying that the poles are the movers is that there are *two* poles, and two movers cannot produce one movement:

[45] For the view that a point is not part of a line, see, e.g., *Ph.* 220^{a}18–21.

[46] In *Cael.* II 2, Aristotle says that the upper and lower hemispheres are distinguished from all others by the immobility of the poles, 285^{b}10 sq.

[47] The theory that the poles are the movers is usually attributed to Speusippus, but Menn 2012, 457, n. 28 suggests Eudoxus as an alternative possibility. As Menn points out (2012, 441 sq.), it is likely that Aristotle took the theory of the poles very seriously as a possible explanation of heavenly motion. The poles satisfy most of the attributes Aristotle ascribes to the unmoved mover in *Metaph. Λ* (1073^{a}3–12). For instance, they are eternal, unmoved, indivisible, partless, and without magnitude.

[48] In *Ph.* VIII 10, Aristotle admits that 'a greater power can reside in a lesser magnitude' (266^{b}7 sq.), and adds 'but a still greater power will be in a greater'. I suspect the assumption behind the argument here is that if two magnitudes are of the same type, then their power will be in proportion to their size.

> For in addition to there being no substance of anything of this sort [i.e. anything without magnitude that is a point or terminus], it is also impossible for the one movement to be produced by two things. But they make the poles two (3, 699ª22–24).[49]

Again, Aristotle does not spell out why there could not be one movement produced by two things. Perhaps the thought is that the movement of the outermost sphere has to be a simple, unified movement, and that a movement produced by two movers could not be simple in this way.[50] That would leave it open that an animal, for example, could undergo a unified movement produced by more than one mover. This would be possible for the animal because the animal is a unified whole made up of parts. But it would not be possible for something that has the kind of simple unity Aristotle ascribes to the heavenly sphere (the kind of unity that would be broken up if any part of the sphere remained at rest).

8. Aristotle's Response to the Atlas Story

Aristotle now says that these considerations might lead one to suppose that 'there is something that is related to the whole of nature in just the way that the earth is related to animals and the things moved by them' (699ª24–27).[51] This is

[49] This second objection is, I think, less fundamental than the first. It relies on the fact that the opponents Aristotle has in mind make *both* the poles the movers. Someone could avoid the force of this second objection by maintaining that just one of the poles moves the heavens. By contrast, it would not be possible to avoid the force of Aristotle's first objection by claiming that the poles have magnitude. If the poles had magnitude, then they would themselves be parts of the heaven and so would fail to be unmoved movers (and if they were moved movers, then Aristotle could invoke his argument that such movers must rest against something unmoved).

[50] In *Cael.* II 6, Aristotle stresses the regularity of the movement of the outermost sphere. A movement of this kind must be caused by a single mover. (In contrast, each of the lower spheres moves with a composite movement, 288ª15–17, which must be caused, in part, by the movements of the various other spheres, within which it is nested, *Cael.* II 12, 292ᵇ31 sqq.) Aristotle concludes that the outermost sphere and its mover must be 'primary and simple and ungenerated and indestructible and generally unchanging' (288ª31–ᵇ2). He says that 'it is the primary that moves the primary, the simple the simple, the indestructible and ungenerated that which is indestructible and ungenerated' (288ᵇ2–4). In *Ph.* VIII 10, Aristotle claims that several movers could not produce a single continuous motion (267ª21 sqq.) (though what he probably had in mind here was several movers operating one after another, rather than several movers each operating forever).

[51] Here I depart slightly from Primavesi's text, which, following the *β*-branch of the manuscript tradition, has 'animals that move themselves' (*τὰ ζῶια τὰ κινούμενα δι' αὑτῶν*). A reason for preferring, with the *α*-tradition, '*δι' αὐτῶν*' (together with *καί*) is that, on the story Aristotle goes on to consider, Atlas is analogous to an animal self-mover and the heavens are analogous to something moved by a self-mover. So 'the whole of nature' (Atlas plus the heavens) is analogous to an animal and what is moved by the animal. The proposal, then, is that there is something that is related to the whole of nature (Atlas plus the heavens) in the way that the earth is related to animals and the things they move (that is, there is

a natural thing to suppose if one is impressed by the difficulties involved in supposing there to be an unmoved mover that is part of, or in, the heavenly sphere (difficulties, some of which he has just explained),[52] and if one wants to avoid the puzzling conclusion that there is an unmoved mover outside the heavens. An obvious way to avoid that puzzling conclusion is to suppose that the heavens are moved by a self-mover (as the boat is, in chapter 2), but for this to be possible, there must be something that the self-mover supports itself against (as animals support themselves against the earth).

In the remainder of the chapter, he begins to respond to this suggestion. He considers a story according to which there is something that is related in this way to the whole of nature (or at least, to the heavens and what moves them),[53] and that something is the earth. (On this view, then, the heavens would be moved by a moved mover, supporting itself against something unmoved.) He argues that this is impossible, and ends by drawing the general conclusion that nothing that (like the earth) was inside[54] the heavens could stand in this relation to the movement of the heavens, and hence that the heavens could not be moved by any mover that was within them:

> If this is impossible, it is also impossible for the heavens to be moved by any such thing within them (3, 699^{b}10 sq.).[55]

The story he considers is that Atlas moves the heavens:[56]

something that serves as a springboard for Atlas, thus enabling him to move the heavens, just as the earth serves as a springboard for animals, thus enabling them to move the things they move). If the proposal were that there was something related to the whole of nature in the way that the earth is related to self-moving animals, then that would suggest that there is something that serves as a springboard for *the whole of nature* (rather than just for the agent responsible for its movement).

[52] Some, but not all of which: for instance, he hasn't yet explained why there couldn't be an unmoved mover, located in the sublunary realm.

[53] It is not clear why someone following the above line of argument need suppose that there is something related in this way to *the whole of nature*, rather than, simply, to the heavenly sphere and the thing that moves it. The story Aristotle in fact considers here is one on which Atlas and the heavens are related to something (the earth) in the way that animals and the things moved by them are related to the springboard/medium that supports animal movement (here, assumed to be the earth).

[54] '*ἐντός*': the thought is that it is within the heavens. (It is not a part of the heavenly sphere; nor is it 'in' the sphere in the sense that the poles are.)

[55] The argument for this must depend in part on what Aristotle goes on to say at the beginning of ch. 4. He claims there that if the heavens were moved by an internal mover that supported itself against something else (whether that something else was internal to the universe, as the earth is, or external), then their continuing to be moved in this way would depend upon the support being strong enough to provide resistance. This, he thinks, makes the continued movement of the heavens too contingent. Their continued movement would depend upon the strength of the support. For this continued movement to be *necessary*, the supporting springboard would have to be such that it *could not possibly* give way. Aristotle assumes that no supporting springboard could be so strong that its giving way was *impossible*.

[56] He also mentions the Atlas story at *Cael.* II 1, describing it as a story put together by people who thought of the celestial bodies as earthy and endowed with weight. There he responds that if the heavens

> Now those who, in the manner of storytellers, represent Atlas with his feet on the earth would seem to have told their story with the idea that[57] he is like a kind of diameter[58] and whirls the heavens about the poles (3, 699ª27–30).

It is natural to consider this proposal after rejecting the theory which makes the poles the movers. The poles were rejected because there were two of them, and because they were without magnitude. An obvious response is to propose that the mover is, instead, the axis that runs between the poles: this axis is a single thing, and it has magnitude (at least in one dimension).[59] Aristotle does not directly address this proposal. Presumably, he thinks a pure axis is not the sort of thing that could exert any kind of power: though it is unlike the poles in being something single, it is like them in being a kind of abstraction, a mere limit of a physical thing. However, the Atlas story can perhaps be thought of as a physical version of the pure-axis view. Aristotle says that Atlas, on this story, is '*like* a kind of diameter' (699ª29). Unlike a pure axis, Atlas can push off against something that is, in the relevant sense, separate: he has his feet on the earth.

In order to play this role, Atlas must push off against something that is at rest (or at least, that does not 'give way', and that is not moving with the movement of the heavens). That is what we learnt in chapter 2. As Aristotle points out, this condition is fulfilled in the story because the earth is at rest: 'And this would turn out to be reasonable, since the earth stands still' (699ª30 sq.). On this story, then, the way Atlas moves the heavens is like the way that a man standing on the bank might move a boat by pushing it. Atlas supports himself against the earth and moves the heavens; the man supports himself against the bank and moves the boat. A consequence of this view (again, according to the conclusions we arrived at in chapter 2) would be that the earth was no part of the heavens.

were moved by a mover of this kind, their movement would be constrained (and hence would not be perfect or necessary, in the way that in fact it is).

[57] In translating '*ἀπὸ διανοίας*' in this way, I follow Lefebvre 2004, 128. See his defence of this in 128, n. 32. (Nussbaum has 'would seem to have a rational basis for their use of'. She cites in support *Ph.* II 5, 197ª2.)

[58] Lefebvre 2004, 124, n. 17 follows Nussbaum's translation in understanding '*διάμετρον*' here as radius. But the translation 'diameter' can, I think, be defended. Atlas's arms (I assume) are stretched out so that they form a straight line, linking one point on the circumference to another. *Strictly speaking*, they will not be a diameter (as the line in question will not go through the centre), but they will *approximate to* a diameter. This, of course, raises questions about how literally we are meant to take the story. How much are we meant to abstract here from the details of the mythical story (e.g. from the fact that Atlas has legs and a torso)? Should we treat Atlas (for the purposes of this argument) as if he were an axis running through the centre of the earth and resting against the earth? One difficulty about attributing this image to Aristotle is that such an axis would presumably be pressing down on the earth from two opposite directions. It is not clear why two equal and opposite forces exerted on the earth would threaten to move the earth away from the centre, though there might, on this story, be a danger of squashing the earth.

[59] See Menn 2012, 441 and 457, n. 29, who points out that the natural response to Aristotle's criticism of the pole theory would be to suppose that the mover was an axis.

Aristotle makes the stronger claim that 'for those saying these things it is necessary to say that the earth is not a part of the all', so he must be assuming that, according to their story, Atlas moves the whole universe, not just the heavenly sphere(s) (699^a31 sq.). If Atlas, in moving the heavens, also moves the whole universe, then the earth that he rests against cannot be part of the universe, since (as Aristotle argued in chapter 2) the thing that a mover supports itself against cannot be part of the thing that is moved (698^b18–20).

Perhaps the proponents of this story would be happy with this consequence. It sounds paradoxical to say that the earth is not a part of the 'all', but they could claim that Atlas moves everything *apart from the earth*. This is compatible with the earth's being 'internal' to what Atlas moves, in the sense that it is spatially within (surrounded by) what Atlas moves. So far, we have seen no reason to suppose that the fact that the earth is spatially within what is moved would prevent its being 'external' to what is moved, in the sense it would need to be in order to function as a support.[60]

But Aristotle now goes on to outline (what he takes to be) a more devastating objection to the Atlas story. This objection depends on a claim about the power that the earth would have to have if it were to play this role. Aristotle argues that the earth could not possibly be strong enough to function as the springboard supporting Atlas's attempt to move the heavens. Instead of providing the resistance needed to support Atlas, the earth would end up being moved from its proper place. Thus, this attempt to explain how the heavens get moved fails.

That, at least, is the general outline of Aristotle's argument. The details are less clear. As we shall see, he first of all lays down some general principles about the relative strengths of a mover, the thing it moves, and the springboard that acts as its support. He then, in a particularly obscure passage, goes on to apply these principles to the case of Atlas, the heavens, and the earth. His conclusion is that the earth could not act as the springboard for Atlas.

9. General Considerations about Relative Strength

Aristotle first sets out some general principles about the relation between the strength of a mover, the strength of the thing it rests against, and the strength of the thing it moves:

[60] In ch. 2, we were told that the thing that the self-mover fixed itself against had to be ἔξω/ἐξωθεν, but at the end of this chapter (699^a9–11) the reason the boat-mover has to fix himself against something ἔξωθεν is said to be that what he fixes himself against (e.g. the earth) has to be no part of the thing he is moving (e.g. the boat).

> And in addition, it is necessary to make equal the strength of the mover and that of the thing that stays still. For there is a certain amount of strength and power in accordance with which the thing that remains still so remains, just as there is in virtue of which the mover produces motion. And there is some proportion, by necessity, just as of opposite motions, so also of states of rest. And though those that are equal are unaffected by each other, they are overcome when there is superiority (3, 699^{a}32–^{b}1).

Aristotle is setting out the conditions that must be fulfilled when a mover pushes against something but that thing remains at rest. He says that for this to happen, the strength of the mover and that of the thing that remains at rest must be equal.

His claim is that a thing that remains at rest has a certain capacity to resist being moved. If it is to remain at rest, its maximum capacity to resist being moved must be at least as great as the force exerted on it when it is pushed. This is a point he makes elsewhere.[61] For example, when discussing floating in *Cael.* IV 6,[62] he says an object will float on a medium if its weight (the power for downwards motion that it exerts) is less than the maximum power the medium has to resist being divided (and that it will sink if its power is greater than the medium's power to resist).[63] Aristotle also mentions a power to resist being moved in *Ph.* VII 5.[64] He says that there is a certain threshold power for movement that B must exert on A if A is to be moved at all: B must exert enough power to overcome A's power to resist being moved. That is why from the fact that ten men can move a ship a certain distance in a certain time, it does not follow that one man can move the ship a tenth of that distance

[61] Aristotle explicitly appeals to a force to resist being moved when discussing the way in which an object moves through a medium. The speed with which an object falls through a medium will depend upon the weight of the object and the resistance of the medium (*Ph.* IV 8, 215^{a}24–31). Aristotle explains that the resistance of the medium depends on whether it is stationary or moving in the opposite direction to the thing that is moving through it (215^{a}29 sq.) and also on its density (the ease with which it can be divided) (215^{a}30 sq.).

[62] *Ἐπεὶ δὲ τό τε βάρος ἔχει τινὰ ἰσχὺν καθ' ἣν φέρεται κάτω, καὶ τὰ συνεχῆ πρὸς τὸ μὴ διασπᾶσθαι, ταῦτα δεῖ πρὸς ἄλληλα συμβάλλειν· ἐὰν γὰρ ὑπερβάλλῃ ἡ ἰσχὺς ἡ τοῦ βάρους τῆς ἐν τῷ συνεχεῖ πρὸς τὴν διάσπασιν καὶ διαίρεσιν, βιάσεται κάτω θᾶττον, ἐὰν δὲ ἀσθενεστέρα ᾖ, ἐπιπολάσει.*

'But since a heavy thing has some power (*ἰσχύς*) in respect of which it is carried downwards and a continuous thing has a power of not being broken apart, these must be reckoned against one another. For if the power of the heavy thing exceeds that in the continuum, in relation to being broken apart and divided, the heavy thing will be forced downwards more quickly, whereas if the power of the heavy thing is the weaker, it will float' (313^{b}16–21).

[63] In this passage, he does not say what will happen when the two powers are equal. However, our *MA* passage suggests that in this case too the thing will float.

[64] See Hussey 1991 for a discussion of this passage and of the various proportionalities Aristotle asserts here: the proportionality between the amount of the change and the time taken, between the amount of the power and the amount of the changing thing, and the inverse proportionality between the amount of the changing thing and the amount of the change (250^{a}1–9).

in the same time: the single man might not have enough power to move the ship at all.

However, these discussions elsewhere raise a puzzle. In these cases, the power of the mover and that of the thing that resists motion do not have to be *equal* if there is to be stationariness. What is important is that the thing that resists motion has a power to resist that is *equal to or greater than* the power exerted on it by the mover. When we push the ship, it will remain stationary if its power to resist motion is greater than the force we exert on it; the ship will float on water if water's power to resist motion is greater than the downwards force the ship exerts. In neither case do the powers have to be equal. Why, then, does Aristotle say in our passage that the relevant strengths must be equal?

The answer, I suspect, is that he has in mind here *exerted power*, and that he thinks that in resisting motion a thing only exerts as much power as is needed to remain at rest. If this is his view, then in keeping a feather afloat, water only exerts as much power as is needed to resist the power the feather is exerting in pressing downwards. Of course, heavier things than feathers can float on water, so the water will *have* a greater power for resisting motion than the power it is *exerting* in this case. If something is to float on water, then the power the water *has* for resisting motion must be *at least as great as* the power the floating thing is exerting in pressing downwards, but (I suggest) the power the water *exerts* in resisting motion will be *exactly equal to* the power the floating thing is exerting in pressing downwards.

This helps to explain Aristotle's reference, in our passage, to the proportionality between 'two opposite movements'. Aristotle points out in *Physics* VIII ($262^{a}6$–8) that opposite movements stop each other.[65] His point must be that if two things are exerting equal and opposite powers for movement, they will stay in equilibrium. If A is pushing B, B can resist A's movement by pushing back.[66] In such a case, it is clear that if equilibrium is to be maintained, *the power B exerts in acting on A* must be equal to the *power A exerts in acting on B*. If the two exerted powers are equal, then A and B will stay stationary. If A exerts more power than B does, it will move B; if B exerts more power than A does,

[65] Of course, in this limiting case, the movements do not in fact occur. Proportionalities between opposite movements are seen when one movement resists another, as for example when a boat moves more slowly because it is being rowed against the current.

[66] Does Aristotle think this always happens when B resists A's movement? For example, does he think that, when something floats in a certain medium, the medium pushes the floating thing upwards with an equal and opposite force to the downwards force exerted by the floating thing? This isn't clear: it certainly isn't a point he emphasizes when he discusses floating (where the medium's power is described as a power to resist being divided, not a power for pushing the floating thing upwards). But this thought is perhaps suggested by his discussion here in the *MA*, with its claim that, for a stationary equilibrium to be maintained, the power exerted by the thing that is resisting motion must be equal to that exerted by the potential mover.

it will move A. Perhaps it is because he has this model in mind that Aristotle is confident that the powers *that are exerted* must be equal if stationariness is to be maintained.[67]

10. The Application of these Considerations to the Atlas Story

Aristotle now goes on to apply these general claims about proportionality to the Atlas story:

> That is why, whether the mover from within be Atlas or anything else of this sort, it must exert no more pressure than the fixedness with which the earth remains still, otherwise the earth will be moved away from the centre and from its own place. For as the pusher pushes, so is the pushed pushed—that is, similarly in respect of strength (699^b1–5).

If the earth is to remain stationary when Atlas (or anything else of that sort) pushes back against it, then 'the fixedness with which the earth remains still' must be at least as great as the power Atlas exerts in pushing back against it. 'The fixedness with which the earth remains still' must here mean the total power the earth *has* for remaining still. *This* is the power that must be *at least as great as* the power Atlas exerts (or in other words, as Aristotle puts it here, the power Atlas exerts must be *no more than* the fixedness with which the earth remains still). As we have just seen, Aristotle thinks that the power the earth *actually exerts* in remaining still will be *exactly equal* to the power exerted on it by whatever is pushing against it. (Perhaps this is what he means when he says, 'as the pusher pushes, so is the pushed pushed—that is, similarly in respect of strength'.)[68]

Aristotle is clearly assuming that the pressure that Atlas exerts on the earth will be the same as the power he exerts in moving the heavens. From this, it follows that, if the earth is to serve as a springboard and not move from its place,[69] Atlas can use no more power to move the heavens than the power the

[67] See also the useful questions raised about the 'power for rest' in Lefebvre 2004, 131 sq. For discussion of the relation between Aristotle's remarks here and later views about inertia see references in Lefebvre 2004, 132, n. 43.

[68] Alternatively, this sentence could be making the point that the force Atlas exerts in moving the heavens will be equal to the force with which he needs to push back on the earth (i.e. as the pusher pushes [the thing it moves] with the same force is the pushed [springboard] pushed back against by the pusher).

[69] As we have seen, in general a thing needn't stay completely still if it is to act as a springboard. What is necessary is just that it should provide some resistance, but (Aristotle would argue, I assume) if the earth were to be moved away from its place by the thing pressing down on it, it would not be able to provide the needed resistance.

earth has for staying still (since the earth will have to be capable of exerting exactly the same power on Atlas as he exerts on it). Aristotle goes on to argue that the power Atlas would have to exert, if he were to move the heavens, would be so great that the earth could not possibly serve as a springboard for him.

The difficult interpretative question here is how exactly Aristotle justifies this claim. His argument comes in lines 699^{b}6–8:

> κινεῖ δὲ τὸ ἠρεμοῦν πρῶτον,[70] ὥστε μᾶλλον καὶ πλείων ἡ ἰσχὺς
> ἢ ὁμοία καὶ ἴση τῆς ἠρεμίας, ὡσαύτως δὲ καὶ τοῦ κινουμένου μέν, μὴ κινοῦντος δέ.

The translation of this passage is controversial.[71] With regards to the first part of the sentence alone ('κινεῖ δὲ τὸ ἠρεμοῦν πρῶτον'), we need to decide: (i) what is the subject of 'κινεῖ'—is the subject τὸ ἠρεμοῦν or is the subject to be understood from the surrounding lines? (ii) what does 'τὸ ἠρεμοῦν' refer to, and what is its grammatical role within the sentence? (iii) what is the role of 'πρῶτον'—does it modify 'κινεῖ' or 'ἠρεμοῦν'? We can then turn to (iv) the rest of the sentence.

(i) The subject of 'κινεῖ'

A few lines earlier (at 699^{b}2), Aristotle has described Atlas as 'the mover' (τὸ κινοῦν). Consistently with this, the subject of 'κινεῖ' at 699^{b}6 must, I think, be Atlas (or perhaps, if the sentence has a more general import: whatever plays the Atlas-role of moving something else, while pushing back against a third thing). Either this subject is to be understood from the surrounding lines or the subject is 'τὸ ἠρεμοῦν' and this refers here to Atlas (or whatever plays a similar role). Alternatives that have been proposed are the earth[72] or the unmoved mover within Atlas.[73] But I think both of these alternatives should be rejected: the first, because Aristotle never describes the springboard (in this case, the earth) as a mover; the second, because up to this point in the *MA*, though Aristotle has argued that there must be something unmoved within any self-mover, he has described this unmoved element as a kind of internal springboard (something at rest, supporting itself against which the animal can move, 698^{a}14–^{b}7), not as an internal unmoved mover, of the kind he argues for in *Ph.* VIII 5, 258^{a}1 sq.[74]

[70] I discuss an alternative punctuation below, n. 76.

[71] See Lefebvre 2004, 132–5 for a discussion of some of the difficulties. Lefebvre concludes that there is no entirely satisfactory way to interpret these lines.

[72] This suggestion is made by Barnes 1980, 224.

[73] This suggestion was made to me by Pieter Sjoerd Hasper.

[74] Aristotle does say, in ch. 1, that (as he has shown elsewhere) the origin of self-movers is something unmoved, and that the first mover must necessarily be unmoved (698^{a}8–9), but he does not here make the claim that any self-mover must have such an unmoved mover as a part.

(ii) What does 'τὸ ἠρεμοῦν' refer to, and what is its grammatical role?

It is clear, I think, that 'τὸ ἠρεμοῦν' cannot refer to the earth. I have already argued that if 'τὸ ἠρεμοῦν' is the subject of the sentence, then it must refer to Atlas (or to whatever plays a role analogous to that played, in the myth, by Atlas). On the other hand, if 'τὸ ἠρεμοῦν' is the object of 'κινεῖ', then it cannot refer to the earth. The sentence is outlining the conditions that would need to be met if Atlas were to move the heavens by pushing back against a stationary earth. These are conditions under which the earth is not moved. The two remaining possibilities then are that 'τὸ ἠρεμοῦν' refers to Atlas (in which case it could be either the subject or the object of 'κινεῖ') and that 'τὸ ἠρεμοῦν' refers to the heavens (in which case it must be the object of 'κινεῖ').

(iii) What is the grammatical role of the word 'πρῶτον'?

The word 'πρῶτον' could modify either 'κινεῖ' or 'τὸ ἠρεμοῦν'. In either case, it might mean 'primarily' (as opposed to 'secondarily'): 'what produces movement primarily', or 'what is primarily at rest'. Or it might mean 'first of all' (understood temporally): 'what first of all produces movement' or 'what is first of all at rest'. But none of these suggestions makes much sense in this context: it is not clear what the contrast between 'primarily' and 'secondarily' would amount to, and Aristotle is discussing a hypothesis about a stable system, not a system in which something first produced movement and then later did not (or in which something was first of all at rest, and then later was not). What, then, can 'πρῶτον' mean here? The solution, I suggest, is to take 'πρῶτον' to modify 'τὸ ἠρεμοῦν', and to take 'τὸ ἠρεμοῦν πρῶτον' to have a counterfactual sense: what is 'first of all at rest', in the sense that it *would otherwise be at rest* (it would be at rest if Atlas were not moving the heavens). If this suggestion is right, then Aristotle's thought is that we can get clear about the conditions needed for Atlas to move the heavens, if we first explain what would be needed for the whole system to remain in equilibrium, and then ask what in addition would be needed if Atlas were to move the heavens.

If we accept the claims I've defended above, we are left with two alternatives for interpreting the first part of the sentence. On the first interpretation, 'τὸ ἠρεμοῦν πρῶτον' is the subject. Aristotle is saying that what would otherwise be at rest (namely Atlas, or whatever plays a similar role) produces movement. On the second interpretation, 'τὸ ἠρεμοῦν πρῶτον' is the object. Aristotle's point is that Atlas (or whatever mover plays an analogous role) moves the thing that would otherwise be at rest (presumably, the heavens).[75] If we consider merely the

[75] If 'τὸ ἠρεμοῦν πρῶτον' is (as on this second interpretation) the object that Atlas moves, then this object *could* be Atlas himself (since Atlas is a self-mover, moving his arms about), but the object Aristotle

first half of this sentence, either of these two interpretations is possible. However, I shall argue that when we take into account the rest of the sentence, the second interpretation (on which '*τὸ ἠρεμοῦν πρῶτον*' is the object) becomes preferable.

(iv) The rest of the sentence ('ὥστε μᾶλλον . . . μὴ κινοῦντος δέ')

The remainder of this sentence should, I suggest, be translated: 'So that its strength is rather (*μᾶλλον*) even greater than (*καὶ πλείων*), instead of (*ἤ*) similar and indeed equal to, the rest. And in the same way [its strength is greater] than, [rather than similar or equal to that of] the thing that is moved and isn't a mover.'[76]

In these lines, Aristotle makes two points:

(a) the mover's (i.e. Atlas') strength must be greater than the rest,

(b) the mover's strength must similarly be greater than that of the thing that is moved but isn't a mover.

has in mind is more likely to be the heavens (since his emphasis so far has been on how Atlas moves the heavens, not on how Atlas moves himself).

[76] Some remarks on the translation of '*ὥστε μᾶλλον καὶ πλείων ἡ ἰσχὺς ἢ ὁμοία καὶ ἴση τῆς ἠρεμίας*'. Three constraints on translating this: (i) the words '*μᾶλλον*' and '*πλείων*' must have different functions (since '*μᾶλλον*' is an adverb, whereas '*πλείων*' is an adjective modifying *ἡ ἰσχύς*). This, I think, rules out Lefebvre's 'de sorte que sa force est supérieure et plus grande ou <au moins> semblable et égale au repos' (Lefebvre 2004, 132). (ii) '*ἤ*' could mean either '(rather) than' or 'or', but there are, I think, philosophical grounds for taking it to mean '(rather) than', not 'or'. In the next part of the sentence, Aristotle will say that the strength in question would need to be *πλείων . . . ἢ ὁμοία καὶ ἴση* than that of the thing that is moved but not a mover (i.e. than that of the heavens), ^{b}7 sq. This remark is meant to follow from what Aristotle has said earlier. But as we have seen, his earlier remarks make it clear that if X is to move Y, X must use *more* strength than (not just a strength equal to that which) Y uses in resisting being moved. (iii) On the other hand, even if '*ἤ*' does mean '(rather) than' the word order makes it hard to take '*ἤ*' very closely with '*μᾶλλον*'.

Bearing in mind these three constraints, I suggest we understand the phrase as follows. In the previous sentence, Aristotle has mentioned that the strength that would be needed, if things were to remain in equilibrium, would be equal (to the strength exerted by the thing acted upon). I take the '*μᾶλλον*' in our sentence to be introducing a contrast with this: the strength exerted by the mover would rather ('*μᾶλλον*') (unlike the strength mentioned in the previous sentence) have to be *greater* ('*πλείων*') (than its rest). The parenthetical '*ἢ ὁμοία καὶ ἴση*' simply spells this out: the strength would have to be greater than (as opposed to similar and indeed equal to) its rest.

Edward Hussey suggested to me an alternative way to understand this sentence, which depends on altering the punctuation. His suggestion is to delete the comma after '*πρῶτον*' and add a colon or full stop after '*μᾶλλον*', to give : '*κινεῖ δὲ τὸ ἠρεμοῦν πρῶτον ὥστε μᾶλλον. καὶ πλείων ἡ ἰσχὺς ἢ ὁμοία καὶ ἴση τῆς ἠρεμίας*'. '*μᾶλλον*' would then mean 'more', and modify an (understood) '*κινεῖ*', so '*ὥστε μᾶλλον*' would mean *so that (or in such a way that) it moves [whatever it moves] more*. What exactly would this mean, in the context? It could mean either that the mover (Atlas) moves the heavens more than he would have been moving them when the whole system was at rest, or perhaps that the mover moves the heavens more than they move him. Either of these possibilities would fit with the overall interpretation that I suggest above. But both are, I think, slightly awkward. If the heavens were at rest, then though the mover might be pushing them, he would not be *moving* them at all (so 'more' would have to mean 'more than not at all'). Similarly, though the heavens might be pressing down on Atlas, they are not (on the story we are considering) actually moving him. If we accept Hussey's suggestion about '*ὥστε μᾶλλον*' (together with my point (ii) above about '*ἤ*'), the next sentence would be translated: 'and its strength is greater than (rather than similar and indeed equal to) its rest'.

What exactly does he mean by these two points, and what is the relation between them? Point (b) seems to be fairly clear: Aristotle is saying if Atlas is to move the heavens, his strength must be greater than that of the heavens (i.e. of the thing that is moved and isn't a mover).

It is less easy to make sense of (a). Aristotle must, I think, be saying that Atlas's strength would have to be greater than *his own* power for staying at rest.[77] But what exactly is the function, in the argument, of considering the relation between Atlas's strength and his own power for staying at rest?

Again, there are two possible interpretations here. One possibility is to understand Aristotle as first considering the strength Atlas needs in order to move himself (that is, to overcome his own power for staying at rest), and then second, considering the strength Atlas needs in order to move the heavens. On this interpretation, Aristotle says, in (a), that Atlas will need to have enough strength in order to overcome his own power for staying at rest if he is to move himself, and then adds, in (b), that Atlas will need to have enough strength to overcome the heavens' power for staying at rest if he is to move them.[78] There is, however, some reason to doubt this interpretation. Though Atlas is moving his hands, he isn't moving himself from place to place. Does Aristotle really mean to emphasize here the power that Atlas needs if he is to move *himself* (taking this to be something in addition to the power he needs if he is to move the heavens)?[79] If so, what he says here departs significantly from his *Physics* VII 5 discussion of the proportionalities between the power of the mover, the amount of the thing moved, and the speed of the movement—in the *Physics* discussion, the weight (or amount) of the mover isn't taken into account.

If Aristotle's claim (a) isn't a point about the power Atlas needs in order to overcome his own resistance to movement and hence to move himself, then what does he mean, in (a), by claiming that Atlas's strength must be greater than his rest? There is, I think, an alternative way to understand these lines. This is to take *Atlas's power for rest* here to refer not to Atlas's power for resisting his own attempts to move himself, but rather the power Atlas would need in order to keep the whole system (himself plus the heavens) stationary. If this is what Aristotle has in mind, then in (a) he is comparing the power Atlas needs simply

[77] The alternative is to take him as saying that Atlas's strength would have to be greater than *something else's* power for rest. But the 'something else' here would have to be the heavens (since they are what Atlas is trying to move). On this interpretation, Aristotle would be making the same point twice in (a) and (b): the point that Atlas, if he is to move the heavens, would have to be stronger than they are.

[78] This interpretation is more natural if one takes '*τὸ ἠρεμοῦν πρῶτον*' (whether it is the subject or the object of '*κινεῖ*') to refer to Atlas. The point is that Atlas is first of all at rest, and hence has to set in motion not only the heavens but also himself. This is the interpretation of Nussbaum 1985, 307–9.

[79] As Lefebvre says, Aristotle's interest in our treatise is never in the quantity of force an animal requires in order to move its own body (2004, 133).

to hold the heavens up (so that he and the heavens remain stationary) to the power he needs to move them while also holding them up.[80]

On this interpretation, Aristotle first says that the mover (Atlas) moves what would otherwise be at rest (taking '*τὸ ἠρεμοῦν πρῶτον*' as the object of '*κινεῖ*'). Because of this, he says, Atlas' strength must be greater than (rather than merely equal to) his power for rest; that is, the strength Atlas needs to exert if he is to move the heavens must be greater than the strength he would need in order to keep them (and thus also himself) at rest. To keep the heavens at rest, Atlas would need to push them upwards with a force exactly equal to that with which they, because of their weight,[81] press down on him.[82] To move them, he needs to exert a strength that is greater than this, since he still needs to hold them up but he needs to exert more strength than this to make them move.

Aristotle now goes on to add that Atlas' strength (that is, the strength he would need to exert to move the heavens) would, similarly, need to be greater than the strength exerted by the heavens (that is, the power they exert in resisting movement). What is this strength exerted by the heavens? We have already remarked that the heavens, because of their weight, exert a downwards force on Atlas. Aristotle may think, in addition, that the heavens have a resistance to being moved in a circle (the downwards force is itself a kind of resistance to being moved upwards, but not a resistance to being moved in a circle). To hold the heavens up (and hence keep himself and them at rest), Atlas would have to exert on them a strength that exactly counterbalanced the downwards force of their weight. To move the heavens in a circle, Atlas would still have to exert this strength (since he would still have to resist their downwards force), but he would in addition have to exert a strength that was *greater* than the heavens' power to resist being moved in a circle.

On this interpretation, Aristotle is not first considering how much power Atlas will need to exert in order to overcome *his own* resistance to motion, and then (in '*ὡσαύτως . . . κινοῦντος δέ*') considering how much additional power he will need to exert in order to overcome the resistance-to-motion of the heavens. Rather, he is first pointing out that the power Atlas needs to exert in

[80] Here I am indebted especially to comments from Alan Code.

[81] If this is right, then at least for the purposes of this argument, Aristotle is assuming that the heavenly bodies have weight. At *Cael.* II 1, 284^{a}22–23, he says that this is an assumption made by those who invoke the Atlas myth. In *De Caelo*, this is an assumption he disputes (*Cael.* I 3, 269^{b}18–270^{a}12 and II 1, 284^{a}14–23), but then, on the view Aristotle endorses in *De Caelo*, the heavens would not need *any* external mover. I take it that Aristotle thinks his discussion so far has raised a puzzle for this kind of view: the heavens cannot be self-movers in the way that an animal is (since they have neither joints nor external things against which they can lean), but if they are self-movers in some *other* sense, how are we to understand this other sense?

[82] This follows from Aristotle's claim above that for a system to remain in equilibrium equal forces must be exerted (699^{a}37–^{b}1).

order to move the heavens is greater than the power he would need to exert to keep them at rest (that is, to keep the whole system in equilibrium), and then (in '*ὡσαύτως . . . κινοῦντος δέ*') pointing out that *this very power* (the power he needs to exert if he is to move them) will *also* need to be greater than the power that the heavens exert on him (that is, the total power they exert on him, both in pushing downwards and in resisting circular motion).

11. Aristotle's Conclusion: on this Story, the Earth Could Not Remain Stationary

Finally, Aristotle draws his conclusion: on this story, if the earth were to remain stationary, the power keeping it stationary would need to be at least as great as the power of the heavens and of what moves them (699^{b}8–10). Since he assumes that the earth could not have such a great power keeping it stationary, he concludes that on this story, the earth would be displaced.

What justifies Aristotle's claim that the power keeping the earth stationary would have to be at least as great as the power of the heavens and the power of what moves them? Aristotle's point, I think, must be that if the earth is to remain stationary, the rest-power of the earth will have to be (i) at least as great as the power exerted by the thing that moves the heavens (i.e. Atlas), and (ii) greater than the total power exerted by the heavens in resisting Atlas (this, I assume, is what is meant here by 'the power of the heavens').

Claim (ii), in fact, follows from claim (i). As we have seen, if Atlas not only holds the heavens up but also moves them, then the total power he exerts on them must be greater than the power they exert in resisting him (otherwise he would simply be keeping them stationary). If (as claim (i) asserts) the rest-power of the earth is at least as great as the power exerted by Atlas, and if the power exerted by Atlas is greater than the power exerted by the heavens, then the claim made in (ii) follows: the rest-power of the earth must be greater than the power exerted by the heavens.

Claim (i) is easily justified by the preceding discussion. To remain stationary, the earth would need to resist the downwards pressure with which Atlas pushed back against it. For this, its power to resist motion would need to be at least as great as the power Atlas exerted in moving the heavens[83] (at least, if we assume that the power Atlas exerts in pushing back against the earth must be equal to the power he exerts in moving the heavens). Thus, the earth's power to resist

[83] I take it that this is the point Aristotle made earlier, at 699^{b}1, where he said that the mover from within must 'exert no more pressure than the fixedness with which the earth remains still'.

motion (and hence stay at rest) would have to be at least as great as the power exerted by Atlas (that is, the power of the thing that moves the heavens).[84]

What this shows, then, is that if the earth were to remain stationary, the rest-power of the earth would have to be *at least as great as* the power exerted by the thing that moved the heavens (i.e. Atlas), and that that power (the power exerted by Atlas) would itself have to be *greater than* the total power exerted by the heavens. Hence, the earth's rest-power would have to be greater than the power exerted by the heavens and at least as great as the power exerted by what moves the heavens.[85]

Aristotle assumes that it is impossible for the earth to have this great a strength for resisting motion. He takes this to show that the heavens could not be moved by a mover of this kind, operating from within them (*ἀδύνατον καὶ τὸ κινεῖσθαι τὸν οὐρανὸν ὑπό τινος τοιούτου τῶν ἐντός*) (699^{b}10 sq.). Nothing that operated (as Atlas is said to do) like an animal, standing within the universe and pushing the heavens, could possibly succeed in moving them, since there is nothing within the universe that has the strength that would be needed to serve as a springboard for such a mover.

This, I think, is the most promising reconstruction of Aristotle's argument in this difficult passage. However, the argument (so understood) does depend upon certain undefended claims about the strength of the earth and the strength needed to move the heavens. Aristotle assumes, in particular, that Atlas would need to exert a great deal of strength in order to move the heavens in this way, and he assumes that the earth would not have enough power to support something that was exerting this strength. Both assumptions might be questioned. In response, it is worth noting that Aristotle himself does not need to rely on this argument in order to rule out the possibility that the heavens are moved by some mover pushing back against a springboard, for he immediately goes on to supplement it with a further argument at the beginning of chapter 4. His argument in chapter 4 is that even if a mover such as Atlas *could* in fact move the heavens by supporting himself against some springboard, his being able to do so (and thus, the continued existence of a stable universe with moving heavens) would wholly depend upon his strength and the strength of the springboard.

[84] The alternative is to take 'the strength of what moves the heavens' to be the power Atlas exerts in resisting being moved. But that makes it very puzzling that Aristotle says merely that the earth's strength needs to be 'at least as great' as this. What follows from his argument is that the earth's strength has to be at least as great *as the power Atlas exerts in moving the heavens*, (i.e. at least as great as the total power he exerts), but *greater than* any portion of that power he exerts just in resisting being moved himself.

[85] It is, admittedly, slightly misleading for Aristotle to express this as he does, since the claim he actually makes (that the earth's rest-power needs to be at least as great as that exerted by the heavens and what moves them) is weaker than the claim his argument supports (that the earth's rest-power needs to be greater than the power exerted by the heavens and at least as great as the power exerted by what moves them).

Aristotle argues that facts of this kind about the relative strengths of mover and springboard are too contingent to explain the *necessary* indestructibility of the universe (699^{b}21–23). This argument in chapter 4 does not depend upon any assumptions about how much strength the earth in fact has or how much strength is in fact needed to move the heavens.

However, one might still wonder why Aristotle discusses Atlas at such length here. After all, he elsewhere gives a much simpler argument against the view that any mover that was, like Atlas, finite in size could move the heavens: the heavens are moved eternally and nothing finite in magnitude could produce eternal motion (*Ph.* VIII 10).[86] Why, then, does he not simply dismiss the Atlas story with an argument of this sort? The answer, I suspect, is that he is interested in exploring in what sense the principle he articulated in chapter 1 is true: the principle that the origin of all movements is self-movement and the origin of self-movement is something that is unmoved (698^{a}7 sq.). Aristotle has been discussing one way in which animal self-motion has its origin in something unmoved: an animal moves itself by supporting itself against a springboard. This raises the question whether the movement of the heavens also depends ultimately on a self-mover that supports itself against something unmoved. As I suggested earlier, Aristotle explores this possibility in some detail here because he is trying to spell out in what sense heavenly motion has its origin in something unmoved. If heavenly motion does not depend upon the existence of an unmoved springboard, then we need some other account of the way in which this motion depends upon an unmoved origin.

12. Conclusion

Aristotle begins chapter 2 with the claim that an animal self-mover needs an external springboard if it is to move. He says that this claim also bears on questions about the movement of the universe. We can now see why. He will argue (in chapter 3 and in the first part of chapter 4) that the movement of the heavens could not be the result of the action of a self-mover, supporting itself against an unmoved springboard of this kind. In chapter 3, he argues against the possibility that the earth (or more generally anything within the heavens) could support such a mover; in chapter 4, he gives a more general argument that rules out the possibility that some unmoved springboard outside the heavens could support such a mover. If heavenly motion is not explained in this way,

[86] See also *Metaphysics Λ* 7, 1073^{a}3–13. Lefebvre 2004, 129 also remarks on the availability of this simpler argument.

then in what sense (if at all) does such motion depend on the existence of something unmoved?

In chapters 3 and 4, Aristotle provides an extended argument for the conclusion that what moves the heavens must be something that is unmoved, not a part of the heavens, and not in the heavens. By the end of chapter 3, he has argued that the heavens cannot be moved by a self-mover within them (such as Atlas); in chapter 4, he will argue that they cannot be moved by a self-mover that is outside them. In chapter 3, he has also ruled out certain ways in which the heavens might be moved by an unmoved mover: they cannot be moved by an unmoved mover that is a part of them, since no part of them can be stationary; nor can they be moved by point-like unmoved movers (like the poles) that are in the heavens without being parts of the heavens, since such point-like things cannot cause movement. In chapter 4, he goes on to discuss the remaining possibilities. The upshot of all this is that the heavens must be moved by an unmoved mover that is neither in them nor a part of them.

As I have said, this conclusion, in its turn, is relevant to Aristotle's account of animal self-motion. Aristotle's account of animal self-motion in *MA* 1 and 2, if taken by itself, might suggest that the reason something *unmoved* is needed for animal self-motion is simply so that it can provide an internal and external support: something against which the animal can push itself off when it moves. In chapters 3 and 4, we come to see that the movement of the heavens depends in quite a different way on something unmoved: it depends on the existence of an external *unmoved mover*. Once we appreciate this, we are naturally led to wonder whether *MA* 1 and 2 provide a full account of the role of unmoved things in animal self-motion. We are led to ask: might animal self-motion depend not simply on an unmoved support, but also on an external unmoved *mover*? This is a question to which Aristotle turns in chapter 6.