

## Chapter One

# The Stars Are Eternal.

In *On the Heavens*, his cosmological treatise, Aristotle argues that the heavenly bodies (moon, planets, sun, and stars) revolve around the earth on fixed circular paths. They are made of stuff not found here on earth and are more “honorable” than, ontologically superior to, bodies found in the sub-lunar sphere. They are weightless and eternal. They are divine.

We take Aristotle’s claims to be not merely wrong but laughably so. The sun, not the earth, is the center of our solar system, the planets do not move in circular orbits, matter is homogeneous, and stars have both weight and a history.

This chapter analyzes Aristotle’s arguments on behalf of these claims. Not only that: it defends them.

### I.1: There Are Only Three Dimensions.

Aristotle begins his study of the heavenly bodies by asserting that bodies, or physical entities in general, have three dimensions. A “continuous magnitude,” or an infinitely divisible measure of quantity, that is divisible in one way only is a line. A magnitude divisible in two ways, namely length and width, is a plane; in three ways—length, width, depth—a body. “There is no other magnitude or dimension besides these” (*On the Heavens* 268a9). Three-dimensional bodies are, therefore, the complete magnitude.

Proponents of today’s “string theory” would disagree. For them there are as many as twenty-six dimensions. Others would count time as a fourth dimension. Contemporary topologists are free to work (algebraically) with as many dimensions as they like. But for Aristotle, there are only three. Of course, three-dimensionality is the way in which we experience bodies in everyday life. But Aristotle does more than simply rely on this commonsensical fact as support for his position. Instead, he offers the following argument defending it.

There is no dimension other than these [the three dimensions] since three are all and “in three ways” is the same as “in all ways.” For<sup>#1</sup> just as the Pythagoreans say, the all and all things have been determined by the three. For<sup>#2</sup> end (*teleutê*), middle (*meson*) and beginning (*archê*) hold the number of the all, and their number is three. Thus it is that we have taken this number from nature as one of her laws. Furthermore<sup>#3</sup> we use this number in the rituals performed in worship of the gods. And<sup>#4</sup> the way we name objects reveals this same point as well. For of two things or two people we say “both” and we do not say “all.” We first use this term when it comes to three. As has been said, we follow these practices because nature itself leads us in this way. (268a9–20)

Aristotle summons four reasons, flagged by my underlining and numeration, to demonstrate that “three are all,” a proposition that in turn is used to support the claim that physical bodies have three dimensions. The first (#1) summons a reputable belief (one that is *endoxos*) passed down by the Pythagoreans.<sup>1</sup> On its own, such a reference would hardly prove that “three are all” or even explain what this phrase means. Nonetheless, as discussed in the Introduction, a reputable belief is that which “seems true to everyone or to most people or to the wise, either to all of the wise or to most of the wise or to the best known and most reputable of the wise” (*Topics*, 100b21–22) and by itself carries some evidentiary force. Even if it is neither entirely right nor maximally clear, it will never be all wrong. It can thus be counted as some sort of epistemic clue (>IV).

Aristotle next supplies an independent conceptual argument on behalf of the claim that “three are all.” He asserts in #2 that a whole must have an end, middle, and beginning, and thus is triadic in structure. This is the key to understanding and appreciating Aristotle’s argument and it is discussed in detail shortly (>I.2).

In #3 Aristotle alludes to religious practices in which the triad figures prominently. He may be referring to the pouring of one libation to the gods, a second to the heroes, and a third to Zeus the savior. Whether he is or not cannot be determined because so many Greek religious rituals were triadically structured.<sup>2</sup> This prominence of the triad may be derived from a primitive division of the cosmos into sky above, earth below, and some in between that mediates or connects the two. Hesiod, for example, has the god Sky descend upon the goddess Earth in order to begin the process of generating the rest of the cosmos. In this case, nightfall could be construed

as a connective tissue (as could rainfall). Many a myth, including one found in Plato's *Symposium*, treats human being as in between the immortal, found above, and the mortal, found below.<sup>3</sup>

Reason #4 refers to the fact that ordinary language, both Greek and English at least, testifies to the exceptional status of the three. If there are two apples on the table, and I tell you that I want them, you might ask, "Do you really want both?" You wouldn't ask, "Do you want all of them?" If my eyes hurt, and you ask me, "Which one hurts?" I will answer, "Both of them" rather than "All of them." The word "all" is first used when I have at least three items to count. (That Greek verbs have, in addition to the singular and the plural, the dual further reinforces this point.) For Aristotle, this linguistic observation counts as another piece of evidence for, a reason to believe that, threeness determines allness.<sup>4</sup>

Differently stated, in a (nontechnical) sense three is the first "real" number. If there is but a single item clearly visible on the table, say a book, no one would ask the question, "How many books are on the table?" Instead, someone might ask, "What's that on the table?" One item is not counted, but recognized for what it is. Only when there are at least two items does the question "How many?" become relevant. This fact is reflected in the Greek word *arithmos*, which means "number" as well as "a count." A count requires a plurality, a number of items or units. This is also why, in standard Greek arithmetic, two was taken to be the first number. (See *Physics* 220a27.) However, in order to determine that there are two books on the table, there must be some way of differentiating them. Either they are not by the same author, or even if they are two virtually identical copies of the same book, they are made from different pieces of paper and located in different places on the table. In short, if there is to be a two there must be a third; a differentiating principle. In this sense, three is the first "real" number.

Because reasons #3 and #4 seem to do no more than report bits of anthropological data, it is easy to formulate objections to them. Why, for example, should the fact that many religious rituals and practices are triadically structured play any role whatsoever in an argument about the nature of the nonhuman cosmos? This question resurfaces later in *On the Heavens* when Aristotle deploys a similar argumentative strategy. After having argued that the "first body," the fifth element of which the stars and planets are made, is eternal and divine, and so more "honorable" than any found here on earth, he asserts that "all human beings have a conception of the gods and all, both barbarian and Greek, assign the highest place to the divine" (270b5–7). He cites this putative fact as a supplementary piece

of evidence to confirm his theoretical analysis of the nature of the “first body.” Exactly as in #3, Aristotle marshals an anthropological datum—namely, that human beings regularly locate god upstairs—in the service of his scientific claim that the heavenly bodies above us are eternal. (Also see *Metaphysics* 1074b1–15.)

Aristotle seems to invest these sorts of anthropological data with the same sort of evidentiary value he finds in empirical observations. “By appealing to perception, this conclusion [that the heavenly bodies are eternal] follows in a manner sufficient in order to generate human conviction. For in all time past, according to the memory that has been passed down, no change has appeared (*phainetai*) to have taken place either in the whole of the outermost heaven or in any one of its proper parts” (270b13–15).<sup>5</sup>

In other words, according to the best record of empirical observations made by astronomers available at the time, nothing has changed in the heavens. Therefore, Aristotle reasons, the heavenly bodies must eternally move in the same orbit.

Aristotle’s conjunction of these two strands of evidence—one citing the phenomena of religious belief and ordinary language and the other empirical observations of the heavens—tells much about how he argues, how he thinks, in general. As discussed in the Introduction, his theory aims to do justice to the phenomena, the way the world shows itself to us in ordinary experience. It is, in other words, “phenomenological.” The “phenomena,” however, must be construed broadly, for they include both empirical observations and the “reputable beliefs” (*ta endoxa*). They include, as Owen put it in a famous essay, the *legomena*, “the things said” or “linguistic usage” or “the conceptual structure revealed by language.” Or to cite Nussbaum, in addition to empirical observations, “Aristotle’s *phainomena* must be understood to be our beliefs and interpretations, often as revealed in linguistic usage.”<sup>6</sup> The world shows itself to us not only through our senses, but also in the way we talk and how we conduct ourselves in daily life.

Because his theorizing is characterized by this sort of hybrid argumentation, Aristotle seems subject to the charge of anthropocentrism—or, even worse, anthropomorphism—of exactly the sort Bacon and Spinoza criticized so harshly. Regardless of whether this charge is fair or not, Aristotle himself certainly would deny that he is projecting a human perspective onto a nonhuman screen. Instead, he claims quite the opposite: “we follow these practices because nature itself leads us in this way” (268a19–20). So, for example, the number three is privileged in human practices and language not because human beings favor it, but because we “have taken it from nature” (268a13). The ways in which we speak and perform our religious

rituals are guided by the way things really are. In turn, such phenomena can provide evidence about the world as it really is.

Of course, it is necessary to explain why phenomena like ordinary language and religious practices have epistemic value. To prefigure the discussion whose elaboration constitutes a major chunk of Chapter Four, Aristotle believes that human beings by nature tend to get things right. As he puts it, “human beings are naturally and sufficiently disposed towards seeking the truth, and in most cases attain the truth” (*Rhetoric* 1355a15). We are “truthing” animals whose perceptual, cognitive, and linguistic apparatus are well suited to know the world. As such, it is entirely reasonable to pay attention to how we talk and act in order to figure out how things, including things like the planets and stars, really are.<sup>7</sup>

## I.2: Threeness Determines Wholeness.

Back to the argument in *On the Heavens*: bodies have only three dimensions because “end, middle and beginning hold the number of the all, and their number is three.” To begin elaboration, consider the following definitions Aristotle offers of the “all” and the “whole”:

1. “‘Whole’ (*holon*) means ‘that from which no part of that which is said to be by nature a whole is missing’ (*Metaphysics* 1023b26).
2. “That of which nothing is outside is complete (*teleion*) and whole. For we define a ‘whole’ thus: as that from which nothing is absent” (*Physics* 207a9–11).
3. “‘All’ (*pan*) means ‘a quantity that has a beginning, middle and termination point (*eschaton*) but whose positions make no difference.’ If position does make a difference, then it is a whole” (*Metaphysics* 1024a1–3).

A “whole” is an ordered unity of parts, whereas an “all” is an unordered collection or sum of parts. Aristotle’s terminology vacillates between these three texts and *On the Heavens*. In the latter, *pan*, translated as “all,” actually means “whole” in the sense given in the *Metaphysics* and *Physics* (and which is the only concern of this section).<sup>8</sup>

These definitions illuminate what Aristotle means when he says, to paraphrase, that the number of the whole is three; or that threeness

determines wholeness; or that wholes are by nature triadic. Because it is an ordered unity of parts, a whole has a beginning and an end, and something in between. So, for example, the word “BAT” is a whole. It is not an “all” because the position of the elements does matter. The word “BAT” cannot be captured by a simple list of its letters, for the letters B, A, and T can be combined in more than one way. “TAB” is not the same as “BAT.” For “BAT” to be what it is, its three letters must be in their proper order. A whole is more than “all” of its parts because it has a formal structure, an intelligible ordering of its parts. The spelling of “BAT” begins with the letter B and continues in proper sequence until T. Then the end has been reached, and the word is complete. “BAT” stands available for inspection as a whole.<sup>9</sup>

To approach this same point from a different angle: in the *Physics*, Aristotle says, “The whole and the complete (*teleion*) are either entirely the same or of kindred nature.” The whole is “complete” because its *telos*, its end, goal, or purpose, has been achieved and “nothing is complete that does not have a *telos*.” This implies, as Aristotle next states, that “the *telos* is a limit (*peras*)” (207a13–15). For if something can be completed then it is limited; after beginning and traversing what is in-between, an end is reached. Recall that in *On the Heavens* Aristotle says that the three-dimensional body is the “complete” (*teleion*: 268a22) magnitude. With it the counting of the dimensions reaches its end.

Another sense of *teleion* requires brief mention. In the *Metaphysics*, Aristotle assigns it two meanings. The first is essentially the same as that of the “whole:” it is that “outside of which it is impossible to find one of its parts” (1021b12–13). The second is “that which is in accord with excellence and the good cannot be exceeded in its kind. For example, a perfect doctor or a perfect flutist are those who, according to the form of the excellence that belongs to them, lack nothing” (1021b15–17). Here *teleion* is translated as “perfect,” which in English has the same ambiguity as the Greek; it means both “complete” or “without omission” and “most excellent” (>II.8). In some sense, then, three-dimensional bodies, as the complete or *teleion* magnitude, are better than lines or planes.

Aristotle argues that because “three are all and ‘in three ways’ is the same as ‘in all ways’”—in other words, because threeness determines the wholeness—there are only three dimensions. Three, in other words, is privileged, for it is the number of completeness. On the one hand, this is a just silly bit of numerology. Three is not special. It’s just another number. To glorify it as Aristotle (following the Pythagoreans) does is to invest it with qualities that belong not to it, but to a prejudice held by (some) human beings. On the other hand, if Aristotelian cosmology is construed

as phenomenological and is thus required to remain faithful to ordinary experience, a possible line of defense is opened up. For our experience is indeed constituted by the triadic nature of wholeness. Consider the following examples.

1. *The topological whole.* When we open our eyes and walk forward, what is in front of us appears as a triangulated whole. There is what is to the left of us, the right of us, and in front of us. When we stop walking and remain in one place, we can look upward to what is above, downward to what is below, and straight ahead to what is level with ourselves. Finally, there is front, back, and center. In sum, our experience of occupying a place in the physical world is triangulated, and is so in three different ways. In Aristotelian terms, there are six “parts and forms,” six “divisions” or “directions,” of place: up, down, left, right, front, back (*Physics* 208b12).

It is reasonably easy to explain why we experience the world this way. Like other animals, we are bilaterally symmetrical, and vision is thus bifocal. We have left and right eyes, as well as hands, legs, and so forth, and we divide our visual field directionally as a result. Left and right are defined by means of a center. There is that which is to the left of the center, that is, me, and that which is to the right, and so the horizontal directionality of the visual field is triangulated. So too is it divided vertically. There is the above me, accessible visually when I tilt my head and look upward, the below me, and the place I occupy right here. Because I look forward, but remember and so am aware that there is something behind, so too are these directions bifurcated.

Aristotle is thus quite right. Our experience of the world, of the way we occupy a place, is as a triangulated whole. But Aristotle does not rest content with this. For the next move he makes is to insist that the six directions are not relative to us.

Up and down, right and left [front and back] are not only relative to us. For they are not always the same in relation to us, but instead depend on our position so that when we turn they change. . . . In nature, however, each is distinct and exists independently. For that which is up is not a matter of chance but instead is to where fire or a light body moves. Similarly, what is down is not a matter of chance but is to where heavy or earthy bodies move. They differ not only in position but also in power. (*Physics* 208b14–22)

Up and down, left and right, are objective features of the world. As Aristotle puts it in *On the Heavens*, “it is clear that the heavens have up

and down and right and left” (285a30). Furthermore, “the beginning of the rotation of the heavens is the side from which the stars rise, so that would be its right, and where they set would be its left” (285b20). Such assertions seem to be a clear, even a pathetic, case of anthropocentrism. This at least was the verdict of one of Aristotle’s first modern critics. Giordano Bruno, an early (around 1600) advocate for an infinite universe, argued against Aristotle that “doubtlessly the inhabitants of the moon believe themselves at the centre [of a great horizon] that embraces the earth, the sun, and the other stars, and is the boundary of the radii of their own horizon.”<sup>10</sup> In other words, for the man in the moon, the earth is above and not below. In Bruno’s infinite universe, up and down are relative, and Aristotle’s argument that they are objective is faulty at best.

Nonetheless, Aristotle’s argument can be defended if we construe it as operating, to cite Nussbaum again, “inside the circle of appearances.”<sup>11</sup> We experience an orderly world divided into up and down and right here; we witness the sun rising in the East (to the right) and setting in the West. In this sense, *On the Heavens* is a “phenomenological cosmology,” a theoretical account of the way the heavenly bodies show themselves to us. Even so, Aristotle insists that his theory is objectively true of the world. We have, for example, privileged the number three as the source of wholeness not because of any uniquely human inclination, but because we have learned this lesson “from nature itself.” A comment by Helen Lang helps to explain.

Unlike later physics (and much philosophy) Aristotle’s arguments respond immediately and directly to experience. We experience objects as heavy and as always going down when they are left to “do their own thing”; the stars appear to move while we feel ourselves to be stationary and in the center. Indeed, the range of Aristotle’s examples, consistently appealing to everyday experience and common sense, may be unequalled in the history of science or philosophy. . . . By answering to experience, these arguments speak and have always spoken to their readers. And so they speak also to us.<sup>12</sup>

2. *The temporal triad.* Like our experience of a triangulated topological whole, by whose directions we orient ourselves as we propel ourselves through it, so too is our experience of time divided triadically. Aristotle defines time as “the counting of motion with respect to the before and after” (*Physics* 219b2). As he later formulates, “the now is a mid-point (*mesotês*)



serving as both beginning and end—the beginning of the future time, and the end of past time” (251b20–22).

3. *The syllogistic whole.* Logical reasoning, which for Aristotle is paradigmatically found in the “syllogism,” is the making of connections, and thus is structurally triadic. He explains: “a syllogism is a form of words (*logos*) in which, when some certain assumptions are made, something other than what has been assumed necessarily follows from the fact that the assumptions are such” (*Prior Analytics* 24b20). A syllogism is an argument, a logically connected whole, and it “is effected by means of three terms” (*Posterior Analytics* 81b10): the major, the minor, and the middle. (See *Prior Analytics* 26a22.) To illustrate, consider the first example Aristotle offers in the *Prior Analytics*: “if A is predicated of all B, and B of all C, A must necessarily be predicated of all C” (25b36–38). To diagram this in such a way as to make its structure visible:

All B is A.  
 All C is B.  
 Therefore, All C is A.

If all human beings (B) have hearts (A), and if all women (C) are human beings (B), then all women (C) have hearts (A). The major term is A; it is that “in which the middle is contained.” The minor term is C; it is that “which falls under the middle term” (26a3). The middle term (*to meson*) is B, and as the diagram above clearly shows provides the connective link that drives the logical inference forward. Syllogistic reasoning is a mode of logical connecting and as such is both holistic—it is a self-contained logical package—as well as triadic.<sup>13</sup>

4. *The practical whole.* “Excellence,” Aristotle writes in the *Nicomachean Ethics*, is a midpoint (*mestotês*) that aims at the mean (*to meson*) (1106b26–28). In other words, our practical or ethical lives are structured triadically. To explain by way of an example: you have a friend who is struggling financially. You have some money, and because you strive to be a generous person you want to help. But you are not quite sure how. On the one hand, if you give your friend too much money, you run the risk of demeaning and thus alienating her. A substantial gift can be construed as a kind of domination. On the other hand, you do not want to give too little, either. If you give your friend but a dollar, which provides no substantial assistance, you run the risk of being, and being thought of as, cheap. In order to be generous, and to retain the friendship, you must give just the

right amount: not too much, not too little. This is what Aristotle calls *to meson*, “the mean” or what can also be translated as “the middle” or “the center.” (See *Nicomachean Ethics* 1106b18 and >V.6.)

Our practical lives are triangulated as we aim to steer a middle path between too much and too little. If, in debating how much money to give your friend, you hit upon what is just right, you have achieved your goal, your *telos*, and completed the transaction well. Our actions, if successful, have a kind of wholeness to them that is determined by the three.

5. *A Whole Life*. A complete human life has three basic stages: being young, in the prime, and old. (See *Rhetoric* II.12–14.) Generally speaking, young people tend to be impetuous, passionate, trusting, hopeful, and eager for companions. At the other extreme, the very old are bad-tempered, mistrustful, small-minded, cowardly, miserly, and bereft of strong desire and hope. They talk repetitively about the past and have no sense of humor. Best of all are those in the prime of life, who are “in between” (*metaxu*: 1390a25) the two extremes. They aim for both what is fine and what is advantageous, are neither frugal nor extravagant, combine prudence with courage.

6. *Tripartite psychology*. When describing themselves, human beings have a natural tendency to bifurcate. So, for example, we often rebuke ourselves. If you eat the third piece of cake, knowing that the excess calories will do you no good, you may then get angry with yourself and even say aloud, “You idiot!” Who’s talking to whom here? Somehow the self speaks to itself. But this bifurcation invites, as always, a tripartition. For there must be some sort of bridge between the rebuker, which Plato in Book IV of the *Republic* called “reason”—in this case, the rational capacity to determine that a third piece of cake is unhealthy—and the rebuked, which he called “desire.” The bridge between the two is the emotional energy, in this case anger, that fuels the rebuke. Reason may determine that three pieces of cake are too many, even while desire craves them. But only by becoming angry at itself can the *psyche* rebuke itself. (The Greek word *psuchê* is usually but inadequately translated as “soul.” Throughout this book *psyche* is used: >IV.1. Thus, Aristotle’s book whose traditional title is *De Anima* is rendered as *On the Psyche*.)

In the *Nicomachean Ethics* Aristotle offers a similar psychological bifurcation: one aspect of the human *psyche* is rational or “has *logos*,” whereas the other is bereft of reason (*alagon*: 1102a28). The latter can be subdivided: one is “responsible for nurture and growth”—in other words is entirely irrational—whereas the other does “partake of reason” (1102b14). It can somehow listen to rational commands, and as such provides the bridge between the fully rational and the irrational aspects or parts of the *psyche*.

(Chapter Four below shows just how fully Aristotle deploys the notion of a tripartite *psyche*.)

7. *Motion (or change) is triadic.* In Book I of the *Physics*, Aristotle, as he customarily does, reviews the theories of his predecessors who did notable work in the study of nature (*phusis*). All were, in one way or another, concerned with articulating the principles that would explain the observable fact that natural beings move or change. Aristotle notes that in attempting to do this, his predecessors, the first physicists, “made their first principles opposites” (188a19). So, for example, Democritus believed that the world of physical change could ultimately be explained by reference to “the full,” his solid and indivisible atoms, and “the empty,” the void through which his atoms moved (188a22). Other thinkers invoked pairs of opposites, such as the hot and cold, wet and dry, odd and even, love and hate (188b33). First principles must come in pairs, Aristotle argues, because, since they are primary, they cannot be derived either from each other or from anything else. If a first principle could be explained as coming from something else, then it would not be first. Furthermore, there cannot be but one first principle since it must be “of something” (184a4); hence, the very notion of a principle implies that there must be at least two. Finally, there cannot be an unlimited number of principles because Nature itself is intelligible, and the unlimited is not knowable (189a15). (See >II.8.)

For the study of nature, there must be at least two opposed first principles because change is a kind of “becoming,” and when something changes it becomes other than it is. So, for example, my hair, formerly brown, became gray. As such, it became not-brown. An animal, now alive, will die and thus cease to be alive. An object here on my desk will fall to the floor. It is here now, but upon completing its fall will no longer be here. Change understood as something becoming other-than-what-it-was is thus a transition between opposites, and so it was that “the truth itself forced” (188b30) the first physicists to think in terms of opposites. But two principles by themselves are not enough to explain change. If my hair, once brown, is now gray and thus not-brown, it nonetheless remains my hair. Brown does not become not-brown; this is what happened to my hair. Brownness was once present in my hair; now it is gone. But the hair remains. Similarly, if the animal shifts from being alive to being not-alive, its body remains as a pile of inanimate material stuff. An animal is an organically intact and animated material clump rather than an inert and decomposing pile. Living cannot simply become dead; only animals suffer that change. In general, then, an opposite cannot simply leap over into its opposite. Instead, a third principle must somehow underlie or suffer the change. As

Aristotle puts it, “It is clear something must underlie the opposites, and that the opposites are always two” (191a4–5). Here today, gone tomorrow. What is? Something. Hence, the principles are three.<sup>14</sup>

Another opponent Aristotle takes up in Book I is Parmenides, who maintained that, appearances to the contrary, change is not really real. His argument was roughly this: If something changes, it comes to be other than it was. If something comes to be, it comes to be from either being or from non-being. If it comes to be from being, it does not really come to be at all. And nothing can come from non-being. Therefore, change itself is conceptually impossible.

To derail this argument, and to save the phenomena, Aristotle invokes three principles: matter, privation, and form. The privation is what is absent from something before it suffers a change. The form is what the substance gains, what becomes present in it, after the change has occurred. The remaining principle is the matter, what underlies and persists through the transition from absence to presence. This triad allows Aristotle to avoid the Parmenidean dilemma. When something changes or comes into being—when, say, my hair becomes gray—it comes into being both from what is, namely my hair, and from what is not; from the privation, the non-being, of gray.

This complicated train of thought is discussed below (>II.4). For the moment, let this suffice: change over time is experienced as a transition between opposites undergirded by a substratum underlying or suffering the change. When something changes, the process is a unified, because triadic, whole.

To put this point more simply: change proceeds from opposites. What is brown becomes gray or not-brown. “But there must be something underlying which changes to contraries, for it is not the contraries that change. Matter, this underlying object, remains during the change. [This, in addition to the two contraries, is the] the third besides the contraries” (*Metaphysics* 1069b8). Such is, at least, the experience of ordinary motion.

8. *The narrative whole*. In the *Poetics*, Aristotle says that a tragedy is an “imitation of an action that is serious, complete (*teleias*) and of a certain magnitude” (1449b25). Later he reformulates: “Tragedy is an imitation of an action that is complete and whole (*holês*: 1450b25),” and he defines a “whole” in the same terms he uses in *On the Heavens*: “that which has a beginning, middle and an end” (1450b27).

A good tragedy must have a unified plot. Plot, “the arrangement of the incidents” (1450a5), is defined as an “imitation of the action” (1450a4), and so it becomes the central element, or as Aristotle calls it, the animating principle or “soul” (1450a37), of tragedy as such. Without a unified nar-

rative or plot, a drama is no more than a string of episodes. It is not only a bad piece of work, but also a lifeless one.

A good tragedy requires narrative unity because it is an imitation of an “action” or a *praxis*. Like many of Aristotle’s critical terms, this one is equivocal. In the broadest sense, it can refer to any kind of “doing” whatsoever. In the *Historia Animalium*, for example, “the behaviors (*praxeis*)” of animals are said to be a way of differentiating them (487a11), while in the *Nicomachean Ethics* neither children nor animals are said to “act” (*praxeis*: 1111a26). One sense of the word is of a human life conceived neither as an isolated action nor as a sequence of merely biological activities, but as the consistent and characteristic pattern of activity a human being engages in over a long period of time. This is what Aristotle has in mind when he says in the *Politics* (1325a32) that “happiness is a *praxis*.” Happiness does not occur in an isolated or single moment. It is the work of a lifetime. This sense of *praxis* comes close to what Aristotle calls “actuality” (*energeia*) in his definition of happiness in the *Ethics* as “actuality in conformity with virtue” (1098b31), and is discussed in some detail below (>II.4, III.5, V.2).

A tragedy imitates a *praxis* in this last sense. It must have a unified plot structure because *praxis* conceived as a significant chunk of a human life is a meaningful whole.<sup>15</sup> To be intelligible one must be able to tell a story about it; it must have a beginning, a middle, and an end. We begin in childhood, and if we are lucky we mature and then die in our old age. In order for our lives, or any portion of our lives, to be meaningfully discussed or shared with another, there must be a coherent structuring of these parts. Human life, in other words, must have a narrative structure in order to make sense. We must be able to tell our stories. For example, when two people begin the process of getting to know each other, and perhaps of becoming friends, they exchange their stories. Where do you come from? Where did you go to school? Who are your parents, where do you live now? Indeed, as poets as old as Homer and neurologists as contemporary as Oliver Sacks have understood, stories are essential in the formation of human identity.<sup>16</sup>

That Aristotle offers the same definition of the “whole” in both *On the Heavens* and the *Poetics* sharply raises the question of whether he is anthropomorphizing. The subject of his cosmology is the heavenly bodies, which are surely not human, but it begins with a discussion of what seems to be a distinctly human notion, or experience, of wholeness. He says that all bodies must have three dimensions because “three is all.” Threeness determines wholeness because it is constituted by a “beginning, middle and end.” This may be true about stories we tell each other in order to make sense of our lives, and words like “BAT.” But Aristotle goes much further.

He says that “we have taken this number from nature itself” (268a14). To reiterate the objection that Hobbes, Bacon, and Spinoza would fire at him: this is anthropomorphic claptrap. We may like the number three down here in our little earthly village. We may use it in our religious practices and give it a special place in our language. Our perceptual, temporal, ethical, and linguistic lives may be organized around it. None of this, however, tells us much about “nature itself.”

Yes, it does. Aristotle articulates the contours of a world seen by the naked eyes of people who speak languages like Greek or English, who look upward to the sky and downward to the earth, who organize their spatial experience by means of left, right, and center. We are people who, in trying to be a decent friend, care about whether our gifts are too much or too little. And in making a friend, we share our stories. Our experience of the world comes in wholes, which are indeed constituted triadically. *On the Heavens* extends this basic conception to the uppermost spheres of the world. As such, his treatise is a work of “commonsense” or “phenomenological” cosmology. It articulates the structure of a world that in its entirety makes sense, and does so in thoroughly human terms.

### I.3: There Are Four Elements.

Back to the main argument of *On the Heavens*, in which Aristotle supports the contention that the stars are eternal. After establishing the three-dimensionality of bodies, he next asserts that there are four simple elements in the sub-lunar world; earth, air, water, and fire. This was the traditional view of Greek science—that is, a reputable belief—dating back at least two hundred years. The Greeks were off by ninety-nine, but the notion of a finite number of primitive elements that compose the larger conglomerates of the material world has long retained its grip on the scientific imagination.

One might wonder, however, why, if threeness determines allness, there are four elements. This is not an inconsistency because Aristotle nowhere insists that all fundamental principles must come in threes. If he were to slavishly follow the principle of threeness by claiming that there are only three elements, he would blind himself to the phenomena. Instead, he bases his enumeration of the elements on the *endoxa*, the prevailing conceptions of ancient “chemistry,” which itself was based on naked-eye observation of what is given to us on a bulky scale in ordinary experience. We take fire and water to be fundamentally unlike each other because we use one to make the other disappear. Earth resists and air surrounds. But the best way to defend the Aristotelian quartet is to try to challenge his thesis on the

same level on which he offers it: what would be a reasonable candidate for a fifth, readily observable element that would be on a par with earth, air, fire, and water? No answer. There are only four.

#### I.4: Elements Naturally Move to Their Natural Place.

*On the Heavens* continues: “We say that all natural bodies and magnitudes are capable in themselves of locomotion [movement in place]. For we say that nature is the origin of motion in them” (268b17). A similar statement is found in the *Physics*: a being that is by nature “has in itself the origin of motion and rest” (192b13–14).

Natural bodies move from place to place. That the origin of their doing so is “in themselves” does not mean that things like rocks move themselves. Self-movement is reserved for living beings, while rocks need to be moved by something else. Still, that they are capable of being moved is a fundamental aspect of what they are, and in this sense movability is “in” them.

On the other hand, there is a sense in which the principle of motion of natural bodies is “in themselves.” If I throw a rock up in the air, it will return to earth. It will do so on its own unless it is impeded by some countervailing object. As a natural being, a rock has its own “natural motion.” Because it is an earthy thing, its natural direction or inclination is downward, or “toward the center.” When the rock hits ground, it stays there. It is at rest and will remain so unless moved by another object because it has reached its natural resting place. The same pattern holds for fire and air. They naturally move upward, away from the center, whereas water flows downward. As Lang puts it, “inclination is an intrinsic ability in each element to be moved toward its proper place as found in nature.”<sup>17</sup>

Aristotle’s conception of place (*topos*) is fundamental not only to his physics but, as Chapters Five and Six of this book show, to his ethical and political thinking as well. In fact, his entire view of the world is deeply “topological.” He begins discussing place in *Physics* Book IV by saying that “everyone assumes that beings (*ta onta*) are somewhere. For what is not is nowhere. For where is the goat-stag or the sphinx?” (*Physics* 208a29–31).<sup>18</sup> We regularly, perhaps even naturally, ask where something is. The goal of *Physics* Book IV is thus to provide an answer to the question “What is the where of things?” (Lang 1998, 68).<sup>19</sup>

There are at least two reasonable candidates for a general answer: in a place or in the void. Aristotle rejects the latter because for him it is no more than “a special case of place, i.e., a place with nothing in it” (Lang

1998, 68). Because his conception of the void is similar to the indeterminate space of the modern universe, his rejection of it sheds light on how radically his physics differs from our own. Most important, Aristotelian place, unlike space, has a kind of “power” (208b11), which is intimately linked to the notion of the objectivity of direction. Each of the four elements, unless obstructed, is carried to its own place. Fire is always carried up and earth down. As mentioned above (<I.2), the six distinctions within, or the six forms of, place—up, down, left, right, front, and back—are not just relative to us, but are objective features of the natural world. Places do not differ merely by position. Instead, they have a kind of causal power insofar as the elements naturally move toward them. An earthy, heavy body naturally moves downward. By contrast, the void is no more than a neutral or indeterminate space through which all bodies move by following the same laws of motion. Most important, space of this sort “is internally undifferentiated—two spaces are identical, if they are of equal dimensions” (Lang 1998, 69). Aristotle sees it differently. The heavens above us are different from the earth below. Fire goes up, water down. Right, where the sun rises, is different from left where it sets. The world is heterogeneous, differentiated, stratified into different places.

Aristotle’s theory of place may seem easily debunked by means of Newtonian mechanics and its concept of empty space. It is not, for Aristotle’s theory conforms to the patterns of everyday interaction with the material world. When we perceive a body, say a tree, it is located somewhere. We do not experience it as being in the midst of an indeterminate space whose many locations can only be determined by means of a coordinate system, for we never actually experience the indeterminate or the void. This is why “most people” assign such significance to place. Things belong somewhere. When we build a campfire, we put the newspaper on the bottom, the kindling on top of that, and the heavier pieces of wood on top of the kindling. We do so because we know that fire moves upward. When we buy a house, we examine the basement carefully to see if there has been water damage, because that is where water goes. The world makes sense. It is orderly. Things have a place.

Not surprisingly, Aristotle cites a reputable opinion as confirmation of his topologically based physics. He refers to the poet Hesiod, whose *Theogony* is the story of how the world and all its objects came into being. First of all, says Hesiod, there was *chaos*, which even if etymologically the same as our “chaos” (which means an unordered mess of parts) is better translated as “chasm” or even emptiness. Immediately after the chasm came earth. Aristotle interprets this line as revealing Hesiod’s understanding of the



fact that there needs to be a place for all the many things—trees, mountains, people, rivers, nymphs—his poem describes as coming into being. For they cannot exist nowhere or in the chasm.

That there is place and that it is independent of bodies and that every body is perceptible as being in a place is a reasonable belief. Thus it would seem that Hesiod spoke correctly when he made “the chasm” the first of all things. For he wrote, at any rate, that “first of all the chasm came to be, and then next broad bosomed earth.” He did so because he understood that it was necessary first of all for there to be room for things. Just like most people, he understood that every thing has to be somewhere and in a place. (*Physics* 208b27–33)<sup>20</sup>

Aristotle defines *topos* as the limit “of the containing body” (211b14). As such, place is not itself a material part of a thing. Instead it is more like the form or the shape of a thing. My computer has three dimensions and is sitting on my desk. It is made of stuff like plastic and silicon; in Aristotle’s lingo, some bits of earth, air, water, or fire. The stuff has been molded into a shape or form by the computer maker. Its shape is visible, which is why the Greek word for form, *eidos*, is derived from the verb “to see” and could be translated as “the look” of a thing. Rather than being a separate part, the form is the entirety of the way the computer, shaped by its outermost edge or limit, looks.

Even though it too is a limit, a place is not a form. A form “is the limit of the thing contained whereas place is the limit of the containing body” (Lang 1998, 86). A place is like a “vessel” (210a24). A vessel, like a bottle, is that which things, which have a form, are *in*. Like an immovable vessel, a place “holds” change.

Problems aplenty arise. For example, place seems close to being a body because it is three-dimensional, but the phenomenon of “replacement” shows that it is not. There may now be water in a bottle. When the water is poured out it is replaced by air. Where the water was is now where the air is, and the air also could be replaced by another body. Because the same place can be occupied by different bodies, place is not body. (See *Physics* 208b1–7.) Nor, as argued above, is it a form. Instead, place “is the first unmoved limit of that which contains” (212a20).

To do more than scratch the surface of this issue would require a much longer book. For present purposes the key point is only this: place has “power.” It causes the “order of nature” itself. Lang explains that “place is the

formal constitutive principle that renders the cosmos directional . . . and so constitutes all place within the cosmos as ‘up,’ ‘down,’ and so forth” (Lang 1998, 69). It is precisely such directionality that renders the cosmos itself orderly. To cite Koyré’s definition again, a cosmos is “a conception of the world as a finite, closed, and hierarchically ordered whole.” To say it is “hierarchical” means that things have their place. They fit somewhere in the cosmos. Stars are above us, earth below, and animals like us are in between.

By contrast, in a universe of indefinite space nothing belongs anywhere or is objectively above or below, to the right or the left. Such directions are entirely relative, for there is no stable center. Perhaps this is the view from the perspective of the Hubble telescope, but it defies the logic of human experience and activity. We do belong. We are higher than mosquitoes, which is why we do not clutch in guilt when we kill one, and we are lower than the sun, on which all life on earth depends. Aristotle’s physics is topological. It articulates a finite, determinate cosmos, not an indefinite universe. While the notion of a cosmos is entirely outdated in the twenty-first century, it is so only in the hands of the practicing astrophysicists. For daily life is lived in order, in a place, on earth, at home.

Koyré reveals much when he offers the following eulogy of Copernicus. “It is very difficult,” he tells us, “at the present time to comprehend and appreciate the magnitude of intellectual effort, boldness and moral courage involved in the work of Copernicus.” The heliocentric system he championed forced him to challenge and then dismiss “what common sense accepts with naive, confident certitude”; namely the apparently observable facts that the earth stands still and the heavens above move, facts that were enshrined not only in the cosmology of ancient and medieval physics, but in philosophy and theology as well. Copernicus was “incomparably daring” because his thought “tore the Earth from its foundations and launched it into the heavens.”<sup>21</sup> He forced the scientist to think himself outside of himself, into a world of mathematical physics in which human beings have no special place. His physics was a vast improvement over Aristotle’s in terms of actually understanding how the solar system works. It fulfilled the Baconian dream of forging a new knowledge that actually bequeaths to its possessor genuine power. For only in the light of the Copernican revolution has it become possible to create machines that can actually take us to the moon, launch the Hubble telescope, and let us glimpse the universe for what it really is.

The problem is that we still do live on earth and so, as long as we are here, the stars are above us, the earth under our feet.

The background assumptions Aristotle needs to complete his argument that the stars are eternal are now available, and so he can continue.

Every motion from place to place [locomotion] is either straight or circular or a mixture of the two. For these two are the only simple motions. The reason for this is that straight and circular lines are the only simple magnitudes. Circular motion is that around the center; straight is up and down. By “up” I mean away from the center; by “down” I mean toward the center. Thus, every simple motion is either away from the center, towards the center, or around the center. This seems to follow the argument put forth at the beginning: for body was completed by the number three and so too is the motion of body. (*On the Heavens* 268b17–27)

Here Aristotle does invoke the principle that threeness determines allness but not in order to clinch his argument that there are only three simple motions. Instead, his conclusion “seems to follow” his earlier argument that, like all else, body is completed by the three, and so has only three dimensions. His actual argument is independent. There are only two simple lines—the straight and the circle—and thus only two simple motions that correspond: rectilinear and circular. There are, therefore, only three primary, directed motions: straight up, or away from the center; straight down, or toward the center; and circular motion around the center. As just discussed, each of four simple bodies has a natural motion. Earth and water move straight down, fire and water move straight up. But what moves around in a circle? This is a slot that has to be filled, and by a simple body. None is available, at least down here on earth. Therefore, Aristotle concludes, the simple body that moves in a circle must be composed of a fifth element unlike the four sub-lunar ones, all of which naturally move in a rectilinear fashion. That this “first body” moves in a circle has extraordinary consequences.

### I.5: The Circle Is Perfect.

Circular motion is “primary” because the circle, unlike any other figure, is “complete” or “perfect” (*teleion*: 269a20; <I.2, >II.8). An infinite line cannot be complete for the obvious reason that it has no end, and a

finite line segment can always be extended (269a23). A circle is complete, intact, wholly itself, because its radius cannot be extended or shortened without an entirely new circle being drawn. It simply is what it is, for it lacks nothing.

Regardless of whether the circle is “perfect” within the field of geometry, it can be verified phenomenologically. For the circle maintains a very strong hold on our imaginations. Perhaps this is because we are conscious of living diurnally; our days revolve from dawn to dawn. Our seasons too move cyclically, beginning in spring, moving through the harvest of fall, dying in the winter only to begin again. If we are lucky we give birth to our children, who give birth to theirs, and we thereby become, however metaphorically, immortal. In these senses, the circle represents completion.

As every teacher knows, a classroom whose seats are arranged in a circle has an entirely different feel than one whose seats are arranged in straight lines that direct the student’s attention to the front. In the latter, there is a single authority figure to whom the students defer. In the former, every seat is equal. Each point on a circle is both beginning and end, and equidistant from the center. There is no way of adding a seat without changing the circle. Because of its completeness, each individual is an equal participant, and conversation is more likely to occur. Any number of traditions, from religious conceptions of sacred geometry to artistic ones that feature the circle and sphere, could be summoned to reinforce this privileging of the circle. Such reasoning sounds like anthropomorphizing at its worst. Hume certainly thought so.

Euclid has fully explained all the qualities of the circle; but has not, in any proposition, said a word of its beauty. The reason is evident. The beauty is not a quality of the circle. It lies not in any part of the line, whose parts are equally distant from a common center. It is only the effect, which that figure produces upon the mind, whose peculiar fabric or structure renders it susceptible of such sentiments.”<sup>22</sup>

For Hume, the aesthetic experience of the beautiful circle is explicable solely on the basis of the “peculiar fabric or structure” of the human mind. In his view, to attribute beauty to the circle is to impose or project human inclinations upon it. Even if this were so, it still would not be necessary to junk Aristotle. If the goal of his theory is to save the phenomena, and these include a wide variety of human experiences and practices, then his argument too can be saved. As he says, “for they say that human affairs