

the uneducated can become educated. But bare opposites such as white and not-white cannot turn into each other; some underlying thing that had one of the opposites in it comes to have the other in it. Now either of these opposites gives some sort of order or definiteness or *form* to the indeterminate underlying thing, and with respect to it, the other opposite is a lack or deprivation of that form. Deprivation of a form in some underlying thing capable of possessing that form is a special kind of non-being. Parmenides' thinking had lost its way over the impossibility of thinking what is not, while all change would have to be from what was not. But while a rock is not educated, only a human being can be uneducated. The deprivation of form in some underlying material to which that form is suited is a potent kind of non-being that yearns for what it lacks. The single ultimate opposition that stands behind all possible pairs of opposites is the distinction between form and material. Aristotle is often accused of taking this distinction from the realm of art and imposing it arbitrarily on nature. One needs only to read Chapters 5 through 9 of Book I of the *Physics* to see that this distinction is in fact deduced as a necessary condition of change in general.

The idea of form is explored in many of Plato's dialogues, and it is later members of Plato's Academy to whom Aristotle refers at the beginning of Chapter 9 as not having paid sufficient attention to the nature of material. Aristotle understands material as potency, stretching out toward form. An account of form itself belongs to "first philosophy," what we call metaphysics, and can be found especially in Books VIII and IX of Aristotle's *Metaphysics*. For the purposes of the study of nature, which Aristotle calls "second philosophy," form and material together, necessarily involved in all becoming, are available as starting points for an approach to understanding.

Book II, Chapters 1–3

Causes

Chapter 1

192b, 8 Of the things that are, some are by nature, others through other causes: by nature are animals and their parts, plants, and the simple bodies, such as earth, fire, air, and water (for these things and such things we say to be by nature), and all of them obviously differ from the things not put together by nature. For each of these has in itself a source of motion and rest, either in place, or by growth and shrinkage, or by alteration; but a bed or a cloak, or any other such kind of thing there is, in the respect in which it has happened upon each designation and to the extent that it is from art, has no innate impulse of change 20 at all. But in the respect in which they happen to be of stone or earth or a mixture of these, they do have such an impulse, and to that extent, since nature is a certain source and cause of being moved and of coming to rest in that to which it belongs primarily, in virtue of itself and not incidentally. (I say not incidentally because someone might himself become a certain cause of health in himself if he is a doctor. Still, it is not in the respect in which he is cured that he has the medical art, but it happens to the same person to be a doctor and be cured, on account of which they are also sometimes separated from each other.) And similarly with each of the other things produced: for none of them has in itself the source 30 of its making, but some in other things and external, such as a house and each of the other products of manual labor, others in themselves but not from themselves, as many as incidentally become causes for themselves.

Nature then is what has been said, and as many things have a nature as have such a source. And every thing that has a nature is an independent thing, since it is something that underlies [and persists through change], and nature is always in an underlying thing. According to nature are both these things and as many things as belong to these in virtue of themselves, as being carried up belongs to fire. For this is not a nature, nor does it have 193a a nature, but it is something by nature and according to nature. What nature is,

then, has been said, and what is something by nature and according to nature. *That* nature is, it would be ridiculous to try to show, for it is clear that among the things that are, such things are many. But to show things that are clear by means of things that are unclear is the act of one who cannot distinguish what is known through itself from what is known not through itself. (That it is possible to suffer this is not unclear, for someone blind from birth might reason about colors.) So it is necessary that the speech of such people be about names, while they have insight into nothing.

10 Now to some it seems that nature or the thinghood of things by nature is the first thing present in each which is unarranged as far as it itself is concerned; thus the nature of a bed would be wood, and of a statue, bronze. And Antiphon says that a sign of this is that, if someone were to bury a bed, and what rotted had the power to put up a sprout, it would not become a bed but wood, since what belongs to it by accident is the arrangement according to convention and art, while the thinghood of it is that which remains continuously even while it is undergoing these things. And if each of *these* things is in the same case in relation to something 20 else (as bronze or gold to water, and bones or wood to earth, and similarly with anything else at all), *that* would be the nature and thinghood of them. On account of which, some say fire, some earth, some air, some water, some say some of these, and some all of these to be the nature of things that are. For whatever from among these anyone supposes to be such, whether one of them or more, this one or this many he declares to be all thinghood, while everything else is an attribute or condition or disposition of these; and whatever is among these he declares to be eternal (since for them there could be no change out of themselves), while the other things come into being and pass away an unlimited number of times.

In one way then, nature is spoken of thus, as the first material underlying each of the 30 things that have in themselves a source of motion and change, but in another way as the form, or the look that is disclosed in speech. For just as art is said of what is according to art or artful, so also nature is said of what is according to nature and natural. We would not yet say anything to be according to art if it is only potentially a bed and does not yet have the look of a bed, nor that it is art, and similarly not in the case of things composed by nature. 193b For what is potentially flesh or bone does not yet have

its own nature, until it takes on the look that is disclosed in speech, that by means of which we define when we say what flesh or bone is, and not until then is it by nature. So in this other way, nature would be, of the things having in themselves a source of motion, the form or look, which is not separate other than in speech. (What comes from these, such as a human being, is not nature but by nature.)

And this form or look is nature more than the material is. For each thing is meant when it is fully at work, more than when it is potentially. Moreover, a human being comes about from a 10 human being, but not a bed from a bed. On this account, they say that not the shape but the wood is the nature, since if it were to sprout, it would become not a bed but wood. But if, therefore, this is nature, then also the form is nature, for from a human being comes a human being. And still further, the nature spoken of as coming into being is a road into nature. For it is not like the process of medicine, which is meant to be a road not into the medical art but into health, for it is necessary that the medical process be from the medical art and not into it. But not thus is nature related to nature, but the growing thing, insofar as it grows, does proceed from something into something. What then is it that grows? Not the from-which, but the to-which. Therefore nature is the form.

20 But form and nature are meant in two ways, for deprivation is a sort of form. But whether in the case of a simple coming-into-being there is or is not a deprivation and an opposite, must be looked into later.

Chapter 2

Now that nature has been marked off in a number of ways, after this one must see how the mathematician differs from one who studies nature (for natural bodies too have surfaces and solids and lengths and points, about which the mathematician inquires), and whether astronomy is different from or part of the study of nature. For if it belongs to the one who studies nature to know what the sun and moon are, but none of the properties that belong to them in themselves, this would be absurd, both in other ways and because those 30 concerned with nature obviously speak about the shape of the moon and sun and especially whether the earth and the cosmos are of spherical shape or not.

The mathematician does busy himself about the things mentioned, but not insofar as each is a limit of a natural body, nor does he examine their properties insofar as they belong to them because they pertain to natural bodies. On account of this also he separates them. For in his thinking they are separated from motion, and it makes no difference, nor do they become false by being separated. Those who speak of the forms also do this, but without being aware of it, for they separate the natural things, which are less separable than the 194a mathematical ones. This would become clear if one should try to state the definitions of each of these things, both of themselves and of their properties. For the odd and even, and the straight and the curved, and further, number, line, and figure will be without motion, but no longer so with flesh, bone, or human being, but these are spoken of like a snub-nose and not like the curved. The more natural of the mathematical studies, such as optics, harmonics, and astronomy, also show this, for they in a certain way stand contrariwise to geometry. For 10 geometry inquires about a natural line, but not as natural, but optics about a mathematical line, not as mathematical but as natural.

But since nature is twofold, and is both form and material, we must consider it as though we were inquiring about what snubness is. As a result, such things will be neither without material, nor determined by their material. And in fact, since there are two natures, one might be at an impasse about which of them belongs to the study of nature. Or is it about that which comes from both? But if it is about that which comes from both, it is also about each of the two. Then does it belong to the same study or different ones to know each? If one looks to the ancients, it would seem to be about material (for only a little bit 20 did Empedocles and Democritus touch on form or the what-it-is-to-be of things). But if art imitates nature, and if it belongs to the same knowledge to know the form and the material to some extent (as it is the doctor's job to know health and also bile and phlegm, in which health is, and the housebuilder's to know both the form of a house and its material, that it is bricks and lumber, and in like manner with the rest), it would also be part of the study of nature to pay attention to both natures.

Further, that for the sake of which, or the end, as well as whatever is for the sake of these, belong to the same study. But nature is an end and a that-for-the-sake-of-which. (For of those things of which

there is an end, if the motion is continuous, the end is both the last 30 stage and that for the sake of which; which induced the poet to say, absurdly, "He has his death, for the sake of which he was born." For not every last thing professes itself to be an end, but only what is best.) And the arts make even their material, some simply and others working it up, and we make use of everything there is as though it is for our sake (for we are also in some way an end, and "that for the sake of which" is double in meaning,^o but 194b this is discussed in the writings on philosophy). But the arts which govern and understand the material are two, one of using and one of directing the making. The art of using is for that very reason somehow directive of the making, but they differ in that the one is attentive to the form, the other, as productive, to the material. For the steersman recognizes and gives orders about what sort of form belongs to the rudder, but someone else about what sort of wood and processes it will come from. In things that come from art, then, we make the material for the sake of the work, but in natural things it is in being from the beginning. Further, material is among the relative things: for a different form, a different material.

10 To what extent is it necessary for the one who studies nature to know the form or whatness? Is it just as the doctor knows connective tissue or the metal-worker knows bronze, to the extent of knowing what each is for the sake of, even about those things which, while separate in form, are present in material? For both a human being and the sun beget a human being. But what manner of being the separate thing and the whatness have, it is the work of first philosophy to define.

Chapter 3

These things having been marked out, it is necessary to examine the causes, both what sort there are and how many in number. For since this work is for the sake of knowing, but we think we do not yet know each thing until we have taken hold of the why 20 of it (and to do this is to come upon the first cause), it is clear that we too must do this about both coming into being and passing away and about every natural change, so that, once we know them, we may try to lead back to them each of the things we inquire about.

One way cause is meant, then, is that out of which something comes into being, still being present in it, as bronze of a statue or silver of a bowl, or the kinds of these. In another way it is the form or pattern, and this is the gathering in speech of the what-it-is-for-it-to-be, or again the kinds of this (as of the octave, the two-to-one ratio, or generally number), and the parts that are in its articulation. In yet another it is that from which the first 30 beginning of change or of rest is, as the legislator is a cause, or the father of a child, or generally the maker of what is made, or whatever makes a changing thing change. And in still another way it is meant as the end. This is that for the sake of which, as health is of walking around. Why is he walking around? We say "in order to be healthy," and in so saying think we have completely given the cause. Causes also are as many things as come 195a between the mover of something else and the end, as, of health, fasting or purging or drugs or instruments. For all these are for the sake of the end, but they differ from one another in that some are deeds and others tools.

The causes then are meant in just about this many ways, and it happens, since they are meant in more than one way, that the non-accidental causes of the same thing are also many, as of the statue both the art of sculpture and bronze, not as a consequence of anything else but just as a statue, though they are not causes in the same way, but the one as material and the other as that from which the motion was. And there are also in a certain way causes of one another, as hard work is a cause of good condition and this in turn is a cause of hard work, though again not in 10 the same way, but the one as end and the other as source of motion. Further, the same thing is a cause of opposite things. For the present thing is responsible for this result, and we sometimes blame it, when it is absent, for the opposite result, as the absence of the pilot for the ship's overturning, whose presence was the cause of its keeping safe. But all the causes now being spoken of fall into four most evident ways. For the letters of syllables and the material of processed things and fire (and such things) of bodies and parts of a whole and hypotheses of a conclusion are causes as that out of which, and while the one member of each 20 of these pairs is a cause as what underlies, such as parts, the other is so as the what-it-is-for-it-to-be, a whole or composite or form. But the semen and the doctor and the legislator, and generally the maker, are all causes as

that from which the source of change or rest is, but other things are causes as the end or the good of the remaining ones. For that-for-the-sake-of-which means to be the best thing and the end of the other things, and let it make no difference to say the good itself or the apparent good.

The causes then are these and are so many in form, but the ways the causes work are many in number, though even these are fewer if they are brought under headings. For cause 30 is meant in many ways, and of those of the same form, as preceding and following one another. For example, the cause of health is the doctor and also the skilled knower, and of the octave the double and also number, and always comprehensive things in relation to particular ones. Further, there is what is incidental, and the kinds of these, as of the statue, in one way Polycleitus and in another the sculptor, because it is incidental to the sculptor to be Polycleitus. And there are the things comprehensive of the incidental cause, as if a 195b human being were the cause of a statue, or generally, an animal. And also among incidental things, some are more remote and others nearer, as if the pale man or the one with a refined education were said to be the cause of a statue. And all of them, both those meant properly and those incidentally, are meant some as potential and others as at-work, as of building a house, either the builder or the builder building. And similarly to the things that have been said, an account will be given for those things of which the causes are causes, as of this statue or a statue or in general an image, and of this bronze or of bronze or in general of 70 material, and likewise with the incidental things. Further, things tangling these and those together will be said, such as not Polycleitus nor a sculptor but the sculptor Polycleitus.

Nevertheless, all these are six in multitude, but spoken of in a twofold way: there is the particular or the kind, the incidental or the kind of the incidental thing, and these entangled or spoken of simply, and all as either at-work or in potency. And they differ to this extent, that what is at-work and particular is and is not at the same time as that of which it is the cause, as this one healing with this one being cured or this one building with 20 this thing being built, but not always so with what is potential. The house and the house-builder are not finished off simultaneously.

And it is necessary always to seek out the ultimate cause of each thing, and in just the same way as with the others. (For example, a

man builds because he is a builder, but is a builder as a result of the housebuilder's art; this, then, is the prior cause, and thus with everything.) Further, the kinds belong to the kinds and the particulars to the particulars (as a sculptor to a statue, but this sculptor to this statue.) Also the potencies belong to the potencies, but what is at work corresponds to what is being worked upon. How many then are the causes and in what way they are causes, let it have been marked out sufficiently for us.

Commentary on Book II, Chapters 1–3

Since Book I was preparatory for the inquiry into nature, Book II is its true beginning. Aristotle identifies nature as an “innate impulse of change” that not only sets things in motion but governs the course of those motions and brings them to rest. Only certain things have such inner sources of motion. A tentative list of natural beings is given in the first sentence of Book II, but it is corrected in the second paragraph. The *parts* of animals are not independent things, so while blood, say, or bone is natural, neither of them is that to which an inner source of motion belongs primarily, in virtue of itself. It is only the whole animal that has a nature, or a whole plant. Similarly, *fire* cannot properly be said to have a nature, since it is incapable of being a whole. Like blood and bone, fire, along with earth, air, and water, is only part of the whole being that has a nature. The ordered whole of the cosmos is the one independent thing in nature that is not an animal or plant.

What is the nature of a natural being? Almost all of Aristotle's predecessors would have located the nature of anything in the unorganized material underlying it. It is this material nature that would reassert itself if, in Antiphon's fantasy-experiment, a buried bed were to rot and put up a sprout. Aristotle begins by granting this materialist account of nature, but then modifies it in three steps: even if nature is material, it is *also* form; but nature is *more-so* form than material; and finally, nature *is* form. This is a characteristic way that Aristotle argues, and it shows why sentences from his writings cannot be casually plucked out of context. The materialist account has an initial plausibility, but in nature, when something develops or grows, it is the to-which of the process, not the from-which, that

governs it. And Antiphon's example misses the point in any case; the bed is certainly not natural, but what underlies it is not undifferentiated wood, and this would be apparent by his own experiment. If anything sprouted it would not be unarranged wood, which human artisans produce by doing violence to trees, but an intact young olive tree, or cypress, or oak. When one adjusts one's perspective, both the from-which and the to-which of any process of growth are the same, and each is the form of a natural kind—oak tree in one case, human being in another.

But how should form be understood? Those of Aristotle's predecessors and contemporaries who were not materialists, the Pythagoreans and the members of Plato's Academy, understood the true natures of things to be mathematical. They too miss the mark, but on the opposite side, since they treat natural things as though they had no material. Natural things are not determined by their material, but they are composed of both material and form. The mathematician loses sight of motion altogether, in the rich sense of motion that natural beings display, which includes birth, growth, and qualitative change. Nor can the mathematical perspective recognize anything as inherently whole, and it therefore cannot see the wholeness for the sake of which natural beings do all that they do. Aristotle's understanding of nature is causal and therefore cannot be mathematical. It is a striking fact about the mathematical physics of our own times that its founders repeatedly and explicitly abandon the quest for causes. Galileo, Descartes, and Newton tell us that the investigation of causes in nature is useless, unnecessary, and inappropriate to the science. One legacy of the centuries during which mathematical physics has flourished is the virtual disappearance of the idea of cause as the origin of responsibility for the way something is.

According to Aristotle, the responsibility for anything can be traced back along four lines of investigation. First there is the material out of which something comes to be. This is a cause only according to the understanding of material achieved in Book I, Chapter 9, as something deprived of and stretching out toward form. Form is a cause in a second and more adequate way. It comes to sight in the *Physics* in three steps: in I, 5, as the source of orderliness in anything, and in II, 1, first as the “look disclosed in speech” (*to eidos to kata ton logon*), and then as the source of the