PHYSICS

Translated by *R. P. Hardie and R. K. Gaye*[2]

BOOK I

184a10-184a16 § 1 · When the objects of an inquiry, in any department, have principles, causes, or elements, it is through acquaintance with these that knowledge and understanding is attained. For we do not think that we know a thing until we are acquainted with its primary causes or first principles, and have carried our analysis as far as its elements. Plainly, therefore, in the science of nature too our first task will be to try to determine what relates to its principles.

184a17-184a21 The natural way of doing this is to start from the things which are more knowable and clear to us and proceed towards those which are clearer and more knowable by nature; for the same things are not knowable relatively to us and knowable without qualification. So we must follow this method and advance from what is more obscure by nature, but clearer to us, towards what is more clear and more knowable by nature.

184a22-184b14 Now what is to us plain and clear at first is rather confused masses, the elements and principles of which become known to us later by analysis. Thus we must advance from universals to particulars; for it is a whole that is more knowable to sense-perception, and a universal is a kind of whole, comprehending many things within it, like parts. Much the same thing happens in the relation of the

[2]TEXT: W. D. Ross, OCT, Oxford, 1950

name to the formula. A name, e.g. 'circle', means vaguely a sort of whole: its definition analyses this into particulars. Similarly a child begins by calling all men father, and all women mother, but later on distinguishes each of them.

§ 2 · The principles in question must be either one or more than one. If one, it must be either motionless, as Parmenides and Melissus assert, or in motion, as the physicists hold, some declaring air to be the first principle, others water. If more than one, then either a finite or an infinite plurality. If finite (but more than one), then either two or three or four or some other number. If infinite, then either as Democritus believed one in kind, but differing in shape; or different in kind and even contrary. 184b15-184b22

A similar inquiry is made by those who inquire into the number of existents; for they inquire whether the ultimate constituents of existing things are one or many, and if many, whether a finite or an infinite plurality. So they are inquiring whether the principle or element is one or many. 184b23-184b26

Now to investigate whether what exists is one and motionless is not a contribution to the science of nature. For just as the geometer has nothing more to say to one who denies the principles of his science—this being a question for a different science or for one common to all—so a man investigating *principles* cannot argue with one who denies their existence. For if what exists is just one, and one in the way mentioned, there is a principle no longer, since a principle must be the principle of some thing or things. 184b27-185a4

To inquire therefore whether what exists is one in this sense would be like arguing against any other position maintained for the sake of argument (such as the Heraclitean thesis, or such a thesis as that what exists is one man) or like refuting a merely contentious argument—a description which applies to the arguments both of Melissus and of Parmenides: their premisses are false and their conclusions do not follow. Or rather the argument of Melissus is gross and offers no difficulty at all: accept one ridiculous proposition and the rest follows—a simple enough proceeding. 185a5-185a11

We, on the other hand, must take for granted that the things that exist by nature are, either all or some of them, in motion—which is indeed made plain by induction. Moreover, noone is bound to solve every kind of difficulty that may be raised, but only as many as are drawn falsely from the principles of the science: it is not our business to refute those that do not arise in this way; just as it is the duty of the geometer to refute the squaring of the circle by means of segments, but it is not his duty to refute Antiphon's proof. At the same time the holders of the theory of which we are speaking do incidentally raise physical questions, though nature 185a12-185a20

is not their subject; so it will perhaps be as well to spend a few words on them, especially as the inquiry is not without scientific interest.

185a21-185a26 The most pertinent question with which to begin will be this: In what sense is it asserted that all things *are* one? For 'is' is used in many ways. Do they mean that all things are substance or quantities or qualities? And, further, are all things one substance—one man, one horse, or one soul—or quality and that one and the same—white or hot or something of the kind? These are all very different doctrines and all impossible to maintain.

185a27-185a28 For if *both* substance and quantity and quality are, then, whether these exist independently of each other or not, what exists will be many.

185a29-185b5 If on the other hand it is asserted that all things are quality or quantity, then, whether substance exists or not, an absurdity results, if indeed the impossible can properly be called absurd. For none of the others can exist independently except substance; for everything is predicated of substance as subject. Now Melissus says that what exists is infinite. It is then a quantity. For the infinite is in the category of quantity, whereas substance or quality or affection cannot be infinite except accidentally, that is, if at the same time they are also quantities. For to define the infinite you must use quantity in your formula, but not substance or quality. If then what exists is both substance and quantity, it is two, not one; if only substance, it is not infinite and has no magnitude; for to have that it will have to be a quantity.

185b6-185b7 Again, 'one' itself, no less than 'is', is used in many ways, so we must consider in what way the word is used when it is said that the universe is one.

185b8-185b9 Now we say that the continuous is one or that the indivisible is one, or things are said to be one, when the account of their essence is one and the same, as liquor and drink.

185b10-185b11 If their One is one in the sense of continuous, it is many; for the continuous is divisible *ad infinitum.*

185b12-185b17 There is, indeed, a difficulty about part and whole, perhaps not relevant to the present argument, yet deserving consideration on its own account—namely, whether the part and the whole are one or more than one, and in what way they can be one or many, and, if they are more than one, in what way they are more than one. (Similarly with the parts of wholes which are not continuous.) Further, if each of the two parts is indivisibly one with the whole, the difficulty arises that they will be indivisibly one with each other also.

185b17-185b18 But to proceed: If their One is one as indivisible, nothing will have quantity or quality, and so what exists will not be infinite, as Melissus says—nor, indeed, limited, as Parmenides says; for though the limit is indivisible, the limited is not.

But if all things are one in the sense of having the same definition, like raiment and dress, then it turns out that they are maintaining the Heraclitean doctrine, for it will be the same thing to be good and to be bad, and to be good and to be not good, and so the same thing will be good and not good, and man and horse; in fact, their view will be, not that all things are one, but that they are nothing; and that to be of such-and-such a quality is the same as to be of such-and-such a quantity. 185b19-185b25

Even the more recent of the ancient thinkers were in a pother lest the same thing should turn out in their hands both one and many. So some, like Lycophron, were led to omit 'is', others to change the mode of expression and say 'the man has been whitened' instead of 'is white', and 'walks' instead of 'is walking', for fear that if they added the word 'is' they should be making the one to *be* many—as if 'one' and 'is' were always used in one and the same way. What is may be many either in definition (for example to be white is one thing, to be musical another, yet the same thing may be both, so the one is many) or by division, as the whole and its parts. On this point, indeed, they were already getting into difficulties and admitted that the one was many—as if there was any difficulty about the same thing being both one and many, provided that these are not opposites; for what is one may be either potentially one or actually one. 185b26-186a3

§ 3 · If, then, we approach the thesis in this way it seems impossible for all things to be one. Further, the arguments they use to prove their position are not difficult to expose. For both of them reason contentiously—I mean both Melissus and Parmenides. [Their premisses are false and their conclusions do not follow. Or rather the argument of Melissus is gross and offers no difficulty at all: admit one ridiculous proposition and the rest follows—a simple enough proceeding.][3] 186a4-186a10

The fallacy of Melissus is obvious. For he supposes that the assumption 'what has come into being always has a beginning' justifies the assumption 'what has not come into being has no beginning'. Then this also is absurd, that in every case there should be a beginning of the *thing*—not of the time and not only in the case of coming to be *simpliciter* but also in the case of qualitative change—as if change never took place all at once. Again, does it follow that what is, if one, is motionless? Why should it not move, the whole of it within itself, as parts of it do which are unities, e.g. this water? Again, why is qualitative change impossible? But, further, what is cannot be one in form, though it may be in what it is made of. (Even some of the physicists hold it to be one in the latter way, though not in the former.) Man obviously differs from horse in form, and contraries from each other. 186a11-186a21

[3]The bracketed words are probably wrongly inserted from 185a9-12.

186a22-186a32 The same kind of argument holds good against Parmenides also, besides any that may apply specially to his view: the answer to him being that *this* is not true and *that* does not follow. His assumption that 'is' is used in a single way only is false, because it is used in several. His conclusion does not follow, because if we take only white things, and if 'white' has a single meaning, none the less what is white will be many and not one. For what is white will not be one either in the sense that it is continuous or in the sense that it must be defined in only one way. Whiteness will be different from what has whiteness. Nor does this mean that there is anything that can exist separately, over and above what is white. For whiteness and that which is white differ in definition, not in the sense that they are things which can exist apart from each other. But Parmenides had not come in sight of this distinction.

186a33-186b3 It is necessary for him, then, to assume not only that 'is' has the same meaning, of whatever it is predicated, but further that it means what *just is* and what is *just one.* For an attribute is predicated of some subject, so that the subject to which 'is' is attributed will not be, as it is something different from being. Something, therefore, which is not will be. Hence what just is will not belong to anything else. For the subject cannot be a *being,* unless 'is' means several things, in such a way that each *is* something. But *ex hypothesi* 'is' means only one thing.

186b4-186b12 If, then, what just is is not attributed to anything, but other things are attributed to it, how does what just is mean what is rather than what is not? For suppose that what just is is also white, and that being white is not what just is (for being cannot even be attributed to white, since nothing is which is not what just is), it follows that what is white is not—and that not in the sense of not being something or other, but in the sense that it is not at all. Hence what just is is not; for it is true to say that it is white, and we found this to mean what is not. So 'white' must also mean what just is; and then 'is' has more than one meaning.

186b13-186b13 In particular, then, what is will not have magnitude, if it is what just is. For each of the two parts must *be* in a different way.

186b14-186b18 What just is is plainly divisible into other things which just are, if we consider the mere nature of a definition. For instance, if man is, what just is, animal and biped must also be what just is. For if not, they must be attributes—and if attributes, attributes either of man or of some other subject. But neither is possible.

186b19-186b30 For an attribute is either that which may or may not belong to the subject or that in whose definition the subject of which it is an attribute is involved. Thus sitting is an example of a separable attribute, while snubness contains the definition of nose, to which we attribute snubness. Further, the definition of the whole is not contained in the definitions of the contents or elements of the definitory formula;

that of man for instance in biped, or that of white man in white. If then this is so, and if biped is supposed to be an attribute of man, it must be either separable, so that man might possibly not be biped, or the definition of man must come into the definition of biped—which is impossible, as the converse is the case.

If, on the other hand, we suppose that biped and animal are attributes not of man but of something else, and are not each of them what just is, then man too will be an attribute of something else. But we must assume that what just is is *not* the attribute of anything, and that the subject of which both biped and animal are predicated is the subject also of the complex. Are we then to say that the universe is composed of indivisibles? 186b31-186b36

Some thinkers did, in point of fact, give way to both arguments. To the argument that all things are one if being means one thing, they conceded that what is not is; to that from bisection, they yielded by positing atomic magnitudes. But obviously it is not true that if being means one thing, and nothing can at the same time both be and not be, there will be nothing which is not; for even if what is not cannot *be* without qualification, there is no reason why it should not be something or other. To say that all things will be one, if there is nothing besides what is itself, is absurd. For who understands 'what is itself' to be anything but some particular thing? But if this is so, there is still nothing to prevent there being many beings, as has been said. 187a1-187a10

It is, then, clearly impossible for what is to be one in this sense. 187a11-187a11

§ 4 · The physicists on the other hand have two modes of explanation. 187a12-187a12

The first set make the underlying body one—either one of the three[4] or something else which is denser than fire and rarer than air—then generate everything else from this, and obtain multiplicity by condensation and rarefaction. (Now these are contraries, which may be generalized into excess and defect. Compare Plato's 'Great and Small'—except that he makes these his matter, the one his form, while the others treat the one which underlies as matter and the contraries as differentiae, i.e. forms.) 187a13-187a19

The second set assert that the contrarieties are contained in the one and emerge from it by segregation, for example Anaximander and also all those who assert that what is is one and many, like Empedocles and Anaxagoras; for they too produce other things from their mixture by segregation. These differ, however, from each other in that the former imagines a cycle of such changes, the latter a single series. Anaxagoras again made both his homogeneous substances and his contraries infinite, whereas Empedocles posits only the so-called elements. 187a20-187a26

[4] I.e. water, air, fire.

187a27-187b6 The theory of Anaxagoras that the principles are infinite was probably due to his acceptance of the common opinion of the physicists that nothing comes into being from what is not. (For this is the reason why they use the phrase 'all things were together' and the coming into being of such and such a kind of thing is reduced to change of quality, while some spoke of combination and separation.) Moreover, the fact that the contraries come into being from each other led them to the conclusion. The one, they reasoned, must have already existed in the other; for since everything that comes into being must arise either from what is or from what is not, and it is impossible for it to arise from what is not (on this point all the physicists agree), they thought that the truth of the alternative necessarily followed, namely that things come into being out of existent things, i.e. out of things already present, but imperceptible to our senses because of the smallness of their bulk. So they assert that everything has been mixed in everything, because they saw everything arising out of everything. But things, as they say, appear different from one another and receive different names according to what is numerically predominant among the innumerable constituents of the mixture. For nothing, they say, is purely and entirely white or black or sweet, or bone or flesh, but the nature of a thing is held to be that of which it contains the most.

187b7-187b13 Now the infinite *qua* infinite is unknowable, so that what is infinite in multitude or size is unknowable in quantity, and what is infinite in variety of kind is unknowable in quality. But the principles in question are infinite both in multitude and in kind. Therefore it is impossible to know things which are composed of them; for it is when we know the nature and quantity of its components that we suppose we know a complex.

187b14-187b21 Further, if the parts of a whole may be indefinitely big or small (by parts I mean components into which a whole can be divided and which are actually present in it), it is necessary that the whole thing itself may also be of any size. Clearly, therefore, if it is impossible for an animal or plant to be indefinitely big or small, neither can its parts be such, or the whole will be the same. But flesh, bone, and the like are the parts of animals, and the fruits are the parts of plants. Hence it is obvious that neither flesh, bone, nor any such thing can be of indefinite size in the direction either of the greater or of the less.

187b22-188a2 Again, according to the theory all such things are already present in one another and do not come into being but are constituents which are separated out, and a thing receives its designation from its chief constituent. Further, anything may come out of anything—water by segregation from flesh and flesh from water. Hence, since every finite body is exhausted by the repeated abstraction of a finite body, it is evident that everything cannot subsist in everything else. For let flesh

be extracted from water and again more flesh be produced from the remainder by repeating the process of separation; then, even though the quantity separated out will continually decrease, still it will not fall below a certain magnitude. If, therefore, the process comes to an end, everything will not be in everything else (for there will be no flesh in the remaining water); if on the other hand it does not, and further extraction is always possible, there will be an infinite multitude of finite equal parts in a finite quantity—which is impossible. Another proof may be added: since every body must diminish in size when something is taken from it, and flesh is quantitatively definite in respect both of greatness and smallness, it is clear that from the minimum quantity of flesh no body can be separated out; for the flesh left would be less than the minimum of flesh.

Again, in each of his infinite bodies there would be already present infinite flesh and blood and brain—having a distinct existence, however, from one another,[5] and no less real than the infinite bodies, and each infinite: which is contrary to reason. 188a3-188a4

The statement that complete separation never will take place is correct enough, though Anaxagoras is not fully aware of what it means. For affections are indeed inseparable. If then colours and states had entered into the mixture, and if separation took place, there would be something white or healthy which was nothing *but* white or healthy, i.e. was not the predicate of a subject. So his Mind absurdly aims at the impossible, if it is supposed to wish to separate them, and it is impossible to do so, both in respect of quantity and of quality—of quantity, because there is no minimum magnitude, and of quality, because affections are inseparable. 188a5-188a11

Nor is Anaxagoras right about the coming to be of homogeneous bodies. It is true there is a sense in which clay is divided into pieces of clay, but there is another in which it is not. Water and air are, and are generated, from each other, but not in the way in which bricks come from a house and again a house from bricks. And it is better to assume a smaller and finite number of principles, as Empedocles does. 188a12-188a18

All thinkers then agree in making the contraries principles, both those who describe the universe as one and unmoved (for even Parmenides treats hot and cold as principles under the names of fire and earth) and those too who use the rare and the dense. The same is true of Democritus also, with his plenum and void, both of which exist, he says, the one as being, the other as not being. Again he speaks of differences in position, shape, and order, and these are genera of which the species are contraries, namely, of position, above and below, before and 188a19-188a26

[5]Retaining the MS text; Ross reads: *kechorismena mentoi ap' allelon [ou]* ('not, however, separated from one another').

behind; of shape, angular and angle-less, straight and round.

188a27-188a31 It is plain then that they all in one way or another identify the contraries with the principles. And with good reason. For first principles must not be derived from one another nor from anything else, while everything has to be derived from them. But these conditions are fulfilled by the primary contraries, which are not derived from anything else because they are primary, nor from each other because they are contraries.

188a32-188b3 But we must see how this can be arrived at as a reasoned result. Our first presupposition must be that in nature nothing acts on, or is acted on by, any other thing at random, nor may anything come from anything else, unless we mean that it does so accidentally. For how could white come from musical, unless musical happened to be an attribute of the not-white or of the black? No, white comes from not-white—and not from *any* not-white, but from black or some intermediate. Similarly, musical comes to be from non-musical, but not from any thing other than musical, but from unmusical or any intermediate state there may be.

188b4-188b8 Nor again do things pass away into the first chance thing; white does not pass into musical (except, it may be, accidentally), but into not-white—and not into any chance thing which is not white, but into black or an intermediate; musical passes into not-musical—and not into any chance thing other than musical, but into unmusical or any intermediate state there may be.

188b9-188b20 The same holds of other things also: even things which are not simple but complex follow the same principle, but the opposite state has not received a name, so we fail to notice the fact. For what is in tune must come from what is not in tune, and *vice versa;* the tuned passes into untunedness—and not into *any* untunedness, but into the corresponding opposite. It does not matter whether we take attunement, order, or composition for our illustration; the principle is obviously the same in all, and in fact applies equally to the production of a house, a statue, or anything else. A house comes from certain things in a certain state of separation instead of conjunction, a statue (or any other thing that has been shaped) from shapelessness—each of these objects being partly order and partly composition.

188b21-188b26 If then this is true, everything that comes to be or passes away comes from, or passes into, its contrary or an intermediate state. But the intermediates are derived from the contraries—colours, for instance, from black and white. Everything, therefore, that comes to be by a natural process is either a contrary or a product of contraries.

188b27-188b35 Up to this point we have practically had most of the other writers on the subject with us, as I have said already; for all of them identify their elements, and what they call their principles, with the contraries, giving no reason indeed for the the-

ory, but constrained as it were by the truth itself. They differ, however, from one another in that some assume contraries which are prior, others contraries which are posterior; some those more knowable in the order of explanation, others those more familiar to sense. For some make hot and cold, or again moist and dry, the causes of becoming; while others make odd and even, or again Love and Strife; and these differ from each other in the way mentioned.

Hence their principles are in one sense the same, in another different; different certainly, as indeed most people think, but the same inasmuch as they are analogous; for all are taken from the same table of columns, some of the pairs being wider, others narrower in extent. In this way then their theories are both the same and different, some better, some worse; some, as I have said, take as their contraries what is more knowable in the order of explanation, others what is more familiar to sense. (The universal is knowable in the order of explanation, the particular in the order of sense; for explanation has to do with the universal, sense with the particular.) The great and the small, for example, belong to the former class, the dense and the rare to the latter. 188b36-189a9

It is clear then that our principles must be contraries. 189a10-189a10

§ 6 · The next question is whether the principles are two or three or more in number. 189a11-189a11

One they cannot be; for there cannot be one contrary. Nor can they be innumerable, because, if so, what is will not be knowable; and in any one genus there is only one contrariety, and substance is one genus; also a finite number is sufficient, and a finite number, such as the principles of Empedocles, is better than an infinite multitude; for Empedocles professes to obtain all that Anaxagoras obtains from his innumerable principles. Again, some contraries are prior to others, and some arise from others—for example sweet and bitter, white and black—whereas the principles must always remain principles. 189a12-189a19

This will suffice to show that the principles are neither one nor innumerable. 189a20-189a20

Granted, then, that they are a limited number, it is plausible to suppose them more than two. For it is difficult to see how either density should be of such a nature as to act in any way on rarity or rarity on density. The same is true of any other pair of contraries; for Love does not gather Strife together and make things out of it, nor does Strife make anything out of Love, but both act on a third thing different from both. Some indeed assume more than one such thing from which they construct the world of nature. 189a21-189a27

Other objections to the view that it is not necessary to posit some other nature under the contraries may be added. We do not find that the contraries constitute 189a28-189a35

the substance of any thing. But what is a first principle ought not to be predicated of any subject. If it were, there would be a principle of the supposed principle; for the subject is a principle, and prior presumably to what is predicated of it. Again, we hold that a substance is not contrary to another substance. How then can substance be derived from what are not substances? Or how can non-substance be prior to substance?

189a36-189b16 If then we accept both the former argument and this one, we must, to preserve both, posit some third thing, such as is spoken of by those who describe the universe as one nature—water or fire or what is intermediate between them. What is intermediate seems preferable; for fire, earth, air, and water are already involved with pairs of contraries. There is, therefore, much to be said for those who make the underlying substance different from these four; of the rest, the next best choice is air, as presenting sensible differences in a less degree than the others; and after air, water. All, however, agree in this, that they differentiate their One by means of the contraries, such as density and rarity and more and less, which may of course be generalized, as has already been said, into excess and defect. Indeed this doctrine too (that the One and excess and defect are the principles of things) would appear to be of old standing, though in different forms; for the early thinkers made the two the active and the one the passive principle, whereas some of the more recent maintain the reverse.

189b17-189b18 To suppose then that the elements are three in number would seem, from these and similar considerations, a plausible view, as I said before. On the other hand, the view that they are more than three in number would seem to be untenable.

189b19-189b27 For one thing is sufficient to be acted on; but if we have four contraries, there will be two contrarieties, and we shall have to suppose an intermediate nature for each pair separately. If, on the other hand, the contrarieties, being two, can generate from each other, the second contrariety will be superfluous. Moreover, it is impossible that there should be more than one *primary* contrariety. For substance is a single genus of being, so that the principles can differ only as prior and posterior, *not* in genus; for in a single genus there is always a single contrariety, all the other contrarieties in it being held to be reducible to one.

189b28-189b29 It is clear then that the number of elements is neither one nor more than two or three; but whether two or three is, as I said, a question of considerable difficulty.

189b30-189b33 § 7 · We will now give our own account, approaching the question first with reference to becoming in its widest sense; for we shall be following the natural order of inquiry if we speak first of common characteristics, and then investigate the characteristics of special cases.

We say that 'one thing comes to be from another thing, and something from something different, in the case both of simple and of complex things. I mean the following. We can say the man becomes musical, or what is not-musical becomes musical, or the not-musical man becomes a musical man. Now what becomes in the first two cases—man and not-musical—I call *simple,* and what each becomes—musical—simple also. But when we say the not-musical man becomes a musical man, both what becomes and what it becomes are *complex.* 189b34-190a4

In some cases, we say not only this becomes so-and-so, but also from being this, it comes to be so-and-so (e.g.: from being not-musical he comes to be musical); but we do not say this in all cases, as we do not say from being a man he came to be musical but only the man became musical. 190a5-190a8

When a simple thing is said to become something, in one case it survives through the process, in the other it does not. For the man remains a man and is such even when he becomes musical, whereas what is not musical or is unmusical does not survive, either simply or combined with the subject. 190a9-190a12

These distinctions drawn, one can gather from surveying the various cases of becoming in the way we are describing that there must always be an underlying something, namely that which becomes, and that this, though always one numerically, in form at least is not one. (By 'in form' I mean the same as 'in account'.) For to be a man is not the same as to be unmusical. One part survives, the other does not: what is not an opposite survives (for the man survives), but not-musical or unmusical does not survive, nor does the compound of the two, namely the unmusical man. 190a13-190a21

We speak of 'becoming that from this' instead of 'this becoming that' more in the case of what does not survive the change—'becoming musical from unmusical', not 'from man'—but we sometimes use the latter form of expression even of what survives; we speak of a statue coming to be from bronze, not of the bronze becoming a statue. The change, however, from an opposite which does not survive is described in both ways, 'becoming that from this' or 'this becoming that'. We say both that the unmusical becomes musical, and that from unmusical he becomes musical. And so both forms are used of the complex, 'becoming a musical from an unmusical man', and 'an unmusical man becoming musical'. 190a22-190a31

Things are said to come to be in different ways. In some cases we do not use the expression 'come to be', but 'come to be so-and-so'. Only substances are said to come to be without qualification. 190a32-190a33

Now in all cases other than substance it is plain that there must be something underlying, namely, that which becomes. For when a thing comes to be of such a 190a34-190a37

quantity or quality or in such a relation, time,[6] or place, a subject is always presupposed, since substance alone is not predicated of another subject, but everything else of substance.

190b1-190b4 But that substances too, and anything that can be said to be without qualification, come to be from some underlying thing, will appear on examination. For we find in every case something that underlies from which proceeds that which comes to be; for instance, animals and plants from seed.

190b5-190b9 Things which come to be without qualification, come to be in different ways: by change of shape, as a statue; by addition, as things which grow; by taking away, as the Hermes from the stone; by putting together, as a house; by alteration, as things which turn in respect of their matter.

190b10-190b10 It is plain that these are all cases of coming to be from some underlying thing.

190b11-190b16 Thus, from what has been said, whatever comes to be is always complex. There is, on the one hand, something which comes to be, and again something which becomes that—the latter in two senses, either the subject or the opposite. By the opposite I mean the unmusical, by the subject, man; and similarly I call the absence of shape or form or order the opposite, and the bronze or stone or gold the subject.

190b17-190b23 Plainly then, if there are causes and principles which constitute natural objects and from which they primarily are or have come to be—have come to be, I mean, what each is said to be in its substance, not what each is accidentally—plainly, I say, everything comes to be from both subject and form. For the musical man is composed in a way of man and musical: you can analyse it into the definitions of its elements. It is clear then that what comes to be will come to be from these elements.

190b24-190b28 Now the subject is one numerically, though it is two in form. (For there is the man, the gold—in general, the countable matter; for it is more of the nature of a 'this', and what comes to be does not come from it accidentally; the privation, on the other hand, and the contrariety *are* accidental.) And the form is one—the order, the art of music, or any similar predicate.

190b29-191a2 There is a sense, therefore, in which we must declare the principles to be two, and a sense in which they are three; a sense in which the contraries are the principles—say for example the musical and the unmusical, the hot and the cold, the tuned and the untuned—and a sense in which they are not, since it is impossible for the contraries to be acted on by each other. But this difficulty also is solved by the fact that what underlies is different from the contraries; for it is

[6] Ross excises 'time'.

itself not a contrary. The principles therefore are, in a way, not more in number than the contraries, but as it were two; nor yet precisely two, since there is a difference of being, but three. For to be man is different from to be unmusical, and to be unformed from to be bronze.

We have now stated the number of the principles of natural objects which are subject to generation, and how the number is reached; and it is clear that there must be something underlying the contraries, and that the contraries must be two. (Yet in another way of putting it this is not necessary, as one of the contraries will serve to effect the change by its absence and presence.) 191a3-191a8

The underlying nature can be known by analogy. For as the bronze is to the statue, the wood to the bed, or the matter and[7] the formless before receiving form to any thing which has form, so is the underlying nature to substance, i.e. the 'this' or existent. 191a9-191a12

This then is one principle (though not one or existent in the same sense as the 'this'); one is the form or definition;[8] then further there is its contrary, the privation. In what sense these are two, and in what sense more, has been stated above. We explained first that only the contraries were principles, and later that something else underlay them, and that the principles were three; our last statement has elucidated the difference between the contraries, the mutual relation of the principles, and the nature of what underlies. Whether the form or what underlies is the substance is not yet clear. But that the principles are three, and in what sense, and the way in which each is a principle, is clear. 191a13-191a21

So much then for the question of the number and the nature of the principles. 191a22-191a22

§ 8 · We will now proceed to show that the difficulty of the early thinkers, as well as our own, is solved in this way alone. 191a23-191a24

The first of those who studied philosophy were misled in their search for truth and the nature of things by their inexperience, which as it were thrust them into another path. So they say that none of the things that are either comes to be or passes out of existence, because what comes to be must do so either from what is or from what is not, both of which are impossible. For what is cannot come to be (because it *is* already), and from what is not nothing could have come to be (because something must be underlying). So too they exaggerated the consequence of this, and went so far as to deny even the *existence* of a plurality of things maintaining that only what is itself is. Such then was their opinion, and such the reason for its adoption. 191a25-191a34

[7] Ross omits 'the matter and'.

[8] Reading *mia to eidos e ho logos* (Bonitz).

191a35-191b9 Our explanation on the other hand is that for something to come to be from what is or from what is not, or what is not or what is to do something or have something done to it or become some particular thing, are in one way no different from a doctor doing something or having something done to him, or being or becoming something from being a doctor. These expressions may be taken in two ways, and so too, clearly, may 'from what is', and 'what is acts or is acted on'. A doctor builds a house, not *qua* doctor, but *qua* housebuilder, and turns gray, not *qua* doctor, but *qua* dark-haired. On the other hand he doctors or fails to doctor *qua* doctor. But we are using words most appropriately when we say that a doctor does something or undergoes something, or becomes something from being a doctor, if he does, undergoes, or becomes *qua* doctor. Clearly then also to come to be so-and-so from what is not means '*qua* what is not'.

191b10-191b12 It was through failure to make this distinction that those thinkers gave the matter up, and through this error that they went so much farther astray as to suppose that nothing else comes to be or exists apart from what is itself, thus doing away with all becoming.

191b13-191b17 We ourselves are in agreement with them in holding that nothing can be said without qualification to come from what is not. But nevertheless we maintain that a thing may come to be from what is not in a qualified sense, i.e. accidentally. For a thing comes to be from the privation, which in its own nature is something which is not—this not surviving as a constituent of the result. Yet this causes surprise, and it is thought impossible that something should come to be in the way described from what is not.

191b18-191b26 In the same way we maintain that nothing comes to be from what is, and that what is does not come to be except accidentally. In that way, however, it does, just as animal might come to be from animal, and an animal of a certain kind from an animal of a certain kind. Thus, suppose a dog to come to be from a dog, or a horse from a horse. The dog would then, it is true, come to be from animal (as well as from an animal of a certain kind) but not as *animal*, for that is already there. But if anything is to become an animal, *not* accidentally, it will not be from animal; and if what is, not from what is—nor from what is not either, for it has been explained that by 'from what is not' we mean *qua* what is not.

191b27-191b27 Note further that we do not subvert the principle that everything either is or is not.

191b28-191b29 This then is one way of solving the difficulty. Another consists in pointing out that the same things can be spoken of in terms of potentiality and actuality. But

this has been done with greater precision elsewhere.[9]

So, as we said, the difficulties which constrain people to deny the existence of some of the things we mentioned are now solved. For it was this reason which also caused some of the earlier thinkers to turn so far aside from the road which leads to coming to be and passing away and change generally. If they had come in sight of this nature, all their ignorance would have been dispelled. 191b30-191b34

§ 9 · Others, indeed, have apprehended the nature in question, but not adequately. 191b35-191b35

In the first place they allow that a thing may come to be without qualification from what is not, accepting on this point the statement of Parmenides. Secondly, they think that if it is one numerically, it must have also only a single potentiality—which is a very different thing. 191b36-192a3

Now we distinguish matter and privation, and hold that one of these, namely the matter, accidentally is not, while the privation in its own nature is not; and that the matter is nearly, in a sense is, substance, while the privation in no sense is. They, on the other hand, identify their Great and Small alike with what is not, and that whether they are taken together as one or separately. Their triad is therefore of quite a different kind from ours. For they got so far as to see that there must be some underlying nature, but they make it one—for even if one philosopher[10] makes a dyad of it, which he calls Great and Small, the effect is the same; for he overlooked the other nature. For the one which persists is a joint cause, with the form, of what comes to be—a mother, as it were. But the other part of the contrariety may often seem, if you concentrate your attention on it as an evil agent, not to exist at all. 192a4-192a15

For admitting that there is something divine, good, and desirable, we hold that there are two other principles, the one contrary to it, the other such as of its own nature to desire and yearn for it. But the consequence of their view is that the contrary desires its own extinction. Yet the form cannot desire itself, for it is not defective; nor can the contrary desire it, for contraries are mutually destructive. The truth is that what desires the form is matter, as the female desires the male and the ugly the beautiful—only the ugly or the female not in itself but accidentally. 192a16-192a24

The matter comes to be and ceases to be in one sense, while in another it does not. As that which contains the privation, it ceases to be in its own nature; for what ceases to be—the privation—is contained within it. But as potentiality it does not cease to be in its own nature, but is necessarily outside the sphere of becoming 192a25-192a34

[9] See *Metaphysics D*7, and *Th*.

[10] I.e. Plato.

and ceasing to be. For if it came to be, something must have existed as a primary substratum from which it should come and which should persist in it; but this is its own very nature, so that it will be before coming to be. (For my definition of matter is just this—the primary substratum of each thing, from which it comes to be, and which persists in the result, not accidentally.) And if it ceases to be it will pass into that at the last, so it will have ceased to be before ceasing to be.

192a35-192b2 The accurate determination of the first principle in respect of form, whether it is one or many and what it is or what they are, is the province of first philosophy; so these questions may stand over till then. But of the natural, i.e. perishable, forms we shall speak in the expositions which follow.

192b3-192b8 The above, then, may be taken as sufficient to establish that there are principles and what they are and how many there are. Now let us make a fresh start and proceed.

Book II

§ 1 · Of things that exist, some exist by nature, some from other causes. By nature the animals and their parts exist, and the plants and the simple bodies (earth, fire, air, water)—for we say that these and the like exist by nature. 192b9-192b11

All the things mentioned plainly differ from things which are *not* constituted by nature. For each of them has within itself a principle of motion and of stationariness (in respect of place, or of growth and decrease, or by way of alteration). On the other hand, a bed and a coat and anything else of that sort, *qua* receiving these designations—i.e. in so far as they are products of art—have no innate impulse to change. But in so far as they happen to be composed of stone or of earth or of a mixture of the two, they *do* have such an impulse, and just to that extent—which seems to indicate that nature is a principle or cause of being moved and of being at rest in that to which it belongs primarily, in virtue of itself and not accidentally. 192b12-192b23

I say 'not accidentally', because (for instance) a man who is a doctor might himself be a cause of health to himself. Nevertheless it is not in so far as he is a patient that he possesses the art of medicine: it merely has happened that the same man is doctor and patient—and that is why these attributes are not always found together. So it is with all other artificial products. None of them has in itself the principle of its own production. But while in some cases (for instance houses and the other products of manual labour) that principle is in something else external to the thing, in others—those which may cause a change in themselves accidentally—it lies in the things themselves (but not in virtue of what they are). 192b24-192b32

Nature then is what has been stated. Things have a nature which have a principle of this kind. Each of them is a substance; for it is a subject, and nature is always in a subject. 192b33-192b34

The term 'according to nature' is applied to all these things and also to the attributes which belong to them in virtue of what they are, for instance the property of fire to be carried upwards—which is not a nature nor has a nature but is by nature or according to nature. 192b35-193a2

What nature is, then, and the meaning of the terms 'by nature' and 'according to nature', has been stated. *That* nature exists, it would be absurd to try to prove; for it is obvious that there are many things of this kind, and to prove what is obvious by what is not is the mark of a man who is unable to distinguish what is 193a3-193a9

self-evident from what is not. (This state of mind is clearly possible. A man blind from birth might reason about colours.) Presumably therefore such persons must be talking about words without any thought to correspond.

193a10-193a12 Some identify the nature or substance of a natural object with that immediate constituent of it which taken by itself is without arrangement, e.g. the wood is the nature of the bed, and the bronze the nature of the statue.

193a13-193a16 As an indication of this Antiphon points out that if you planted a bed and the rotting wood acquired the power of sending up a shoot, it would not be a bed that would come up, but *wood* which shows that the arrangement in accordance with the rules of the art is merely an accidental attribute, whereas the substance is the other, which, further, persists continuously through the process.

193a17-193a27 But if the material of each of these objects has itself the same relation to something else, say bronze (or gold) to water, bones (or wood) to earth and so on, *that* (they say) would be their nature and substance. Consequently some assert earth, others fire or air or water or some or all of these, to be the nature of the things that are. For whatever any one of them supposed to have this character—whether one thing or more than one thing—this or these he declared to be the whole of substance, all else being its affections, states, or dispositions. Every such thing they held to be eternal (for it could not pass into anything else), but other things to come into being and cease to be times without number.

193a28-193a29 This then is one account of nature, namely that it is the primary underlying matter of things which have in themselves a principle of motion or change.

193a30-193a31 Another account is that nature is the shape or form which is specified in the definition of the thing.

193a32-193b6 For the word ‘nature’ is applied to what is according to nature and the natural in the same way as ‘art’ is applied to what is artistic or a work of art. We should not say in the latter case that there is anything artistic about a thing, if it is a bed only potentially, not yet having the form of a bed; nor should we call it a work of art. The same is true of natural compounds. What is potentially flesh or bone has not yet its own nature, and does not exist by nature, until it receives the form specified in the definition, which we name in defining what flesh or bone is. Thus on the second account of nature, it would be the shape or form (not separable except in statement) of things which have in themselves a principle of motion. (The combination of the two, e.g. man, is not nature but by nature.)

193b7-193b12 The form indeed is nature rather than the matter; for a thing is more properly said to be what it is when it exists in actuality than when it exists potentially. Again man is born from man but not bed from bed. That is why people say that the shape is not the nature of a bed, but the wood is—if the bed sprouted, not a

bed but wood would come up. But even if the shape *is* art,[11] then on the same principle the shape of man is his nature. For man is born from man.

Again, nature in the sense of a coming-to-be proceeds towards nature. For it is not like doctoring, which leads not to the art of doctoring but to health. Doctoring must start from the art, not lead to it. But it is not in this way that nature is related to nature. What grows *qua* growing grows from something into something. Into what then does it grow? Not into that from which it arose but into that to which it tends. The shape then is nature. 193b13-193b18

Shape and nature are used in two ways. For the privation too is in a way form. But whether in unqualified coming to be there is privation, i.e. a contrary, we must consider later. 193b19-193b21

§ 2 · We have distinguished, then, the different ways in which the term 'nature' is used. 193b22-193b22

The next point to consider is how the mathematician differs from the student of nature; for natural bodies contain surfaces and volumes, lines and points, and these are the subject-matter of mathematics. 193b23-193b25

Further, is astronomy different from natural science or a department of it? It seems absurd that the student of nature should be supposed to know the nature of sun or moon, but not to know any of their essential attributes, particularly as the writers on nature obviously do discuss their shape and whether the earth and the world are spherical or not. 193b26-193b31

Now the mathematician, though he too treats of these things, nevertheless does not treat of them as the limits of a natural body; nor does he consider the attributes indicated as the attributes of such bodies. That is why he separates them; for in thought they are separable from motion, and it makes no difference, nor does any falsity result, if they are separated. The holders of the theory of Forms do the same, though they are not aware of it; for they separate the objects of natural science, which are less separable than those of mathematics. This becomes plain if one tries to state in each of the two cases the definitions of the things and of their attributes. Odd and even, straight and curved, and likewise number, line, and figure, do not involve motion; not so flesh and bone and man—*these* are defined like snub nose, not like curved. 193b32-194a6

Similar evidence is supplied by the more natural of the branches of mathematics, such as optics, harmonics, and astronomy. These are in a way the converse of geometry. While geometry investigates natural lines but not *qua* natural, optics investigates mathematical lines, but *qua* natural, not *qua* mathematical. 194a7-194a11

[11] Reading *techne*, with the MSS, for Ross' *physis*.

194a12-194a18 Since two sorts of thing are called nature, the form and the matter, we must investigate its objects as we would the essence of snubness, that is neither independently of matter nor in terms of matter only. Here too indeed one might raise a difficulty. Since there are two natures, with which is the student of nature concerned? Or should he investigate the combination of the two? But if the combination of the two, then also each severally. Does it belong then to the same or to different sciences to know each severally?

194a19-194a21 If we look at the ancients, natural science would seem to be concerned with the *matter.* (It was only very slightly that Empedocles and Democritus touched on form and essence.)

194a22-194a27 But if on the other hand art imitates nature, and it is the part of the same discipline to know the form and the matter up to a point (e.g. the doctor has a knowledge of health and also of bile and phlegm, in which health is realized and the builder both of the form of the house and of the matter, namely that it is bricks and beams, and so forth): if this is so, it would be the part of natural science also to know nature in both its senses.

194a28-194a33 Again, that for the sake of which, or the end, belongs to the same department of knowledge as the means. But the nature is the end or that for the sake of which. For if a thing undergoes a continuous change toward some end, that last stage[12] is actually that for the sake of which. (That is why the poet was carried away into making an absurd statement when he said 'he has the end for the sake of which he was born'. For not every stage that is last claims to be an end, but only that which is best.)

194a34-194b8 For the arts make their material (some simply make it, others make it serviceable), and we use everything as if it was there for our sake. (We also are in a sense an end. 'That for the sake of which' may be taken in two ways, as we said in our work *On Philosophy.*) The arts, therefore, which govern the matter and have knowledge are two, namely the art which uses the product and the art which directs the production of it. That is why the using art also is in a sense directive; but it differs in that it knows the form,[13] whereas the art which is directive as being concerned with production knows the matter. For the helmsman knows and prescribes what sort of form a helm should have, the other from what wood it should be made and by means of what operations. In the products of art, however, we make the material with a view to the function, whereas in the products of nature the matter is there all along.

[12] Reading *touto eschaton*.

[13] Omitting *he architektonike*.

Again, matter is a relative thing—for different forms there is different matter. 194b9-194b9

How far then must the student of nature know the form or essence? Up to a point, perhaps, as the doctor must know sinew or the smith bronze (i.e. until he understands the purpose of each);[14] and the student of nature is concerned only with things whose forms are separable indeed, but do not exist apart from matter. Man is begotten by man and by the sun as well. The mode of existence and essence of the separable it is the business of first philosophy to define. 194b10-194b15

§ 3 · Now that we have established these distinctions, we must proceed to consider causes, their character and number. Knowledge is the object of our inquiry, and men do not think they know a thing till they have grasped the 'why' of it (which is to grasp its primary cause). So clearly we too must do this as regards both coming to be and passing away and every kind of natural change, in order that, knowing their principles, we may try to refer to these principles each of our problems. 194b16-194b23

In one way, then, that out of which a thing comes to be and which persists, is called a cause, e.g. the bronze of the statue, the silver of the bowl, and the genera of which the bronze and the silver are species. 194b24-194b26

In another way, the form or the archetype, i.e. the definition of the essence, and its genera, are called causes (e.g. of the octave the relation of 2:1, and generally number), and the parts in the definition. 194b27-194b29

Again, the primary source of the change or rest; e.g. the man who deliberated is a cause, the father is cause of the child, and generally what makes of what is made and what changes of what is changed. 194b30-194b32

Again, in the sense of end or that for the sake of which a thing is done, e.g. health is the cause of walking about. ('Why is he walking about?' We say: 'To be healthy', and, having said that, we think we have assigned the cause.) The same is true also of all the intermediate steps which are brought about through the action of something else as means towards the end, e.g. reduction of flesh, purging, drugs, or surgical instruments are means towards health. All these things are for the sake of the end, though they differ from one another in that some are activities, others instruments. 194b33-195a2

This then perhaps exhausts the number of ways in which the term 'cause' is used. 195a3-195a3

As things are called causes in many ways, it follows that there are several causes of the same thing (not merely accidentally), e.g. both the art of the sculptor 195a4-195a14

[14] Reading *mechri tou · tinos gar* (Jaeger).

and the bronze are causes of the statue. These are causes of the statue *qua* statue, not in virtue of anything else that it may be—only not in the same way, the one being the material cause, the other the cause whence the motion comes. Some things cause each other reciprocally, e.g. hard work causes fitness and *vice versa*, but again not in the same way, but the one as end, the other as the principle of motion. Further the same thing is the cause of contrary results. For that which by its presence brings about one result is sometimes blamed for bringing about the contrary by its absence. Thus we ascribe the wreck of a ship to the absence of the pilot whose presence was the cause of its safety.

195a15-195a26 All the causes now mentioned fall into four familiar divisions. The letters are the causes of syllables, the material of artificial products, fire and the like of bodies, the parts of the whole, and the premisses of the conclusion, in the sense of 'that from which'. Of these pairs the one set are causes in the sense of what underlies, e.g. the parts, the other set in the sense of essence—the whole and the combination and the form. But the seed and the doctor and the deliberator, and generally the maker, are all sources whence the change or stationariness originates, which the others are causes in the sense of the end or the good of the rest; for that for the sake of which tends to be what is best and the end of the things that lead up to it. (Whether we call it good or apparently good makes no difference.)

195a27-195a27 Such then is the number and nature of the kinds of cause.

195a28-195b3 Now the modes of causation are many, though when brought under heads they too can be reduced in number. For things are called causes in many ways and even within the same kind one may be prior to another: e.g. the doctor and the expert are causes of health, the relation 2:1 and number of the octave, and always what is inclusive to what is particular. Another mode of causation is the accidental and its genera, e.g. in one way Polyclitus, in another a sculptor is the cause of a statue, because being Polyclitus and a sculptor are accidentally conjoined. Also the classes in which the accidental attribute is included; thus a man could be said to be the cause of a statue or, generally, a living creature. An accidental attribute too may be more or less remote, e.g. suppose that a pale man or a musical man were said to be the cause of the statue.

195b4-195b7 All causes, both proper and accidental, may be spoken of either as potential or as actual; e.g. the cause of a house being built is either a house-builder or a house-builder building.

195b8-195b12 Similar distinctions can be made in the things of which the causes are causes, e.g. of this statue or of a statue or of an image generally, of this bronze or of bronze or of material generally. So too with the accidental attributes. Again we may use a complex expression for either and say, e.g., neither 'Polyclitus' nor a

'sculptor' but 'Polyclitus, the sculptor'.

All these various uses, however, come to six in number, under each of which again the usage is twofold. It is either what is particular or a genus, or an accidental attribute or a genus of that, and these either as a complex or each by itself; and all either as actual or as potential. The difference is this much, that causes which are actually at work and particular exist and cease to exist simultaneously with their effect, e.g. this healing person with this being-healed person and that house-building man with that being-built house; but this is not always true of potential causes—the house and the housebuilder do not pass away simultaneously. 195b13-195b21

In investigating the cause of each thing it is always necessary to seek what is most precise (as also in other things): thus a man builds because he is a builder, and a builder builds in virtue of his art of building. This last cause then is prior; and so generally. 195b22-195b25

Further, generic effects should be assigned to generic causes, particular effects to particular causes, e.g. statue to sculptor, this statue to this sculptor; and powers are relative to possible effects, actually operating causes to things which are actually being effected. 195b26-195b28

This must suffice for our account of the number of causes and the modes of causation. 195b29-195b30

§ 4 · But chance and spontaneity are also reckoned among causes: many things are said both to be and to come to be as a result of chance and spontaneity. We must inquire therefore in what manner chance and spontaneity are present among the causes enumerated, and whether they are the same or different, and generally what chance and spontaneity are. 195b31-195b36

Some people even question whether there are such things or not. They say that nothing happens by chance, but that everything which we ascribe to chance or spontaneity has some definite cause, e.g. coming by chance into the market and finding there a man whom one wanted but did not expect to meet is due to one's wish to go and buy in the market. Similarly, in other so-called cases of chance it is always possible, they maintain, to find something which is the cause; but not chance, for if chance were real, it would seem strange indeed, and the question might be raised, why on earth none of the wise men of old in speaking of the causes of generation and decay took account of chance; whence it would seem that they too did not believe that anything is by chance. But there is a further circumstance that is surprising. Many things both come to be and are by chance and spontaneity, and although all know that each of them can be ascribed to some cause (as the old argument said which denied chance), nevertheless they all speak 195b37-196a16

of some of these things as happening by chance and others not. For this reason they ought to have at least referred to the matter in some way or other.

196a17-196a24 Certainly the early physicists found no place for chance among the causes which they recognized—love, strife, mind, fire, or the like. This is strange, whether they supposed that there is no such thing as chance or whether they thought there is but omitted to mention it—and that too when they sometimes used it, as Empedocles does when he says that the air is not always separated into the highest region, but as it may chance. At any rate he says in his cosmogony that 'it happened to run that way at that time, but it often ran otherwise'.[15] He tells us also that most of the parts of animals came to be by chance.

196a25-196b4 There are some who actually ascribe this heavenly sphere and all the worlds to spontaneity. They say that the vortex arose spontaneously, i.e. the motion that separated and arranged the universe in its present order. This statement might well cause surprise. For they are asserting that chance is not responsible for the existence or generation of animals and plants, nature or mind or something of the kind being the cause of them (for it is not any chance thing that comes from a given seed but an olive from one kind and a man from another); and yet at the same time they assert that the heavenly sphere and the divinest of visible things arose spontaneously, having no such cause as is assigned to animals and plants. Yet if this is so, it is a fact which deserves to be dwelt upon, and something might well have been said about it. For besides the other absurdities of the statement, it is the more absurd that people should make it when they see nothing coming to be spontaneously in the heavens, but much happening by chance among the things which as they say are not due to chance; whereas we should have expected exactly the opposite.

196b5-196b7 Others there are who believe that chance is a cause, but that it is inscrutable to human intelligence, as being a divine thing and full of mystery.

196b8-196b9 Thus we must inquire what chance and spontaneity are, whether they are the same or different, and how they fit into our division of causes.

196b10-196b17 § 5 · First then we observe that some things always come to pass in the same way, and others for the most part. It is clearly of neither of these that chance, or the result of chance, is said to be the cause—neither of that which is by necessity and always, nor of that which is for the most part. But as there is a third class of events besides these two—events which all say are by chance—it is plain that there is such a thing as chance and spontaneity; for we know that things of this kind are due to chance and that things due to chance are of this kind.

[15] Frag. 53 Diels-Kranz.

Of things that come to be, some come to be for the sake of something, others not. Again, some of the former class are in accordance with intention, others not, but both are in the class of things which are for the sake of something. Hence it is clear that even among the things which are outside what is necessary and what is for the most part, there are some in connexion with which the phrase 'for the sake of something' is applicable. (Things that are for the sake of something include whatever may be done as a result of thought or of nature.) Things of this kind, then, when they come to pass accidentally are said to be by chance. For just as a thing is something either in virtue of itself or accidentally, so may it be a cause. For instance, the housebuilding faculty is in virtue of itself a cause of a house, whereas the pale or the musical is an accidental cause. That which is *per se* cause is determinate, but the accidental cause is indeterminable; for the possible attributes of an individual are innumerable. As we said, then, when a thing of this kind comes to pass among events which are for the sake of something, it is said to be spontaneous or by chance. (The distinction between the two must be made later—for the present it is sufficient if it is plain that both are in the sphere of things done for the sake of something.) 196b18-196b32

Example : A man is engaged in collecting[16] subscriptions for a feast. He would have gone to such and such a place for the purpose of getting the money, if he had known. He actually went there for another purpose, and it was only accidentally that he got his money by going there;[17] and this was not due to the fact that he went there as a rule or necessarily, nor is the end effected (getting the money) a cause present in himself—it belongs to the class of things that are objects of choice and the result of thought. It is when these conditions are satisfied that the man is said to have gone by chance. If he had chosen and gone for the sake of this—if he always or normally went there when he was collecting payments—he would not be said to have gone by chance. 196b33-197a5

It is clear then that chance is an accidental cause in the sphere of those actions for the sake of something which involve choice. Thought, then, and chance are in the same sphere, for choice implies thought. 197a6-197a7

It is necessary, no doubt, that the causes of what comes to pass by chance be indefinite; and that is why chance is supposed to belong to the class of the indefinite and to be inscrutable to man, and why it might be thought that, in a way, nothing occurs by chance. For all these statements are correct, as might be expected. Things *do*, in a way, occur by chance, for they occur accidentally 197a8-197a15

[16] Reading *komizomenos*, with one MS, for Ross's *komizomenou*.

[17] Omitting *tou komisasthai heneka* (Bonitz).

and chance is an accidental cause. But it is not the cause without qualification of anything; for instance, a housebuilder is the cause of a house; accidentally, a fluteplayer may be so.

197a16-197a24 And the causes of the man's coming and getting the money (when he did not come for the sake of that) are innumerable. He may have wished to see somebody or been following somebody or avoiding somebody, or may have gone to see a spectacle. Thus to say that chance is unaccountable is correct. For an account is of what holds always or for the most part, whereas chance belongs to a third type of event. Hence, since causes of this kind are indefinite, chance too is indefinite. (Yet in some cases one might raise the question whether *any* chance fact might be the cause of the chance occurrence, e.g. of health the fresh air or the sun's heat may be the cause, but having had one's hair cut *cannot;* for some accidental causes are more relevant to the effect than others.)

197a25-197a32 Chance is called good when the result is good, evil when it is evil. The terms 'good fortune' and 'ill fortune' are used when either result is of considerable magnitude. Thus one who comes within an ace of some great evil or great good is said to be fortunate or unfortunate. The mind affirms the presence of the attribute, ignoring the hair's breadth of difference. Further, it is with reason that good fortune is regarded as unstable; for chance is unstable, as none of the things which result from it can hold always or for the most part.

197a33-197a36 Both are then, as I have said, accidental causes—both chance and spontaneity—in the sphere of things which are capable of coming to pass not simply, nor for the most part and with reference to such of these as might come to pass for the sake of something.

197a37-197a39 § 6 · They differ in that spontaneity is the wider. Every result of chance is from what is spontaneous, but not everything that is from what is spontaneous is from chance.

197b1-197b13 Chance and what results from chance are appropriate to agents that are capable of good fortune and of action generally. Therefore necessarily chance is in the sphere of actions. This is indicated by the fact that good fortune is thought to be the same, or nearly the same, as happiness, and happiness to be a kind of action, since it is well-doing. Hence what is not capable of action cannot do anything by chance. Thus an inanimate thing or a beast or a child cannot do anything by chance, because it is incapable of choice; nor can good fortune or ill fortune be ascribed to them, except metaphorically, as Protarchus, for example, said that the stones of which altars are made are fortunate because they are held in honour, while their fellows are trodden under foot. Even these things, however, can in a

way be affected by chance, when one who is dealing with them does something to them by chance, but not otherwise.

The spontaneous on the other hand is found both in the beasts and in many inanimate objects. We say, for example, that the horse came spontaneously, because, though his coming saved him, he did not come for the sake of safety. Again, the tripod fell spontaneously, because, though it stood on its feet so as to serve for a seat, it did not fall so as to serve for a seat. 197b14-197b17

Hence it is clear that events which belong to the general class of things that may come to pass for the sake of something, when they come to pass not for the sake of what actually results, and have an external cause, may be described by the phrase 'from spontaneity'. These spontaneous events are said to be from chance if they have the further characteristics of being the objects of choice and happening to agents capable of choice. This is indicated by the phrase 'in vain', which is used when one thing which is for the sake of another, does not result in it.[18] For instance, taking a walk is for the sake of evacuation of the bowels; if this does not follow after walking, we say that we have walked in vain and that the walking was vain. This implies that what is naturally for the sake of an end is in vain, when it does not effect the end for the sake of which it was the natural means—for it would be absurd for a man to say that had had bathed in vain because the sun was not eclipsed, since the one was not done for the sake of the other. Thus the spontaneous is even according to its derivation[19] the case in which the thing itself happens in vain. The stone that struck the man did not fall for the sake of striking him; therefore it fell spontaneously, because it might have fallen by the action of an agent and for the sake of striking. The difference between spontaneity and what results by chance is greatest in things that come to be by nature; for when anything comes to be contrary to nature, we do not say that it came to be by chance, but by spontaneity. Yet strictly this too is different from the spontaneous proper; for the cause of the latter is external, that of the former internal. 197b18-197b36

We have now explained what chance is and what spontaneity is, and in what they differ from each other. Both belong to the mode of causation 'source of change', for either some natural or some intelligent agent is always the cause; but in this sort of causation the number of possible causes is infinite. 198a1-198a4

Spontaneity and chance are causes of effects which, though they might result from intelligence or nature, have in fact been caused by something accidentally. Now since nothing which is accidental is prior to what is *per se*, it is clear that no 198a5-198a13

[18] Reading *to heneka allou ekeino ou* (Prantl).

[19] 'The spontaneous': *to automaton*; 'the thing itself happens in vain': *auto maten genetai*.

accidental cause can be prior to a cause *per se.* Spontaneity and chance, therefore, are posterior to intelligence and nature. Hence, however true it may be that the heavens are due to spontaneity, it will still be true that intelligence and nature will be prior causes of this universe and of many things in it besides.

198a14-198a21 § 7 · It is clear then that there are causes, and that the number of them is what we have stated. The number is the same as that of the things comprehended under the question 'why'. The 'why' is referred ultimately either, in things which do not involve motion, e.g. in mathematics, to the 'what' (to the definition of straight line or commensurable or the like); or to what initiated a motion, e.g. 'why did they go to war?—because there had been a raid'; or we are inquiring 'for the sake of what?'—'that they may rule'; or in the case of things that come into being, we are looking for the matter. The causes, therefore, are these and so many in number.

198a22-198a32 Now, the causes being four, it is the business of the student of nature to know about them all, and if he refers his problems back to all of them, he will assign the 'why' in the way proper to his science—the matter, the form, the mover, that for the sake of which. The last three often coincide; for the what and that for the sake of which are one, while the primary source of motion is the same in species as these. For man generates man—and so too, in general, with all things which cause movement by being themselves moved; and such as are not of this kind are no longer inside the province of natural science, for they cause motion not by possessing motion or a source of motion in themselves, but being themselves incapable of motion. Hence there are three branches of study, one of things which are incapable of motion, the second of things in motion, but indestructible, the third of destructible things.

198a33-198a35 The question 'why', then, is answered by reference to the matter, to the form, and to the primary moving cause. For in respect of coming to be it is mostly in this last way that causes are investigated—'what comes to be after what? what was the primary agent or patient?' and so at each step of the series.

198a36-198b9 Now the principles which cause motion in a natural way are two, of which one is not natural, as it has no principle of motion in itself. Of this kind is whatever causes movement, not being itself moved, such as that which is completely unchangeable, the primary reality, and the essence of a thing, i.e. the form; for this is the end or that for the sake of which. Hence since nature is for the sake of something, we must know this cause also. We must explain the 'why' in all the senses of the term, namely, that from this that will necessarily result ('from this' either without qualification or for the most part); that this must be so if that is to be so (as the conclusion presupposes the premisses); that this was the essence of the

thing; and because it is better thus (not without qualification, but with reference to the substance in each case).

§ 8 · We must explain then first why nature belongs to the class of causes which act for the sake of something; and then about the necessary and its place in nature, for all writers ascribe things to this cause, arguing that since the hot and the cold and the like are of such and such a kind, therefore certain things *necessarily* are and come to be—and if they mention any other cause (one friendship and strife, another mind), it is only to touch on it, and then good-bye to it. 198b10-198b16

A difficulty presents itself: why should not nature work, not for the sake of something, nor because it is better so, but just as the sky rains, not in order to make the corn grow, but of necessity? (What is drawn up must cool, and what has been cooled must become water and descend, the result of this being that the corn grows.) Similarly if a man's crop is spoiled on the threshing-floor, the rain did not fall for the sake of this—in order that the crop might be spoiled—but that result just followed. Why then should it not be the same with the parts in nature, e.g. that our teeth should come up of necessity—the front teeth sharp, fitted for tearing, the molars broad and useful for grinding down the food—since they did not arise for this end, but it was merely a coincident result; and so with all other parts in which we suppose that there is purpose? Wherever then all the parts came about just what they would have been if they had come to be for an end, such things survived, being organized spontaneously in a fitting way; whereas those which grew otherwise perished and continue to perish, as Empedocles says his 'man-faced oxprogeny' did.[20] 198b17-198b33

Such are the arguments (and others of the kind) which may cause difficulty on this point. Yet it is impossible that this should be the true view. For teeth and all other natural things either invariably or for the most part come about in a given way; but of not one of the results of chance or spontaneity is this true. We do not ascribe to chance or mere coincidence the frequency of rain in winter, but frequent rain in summer we do; nor heat in summer but only if we have it in winter. If then, it is agreed that things are either the result of coincidence or for the sake of something, and these cannot be the result of coincidence or spontaneity, it follows that they must be for the sake of something; and that such things are all due to nature even the champions of the theory which is before us would agree. Therefore action for an end is present in things which come to be and are by nature. 198b34-199a8

Further, where there is an end, all the preceding steps are for the sake of that. 199a9-199a19

[20] Frag. 61 Diels-Kranz.

Now surely as in action, so in nature; and as in nature, so it is in each action, if nothing interferes. Now action is for the sake of an end; therefore the nature of things also is so. Thus if a house, e.g., had been a thing made by nature, it would have been made in the same way as it is now by art; and if things made by nature were made not only by nature but also by art, they would come to be in the same way as by nature. The one, then, is for the sake of the other; and generally art in some cases completes what nature cannot bring to a finish, and in others imitates nature. If, therefore, artificial products are for the sake of an end, so clearly also are natural products. The relation of the later to the earlier items is the same in both.

199a20-199a33 This is most obvious in the animals other than man: they make things neither by art nor after inquiry or deliberation. That is why people wonder whether it is by intelligence or by some other faculty that these creatures work,—spiders, ants, and the like. By gradual advance in this direction we come to see clearly that in plants too that is produced which is conducive to the end—leaves, e.g. grow to provide shade for the fruit. If then it is both by nature and for an end that the swallow makes its nest and the spider its web, and plants grow leaves for the sake of the fruit and send their roots down (not up) for the sake of nourishment, it is plain that this kind of cause is operative in things which come to be and are by nature. And since nature is twofold, the matter and the form, of which the latter is the end, and since all the rest is for the sake of the end, the form must be the cause in the sense of that for the sake of which.

199a34-199b7 Now mistakes occur even in the operations of art: the literate man makes a mistake in writing and the doctor pours out the wrong dose. Hence clearly mistakes are possible in the operations of nature also. If then in art there are cases in which what is rightly produced serves a purpose, and if where mistakes occur there was a purpose in what was attempted, only it was not attained, so must it be also in natural products, and monstrosities will be failures in the purposive effort. Thus in the original combinations the 'ox-progeny', if they failed to reach a determinate end must have arisen through the corruption of some principle, as happens now when the seed is defective.

199b8-199b9 Further, seed must have come into being first, and not straightway the animals: what was 'undifferentiated first'[21] was seed.

199b10-199b13 Again, in plants too we find that for the sake of which, though the degree of organization is less. Were there then in plants also olive-headed vine-progeny, like the 'man-headed ox-progeny', or not? An absurd suggestion; yet there must have

[21] Empedocles, frag. 62 Diels-Kranz.

been, if there were such things among animals.

Moreover, among the seeds anything must come to be at random. But the person who asserts this entirely does away with nature and what exists by nature. For those things are natural which, by a continuous movement originated from an internal principle, arrive at some end: the same end is not reached from every principle; nor any chance end, but always the tendency in each is towards the same end, if there is no impediment. 199b14-199b18

The end and the means towards it may come about by chance. We say, for instance, that a stranger has come by chance, paid the ransom, and gone away, when he does so as if he had come for that purpose, though it was not for that that he came. This is accidental, for chance is an accidental cause, as I remarked before. But when an event takes place always or for the most part, it is not accidental or by chance. In natural products the sequence is invariable, if there is no impediment. 199b19-199b26

It is absurd to suppose that purpose is not present because we do not observe the agent deliberating. Art does not deliberate. If the ship-building art were in the wood, it would produce the same results by nature. If, therefore, purpose is present in art, it is present also in nature. The best illustration is a doctor doctoring himself: nature is like that. 199b27-199b31

It is plain then that nature is a cause, a cause that operates for a purpose. 199b32-199b32

§ 9 · As regards what is of necessity, we must ask whether the necessity is hypothetical, or simple as well. The current view places what is of necessity in the process of production, just as if one were to suppose that the wall of a house necessarily comes to be because what is heavy is naturally carried downwards and what is light to the top, so that the stones and foundations take the lowest place, with earth above because it is lighter, and wood at the top of all as being the lightest. Whereas, though the wall does not come to be *without* these, it is not *due* to these, except as its material cause: it comes to be for the sake of sheltering and guarding certain things. Similarly in all other things which involve that for the sake of which: the product cannot come to be without things which have a necessary nature, but it is not due to these (except as its material); it comes to be for an end. For instance, why is a saw such as it is? To effect so-and-so and for the sake of so-and-so. This end, however, cannot be realized unless the saw is made of iron. It is, therefore, necessary for it to be of iron, if we are to have a saw and perform the operation of sawing. What is necessary then, is necessary on a hypothesis, not as an end. Necessity is in the matter, while that for the sake of which is in the definition. 199b33-200a14

Necessity in mathematics is in a way similar to necessity in things which come 200a15-200a30

to be through the operation of nature. Since a straight line is what it is, it is necessary that the angles of a triangle should equal two right angles. But not conversely; though if the angles are *not* equal to two right angles, then the straight line is not what it is either. But in things which come to be for an end, the reverse is true. If the end is to exist or does exist, that also which precedes it will exist or does exist; otherwise just as there, if the conclusion is not true, the principle will not be true, so here the end or that for the sake of which will not exist. For this too is itself a principle, but of the reasoning, not of the action. (In mathematics the principle is the principle of the reasoning only, as there is no action.) If then there is to be a house, such-and-such things must be made or be there already or exist, or generally the matter relative to the end, bricks and stones if it is a house. But the end is not due to these except as the matter, nor will it come to exist because of them. Yet if they do not exist at all, neither will the house, or the saw—the former in the absence of stones, the latter in the absence of iron—just as in the other case the principles will not be true, if the angles of the triangle are not equal to two right angles.

200a31-200b10 The necessary in nature, then, is plainly what we call by the name of matter, and the changes in it. Both causes must be stated by the student of nature, but especially the end; for that is the cause of the matter, not *vice versa;* and the end is that for the sake of which, and the principle starts from the definition or essence: as in artificial products, since a house is of such-and-such a kind, certain things must *necessarily* come to be or be there already, or since health is this, these things must necessarily come to be or be there already, so too if man is this, then these; if these, then those. Perhaps the necessary is present also in the definition. For if one defines the operation of sawing as being a certain kind of dividing, then this cannot come about unless the saw has teeth of a certain kind; and these cannot be unless it is of iron. For in the definition too there are some parts that stand as matter.

Book III

§ 1 · Nature is a principle of motion and change, and it is the subject of our inquiry. 200b11-200b14
We must therefore see that we understand what motion is; for if it were unknown, nature too would be unknown.

When we have determined the nature of motion, our task will be to attack in the 200b15-200b21
same way the terms which come next in order. Now motion is supposed to belong to the class of things which are continuous; and the infinite presents itself first in the continuous—that is how it comes about that the account of the infinite is often used in definitions of the continuous; for what is infinitely divisible is continuous. Besides these, place, void, and time are thought to be necessary conditions of motion.

Clearly, then, for these reasons and also because the attributes mentioned are 200b22-200b24
common to everything and universal, we must first take each of them in hand and discuss it. For the investigation of special attributes comes after that of the common attributes.

To begin then, as we said, with motion. 200b25-200b25

Some things are in fulfilment only, others in potentiality and in fulfilment— 200b26-200b32
one being a 'this', another so much, another such and such, and similarly for the other categories of being. The term 'relative' is applied sometimes with reference to excess and defect, sometimes to agent and patient, and generally to what can move and what can be moved. For what can cause movement is relative to what can be moved, and *vice versa*.

There is no such thing as motion over and above the things. It is always with 200b33-201a3
respect to substance or to quantity or to quality or to place that what changes changes. But it is impossible, as we assert, to find anything common to these which is neither 'this' nor quantity nor quality nor any of the other predicates. Hence neither will motion and change have reference to something over and above the things mentioned; for there *is* nothing over and above them.

Now each of these belongs to all its subjects in either of two ways: namely, 201a4-201a9
substance—the one is its form, the other privation; in quality, white and black; in quantity, complete and incomplete. Similarly, in respect of locomotion, upwards and downwards or light and heavy. Hence there are as many types of motion or change as there are of being.

201a10-201a14 We have distinguished in respect of each class between what is in fulfilment and what is potentially; thus the fulfilment of what is potentially, as such, is motion—e.g. the fulfilment of what is alterable, as alterable, is alteration; of what is increasable and its opposite, decreasable (there is no common name for both), increase and decrease; of what can come to be and pass away, coming to be and passing away; of what can be carried along, locomotion.

201a15-201a19 That this is what motion is, is clear from what follows: when what is buildable, in so far as we call it such, is in fulfilment, it is being built, and that is building. Similarly with learning, doctoring, rolling, jumping, ripening, aging.

201a20-201a27 The same thing can be both potential and fulfilled, not indeed at the same time or not in the same respect, but e.g. potentially hot and actually cold. Hence such things will act and be acted on by one another in many ways: each of them will be capable at the same time of acting and of being acted upon. Hence, too, what effects motion as a natural agent can be moved: when a thing of this kind causes motion, it is itself also moved. This, indeed, has led some people to suppose that every mover is moved. But this question depends on another set of arguments, and the truth will be made clear later.[22] It *is* possible for a thing to cause motion, though it is itself incapable of being moved.

201a28-201b3 It is the fulfilment of what is potential when it is already fulfilled and operates not as itself but as movable, that is motion. What I mean by 'as' is this: bronze is potentially a statue. But it is not the fulfilment of bronze as *bronze* which is motion. For to be bronze and to be a certain potentiality are not the same. If they were identical without qualification, i.e. in definition, the fulfilment of bronze as bronze *would* be motion. But they are not the same, as has been said. (This is obvious in contraries. To be capable of health and to be capable of illness are not the same; for if they were there would be no difference between being ill and being well. Yet the subject both of health and of sickness—whether it is humour or blood—is one and the same.)

201b4-201b6 We can distinguish, then, between the two—just as colour and visible are different—and clearly it is the fulfilment of what is potential as potential that is motion.

201b7-201b15 It is evident that this is motion, and that motion occurs just when the fulfilment itself occurs, and neither before nor after. For each thing is capable of being at one time actual, at another not. Take for instance the buildable: the actuality of the buildable as buildable is the process of building. For the actuality must be either this or the house. But when there is a house, the buildable is no longer there.

[22] See VIII 1-6.

On the other hand, it *is* the buildable which is *being* built. Necessarily, then, the actuality is the process of building. But building is a kind of motion, and the same account will apply to the other kinds also.

§ 2 · The soundness of this definition is evident both when we consider the accounts of motion that the others have given, and also from the difficulty of defining it otherwise. 201b16-201b18

One could not easily put motion and change in another genus—this is plain if we consider where some people put it: they identify motion with difference or inequality or not being; but such things are not necessarily moved, whether they are different or unequal or non-existent. Nor is change either to or from *these* rather than to or from their opposites. 201b19-201b23

The reason why they put motion into these genera is that it is thought to be something indefinite, and the principles in the second column[23] are indefinite because they are privative: none of them is either a 'this' or such or comes under any of the other categories. The reason why motion is thought to be indefinite is that is cannot be classed as a potentiality or as an actuality—a thing that is merely *capable* of having a certain size is not necessarily undergoing change, nor yet a thing that is *actually* of a certain size, and motion is thought to be a sort of *actuality*, but incomplete, the reason for this view being that the potential whose actuality it is is incomplete. This is why it is hard to grasp what motion is. It is necessary to class it with privation or with potentiality or with simple actuality, yet none of these seems possible. There remains then the suggested mode of definition, namely that it is a sort of actuality, or actuality of the kind described, hard to grasp, but not incapable of existing. 201b24-202a2

Every mover too is moved, as has been said—every mover, that is, which is capable of motion, and whose immobility is rest (for when a thing is subject to motion its immobility is rest). For to act on the movable as such is just to move it. But this it does by contact, so that at the same time it is also acted on. Hence motion is the fulfilment of the movable as movable, the cause being contact with what can move, so that the mover is also acted on. The mover will always transmit a form, either a 'this' or such or so much, which, when it moves, will be the principle and cause of the motion, e.g. the actual man begets man from what is potentially man. 202a3-202a11

§ 3 · The solution of the difficulty is plain: motion is in the movable. It is the fulfilment of this potentiality by the action of that which has the power of causing 202a12-202a20

[23] Compare the Pythagorean columns at *Metaphysics A* 5 986a25.

motion; and the actuality of that which has the power of causing motion is not other than the actuality of the movable; for it must be the fulfilment of *both.* A thing is capable of causing motion because it *can* do this, it is a mover because it actually *does* it. But it is on the movable that it is capable of acting. Hence there is a single actuality of both alike, just as one to two and two to one are the same interval, and the steep ascent and the steep descent are one—for these are one and the same, although their definitions are not one. So it is with the mover and the moved.

202a21-202a28 This view has a dialectical difficulty. Perhaps it is necessary that there should be an actuality of the agent and of the patient. The one is agency and the other patiency; and the outcome and end of the one is an action, that of the other a passion. Since then they are both motions, we may ask: *in* what are they, if they are different? Either both are in what is acted on and moved, or the agency is in the agent and the patiency in the patient. (If we ought to call the latter also 'agency', the word would be used in two senses.)

202a29-202a31 Now, in the latter case, the motion will be in the mover, for the same account will hold of mover and moved. Hence either *every* mover will be moved, or, though having motion, it will not be moved.

202a32-202a37 If on the other hand both are in what is moved and acted on—both the agency and the patiency (e.g. both teaching and learning, though they are two, in the learner), then, first, the actuality of each will not be present *in* each, and, a second absurdity, a thing will have two motions at the same time. How will there be two alterations of quality in *one* subject towards *one* form? The thing is impossible: the actualization will be one.

202b1-202b5 But (someone will say) it is contrary to reason to suppose that there should be one identical actualization of two things which are different in kind. Yet there will be, if teaching and learning are the same, and agency and patiency. To teach will be the same as to learn, and to act the same as to be acted on—the teacher will necessarily be learning everything that he teaches, and the agent will be acted on.

202b6-202b8 It is not absurd that the actualization of one thing should be in another. Teaching is the activity of a person who can teach, yet the operation is performed in something—it is not cut adrift from a subject, but is of one thing in another.

202b9-202b10 There is nothing to prevent two things having one and the same actualization (not the same in being, but related as the potential is to the actual).

202b11-202b21 Nor is it necessary that the teacher should learn, even if to act and to be acted on are one and the same, provided they are not the same in respect of the account which states their essence (as raiment and dress), but are the same in the sense in which the road from Thebes to Athens and the road from Athens to Thebes are

the same, as has been explained above. For it is not things which are in any way the same that have all their attributes the same, but only those to be which is the same. But indeed it by no means follows from the fact that teaching is the same as learning, that to learn is the same as to teach, any more than it follows from the fact that there is one distance between two things which are at a distance from each other, that being here at a distance from there and being there at a distance from here are one and the same. To generalize, teaching is not the same as learning, or agency as patiency, in the full sense, though they belong to the same subject, the motion; for the actualization of this in that and the actualization of that through the action of this differ in definition.

What then motion is, has been stated both generally and particularly. It is not difficult to see how each of its types will be defined—alteration is the fulfilment of the alterable as alterable (or, more scientifically, the fulfilment of what can act and what can be acted on, as such)—generally and again in each particular case, building, healing. A similar definition will apply to each of the other kinds of motion. 202b22-202b29

§ 4 · The science of nature is concerned with magnitudes and motion and time, and each of these is necessarily infinite or finite, even if some things are not, e.g. a quality or a point—it is not necessary perhaps that such things should be put under either head. Hence it is incumbent on the person who treats of nature to discuss the infinite and to inquire whether there is such a thing or not, and, if there is, what it is. 202b30-202b37

The appropriateness to the science of this problem is clearly indicated; for all who have touched on this kind of science in a way worth considering have formulated views about the infinite, and indeed, to a man, make it a principle of things. 203a1-203a3

Some, as the Pythagoreans and Plato, make the infinite a principle as a substance in its own right, and not as an accident of some other thing. Only the Pythagoreans place the infinite among the objects of sense (they do not regard number as separable from these), and assert that what is outside the heaven is infinite. Plato, on the other hand, holds that there is no body outside (the Forms are not outside, because they are nowhere), yet that the infinite is present not only in the objects of sense but in the Forms also. 203a4-203a9

Further, the Pythagoreans identify the infinite with the even. For this, they say, when it is cut off and shut in by the odd, provides things with the element of infinity. An indication of this is what happens with numbers. If the gnomons are placed round the one, and without the one, in the one construction the figure that 203a10-203a16

results is always different, in the other it is always the same. But Plato has two infinites, the Great and the Small.

203a17-203a22 The physicists, on the other hand, all of them, regard the infinite as an attribute of a substance which is different from it and belongs to the class of the so-called elements—water or air or what is intermediate between them. Those who make them limited in number never make them infinite in amount. But those who make the elements infinite in number, as Anaxagoras and Democritus do, say that the infinite is continuous by contact—compounded of the homogeneous parts according to the one, of the seedmass of the atomic shapes according to the other.

203a23-203a34 Further, Anaxagoras held that any part is a mixture in the same way as the whole, on the ground of the observed fact that anything comes out of anything. For it is probably for this reason that he maintains that once upon a time all things were together. *This* flesh and *this* bone were together, and so of *any* thing; therefore *all* things—and at the same time too. For there is a principle of separation, not only for each thing, but for all. Each thing that comes to be comes to be from a similar body, and there is a coming to be of all things, though not, it is true, at the same time. Hence there must also be a principle of coming to be. One such source there is which he calls Mind, and Mind begins its work of thinking from some principle. So necessarily all things must have been together at a certain time, and must have begun to be moved at a certain time.

203a35-203b2 Democritus, for his part, asserts that no element arises from another element. Nevertheless for him the common body is a principle of all things, differing from part to part in size and in shape.

203b3-203b15 It is clear then from these considerations that the inquiry concerns the student of nature. Nor is it without reason that they all make it a principle. We cannot say that the infinite exists in vain, and the only power which we can ascribe to it is that of a principle. For everything is either a principle or derived from a principle. But there cannot be a principle of the infinite, for that would be a limit of it. Further, as it is a principle, it is both uncreatable and indestructible. For there must be a point at which what has come to be reaches its end, and also a termination of all passing away. That is why, as we say, there is no principle of *this*, but it is this which is held to be the principle of other things, and to encompass all and to steer all, as those assert who do not recognize, alongside the infinite, other causes, such as Mind or Friendship. Further they identify it with the Divine, for it is deathless and imperishable as Anaximander says, with the majority of the physicists.

203b16-203b26 Belief in the existence of the infinite comes mainly from five considerations: From the nature of time—for it is infinite; From the division of magnitudes—for the mathematicians also use the infinite; again, if coming to be and passing away

do not give out, it is only because that from which things come to be is infinite; again, because the limited always finds its limit in something, so that there must be no limit, if everything is always limited by something different from itself. Most of all, a reason which is peculiarly appropriate and presents the difficulty that is felt by everybody—not only number but also mathematical magnitudes and what is outside the heaven are supposed to be infinite because they never give out in our thought.

If what is outside is infinite it seems that body also is infinite, and that there is an infinite number of worlds. Why should there be body in one part of the void rather than in another? Grant only that mass is anywhere and it follows that it must be everywhere. Also, if void and place are infinite, there must be infinite body too; for in the case of eternal things what may be is. 203b27-203b30

But the problem of the infinite is difficult: many contradictions result whether we suppose it to exist or not to exist. If it exists, we have still to ask *how* it exists—as a substance or as the essential attribute of some entity? Or in neither way, yet none the less is there something which is infinite or some things which are infinitely many? 203b31-203b35

The problem, however, which specially belongs to the physicist is to investigate whether there is a sensible magnitude which is infinite. 204a1-204a2

We must begin by distinguishing the various ways in which the term 'infinite' is used: in one way, it is applied to what is incapable of being gone through, because it is not its nature to be gone through (the way in which the voice is invisible); in another, to what admits of a traversal which cannot be completed, or which can only be completed with difficulty, or what naturally admits of a traversal but does not have a traversal or limit. 204a3-204a6

Further, everything that is infinite may be so in respect of addition or division or both. 204a7-204a7

§ 5 · Now it is impossible that the infinite should be a thing which is in itself infinite, separable from sensible objects. If the infinite is neither a magnitude nor an aggregate, but is itself a substance and not an accident, it will be indivisible; for the divisible must be either a magnitude or an aggregate. But if indivisible, then not infinite, except in the way in which the voice is invisible. But this is not the way in which it is used by those who say that the infinite exists, nor that in which we are investigating it, namely as that which cannot be gone through. But if the infinite is accidental, it would not be, *qua* infinite, an element in things, any more than the invisible would be an element of speech, though the voice is invisible. 204a8-204a16

Further, how can the infinite be itself something, unless both number and mag- 204a17-204a19

nitude, of which it is an essential attribute, exist in that way? If they are not substances, *a fortiori* the infinite is not.

204a20-204a29 It is plain, too, that the infinite cannot be an actual thing and a substance and principle. For any part of it that is taken will be infinite, if it has parts; for to be infinite and the infinite are the same, if it is a substance and not predicated of a subject. Hence it will be either indivisible or divisible into infinites. But the same thing cannot be many infinites. (Yet just as part of air is air, so a part of the infinite would be infinite, if it is supposed to be a substance and principle.) Therefore the infinite must be without parts and indivisible. But this cannot be true of what is infinite in fulfilment; for it must be a definite quantity.

204a30-204a32 Suppose then that infinity belongs accidentally. But, if so, it cannot, as we have said, be described as a principle, but rather that of which it is an accident—the air or the even number.

204a33-204a35 Thus the view of those who speak after the manner of the Pythagoreans is absurd. With the same breath they treat the infinite as substance, and divide it into parts.

204a36-204b3 This discussion, however, involves the more general question whether the infinite can be present in mathematical objects and things which are intelligible and do not have extension. Our inquiry is limited to our special subject-matter, the objects of sense, and we have to ask whether there is or is not among them a body which is infinite in the direction of increase.

204b4-204b4 We may begin with a dialectical argument and show as follows that there is no such thing.

204b5-204b9 If 'bounded by a surface' is the definition of body there cannot be an infinite body either intelligible or sensible. Nor can number taken in abstraction be infinite; for number or that which has number is numerable. If then the numerable can be numbered, it would also be possible to go through the infinite.

204b10-204b11 If, on the other hand, we investigate the question more in accordance with principles appropriate to physics, we are led as follows to the same result.

204b12-204b12 The infinite can be either compound, or simple.

204b13-204b21 It will not be compound, if the elements are finite in number. For they must be more than one, and the contraries must always balance, and no *one* of them can be infinite. If one of the bodies falls in any degree short of the other in potency—suppose fire is finite in amount while air is infinite and a given quantity of fire exceeds in power the same amount of air in any ratio provided it is numerically definite—the infinite body will obviously prevail over and annihilate the finite body. On the other hand, it is impossible that *each* should be infinite. Body is what has extension in all directions and the infinite is what is boundlessly extended, so

that the infinite body would be extended in all directions *ad infinitum.*

Nor can an infinite body be one and simple, whether it is, as some hold, a thing over and above the elements (from which they generate the elements) or is not thus qualified. There *are* some people who make this the infinite, and not air or water, in order that the other elements may not be annihilated by the element which is infinite. They have contrariety with each other—air is cold, water moist, fire hot; if one were infinite, the others by now would have ceased to be. As it is, they say, the infinite is different from them and is their source. 204b22-204b28

It is impossible, however, that there should be such a body; not because it is infinite—on that point a general proof can be given which applies equally to all, air, water, or anything else—but because there is no such sensible body, alongside the so-called elements. Everything can be resolved into the elements of which it is composed. Hence the body in question would have been present in our world here, alongside air and fire and earth and water; but nothing of the kind is observed. 204b29-204b34

Nor can fire or any other of the elements be infinite. For generally, and apart from the question how any of them could be infinite, the universe, even, if it were limited, cannot either be or become one of them, as Heraclitus says that at some time all things become fire. (The same argument applies also to the one which the physicists suppose to exist alongside the elements: for everything changes from contrary to contrary, e.g. from hot to cold.) 205a1-205a6

In each case, we should consider along these lines whether it is or is not possible that it should be infinite. The following arguments give a general demonstration that it is not possible for there to be an infinite sensible body. 205a7-205a9

It is the nature of every kind of sensible body to be somewhere, and there is a place appropriate to each, the same for the part and for the whole, e.g. for the whole earth and for a single clod, and for fire and for a spark. 205a10-205a12

Suppose that the infinite sensible body is homogeneous. Then each will be either immovable or always being carried along. Yet neither is possible. For why downwards rather than upwards or in any other direction? I mean, e.g., if you take a clod, where will it be moved or where will it be at rest? For the place of the body akin to it is infinite. Will it occupy the whole place, then? And how? What then will be the nature of its rest and of its movement, or where will they be? It will either be at rest everywhere—then it will not be moved; or it will be moved everywhere—then it will not come to rest. 205a13-205a19

But if the universe has dissimilar parts, the proper places of the parts will be dissimilar also, and the body of the universe will have no unity except that of contact. Then, further, the parts will be either finite or infinite in variety of kind. 205a20-205a22

Finite they cannot be; for if the universe is to be infinite, some of them would 205a23-205a24

have to be infinite, while the others were not, e.g. fire or water will be infinite. But such an element would destroy what is contrary to it.

205a25-205a34 But if the parts are *infinite* in number and simple, their proper places too will be infinite in number, and the same will be true of the elements themselves. If that is impossible, and the places are finite, the whole too must be finite; for the place and the body cannot but fit each other. Neither is the whole place larger than what can be filled by the body (and then the body would no longer be infinite), nor is the body larger than the place; for either there would be an empty space or a body whose nature it is to be nowhere. This indeed is the reason why none of the physicists made fire or earth the one infinite body, but either water or air or what is intermediate between them, because the abode of each of the two was plainly determinate, while the others have an ambiguous place between up and down.

205b1-205b6 Anaxagoras gives an absurd account of why the infinite is at rest. He says that the infinite itself is the cause of its being fixed. This because it is *in* itself, since nothing else contains it—on the assumption that wherever anything is, it is there by its own nature. But this is not true: a thing could be somewhere by compulsion, and not where it is its nature to be.

205b7-205b17 Thus however true it may be that the whole is not moved (for what is fixed by itself and is in itself must be immovable), yet we must explain *why* it is not its nature to be moved. It is not enough just to make this statement and then decamp. For it might be not moving because there is nowhere else for it to move, even though there is no reason why it should not be its nature to be moved. The earth is not carried along, and would not be carried along if it were infinite, provided it is held together by the centre. But it would not be because there was no other region in which it could be carried along that it would remain, but because this is its nature. Yet in this case also we may say that it fixes itself. If then in the case of the earth, supposed to be infinite, it is at rest, not for this reason, but because it has weight and what is heavy rests at the centre and the earth is at the centre, similarly the infinite also would rest in itself, not because it is infinite and fixes itself, but owing to some other cause.

205b18-205b23 It is clear at the same time that part of the infinite body ought to remain at rest. Just as the infinite remains at rest in itself because it fixes itself, so too any part of it you may take will remain in itself. The appropriate places of the whole and of the part are alike, e.g. of the whole earth and of a clod the appropriate place is the lower region; of fire as a whole and of a spark, the upper region. If, therefore, to be in itself is the place of the infinite, that also will be appropriate to the part. Therefore it will remain in itself.

205b24-205b31 In general, the view that there is an infinite body is plainly incompatible with

the doctrine that there is a proper place for each kind of body, if every sensible body has either weight or lightness, and if a body has a natural locomotion towards the centre if it is heavy, and upwards if it is light. This would need to be true of the infinite also. But neither character can belong to it: it cannot be either as a whole, nor can it be half the one and half the other. For how should you divide it? or how can the infinite have the one part up and the other down, or an extremity and a centre?

Further, every sensible body is in place, and the kinds or differences of place are up-down, before-behind, right-left; and these distinctions hold not only in relation to us and by convention, but also in the whole itself. But in the infinite body they cannot exist. In general, if it is impossible that there should be an infinite place, and if every body is in place, there cannot be an infinite body. 205b32-206a2

Surely what is in a place is somewhere, and what is somewhere is in a place. Just, then, as the infinite cannot be quantity—that would imply that it has a particular quantity, e.g. two or three cubits; quantity just means these—so a thing's being in a place means that it is somewhere, and that is either up or down or in some other of the six differences of position; but each of these is a limit. 206a3-206a6

It is plain from these arguments that there is no body which is actually infinite. 206a7-206a8

§ 6 · But on the other hand to suppose that the infinite does not exist in any way leads obviously to many impossible consequences: there will be a beginning and an end of time, a magnitude will not be divisible into magnitudes, number will not be infinite. If, then, in view of the above considerations, neither alternative seems possible, an arbiter must be called in; and clearly there is a sense in which the infinite exists and another in which it does not. 206a9-206a13

Now things are said to exist both potentially and in fulfilment. Further, a thing is infinite either by addition or by division. Now, as we have seen, magnitude is not actually infinite. But by division it is infinite. (There is no difficulty in refuting the theory of indivisible lines.) The alternative then remains that the infinite has a potential existence. 206a14-206a18

But we must not construe potential existence in the way we do when we say that it is possible for this to be a statue—this will *be* a statue, but something infinite will not be in actuality. Being is spoken of in many ways, and we say that the infinite is in the sense in which we say it is day or it is the games, because one thing after another is always coming into existence. For of these things too the distinction between potential and actual existence holds. We say that there are Olympic games, both in the sense that they may occur and that they are actually occurring. 206a19-206a25

206a26-206a34 The infinite exhibits itself in different ways—in time, in the generations of man, and in the division of magnitudes. For generally the infinite has this mode of existence: one thing is always being taken after another, and each thing that is taken is always finite, but always different. [Again, 'being' is spoken of in several ways, so that we must not regard the infinite as a 'this', such as a man or a horse, but must suppose it to exist in the sense in which we speak of the day or the games as existing—things whose being has not come to them like that of a substance, but consists in a process of coming to be or passing away, finite, yet always different.][24]

206b1-206b3 But in spatial magnitudes, what is taken persists, while in the succession of time and of men it takes place by the passing away of these in such a way that the source of supply never gives out.

206b4-206b12 In a way the infinite by addition is the same thing as the infinite by division. In a finite magnitude, the infinite by addition comes about in a way inverse to that of the other. For just as we see division going on *ad infinitum*, so we see addition being made in the same proportion to what is already marked off. For if we take a determinate part of a finite magnitude and add another part determined by the same ratio (not taking in the same amount of the original whole), we shall not traverse the given magnitude. But if we increase the ratio of the part, so as always to take in the same amount, we shall traverse the magnitude; for every finite magnitude is exhausted by means of any determinate quantity however small.

206b13-206b16 The infinite, then, exists in no other way, but in this way it does exist, potentially and by reduction. It exists in fulfillment in the sense in which we say 'it is day' or 'it is the games'; and potentially as matter exists, not independently as what is finite does.

206b17-206b20 By addition then, also, there is potentially an infinite, namely, what we have described as being in a sense the same as the infinite in respect of division. For it will always be possible to take something *ab extra*. Yet the sum of the parts taken will not exceed every determinate magnitude, just as in the direction of division every determinate magnitude is surpassed and there will always be a smaller part.

206b21-206b33 But in respect of addition there cannot even potentially be an infinite which exceeds every assignable magnitude, unless it is accidentally infinite in fulfillment, as the physicists hold to be true of the body which is outside the world, whose substance is air or something of the kind. But if there cannot be in this way a sensible body which is infinite in fulfilment, evidently there can no more be a body which is potentially infinite in respect of addition, except as the inverse of the infinite by

[24] Ross excises the bracketed sentence as an alternative version of 206a18-29.

division, as we have said. It is for this reason that Plato also made the infinites two in number, because it is supposed to be possible to exceed all limits and to proceed *ad infinitum* in the direction both of increase and of reduction. Yet though he makes the infinites two, he does not use them. For in the numbers the infinite in the direction of reduction is not present, as the monad is the smallest; nor is the infinite in the direction of increase, for he makes numbers only up to the decad.

206b34-207a6 The infinite turns out to be the contrary of what it is said to be. It is not what has nothing outside it that is infinite, but what always has something outside it. This is indicated by the fact that rings also that have no bezel are described as infinite,[25] because it is always possible to take a part which is outside a given part. The description depends on a certain similarity, but it is not true in the full sense of the word. This condition alone is not sufficient: it is necessary also that the same part should never be taken twice. In the circle, the latter condition is not satisfied: it is true only that the next part is always different.

207a7-207a14 Thus something is infinite if, taking it quantity by quantity, we can always take something outside. On the other hand, what has nothing outside it is complete and whole. For thus we define the whole—that from which nothing is wanting, as a whole man or box. What is true of each particular is true of the whole properly speaking—the whole is that of which nothing is outside. On the other hand that from which something is absent and outside, however small that may be, is not 'all'. Whole and complete are either quite identical or closely akin. Nothing is complete which has no end and the end is a limit.

207a15-207a31 Hence Parmenides must be thought to have spoken better than Melissus. The latter says that the whole is infinite, but the former describes it as limited, 'equally balanced from the middle'.[26] For to connect the infinite with the universe and the whole is not like joining two pieces of string; for it is from this they get the dignity they ascribe to the infinite—its containing all things and holding the universe in itself—from its having a certain similarity to the whole. It is in fact the matter of the completeness which belongs to size, and what is potentially a whole, though not in fulfilment. It is divisible both in the direction of reduction and of the inverse addition. It is a whole and limited; not, however, in virtue of its own nature, but in virtue of something else. It does not contain, but, in so far as it is infinite, is contained. Consequently, also, it is unknowable, *qua* infinite; for the matter has no form. (Hence it is plain that the infinite stands in the relation of part rather than of whole. For the matter is part of the whole, as the bronze is of the bronze

[25] Rings are *apeiroi* in the sense of having no ends (*perata*).

[26] Frag. 8, line 44, Diels-Kranz.

statue.) If it contains in the case of sensible things, in the case of intelligible things the great and the small ought to contain them. But it is absurd and impossible to suppose that the unknowable and indeterminate should contain and determine.

207a32-207b15 § 7 · It is reasonable that there should not be held to be an infinite in respect of addition such as to surpass every magnitude, but that there should be thought to be such an infinite in the direction of division. For the matter and the infinite are contained inside what contains them, while it is the form which contains. It is reasonable too to suppose that in number there is a limit in the direction of the minimum, and that in the other direction every amount is always surpassed. In magnitude, on the contrary, every magnitude is surpassed in the direction of smallness, while in the other direction there is no infinite magnitude. The reason is that what is one is indivisible whatever it may be, e.g. a man is one man, not many. Number on the other hand is a plurality of 'ones' and a certain quantity of them. Hence number must stop at the indivisible; for 'two' and 'three' are derivative terms, and so with each of the other numbers. But in the direction of largeness it is always possible to think of a large number; for the number of times a magnitude can be bisected is infinite. Hence this infinite is potential, never actual: the number of parts that can be taken always surpasses any definite amount. But this number is not separable, and its infinity does not persist but consists in a process of coming to be, like time and the number of time.

207b16-207b21 With magnitudes the contrary holds. What is continuous is divided *ad infinitum*, but there is no infinite in the direction of increase. For the size which it can potentially be, it can actually be. Hence since no sensible magnitude is infinite, it is impossible to exceed every definite magnitude, for if it were possible there would be something bigger than the heavens.

207b22-207b27 The infinite is not the same in magnitude and movement and time, in the sense of a single nature, but the posterior depends on the prior, e.g. movement is called infinite in virtue of the magnitude covered by the movement (or alteration or growth), and time because of the movement. (I use these terms for the moment. Later I shall explain what each of them means, and also why every magnitude is divisible into magnitudes.)

207b28-207b34 Our account does not rob the mathematicians of their science, by disproving the actual existence of the infinite in the direction of increase, in the sense of the untraversable. In point of fact they do not need the infinite and do not use it. They postulate only that a finite straight line may be produced as far as they wish. It is possible to have divided into the same ratio as the largest quantity another magnitude of any size you like. Hence, for the purposes of proof, it will make no

difference to them whether the infinite is found among existent magnitudes.

In the four-fold scheme of causes, it is plain that the infinite is a cause in the sense of matter, and that its essence is privation, the subject as such being what is continuous and sensible. All the other thinkers, too, evidently treat the infinite as matter—that is why it is inconsistent in them to make it what contains, and not what is contained. 207b35-208a4

§ 8 · It remains to go through the arguments which are supposed to support the view that the infinite exists not only potentially but as a separate thing. Some have no cogency; others can be met by fresh objections that are true. 208a5-208a8

In order that coming to be should not fail, it is not necessary that there should be a sensible body which is actually infinite. The passing away of one thing may be the coming to be of another, the universe being limited. 208a9-208a11

There is a difference between touching and being limited. The former is relative to something and is the touching of something (for everything that touches touches something), and further is an attribute of some one of the things which are limited. On the other hand, what is limited is not limited in relation to anything. Again, contact is not possible between any two things taken at random. 208a12-208a14

To rely on thinking is absurd; for then the excess or defect is not in the thing but in the thought. One might think that one of us is bigger than he is and magnify him *ad infinitum.* But it does not follow that he is bigger than the size we are, just because some one thinks he is, but only because he *is* the size he is. The thought is an accident. 208a15-208a19

Time indeed and movement are infinite, and also thinking; but the parts that are taken do not persist. 208a20-208a21

Magnitude is not infinite either in the way of reduction or of magnification in thought. 208a22-208a23

This concludes my account of the way in which the infinite exists, and of the way in which it does not exist, and of what it is. 208a24-208a25